Improving Infrastructure Systems Development through the Application of Engineering Systems Integration, Business Models, and Political Science Theories

by

Joseph A. Guerre

Bachelor of Science in Civil Engineering
Purdue University, 1996

Submitted to the Department of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE
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Abstract

The United States' infrastructure is in critical condition. A key reason for this sub-standard state of affairs is an increasing gap between the current costs of infrastructure systems development and the available funding. This thesis proposes that infrastructure systems development can be made more efficient through the application of a combination of engineering systems integration methodologies, business models that have been applied widely throughout the private sector, and political science theories. Specifically, (1) the simultaneous use of multiply delivery methods, (2) industry value systems, (3) a vertical integration analysis framework, (4) the five competitive forces that determine industry advantage, (5) the determinants of national competitive advantage, (6) interest group liberalism, and (7) pluralism are discussed and applied to transportation planning and programming.

This thesis illustrates that these frameworks, models, and theories are applicable in general to the broad field of infrastructure systems development and specifically to transportation planning and programming. Lessons learned from the application of these ideas to four transportation case studies are augmented with the planning and programming guidelines used at the Massachusetts Port Authority and applied to an analysis of the Transportation Equity Act of the 21st Century. Finally, a list of recommended amendments to this legislation is provided.

Thesis Supervisor: John B. Miller
Title: Associate Professor of Civil and Environmental Engineering

to Carrie,
my loving, supportive,
and patient wife

and

to Geoff Gessert

Acknowledgements

I would like to express my deepest appreciation to my thesis advisor, Professor John B. Miller, for his guidance and support of my academic and professional endeavors. He supplied the foundation for many of the ideas developed in this thesis through conversations and class discussions.

Thanks also to my classmates and friends at MIT who worked along side of me. They have provided me with the perfect combination of motivation and distraction over the past year. I have experienced tremendous academic and personal growth because of my relationships with them.

Most of all, I would like to thank my family and friends back home for their unconditional love, enthusiasm, and friendship.

Author Biography

Joe Guerre received his Bachelor of Science in Civil Engineering from Purdue University in 1996. At Purdue, his technical concentration was Structural Engineering. After graduation, Joe worked for Great Lakes Engineering L.L.C. of Hammond, IN as a project engineer for two and a half years. At GLE, Joe was involved with several municipal road, drainage, and water reclamation projects in every phase from conception to construction.

Joe is the co-founder of Amtek Incorporated, which resulted from participation in the MIT $50K Entrepreneurship Competition. Amtek designs and manufactures laboratory and medical equipment for developing countries.

Joe has been married to Carrie Guerre, an accountant at the Whitehead Institute in Cambridge, MA, since 1999.

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1 INTRODUCTION

1.1 Infrastructure in the United States

The United States' infrastructure is in critical condition. Recently the American Society of Civil Engineering (ASCE) released a report that assigned grades to the nation's infrastructure facilities (ASCE 1998). Figure 1.1 below summarizes the results.

Mass transit	C
Aviation	C-
Bridges	C-
Solid waste	C-
Wastewater	D+
Drinking water	D
Dams	D
Hazardous waste	D-
Roads	D-
Schools	F

Figure 1-1 ASCE Report Card for America's Infrastructure

A key reason for the sub-standard grades is an increasing gap between the current costs of infrastructure systems development and the available funding. For example, it is estimated that the annual cost to maintain and improve the nation's roadways and bridges over the next twenty years is $150.6-billion (USDOT, FHWA, FTA 1999). This figure is $44.6-billion less than the current annual expenditure. The spending deficit quickly grows larger as other areas of infrastructure are considered.

There are two general strategies available to address this deteriorating state of affairs. The first and most obvious is to increase the amount of funds available for infrastructure development. However, the two main sources of revenue for public owners are limited. Governmental regulations, public convictions, and logistical constraints limit user fees, while multiple layers of legislation and public opinion limit taxes. In addition, infrastructure appropriations must compete with the financial requirements of a broad range of additional governmental programs and services.

Financial projections for maintaining and improving infrastructure in the United States are based on traffic projections and life cycle cost estimates. The cost estimates reflect

current policies and paradigms. New policies and paradigm shifts are a powerful tool that can lower the required expenditures. Therefore, the second strategy for addressing the nation's infrastructure dilemma is to optimize the cost to benefit ratio of the current level of available of resources. This optimization is a by-product of improvements in efficiency in all of the areas of infrastructure systems development including planning, programming, financial engineering, design, procurement, construction, operations, and maintenance. Added efficiencies can result from applying technological advances, harnessing private sector strengths that complement public sector weaknesses, and improving the performance of public employees, which are responsible for a wide variety of tasks in the development process.

Figure 1-1 below represents Paulson's (1976)-influence curve. The figure indicates that the earlier changes are made in the development process, the higher the influence on the outcome and the lower the cost of the change.

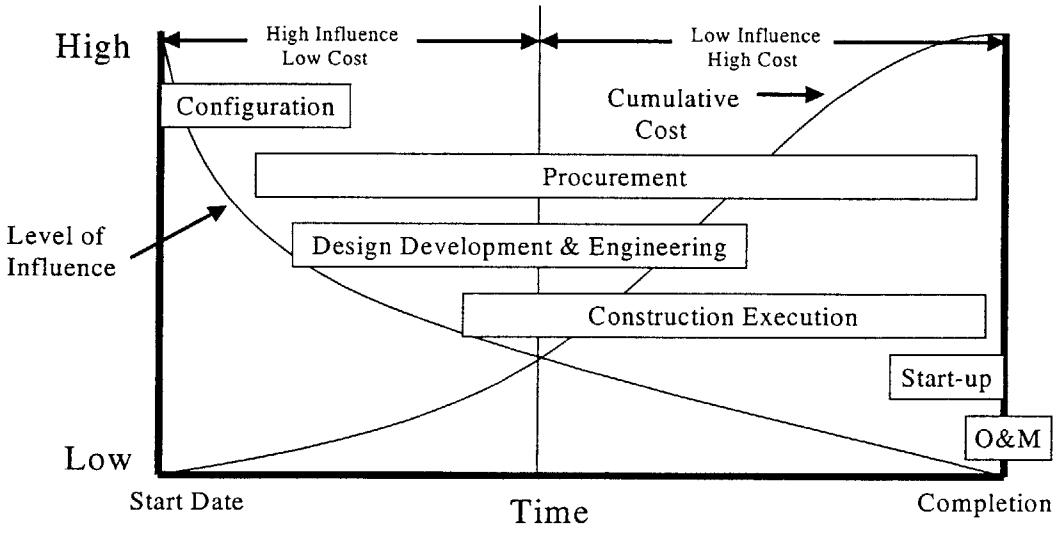

Figure 1-2 Pualson's Influence Curve

This framework suggests that when searching through the tasks that public owners perform for opportunities to increase efficiency, the optimal starting point is at the very beginning of the process.

1.2 Planning and Programming

Capital programming is a process in which public or private entities select projects that meet their goals and objectives, create a schedule for the projects, and decide on how each project should be executed. An effective capital programming process is essential for an entity to optimize the benefits gained through the expenditure of a limited set of resources. Figure 1-1 below summarizes the planning, programming, and delivery process for capital projects (Cambridge Systematics 1995). The highlighted elements are addressed in this thesis.

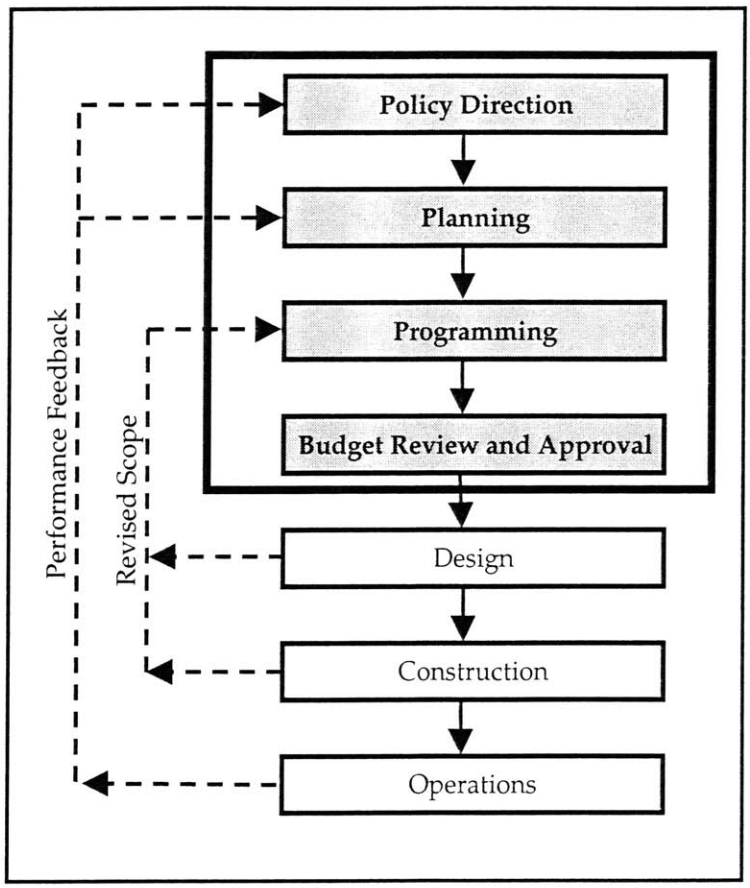

Figure 1-3 Overview of the Planning, Programming and Delivery Process

1.3 Tea-21

President Clinton signed 23 USC 101, which is referred to as the Transportation Equity Act of the 21st Century (TEA-21) on June 9, 1998 as a continuation of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. In brief, these acts established a

federal budget for transportation projects of $218-billion over six years, indicated how the funds would be distributed, and listed the requirements of the recipients. The Federal Highway Administration (1998) summarized one of the main objectives of TEA-21 as follows:

> Continuation of the proven and effective program structure established for highways and transit under the landmark ISTEA legislation. Flexibility in the use of funds, emphasis on measures to improve the environment, focus on a strong planning process as the foundation of good transportation decision – all ISTEA hallmarks – are continued and enhanced by TEA-21.

The guidelines set forth in TEA-21 are used as the foundation for state and local planning and programming policies.

1.4 Research Objective

The objective of this thesis is to illustrate that the development of infrastructure systems can be improved through a combination of engineering systems integration methodologies, business models that have been applied widely throughout the private sector, and political science theories. In order to simplify the manageability of this objective, this thesis addresses the specific area of transportation infrastructure, which is only one part of the broad field of infrastructure system development.

1.5 Scope and Methodology

The first step in this process is to compile previous work and tools that have been applied previously to the analysis and evaluation of problems in various fields. These concepts have been taken from (1) Miller's work on infrastructure systems development at the Massachusetts Institute of Technology, (2) Porter's work on industry value systems, vertical integration, the five competitive forces that determine industry advantage, and the determinants of national competitive advantage, and (3) Lowi's work on interest group liberalism. Next, these ideas are applied to four transportation case studies: the Massachusetts Route 3 North Improvement Project, the Orlando Orange County Expressway Authority Toll Operations Contract, the Reprioritization of Highway 407 Electronic Toll Road in Toronto, and the Interstate 15 Reconstruction Project in Salt Lake City. The case studies are used to highlight the applicability of this

material to the development and management of transportation systems. Lessons learned from the case studies are then augmented with the planning and programming guidelines used at the Massachusetts Port Authority to analyze the policies of TEA-21.

1.6 Results

The results of this work illustrate that the transportation planning and programming processes followed by public and quasi-public agencies throughout the United States can be improved with the introduction of additional frameworks. These tools offer new perspectives on the classic problem of how to optimize the application of a set of material, labor, and financial resources to a portfolio of infrastructure facilities. The success of these models results from their usefulness in (1) maximizing the list of alternatives such as project scope and financial strategy by delaying these decisions until later in the process, (2) optimizing the mixture of public sector talents with those of the private sector, (3) improving private sector attractiveness by viewing public projects or programs from the point of view of the firms that will be competing for them, (4) applying methodologies that have been used successfully throughout the private sector to make strategic decisions in the public sector, and (5) illustrating the trade-off between policies that result from a pluralistic process and policies that are established at the top of the governmental hierarchical structure and passed down.

Improvements to the development of transportation networks may also apply to water, wastewater, energy, communication, refuse, and building portfolios. This assumption is supported by the idea that the objectives of and the relationships between the public and private parties are similar among a wide range of infrastructure systems.

This thesis culminates with the identification of recommended improvements to the transportation planning and programming process established by the federal government through TEA-21.

2 CAPITAL PLANNING AND PROGRAMMING

This chapter presents a model for capital programming that was created by Cambridge Systematics, Inc. of Cambridge, MA for the Massachusetts Port Authority (Massport). This model serves as the benchmark for the discussion throughout this thesis on the planning and programming policies set forth in TEA-21.

2.1 Massport Overview

Massport is a quasi-public revenue bond authority established through the Massachusetts legislative Enabling Act of 1956. The authorities original mission was to develop, operate, and maintain Logan International Airport, the Tobin Memorial Bridge, the Port of Boston's public terminals, and Hanscom Field's aviation facilities. Currently, Massport's annual economic benefit to New England exceeds $8.6-billion. As a quasi-public authority, Massport's operations are independently supported by its revenue streams and investing activities (Adams 1999).

2.2 Policy Direction

This first this step is for an agency to identify and prioritize overall objectives. The goal of this process is to provide strategic direction to the entire structure. A key element in the identification process is the creation of a framework with which overall agency goals can be combined with the specific objectives of smaller departments and groups throughout the agency's hierarchy chart. For example, Figure 2-1 below illustrates Massport's strategic framework (Cambridge Systematics 1995).

At this time, an agency should develop and distribute guidelines to the entire organization regarding the identification of alternative solutions, the evaluation criteria and process used to select projects, and the prioritization process used to allocate resources. These policies assure consistency in planning and programming throughout all levels of the agency (Cambridge Systematics 1995). Consistency is a key ingredient of a transparent process.

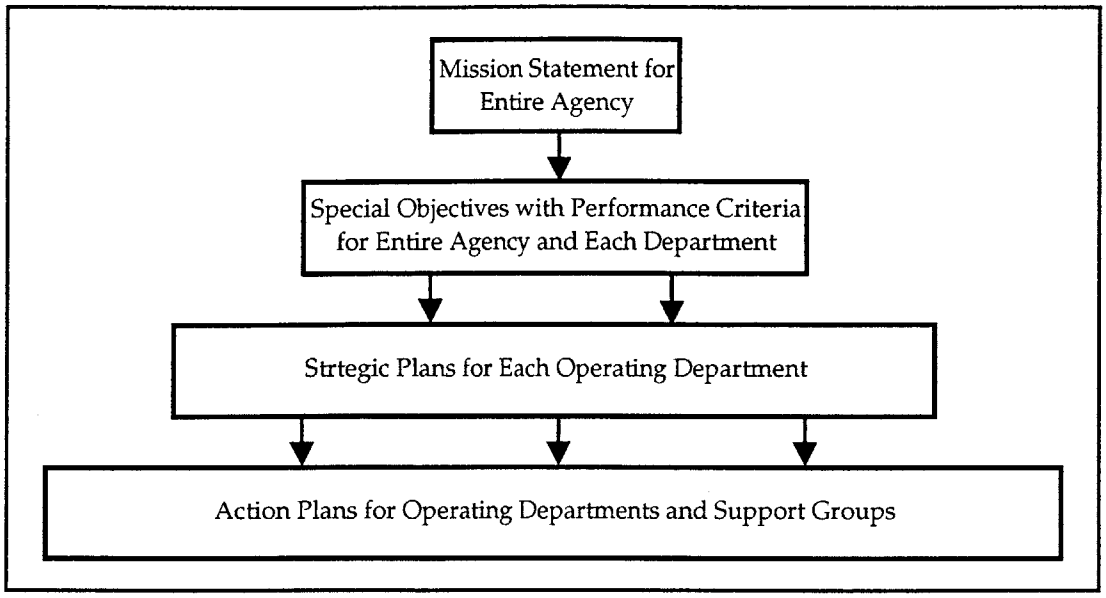

Figure 2-1 Massport's Strategy Framework

Once the goals and guidelines are established, the next task is to translate them into program elements that support the given strategy. These elements should reflect project and program impacts that span all of the agency's goals, provide maximum flexibility for innovative solutions, and reflect the needs of the end-users (Cambridge Systematics 1995).

The final task in establishing policy direction is to identify program budget targets that are consistent with the agency's goals and objectives. These targets give managers a realistic range of budgets for upcoming periods as they define and select projects and programs. Budget targets also encourage managers to identify projects to be developed if additional funding were available (Cambridge Systematics 1995).

2.3 Planning

Figure 2-2 has been adapted from Massport to illustrate the planning process (Cambridge Systematics 1995). The first step is to identify the specific needs of the individual departments. This process is done on a continual basis and tied directly to management practices that assess the condition of the portfolio of facilities and monitor the progress of past projects.

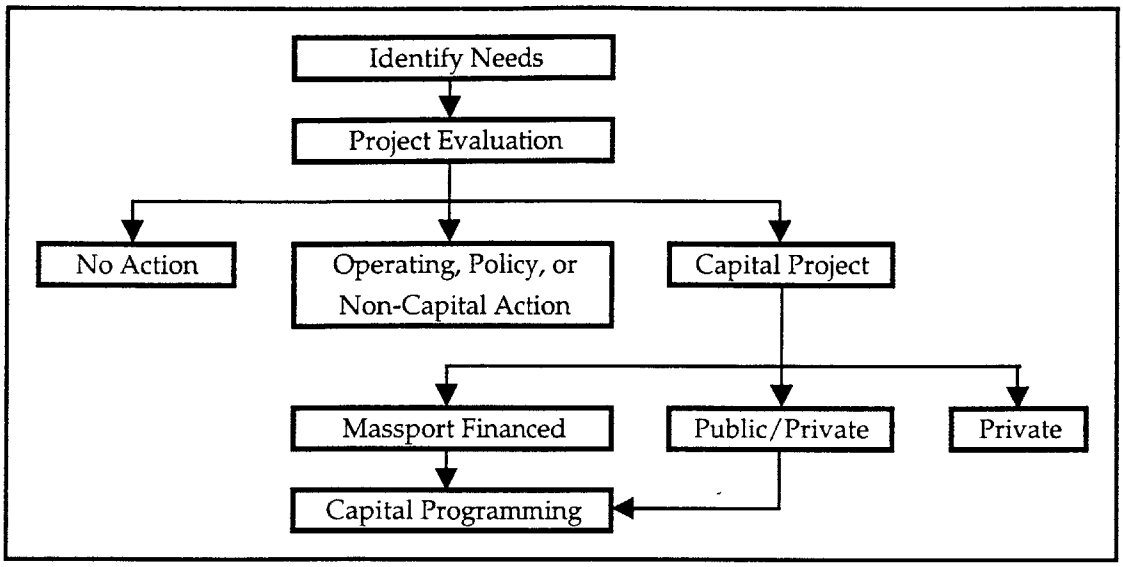

Figure 2-2 Planning Process

Once these needs are identified, alternative maintenance and improvement solutions can be developed. A standard and quasi-transparent process is then used to evaluate the alternatives. The evaluation criteria vary for improvement and maintenance projects. The criteria used to compare alternatives for improvement projects include strategic benefit with respect to each of the agency and department goals, social and environmental impacts, and life cycle cost estimates. For maintenance projects, the criteria include the urgency of the project, estimated savings to the agency and to the end-users, social and environmental impacts, and estimated life cycle costs.

Massport breaks projects into three types based on price, type of work, range of alternatives, and impact on social and environmental issue. For example, routine maintenance is categorized as Type-1, minor improvements are Type-2, and major maintenance or construction projects are Type-3. The depth of the evaluation process varies from a one page summary form for Type-1 projects to a full feasibility report for Type-3 projects. The evaluation process is quasi-transparent because on one hand the criteria is quantified on standard forms that can be compared to one another, but on the other hand the actual numeric values remain subjective.

After the projects are selected from the list of alternatives, capital projects that will be funded internally or with a combination of internal and private funds are then passed on

to be programmed. In the planning process, scope definition and financial information should be completed in sufficient detail to permit further evaluation in the next phase.

2.4 Programming

Programming consists of prioritizing and scheduling the maintenance and improvement capital projects that were selected in the planning process and allocating funds. The prioritization process for Massport follows the same criteria as the evaluation process in the planning stage. Strategic, social, environmental, and economical benefits are translated to a standard numeric scale for comparison. This process is more complicated than the planning evaluation for several reasons. First of all, annual budget targets and funding options are additional variables. Secondly, the trade-off between the benefits and costs of vastly different projects must be analyzed. The result of these two complexities is reliance on an iterative evaluation process with additional subjectivity. Managers that make the final decisions must explain their actions in terms of the original set of goals and objectives established at the start of the planning and programming process. A final added variable in the programming process is the amount of funds required for projects that were approved and started in previous programming periods. Again, this process is quasi-transparent because although the evaluation is the equivalent to comparing apples to oranges, the scoring system is clear and standardized, and the decisions are backed up with explanatory reports.

Once the projects are prioritized and scheduled, the results form the basis of a budget proposal. At this time, assumptions for the sources and uses of the entire program are reviewed and modified if necessary. Also, recommendations for project additions and deletions, which are dependent on final budgetary decisions, are finalized. The budget and program time frames at Massport are summarized in Figure 2-3 below (Cambridge Systematics 1995). They include a two-year capital period and an eight-year span of out-years. Although the program covers ten years, only the expenditures within the first two years are subject to approval. The remaining costs are illustrated in the out years and are scheduled to be addressed in subsequent programming rounds. The projects programmed entirely in the out years facilitate long-term investment planning.

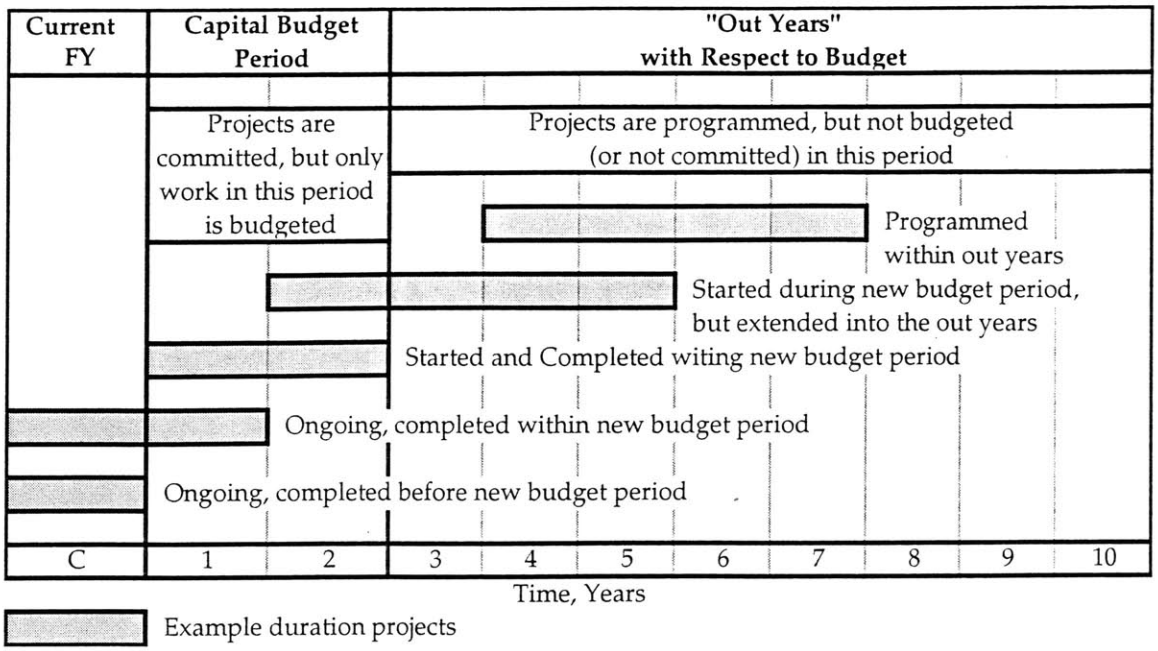

Figure 2-3 Budget and Program Time Frames for Projects

2.5 Budget Review and Approval

A key element of the budgeting process is the establishment of a Maintenance Reserve (MR) fund. Maintenance expenditures are estimated annually for the following year. The required funds are then deposited into the MR fund before the capital budget is established. Once the deposit is made, the programming process proceeds and an annual capital program is established.

After the capital budget is created, there is a final financial review before approval. During this review, the budget department verifies the funding eligibility of the projects, verifies the funding availability, and establishes the deposit to the maintenance reserve for the following year. The operating budget is also reviewed at this time. The simultaneous review of the operating budget and capital budget makes visible the full financial effects of the capital program. For example, new facilities completed in year one may create a need for added staff levels in year two.

At Massport, once the final financial reviews are complete the budget is submitted to the Budget Review Committee for approval. The forms submitted to the committee are standardized. The information that is made available to the committee includes a consolidated budget form and project specific information including a justification for

the ranking process. After the committee approves the budget, the individual project budgets become baselines for tracking progress and performance throughout the program period. The funds or projects scheduled for the out years are not considered committed or formally approved.

3 PREVIOUS WORK, CONCEPTS, AND MODELS

This section includes a summary of previous work, concepts, and models that are applied throughout this thesis to improve the efficiency of infrastructure development by public agencies. The ideas set forth in this section have been compiled from three main sources: (1) Prof. John B. Miller's research on infrastructure development systems at the Massachusetts Institute of Technology, (2) Michael E. Porter's writings on the competitive advantage of nations and industries, and (3) Theodore J. Lowi's political science theories. The summaries are followed by discussions of the applicability of these tools to transportation planning and programming.

3.1 Engineering Systems Integration

In an effort to address infrastructure needs, Owners, engineers, constructors, operators, and bankers continue to develop and explore combinations of project delivery and financial strategies. This history of experimentation has produced several well-known delivery methods: Design-Bid-Build (DBB), Design-Build (DB), Design-Build-Operate (DBO), Design-Build-Finance-Operate (DBFO), and numerous other combinations in between. Engineering Systems Integration is a new discipline in which project delivery and financial strategies are treated as variables throughout the infrastructure development process (Miller 1997). Figure 3-1 represents a quadrant framework that can be used to distinguish and compare delivery methods (Miller 1997).

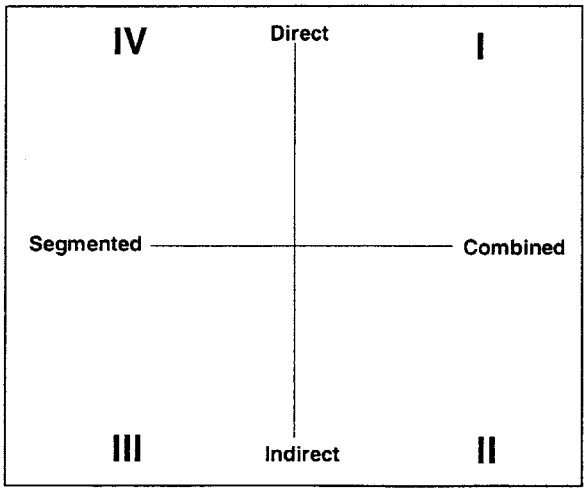

Figure 3-1 Operational Framework for Engineering Systems Integration

The horizontal axis indicates the level of integration between design, construction, and operations. "Segmented" refers to project in which all three services are separated and to projects in which design and construction are combined in a single contract while operations remains separate. The vertical axis indicates the source of project financing. In a "Direct" financing scenario the Owner provides the monetary resources for a project. In an "Indirect" scenario the Producer uses a revenue stream created by the project for financing. "Indirect" financing can be used for projects that are financially self-sufficient such as a well-traveled toll road or a water system. Figure 3-2 indicates the location of several delivery methods within the operational framework (Miller 1997).

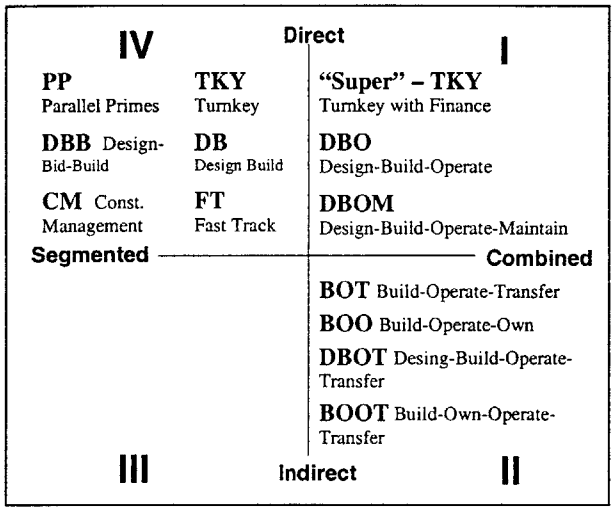

Figure 3-2 Common Delivery Methods in Operational Framework

3.1.1 Simultaneous Use of Multiple Project Delivery Methods

Although for specific projects there are advantages and disadvantages associated with each procurement strategy, Miller has established that throughout history, no delivery method or financial strategy is preferable for all projects or for all sectors (Miller 2000). Currently, the public sector relies heavily on the DBB approach (Miller 1997). Limitations from exclusive use of this delivery method for every project include: (1) owners evaluate a single engineering solution, (2) owners have insufficient provisions for long-term needs, and (3) owners minimize the principle of life-cycle costs, and (4) owners restrict innovation by hiring designers that do not work hand in hand with contractors (Miller, Garvin, Ibbs, and Mahoney 1999). As the construction industry begins to recognize these limitations, a new paradigm is emerging that recognizes that

multiple delivery methods are variables that can be used by owners to analyze, manage, and optimize an infrastructure portfolio (Miller, Garvin, Ibbs, and Mahoney 1999). Mahoney (1998) developed the project life-cycle framework represented in Figure 3-3 below that supports multiple delivery methods. This framework gives the public sector maximum flexibility to identify and implement an optimal mixture of private sector strengths and public sector strengths for a given portfolio.

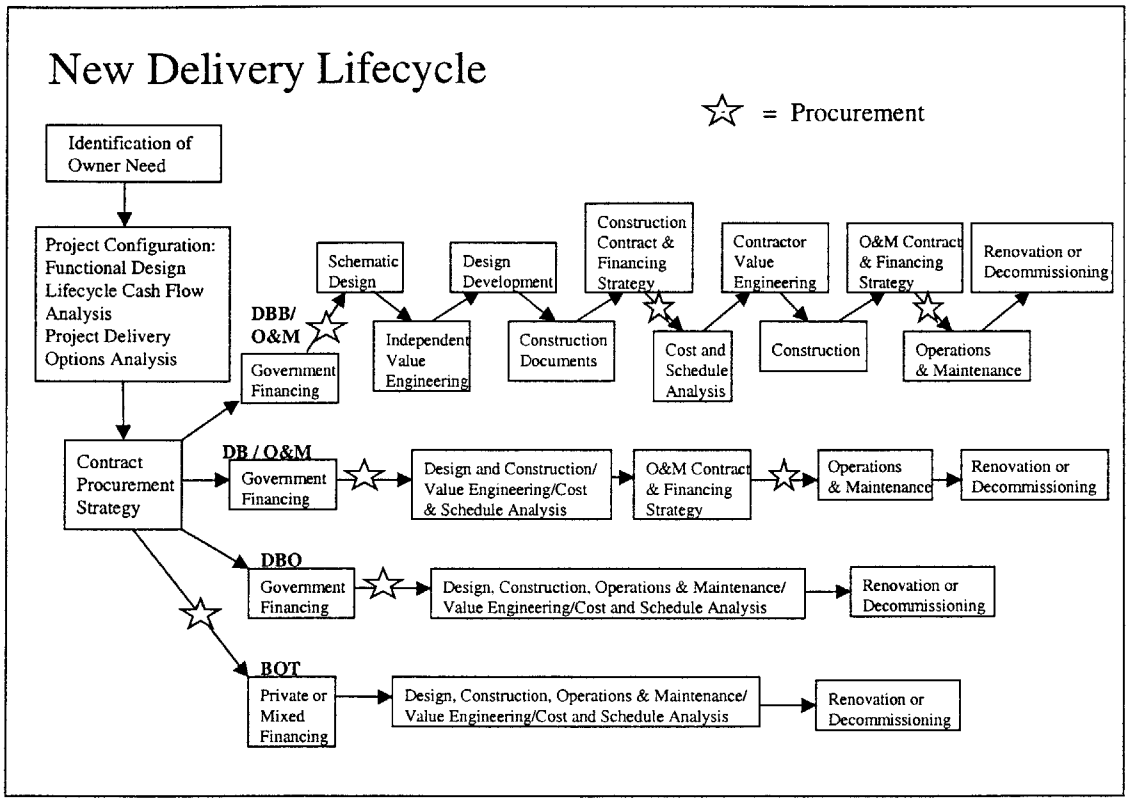

Figure 3-3 Project Life Cycle Framework that Supports Multiple Delivery Methods

3.1.2 CHOICES©

CHOICES© is a spreadsheet-based tool developed at the Massachusetts Institute of Technology that empowers Owners to simultaneously analyze multiple scenarios for their infrastructure portfolio (Evje 1997; Miller and Evje 1999). This analysis is a complicated yet necessary step in Mahoney's framework. CHOICES© enables owners to study the relationship between the sources and uses of funds for a number of

programming scenarios. The two key variables in the scenarios are the delivery method and the pace of the plan (Evje 1997; Miller and Evje 1999).

3.2 Competitive Advantage

Competitive advantage refers to a firm's ability to succeed in a given The process of creating and maintain competitive advantage is not in equilibrium, but rather changes with time (Porter 1990). Following is a summary of key elements of competitive advantages and a discussion of how they relate to infrastructure development systems.

3.2.1 Generic Strategies

There are two generic strategies for creating and maintaining competitive advantage: cost leadership and product differentiation (Porter 1990). A firm can achieve cost leadership by offering the lowest price for a product that is in all other ways comparable to the alternatives. A firm creates product differentiation by offering a product of superior quality or by offering a one of a kind product. Differentiation enables the firm to charge a premium for their goods or services. The skill sets and resource allocation plans differ tremendously between the two strategies described above. Firms that straddle the line between cost leadership and product differentiation and attempt to achieve both are often unable to achieve either (Porter 1990).

In infrastructure development, firms achieve either cost leadership or product differentiation by concentrating on experience, service orientation, technological advancement, strategic partnerships, or economies of scale.

3.2.2 Industry Value System and Vertical Integration

An industry's value system is a tool that can be used to identify the key parties in an industry and to show their relationships to one another (Porter 1990). Figure 3-4 below illustrates the value system for a DBB infrastructure project. The solid lines indicate contractual relationships.

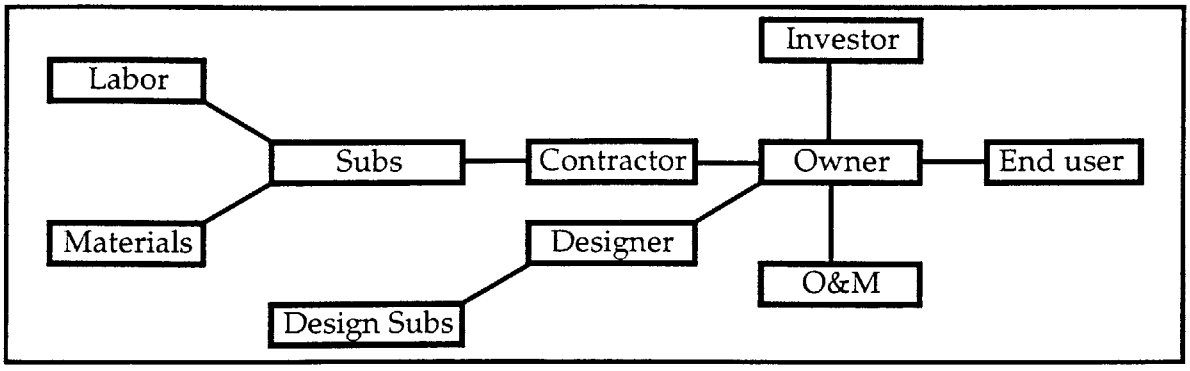

Figure 3-4 Typical Industry Value System for DBB Infrastructure Projects

Vertical integration occurs when an entity performs the tasks listed in more than one box of the value system. For example, an Owner with an in-house design team would be vertically integrated. Porter (1983) has shown that there are a number of strategic benefits and costs associated with vertical integration. Figure 3-5 below summarizes these issues. In infrastructure development, an analysis of these items would aid Owners in their decisions to "make or buy" the services in the value system.

Strategic Benefits	
Economies of scale	Tap into technology
Economies of combined operations	Assure supply and/or demand
Economies of internal control & coordination	Offset bargaining power
	Enhanced ability to differentiate
Economies of information	Alleviate entry and mobility barriers
Economies of avoiding markets	Enter a higher return business
Economies of stable relationships	Defend against foreclosure
Characteristics of vertical integration economies	
Strategic Costs	
Costs of overcoming barriers	Higher overall exit barriers
Increased operating leverage	Maintaining balance
Reduced flexibility to change partners	Dulled incentives
Capital investment requirement	Differing managerial requirements
Foreclosure of access to supplier or consumer research or know-how	

Figure 3-5 Vertical Integration Evaluation Criteria

3.2.3 The Five Competitive Forces that Determine Industry Advantage

As firms attempt to succeed in a given industry, they struggle to position their business to compete favorably against other firms. The nature of competition and the chances for success can be described as the sum of five competitive forces: (1) the threat of new entrants, (2) the threat of substitute products or services, (3) the bargaining power of suppliers, (4) the bargaining power of buyers, and (5) the rivalry among existing competitors (Porter, 1990). Figure 3-6 below is a representation of these forces created by Porter. This framework can be used to analyze the attractiveness and profitability of an industry.

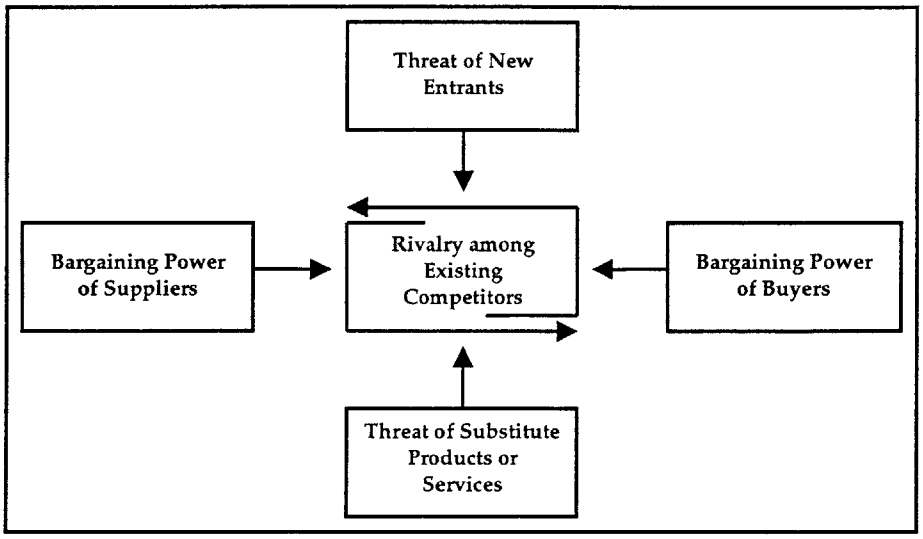

Figure 3-6 The Five Competitive Forces that Determine Industry Competition

Porter suggests that Producers should take great care to analyze their industry or market segment and position their business so that these forces work in their favor. For example, a firm's use of a proprietary technology might create an effective entry barrier to lower the threat of new entrants.

It is one of the ideas presented in this thesis is that the five force framework can also be used to evaluate specific infrastructure projects. At the project level, firms lose their ability to manipulate the forces acting on them. Understanding that they can not change the forces, they will only submit a meaningful bid for a project if their probability of success times the estimated profit exceeds their initial investment required to produce a proposal. In order to understand the cost structure and profit potential of a given

project for the private sector, the owner must understand the competitive structure of that project. Once the owner understands a project from the Producer's perspective with regards to the five competitive forces model, they can increase the probability of project success by structuring the procurement process in a way that attracts a number of quality bids.

3.2.3.1 Threat of New Entrants

A high threat of new entrants limits an industry's overall profit potential because new entrants push down profit margins by seeking market share and increasing capacity (Porter 1990).

The construction industry has (1) low entry barriers, (2) an absence of economies of scale and of an experience curve, (3) high transportation costs, (4) a diverse product line, and (5) a diverse set of market needs. Porter (1983) has shown that any one of these characteristics, among others, can cause an industry to be fragmented. The construction industry is highly fragmented because it has five fragmenting elements. A common strategy for a firm to succeed in a fragmented market is to create entry barriers (Porter 1983).

To an Owner, a lack of entry barriers can lead to lower costs by increasing the competitiveness of a bid process. In this context, competitiveness is taken only as a function of the number of bidders. Such competition is highly advantageous to the Owner for projects that are commodities, those that are driven only by price. This process is not advantageous for the Producer, because as the number of bidders increases, their chance of one particular bidder winning decreases. When a bidder feels that its chances of success are low, it is likely to cut the costs associated with drafting a proposal and submit a bid that is not competitive. The other extreme with regards to entry barriers is a procurement that is based on the selection of a sole proprietor. Such a procurement method is highly advantageous to the Producer because they have a monopoly. In this case, there is again no motivation for the Producer to submit a competitive bid. Therefore, an excessive number of bidders and a single source procurement both have the potential to lead to the same end, inflated bids.

In a large complex infrastructure project it is possible for the Owner to create a procurement strategy that combines the two extreme scenarios described above in order to achieve the advantages of each scenario. Owners can create a process in which the barriers are sufficiently high to attract quality bidder and sufficiently low to create a competitive atmosphere. Following is a list of ways in which owner can manipulate the threat of new entrants in a procurement process:

- Prequalifying bidders creates entry barriers by limiting the number of competing firms. Although there are costs associated with replying to a request for qualification (RFQ), they are often substantially lower than replying to a request for proposal (RFP).
    - Extended contract terms that include operations and maintenance create entry barriers. After the award of one of these contracts, a firm becomes a sole proprietor for the length of the term. After this point, there is no threat of new entrants.
    - Stipends increase the threat of new entrants, because they lower the price of competing. Stipends therefor decrease the threat of new entrants.
- Any combination of design, construction, operations, and financing into one contract creates entry barriers. Each time the scope of a project is expanded, firms that do not have the capacity to provide the additional services and do not have the ability to form project alliances are removed from the competition.

3.2.3.2 Threat of Substitute Products or Services

The price that firms can charge for products or services is limited by the threat of substitutes. Excessive prices erode industry volume because they motivate clients to search for substitutions (Porter 1990).

There are three key issues that pertain to the threat of substitute products or services in infrastructure projects. First of all, in many instances this threat is low because the sub-standard conditions of existing facilities removes the Owner's option of doing nothing. Secondly, in terms of packaging and financing the project, budget constraints can

narrow the Owner's options. The Owner does not have control over these first two issues. However, there is one way in which the Owner can lower the bidder's threat of substitute products or services. They can indicate clear commitment to the project early in the procurement process. A strong commitment to a project by the sponsor alleviates the threat of substitution. Miller has shown that a lack of project commitment by an Owner is a fundamental flaw apparent in several unsuccessful projects (Miller 2000). Owners can signal commitment to bidders by providing a complete scope description in the RFP and by creating legislature that is tied to the project.

3.2.3.3 Bargaining Power of Suppliers

Powerful suppliers decrease the profit potential of an industry by funneling higher margins further back in the supply chain (Porter 1990).

In infrastructure projects, from the point of view of the bidders, supplier power pertains mainly to construction materials and labor. The power of suppliers can be viewed as a financial risk, especially in contracts with long terms. If the Owner passes these risks to the bidders, the bargaining power of the suppliers is increased. Therefore, the prices submitted in the proposals will increase. The owner will pay for these unknown factors whether or not they come to fruition. If the Owner retains these risks, they will only pay for them if they occur. One way for an Owner to lower the bargaining power of suppliers is to include price indexes and adjustment clauses in the contract. These clauses enable the Producer to pass fluctuations in price to the owner. One method to lower the bargaining power of labor forces in a long-term contract is to include a labor agreement in the contract documents.

3.2.3.4 Bargaining Power of Buyers

Powerful buyers also decrease the profit potential of an industry by driving down the price of goods and services charged to the customers (Porter 1990).

Buyer bargaining power is typically viewed as an advantage for the Owner and a disadvantage for the Producer. However, in infrastructure projects, decreasing the buyer's power is not necessarily disadvantageous for the Owner, even if it is advantageous for the Producer. In many cases, lowering the Owner's power can have

mutual befit for both parties. For example, an independent engineering check lowers the Owner's power. However, Miller has shown that the many advantages of a check by an independent engineer include increased public safety and significant insurance savings (Miller 2000). In addition, this practice can lead to time savings if the Owner has a complex approval process.

Additional methods with which an Owner can affect their bargaining power are listed below.

- As the scope of a project is divided, the Owner is able to control more aspects of the procurement. An extreme case is in a multiple prime project in which the owner selects each individual subcontractor. The buyer's power in a contract that combines design, construction, operations, or financing is lower than in a procurement in which all of these services are separated.
- Extended operations and maintenance periods decrease the buyer's power because the Owner is unable to negotiate for lower costs throughout the contract period.
- Owners can increase their power over the Producer by reserving the option to extend the operations or maintenance period periodically throughout the contract term. These clauses enable the owner to terminate the contract if they are losing money and to continue the contract if it is in their favor financially.
- Tying the pay scale to the Producer's performance through an award system increases the buyer's power.
- Owner controlled insurance programs (OCIP) in which the sponsor purchases a single insurance policy that bundles a majority of a project's insurance policies together increases the buyer's power.
- The risk mitigation strategy for a project also affects the buyer's power. When an Owner retains the responsibility for a risk, their power is decreased. When a risk is passed to the Producer, the Owner's power is increased.

3.2.3.5 Rivalry among Existing Competitors

Rivalry is also inherent in fragmented industries because of the shear number of competing firms. Intense internal rivalry in an industry erodes profit margins by driving up the costs of competition and by driving down the customer's price (Porter 1990).

Following is a list of methods with which the Owner of an infrastructure project affects the level of rivalry among competitors.

- Extended contract terms that include operations and maintenance lower rivalry after the contract is awarded, because the Owner locks into a long-term contract with the contractor.
- Performance specifications fuel rivalry among bidders because they increase the threat of new technologies.
- Contract selection based on best-value evaluation criteria increases the rivalry among the competitors because the bidders are forced to compete against one another on the basis of quality and price.
- Miller (2000) argues that a transparent procurement process is advantageous to bidders because it gives them confidence that the Owner will conduct the procurement in a stable, reliable, and predictable manner. Therefore, a level field will increase rivalry by attracting several quality bidders.

- Evaluating technical sections of proposals based on the RFP requirements and not comparing them to the other proposals lowers the rivalry among the bidders.

3.2.4 The Determinants of National Competitive Advantage

The national competitive advantage is synonymous with a nation's productivity level compared to the productivity level of foreign rivals (Porter 1990). In order to understand cumulative productivity growth and the determinants of productivity, individual industries must be analyzed. On page 71 of The Competitive Advantage of Nations Porter defines the four determinates of national competitiveness for a given industry as follows:

1. *Factor Conditions.* The nation's position in factors of production, such as skilled labor or infrastructure, necessary to compete in a given industry.
2. *Demand Conditions.* The nature of home demand for the industry's product or service.
3. *Related and supporting industries.* The presence or absence in the nation of supplier industries and related industries that are internationally competitive.
4. *Firm Strategy, structure, and rivalry.* The conditions in the nation governing how companies are created, organized, and managed, and the nature of domestic rivalry.

To these determinants, two variables are added, (1) chance and (2) government intervention (Porter 1990). Figure 3-7 below represents Porter's schematic illustration of this framework. The arrows indicate that all of the elements of Porter's Diamond influence each other. This addition demonstrates that the system is dynamic and self-supporting (Porter 1990).

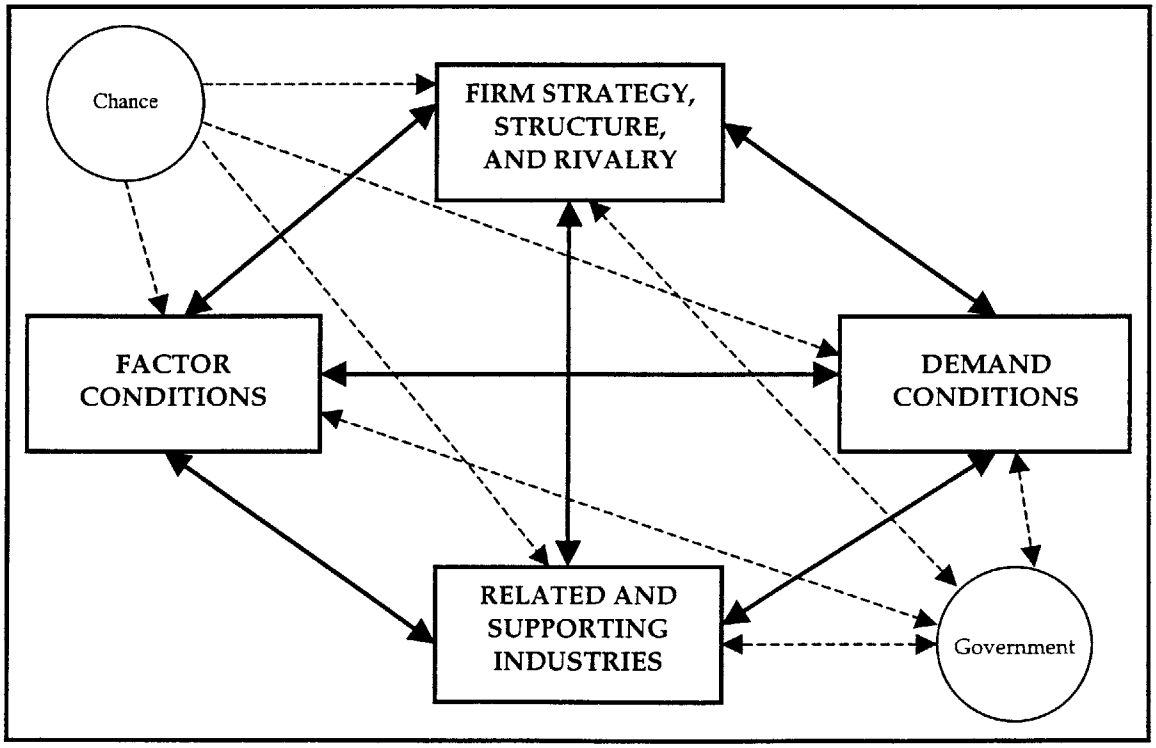

Figure 3-7 The System of National Competitive Advantage

Industries or industry segments with the most favorable national diamond conditions are those that are most likely to succeed.

When applying Porter's system of competitive advantage to infrastructure development, there are several levels. First of all, the government can use infrastructure systems to influence the forces that are advantageous to the private sector in general. For example, increased traffic capacity is a improved factor condition with far reaching benefits to the entire private sector in a region. An alternative method of applying Porter's model to infrastructure development is to look at the government's competitive advantage in efficiently creating factor conditions. The determinants can be applied to the infrastructure industry or to a specific geographic segment of the infrastructure industry.

3.2.4.1 Factor Conditions

Porter's (1990) definition of factor conditions specifically names infrastructure as one of the national elements that is directly related to a firm's ability to compete in an industry. Upgrading transportation networks, communication systems, energy networks, schools, and health related facilities (water plants, wastewater plants, hospitals, etc.) has a direct impact on a nation's ability to increase the productivity of their labor and capital. More than seventy percent (70%) of the nation's rush-hour traffic take places in congested conditions. The annual costs, due to wasted fuel and time, in the United State's ten most congested regions equal $34-billion (ASCE 1998). Additional losses are caused by construction delays when highways in urban areas are reconstructed. In many of these projects, the daily costs to users in wasted time and late deliveries exceeds $100-thousand (Sorenson, Terry, and Mathis 1998).

As previously described, there are two sources of generic strategy for firms: cost leadership and product differentiation. Factor conditions foster cost leadership by decreasing overall production costs. For example, increasing the efficiency of the equipment at a water treatment plant enables the Owner to decrease customer's water rates. Decreased water costs leads to lower overall production costs, which in turn creates a cost leadership advantage for a firm serviced by the upgraded plant. History shows that every dollar invested in the United State's highway system generates annual savings in production costs of at least $0.30 for the lifetime of the project (Sutton and Marks 1999). Roadway projects have the potential to increase the efficiency of the

construction industry specifically because increased capacity and overpass clearances will improve decrease travel times to and from job sites and transportation costs.

Product differentiation is also affected by factor conditions. For example, efficient communication networks and unclogged transportation facilities could lead to significant time savings for a firm relative to their competitors. Low lead-time is a significant source of competitive advantage through product differentiation.

Capital is an important factor condition for the infrastructure industry. There is an upward trend for transportation expenditures. Local, state, and federal government in the United States spent nearly $106-billion in 1998 on highways and roads. This value is thirteen percent (13%) more than the amount spent in 1985 (Cooper 1998). Expenditures can be broken into five main categories: (1) debt service, (2) police and safety, (3) administrative costs and research, (4) maintenance, and (5) capital outlays. Figure 3-8 below illustrates the distribution of highway funding for 1998 (Cooper 1998).

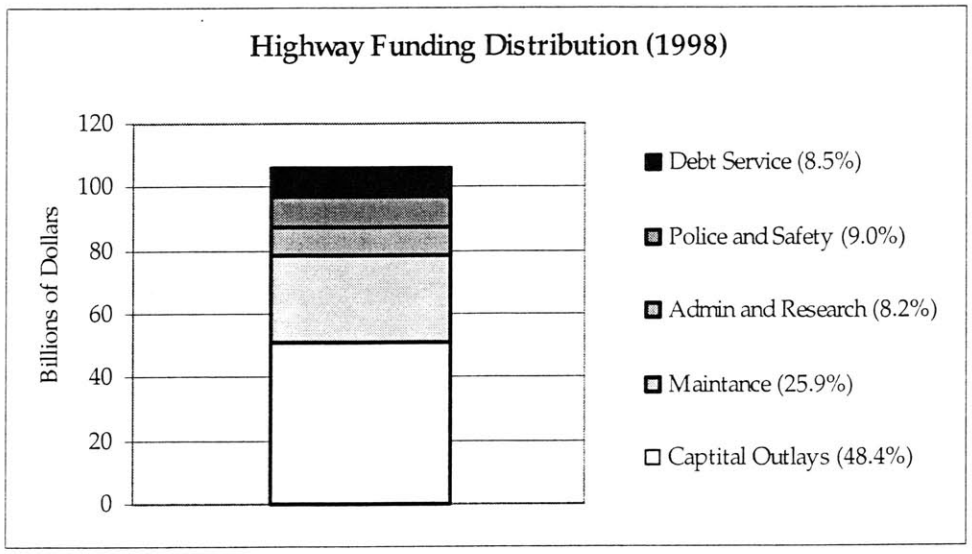

Figure 3-8 Highway Funding Distribution for 1998

There are several sources of highway revenues. They include fuel taxes, license plate fees, vehicle registration fees, levies on heavy vehicles, and tolls (Cooper 1998).

An additional factor condition for the infrastructure industry is the pool of skilled labor. It is natural that the availability of qualified workers fluctuates with the economy.

However agreements with labor unions, which are a common requirement for infrastructure projects, provide a means for the standardization of skills and safety procedures. Another aspect of skill is at the firm level with regards to the scope of the project. For example, the number of firms that have the ability to construct and maintain a facility is much lower than the number of those that have the ability to construct the project only. This issue is discussed in more detail in later sections.

3.2.4.2 Demand Conditions

As a factor condition, large infrastructure projects increase the demand conditions of several industries by bringing a larger work forces to the region.

In terms of the demand conditions of the infrastructure industry, the government is the principal customer. However, demand is a function of the economy, and the number of end-users. For example, passenger travel in the United States doubled from 1970 to 1995, and is projected to increase by an additional sixty-six percent (66%) by 2018 (ASCE 1998). The reasons for increased demand include population growth, urban sprawl, innovations in logistics, globalization of the economy, and a shift in the economy to the just-in-time strategy. Logistical innovations and increased globalization enable firms to purchase components from distant countries and complete the final assembly at a location that is closer to the final customer (Sutton and Marks 1999). In 1998, it was expected that the percentage of American business relying on the just-in-time strategy would reach thirty-three percent (33%) by 2000 (Sorenson, Terry, and Mathis 1998). Almost eighty percent (80%) of executives believe that product delivery is just as vital as product quality (Sutton and marks 1999).

Another measure of demand conditions is an assessment of the existing facilities. Currently, the condition of nearly sixty percent (60%) of urban interstate mileage and almost half of rural interstate mileage is rated from fair to poor (Davies and Sorenson, 2000). In addition, the FHWA estimates that more than thirty-one percent (31%) of all bridges are structurally deficient or functionally obsolete (FHWA 1998).

Demand conditions of the transportation sector are often a self-reinforcing loop; as work is performed, more work is required. For example, increasing capacity on the highways

leading to and from metropolitan areas fosters increased traffic throughout the entire region. Therefor, this work leads to higher demands for the feeder and local roads of the region. Increased travel on these roads and bridges promotes an increased demand for transportation work. In addition, these increased factors conditions create opportunities for development throughout the region. New development directly increases the demand for the construction industry.

3.2.4.3 Related and Supporting Industries

In infrastructure development, the major parties include designers, material producers, material suppliers, constructors, operators, financial institutions, and attorneys. The dynamics between these parties is often project specific and always a function of the structure of the contract.

3.2.4.4 Firm Structure, Strategy, and Rivalry

In order for firms to succeed, they need a good mix of industry competitiveness and firm structure and strategy (Porter 1990). Many of the key issues of firm strategy have been discussed in detail at the beginning of this section.

In the construction industry, a key variable of firm structure revolves around which services a firm provides. Since public owners rely heavily on the DBB procurement model, alternative deliver systems that combine design, finance, construction, or operations force changes in the structure and strategy of companies that are based solely around one service. In these procurements, firms must form new strategic partnerships in order to compete. There are numerous challenges and costs associated with forming and maintaining project specific partnerships. However, there is a learning curve for this process.

Porter (1990) has shown that there is a direct link between vigorous rivalry and the ability of firms to create and sustain a competitive advantage. One source of rivalry in an industry relies on the ability of firms to form new companies by integrating forward or backwards in the industry value system or through strategic partnerships (Porter 1990). A quick review of the issues listed in Table 3-5 indicates that there are substantial opportunities in the construction industry for integration and strategic partnering.

Rivalry in the infrastructure industry also relies on the Owner's ability to create a competitive procurement process. Procurements that include a (1) government defined scope, (2) head-to-head competition based on price and/or qualifications, and (3) a transparent evaluation process, create a level playing field that fosters intense rivalry among bidders (Miller 2000). Rivalry motivates firms to continually improve their operations and strive to develop new technologies. Miller (2000) has shown that openness to technological change is a fundamental element of a successful infrastructure strategy.

3.2.4.5 The Role of Chance

Chance plays a vital role in the national competitive advantage because it alters the conditions of the diamond. Of the examples of chance occurrences that Porter (1990) describes, the following pertain to infrastructure development: acts of invention or entrepreneurship, discontinuities in the costs of materials and supplies, significant shifts in foreign economies or exchange rates, and war.

3.2.4.6 The Role of the Government

Although they are unable to control national advantage, the government should concentrate on unleashing and amplifying the factors within the diamond because the ability of industries to create and sustain competitiveness leads to higher standards of living for its citizens (Porter 1990). In this general scenario, government sponsored infrastructure projects are considered a major component of factor creation. However, on another level, it is in the government's interest to drive the determinants in the infrastructure industry because they are the largest customers. Continual success by Producers will ensure public Owners increased efficiency in obtaining their infrastructure-related goals. These goals include producing better services of higher quality for the end users at lower costs to the taxpayers (Miller 2000). In order to reach these goals, Owners need to understand the diamond from the standpoint of the private sector. Because industry advantage is often geographically concentrated, the same opportunities for improvement are available to the all levels of government including local, state, and federal agencies (Porter 1990).

Many of the ways in which an Owner can drive the determinants of industry competitiveness have been discussed in Section 3.2.3, which addressed the Five Competitive Forces that Determine Industry Advantage. In addition to these firm specific issues, governments effect the factors for the infrastructure industry through the actions listed below. A common characteristic of these items is that there is seldom a direct correlation between short-term cost advantages and long-term competitive advantage. Issues that cut costs in the near future typically will not lead to sustained success, and those that drive future competitiveness will not lead to short-term savings.

- One method to improve the quality of training and safety records of Producers is to encourage and promote ISO Certification. In Porter's model, training capacity is a factor condition.
- Many people believe that labor union agreements also improve work standards and safety records.
- Privatization of infrastructure facilities and contract operations has the potential to drive factor creation and demand conditions. It is believed by many that these strategies bring innovative management solutions, flexibility, and cost-savings (the result of efficiency, expertise, and the economy of scale) to the public sector.
- Regulatory policies that revolve around public safety and environmental standards drive infrastructure demand conditions. For example, waste water standards set by the Environmental Protection Agency force local administrations to upgrade their facilities.
- The positive effects of creating an environment that is open to technological advancement have already been discussed. Once owners are open to technology, the next step is to drive firms to innovate. Construction documents that include performance specifications encourage innovation. This strategy will lead to rivalry, which in turn lead to potential perpetual gains in efficiency in infrastructure projects.
- As the major customer in this industry, government agencies should strive to become sophisticated buyers. Sophistication drives rivalry.

- Owners influence firm structure and the dynamics between related and supporting industries through their choice of delivery methods. Repeat procurement strategies will eventually lead to lower bidding costs for because of the learning curve associated with restructuring and creating partnerships. In addition, delivery methods other than DBB prepare American firms to compete for projects in foreign countries in which no delivery preferences exist.
- Laws that limit the choice of delivery method limit firm structure and strategy options.
- Although policies that are rooted in parochialism have short-term benefits for American firms, the long-term effects are negative because they protect firms from international rivalry.
- In the long run, stipends have a negative impact on firms and industries because they erode the private sector's necessity to innovate in order to remain competitive.
- Deregulation also has the potential to unleash the determinants of the diamond by allowing firms to compete with one another freely.

3.3 Interest Group Liberalism

Interest Group Liberalism (IGL) in the United States can be summarized in two steps: (1) The government monopolizes a specific segment of public activity. In infrastructure, this process was possible through financial domination. (2) After government intervention, a program is authorized which establishes an administrative agency that functions without specific statutory guidelines through a bargaining process that gives back aspects of the monopoly piece by piece to individuals or groups (Lowi 1979).

3.3.1 Pluralism

Special interest groups (1) are composed of potentially biased "experts", (2) have their power and authority backed by higher legislation efforts, and (3) are theoretically self-policing (Lowi 1979). Pluralism describes a society that is self-regulated by these groups. One inherent weakness of pluralism is that factions, whether viewed as "good" or "bad", can not be expected to hold the common good of the country above their collective interests and the interests of their individual members (Lowi 1979). The end

result of a negotiation process involving a number of groups is not necessarily the optimal result for the individuals of which the groups are composed. When this situation exists, it is important to deal with the specific interests of groups in the context of the nation's "big picture" interests. In the area of infrastructure, the concepts summarized above pertain to two categories of factions: builders and owners.

With respect to builders and the groups that represent them, strict head to head competition creates a situation in which the factions must prove that they can complete a project faster, cheaper, or with a higher quality than their competitors. Each group's self interest is put in check by the existence of competing groups and by Owner requirements.

Many factions of builders define themselves by the delivery method or financial strategy that they support. In this case, it is important that Owners not allow direct competition between various groups. For a project to be successful it is imperative that the Owner explores all financial and delivery alternatives and defines a project scope that coincides with their objectives and their resource constraints before they issue an RFQ or RFP (Miller 2000).

When analyzing owner factions, there is a clear difference between programs in which public works departments, municipalities, counties, states, and federal departments act in their own self-interests and programs in which they work toward a common good (Miller 2000). Competition between local agencies for state or federal funding appears to rely heavily on political posturing. This method of allocation creates an unleveled process that is not transparent to the end users that will benefit the most from the projects.

3.3.2 Additional Government Actions that Address IGL

Lowi (1979) has described several government actions that address the shortcomings of IGL. First of all, the government should refrain from including vague clauses in legislation such as "fair competition" and "clean air" that transfer undefined authority to administrators. Instead, they should strive to set clear guidelines for action. This process would push the responsibility and public accountability for making decisions to

the highest levels of government. It would also replace opportunities for interests groups to bargain informally with transparent formal procedures. The end result of these two advantages is that the government would regain and strengthen their ability to plan.

Legislative codification through the collection, simplification, and combination of all of the laws, regulations, administrative decisions, and judicial rulings that are related to a particular subject is also recommended. Codification is a powerful tool that aides in the detection of inconsistencies and illegitimacies, improves accessibility and transparency to the public, and shifts widespread reliance on negotiation to legislation (Lowi 1979).

Finally, sunset requirements for legislation, regulations, programs, and administrative agencies enable decision-makers to revisit policies and terminate or modify them after a learning period. Sunset laws combined with the added transparency of codification would enable the government to realize the advantages of pluralist principles while limiting the disadvantages (Lowi 1979).

4 TEA-21

As previously mentioned, TEA-21 authorized transportation programs and funding appropriations totaling $218-billion over six years. Figure 4-1 below shows TEA-21 summarizes the program.

Program	Funding ($billion)
Highway	173
Highway Safety	3
Transit	41
Rail	1
Total	**218**

Figure 4-1 TEA-21 Funding

TEA-21 continues and enhances the funding structure established by ISTEA for highway and transit systems. The legislation authorizes four core programs: (1) The Interstate/National Highway System program, (2) the Surface Transportation program, (3) the Bridge Rehabilitation program, and (4) the Congestion Mitigation and Air Quality Improvement program. Cumulatively, these programs include funding for the National System of Interstate and Defense Highways, the National Highway System, bridges on any public road, transit projects, and bus facilities.

Construction began on the National System of Interstate and Defense Highways in 1956. To date, this system includes 43,000 miles of highways. The National Highway System was established by the National Highway System Designation Act of 1995. The system includes the Interstate System and an additional 118,000 of priority corridors, major arterials, and the connections to principle intermodal terminals.

The major issues that ISTEA and subsequently TEA-21 addresses include financial flexibility, environmental and safety improvements, and a planning and programming process that relies on local decision-making. This chapter includes a summary of TEA-21's planning and programming policies.

4.1 Policy Direction

Tea-21 established a mission statement complete with goals and objectives. This portion of the legislation is designed to provide guidance and strategic direction to state and local agencies. The following excerpt from paragraph (f) of Sec. 1203 of TEA-21 summarizes seven planning factors that state and local planning agencies are to "consider".

> "(A) support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;
> "(B) increase the safety and security of the transportation system for motorized and nonmotorized users;
> "(C) increase the accessibility and mobility options available to people and for freight;
> "(D) protect and enhance the environment, promote energy conservation, and improve quality of life;
> "(E) enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;
> "(F) promote efficient system management and operation; and
> "(G) emphasize the preservation of the existing transportation system.

Beyond the seven objectives listed above, state and local planning agencies have the flexibility to consider additional issues that the participants in the planning process identify. TEA-21 also provides maximum flexibility regarding the complexity and level of effort required for the planning and programming process. "The process for developing the plans and programs shall...be continuing, cooperative, and comprehensive to the degree appropriate, based on the complexity of the transportation problems to be addressed" (23 USC 101, Paragraph (a)(4) Section 1203).

4.2 Planning

ISTEA and the subsequent TEA-21 emphasize a planning process that uses the cooperation of local officials, state officials, transit operators, and the public to meet collective transportation needs. Figure 4-2 below illustrates the hierarchy of the planning process. Information flows from the bottom to the top of the chart, and funding flows from the top to the bottom.

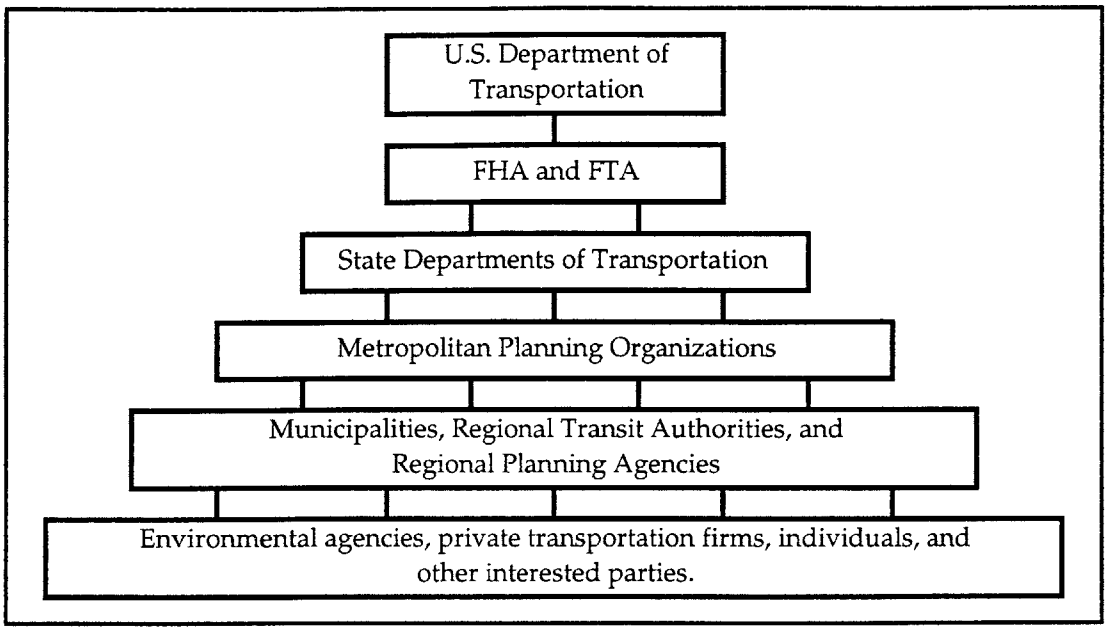

Figure 4-2 TEA-21 Planning Structure

4.2.1 MPOs

Metropolitan Planning Organizations (MPO) are quasi-public agencies established by TEA-21 for urban areas with a population exceeding 50,000. MPOs consist of representatives from municipalities, regional planning agencies, regional transit authorities, the state highway department, and other interested parties throughout the region. In addition to these entities, TEA-21 requires participation by any "interested parties" throughout the planning and programming process.

4.2.2 Transportation Planning Reports

TEA-21 sets forth requirements for three planning reports. The first is the Unified Planning Work Program (UPWP). MPO's, the State, and transit agencies cooperate to develop a UPWP. These reports describe in detail the transportation planning and research activities that are scheduled to take place in a specific region during the following year and identify the party that is responsible for each task.

The second report is the Regional Transportation Plans (RTP). TEA-21 requires each MPO to draft a RTP at least every five years. These regional reports have a at least a 25-year planning horizon and include the following information (FHWA and FTA 1999):

- A discussion of studies targeted at planning, policy making, transportation, social, environmental, or economical needs.
- The region's short-term and long-range transportation planning process goals and strategies.
- A survey of the existing conditions of the region's transportation system.
- The region's projected transportation demands for goods and travelers.
- Socioeconomic projections.
- Operations and management strategies aimed at improving the efficiency of system performance.
- An integration strategy for an intelligent transportation system (ITS).
- An assessment of the capital investments required to preserve the region's transportation system. This section includes the identification of operations, maintenance, and construction projects and programs.
- Descriptions of the scope and design concepts of proposed projects and programs complete with cost estimates.
- Expected environmental, socioeconomic, and transportation impacts of the overall plan.
- A financial analysis of the expected sources and uses of funds over the entire planning horizon for all of the projects and programs addressed in the plan.

The final planning report required by TEA-21 is the State Transportation Plan (STP). The requirements for STPs mirror those of the RTPs. The STP must incorporate a RTP from each MPO in the state without modification. Although federal approval is not required for the STPs, they must be submitted to the FHWA and FTA.

4.2.3 Identification of Project Alternatives

TEA-21 establishes guidelines for project financing and for project scope options. The main restriction on project financing is that the use of federal funds for maintenance of a

facility is not prohibited. This provision means that states can use federal money for design and construction, but that they must secure funds for its remaining life cycle through internal means. Despite this restriction, the legislation introduced two tools that provide states increased financial flexibility in terms of timing. The first mechanism is the Grant Anticipation Revenue Vehicle (GARVEE bond), which permits states to apply anticipated future federal appropriations to long term loans. In some cases, the bonds have been insulated from a state's general budget and rely only on federal appropriations. GARVEE bonds shift the classical "pay as you go" approach to transportation finance to a "pay as you use" approach (Seltzer 2000).

The second mechanism introduced by TEA-21 is the Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA). This legislation provides loans to states for up to one third of the cost of large-scale projects that will produce revenue streams. The states are then required to repay the loans with the future revenues generated by the project. To qualify for TIFIA support, a project must have an investment rating of BBB or higher and cost more than the lesser of $100-million or half of the states total appropriations. For ITS projects, the threshold is lowered to $30-million (Seltzer 2000).

In terms of scope, TEA-21 increases the options available for federally funded projects. In addition to the traditional DBB, the legislation also permits the DB method for selected projects. The DB method is permitted for projects that cost more than $50-million. The threshold is lowered to $5-million for projects that include an ITS element. TEA-21 requires the Secretary of Transportation to establish regulations regarding the approval process by 2001. Until that time, DB approval follows the requirements set forth in Special Experimental Projects No. 14 (SEP-14). SEP-14 was passed on October 23, 1998 to identify contracting practices that have the potential to reduce life-cycle costs while maintaining quality standards (FHWA 1998). Although SEP-14 permits warranties for specific project elements, general maintenance is still removed from federal considerations.

4.3 Programming

Much like the planning procedure, the intent of TEA-21 is to develop programming guidelines that provide states maximum flexibility and stress cooperation among all levels of "interested parties".

4.3.1 Transportation Programming Reports

TEA-21 provides guidelines for two programming reports. The first is the Transportation Improvement Program (TIP). Each MPO is required to approve a TIP at least every two years. This program indicates all "agreed to" highway and transit projects, which require state or federal funds, in a specific region. The minimum horizon for the program is three years. TEA-21 requires the following information for each project or program selected: (FHWA and FTA 1999):

- Scope definition.
- Life cycle cost estimate.
- Agency responsible for project or program implementation.
- Project timing.
- Indication that the project is consistent with the RTP.

In addition to project information, the TIP may include a financial plan that (1) illustrates that the program is financially feasible by identifying the sources and uses for funds for each of the years, (2) recommends financial strategies necessary for additional projects, and (3) lists projects that would be implemented if extra funds were made available (FHWA and FTA 1999).

The second report is the State Transportation Improvement Program (STIP). Each regional TIP in a state is bundled together without modification to form the basis of a STIP. The STIP requirements mirror those for the TIP.

4.3.2 Prioritization

TEA-21 requires that each TIP "identify the criteria and process for prioritizing implementation of transportation plan elements (including intermodal trade-offs) for inclusion in the TIP and any changes in priorities from previous TIPs" (FHWA and FTA 1999). Ideally, this information and a required status report of all previously approved projects are to be used as a management tools to monitor the implementation progress of the region's transportation plan.

4.4 Budget Review and Approval

There are two levels of approval in TEA-21: budget approval and project approval. Of the appropriations listed in Figure 1-4, TEA-21 guarantees $162-billion for highway projects and programs and $36-billion for transit projects and programs from the Highway Trust Fund (HTF). The key component of the HTF is the federal motor fuel tax. For the first time, a firewall was created around these guarantees so that they do not have to compete with the general budget on an annual basis. These guarantees could increase annually to reflect projected increases in the HTF or additional allocations from the general budget. In addition, TEA-21 identifies funding levels for each state. The funds for each state are given as a percentage of the total appropriations (USDOT 1998). Although the actual funding levels are determined on an annual basis, the guarantees established in TEA-21 provide each state with an approximate annual budget for six-year period.

Project approval is done at the program level. The first step in the programming approval process is for each governor to approve all of the TIPs in their state. Upon the governor's approval, the programs are collected and incorporated into the STIP, which is reviewed by the FHWA and FTA to insure that the state planning and programming process is consistent with the process set forth in TEA-21. After the FHWA and FTA approve a STIP, federal funding for the projects and programs listed in the STIP is also approved. TIPs may be modified at anytime with the consent of the key parties responsible for its development.

5 ROUTE 3 NORTH TRANSPORTATION IMPROVEMENTS PROJECT

5.1 Introduction

U.S. Route 3 runs 279 miles from Massachusetts Route 128/I-59 through Massachusetts and New Hampshire and ends at the Canadian border. In Canada, the road continues north as Quebec 257. The 34-mile stretch that runs through the Commonwealth of Massachusetts is designated as Mass. Route 3 North (Rt. 3). A map of Rt. 3 is attached as Appendix 5-A.

Rt. 3 is the only north/south limited-access highway serving the Mass. towns of Burlington, Bedford, Billerica, Chelmsford, Lowell, Westford, and Tyngsborough. It has interchanges with two interstate highways, I-495 and I-95, and eleven interchanges with local roadways throughout the corridor. Rt. 3 is used by thousands of New Hampshire and Mass. workers who commute daily to Boston.

Rt. 3 was constructed throughout the early 1960's as a four-lane highway, two northbound and two southbound lanes separated by a median. A complete timeline of Rt. 3 is attached as Appendix 5-B. Today the road's geometry does not meet current AASHTO or state highway standards and traffic demands are more than double its original design capacity.

5.2 Mass. Transportation Planning and Programming

Following is a summary of the Mass. planning and programming policies. They are in line with the requirements set forth in TEA-21.

There are several parties that participate in the process. First of all, every municipality in Mass. belongs to one of thirteen RPAs. These authorities provide regional coordination of planning issues such as land-use, zoning, housing, environment, and transportation. They also offer technical support to the member communities.

Additional planning entities are the Regional Transit Authorities (RTA). These independent public authorities are responsible for public transportation in their

respective service areas. RTAs are run by a board that consists of elected or appointed members from each of the communities in the region they service. Thirteen of the fifteen RTAs in Mass. do not operate the transportation systems that they are responsible for. Instead, they contract operations to the private sector.

The Mass. Legislature established the Executive Office of Transportation and Construction (EOTC). This office is responsible to develop, coordinate, and implement transportation projects and policies throughout the state.

There are thirteen MPOs in Mass., one for each of the RPAs that have a population of more than 50,000. MPOs consist of representatives from one RPA, the RTAs that service that region, the Mass. Highway Department (MassHighway), the EOTC, and other interested parties throughout the region. For example, the Boston MPO consists of the following voting members:

Mass. Port Authority	Mass. Turnpike Authority	MassHighway
Mass. Bay Transportation Authority	Metropolitan Area Planning Council (MAPC)	Mass. Bay Transportation Authority Advisory Board
City of Boston	City of Everett	City of Newton
City of Peabody	Town of Bedford	Town of Hopkinton
Town of Framingham		EOTC

Figure 5-1 Boston MPO Members

The MAPC is a planning agency that represents the 101 cities and towns of the Boston metropolitan area.

Mass. has established two types of groups to facility public involvement. The first is a Transportation Advisory Group (TAG). Each RTA has a TAG that is responsible for facilitating public involvement in the planning process. Specifically, their duties include: 1) reviewing and approving federally required reports, 2) holding regular public meeting to address planning issues, and 3) serving an advisory role to the MPOs. In addition, Corridor Advisory Committees are created by the RPA's to foster project specific public involvement.

Mass. agencies draft twenty-five year transportation plans every three years and three-year TIP annually. There are seven major steps involved in creating a TIP.

1. The EOTC estimates the expected federal financial aid for the next three years.
2. The state allocates money for the Central Arterial Project, any other mega- projects, and statewide programs.
3. The remaining funds are passed to the MPOs.
4. The RPAs solicit communities and RTAs for projects.
5. Projects are assigned to local or state subcommittees for programming.
6. Each MPO develops a TIP and releases it for public review.
7. The MPOs respond to public comments, make final changes to the TIP, and approve the final program.

Pursuant to TEA-21 guidelines, upon approval, each regional TIP is bundled together to form the basis of a STIP. Table 2 below shows the state's budget totals for fiscal years 2000-2003 as approved in 1999.

(000)s	Projects	Federal Funds	State Funds	Total
Central Artery Project	25	1,105,189	1,417,533	2,522,722
Transit Projects	34	561,470	140,367	701,837
Flexible Funding Projects	4	13,781	3,445	17,226
Highway Projects	69	0	186,537	186,537
Totals	**132**	**$1,680,440**	**$1,747,882**	**$3,428,322**

Figure 5-2 1999 Mass. STIP Summary

5.3 Enabling Legislation

Figure 5-2 above illustrates one of the key issues of the Rt.3 project. Even though the facility has been in dire need of reconstruction for several years, the work has been financially constrained. Planning for the Central Arterial/Tunnel Project, which was originally estimated at $2.6-billion and now has estimates of up to $12.2-billion, began in 1982. (Cassidy 2000) Since construction began in 1991, the project has been the one of the state's top transportation priorities. An additional priority is the annual statewide

bridge and road maintenance program. After the Central Arterial Project and statewide maintenance programs are funded, the remaining funds have been relatively small compared to the $200-million Rt.3 estimate.

In order to deal with tight budgets, Mass. Governor Paul Cellucci announced a plan on April 28, 1998 to privately fund the Rt. 3 improvement project. In accordance with Gov. Cellucci's plan, the Senate and House of Representatives of the Commonwealth of Massachusetts passed a bill providing the commonwealth "an accelerated transportation development and improvement program" On August 12, 1999. Section 6 of Chapter 53 of the Acts of 1999 set forth the requirements regarding the improvement of Rt. 3.

In brief, the legislation enabled the secretary of transportation to pursue an agreement with a developer where by the design, construction, operations, and maintenance of the Rt.3 would be funded in whole or in part by the private sector. The EOTC used this bill as a guideline to prequalify six developers for the project and to develop a request for proposal (RFP). The RFP was issued on December 17, 1999, with proposals due ninety days later on March 16, 2000.

5.4 Project Scope

Section 1.3 of Vol. I of the RFP summarizes the key elements of the improvement project as follows:

> ...the addition of a travel lane in each direction of the 34 km/21 mile long corridor, from and including its interchange with Route I-95/128 in Burlington to the New Hampshire border. The Project also includes the addition of a median shoulder, the addition of a 30 foot clear recovery zone inclusive of shoulders, improvements to thirteen interchanges, replacement of 29 bridges and other structures, creation of an additional pair of travel lanes in each direction to function as a collector/distributor system to aid in handling the high volume of traffic that moves between Route 3 and Route I-495, reconstruction of the Drum Hill rotary, construction of a new northbound ramp at the Concord Road interchange in Billerica, construction of two park and ride lots and installation of an ITS system.

All bridges will be widened to accommodate the potential installation of additional, fourth north/south travel lanes in the future. Improvements will also be made to

facilities off of the Facility, such as new signal timing and lane re-striping to facilitate movement through the corridor.

Initially, the developer is responsible for the design and construction of the improvements listed above. Upon completion, the developer is responsible for reconstruction, operational work, and capital maintenance work for a 30-year term.

5.5 Highway Maintenance Contracting in Mass.

In 1992, the new Commissioner of MassHighway, James M. Kerasiotes was looking for ways to cut the departments spending and at the same time increase the level of service. At this time, according to accounts described on the Commonwealth's web page,

> ...the maintenance division was plagued with numerous problems. There was one foreman for every two laborers, 65% of all equipment was beyond its useful live, and abuse was rampant. Some foreman were making more than $40,000 just in overtime while several maintenance section were averaging 23 or more sick days a year. Moreover, basic maintenance functions were not being performed. The grass was cut only once per year, less than half of the state's highways were swept, catch basins were not cleaned, bridges were not washed to prevent deterioration, and numerous other basic maintenance functions were not being performed.

In an attempt to improve efficiency, the department introduced a pilot program in Essex County that included the competitive contracting of routine maintenance services to the private sector. Through this program, MassHighway received an additional $2-million in maintenance services and cut their annual budget by $2.5-million.

In light of the successes of the pilot program, MassHighway extended the program throughout the entire two easternmost districts. Fifty-seven percent of the state's highway miles were divided into seven contracts. The existing MassHighway workers competed with the private sector for these contracts. The competition resulted in the award of four of the seven contracts to private companies. In the first year of the competition, MassHighway had gained an additional $10-million in services, and saved $7.8-million. In 1996, MassHighway expanded the competitive contracting program to the entire state. With the success of the state's service contracts, it was natural for the state to include operations and maintenance in the scope of the Rt. 3 project.

5.6 Project Financing

The RFP broke the project into two phases. Phase 1 includes design and construction, and is expected to last 42 months. During this phase, the developer is responsible for securing all project financing. However, the state will pay the interest on the developer's debt throughout this phase. The second phase commences upon final acceptance of the work. During this phase, the state will pay the developer under the conditions of a Ground Lease and a Sublease. These lease payments will cover principle and interest payments, O&M expenses, and the developer's capitalization costs.

In addition to state funding, the developers are encouraged to establish joint developments that create additional sources of revenue through the lease of air, surface, and sub-surface rights throughout the corridor. According to Section 1. 5 of Vol. I of the RFP, the Owner "is interested in obtaining the maximum economic benefit from the multiple use of the highway corridor consistent with the federal, state and local law regulatory requirements and concerns (including local zoning) and providing that any such joint or ancillary development does not, in the Owner's sole and absolute discretion, compromise the use, maintenance or operation of the Facility. "

Section 3.5.2 of Vol I of the RFP identifies potential ancillary revenue generators including "fiber optics, communications, roadside services, advertising, naming rights," and real estate development. At least 50% of ancillary revenues shall be used to reduce the O&M components of the Owner's lease payment.

5.7 Evaluation Criteria

The RFP stated that the contract would be awarded to the developer that offers the best value to the owner with respect to the evaluation criteria set forth in the RFP. The design-build section of the proposal would account for sixty percent of the final score, while the O&M section and the financial/joint development proposal would account for thirty percent and ten percent respectively. The RFP broke the three categories listed above into several subcategories. The evaluation committee was to assign a rating of either exceptional, good, acceptable, poor, or unacceptable to each subcategory.

Upon submittal, the evaluation committee will preliminary rank each proposal. After a round of oral presentations by each developer, the committee will reevaluate the proposals and assign a final rank.

Section 4.5 of Vol. I of the RFP describes the evaluation criteria of the DB proposal as follows (stars indicate the most important factors):

- ⋆ Plan for maintenance of traffic.
- ⋆ The proposed plan for management of the DB Work, including the approach to quality control and quality assurance.
- ⋆ The proposed design of the Facility and measure taken to assure quality construction.
- ⋆ The time schedule proposed for completion of the Project and the measures taken to assure that the schedule is met.

- The proposed approach to meeting environmental obligations in a timely and cost-effective manner.
- Responsiveness to local citizen and government concerns and benefit to public in general.
- The developer's ability to ensure labor harmony during the length of the Project.
- The reputation and experience of the bidder and other major participants.

Section 4.6 of Vol. I of the RFP lists the evaluation criteria of the O&M proposal:

- ⋆ The proposed plan for management of the O&M services, including approach to quality control and quality assurance.
- ⋆ Quality of maintenance plan.

- Responsiveness to local concerns, including maintenance of traffic on the Facility, and the minimization of traffic on local roads.

- Ability to ensure labor harmony during the length of the project.
- The reputation and experience of the bidder and other major participants.

The criteria for evaluating the Finance and Development Proposal are listed in Volume I Section 4.7 of the RFP as follows:

  - ⋆ Soundness and reasonableness of the financial plan, such that it can be implemented with a high degree of confidence.
  - ⋆ Proposed strategy for funding the long-term maintenance of the Facility.
  - ⋆ Adequacy and acceptability of safeguards in the investment, custody and accounting of all Project-related funds for both construction and operation of the Facility.
  - ⋆ Level of risk exposure to the Owner under the financial and insurance plans, in terms of potential additional funding, Project delay, construction defects, bondholder recourse, and proposed insurance plan.
- Comprehensiveness and viability of strategy for the development of ancillary revenues within the corridor and likelihood of economic return to the Owner.
- Benefits to the Owner, the road users and the general public of proposed development.

In addition to the above criteria, the RFP required that each proposal be evaluated on a pass/fail basis to insure that the bidder's financial capabilities match those described in the pre-qualification round, that the Major Participants are consistent with those described in the statement of qualifications, and that the proposal meets the state's goals regarding project participation by disadvantaged, minority, and women business enterprises.

5.8 Appendix 5-A. Project Map

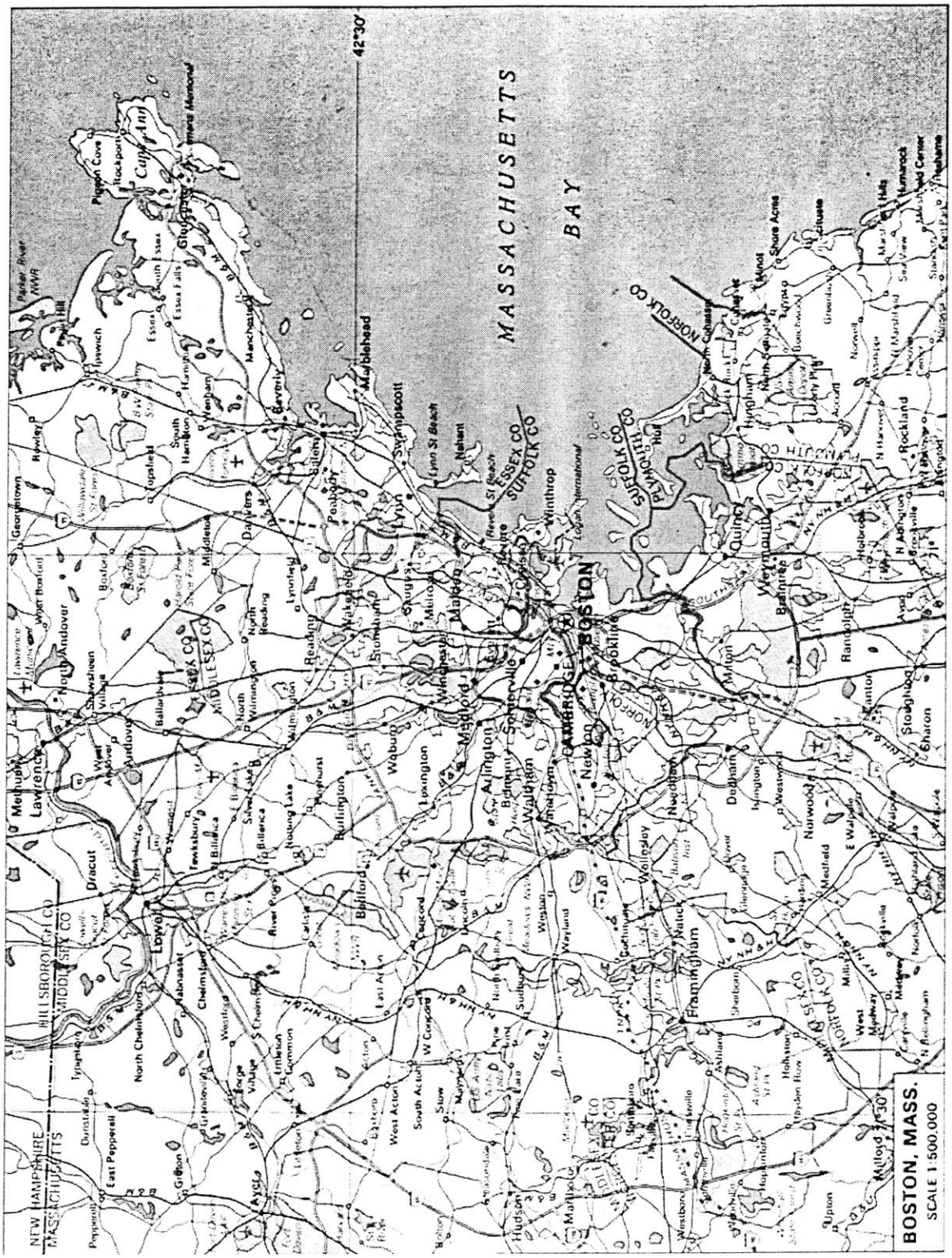

Figure 5-3 Rte. 3 Location Map

5.9 Appendix 5-2. Route 3 North Timeline

Date	Summary
1960s	Twenty-one miles of Massachusetts Route 3 North (Rt. 3) was designed and constructed from Burlington, MA to the New Hampshire.
1970s	A group of contractors submitted an unsolicited proposal to State Senator Chester Atkins to privatize Rt. 3.
1982	Planning began for the Central Artery/Tunnel Project.
Jan. 1985	The Northern Middlesex Area Commission found that the traffic on Rt. 3 averaged 80,000 VPD and projected it to increase to 100,000 by 1990. (Milne, 1985)
7 Feb. 1985	Massachusetts Governor Michael Dukakis announced the state's commitment to widening Rt. 3 in order to relieve chronic congestion. He also proposed short-term solutions such as upgrades in mass transportation and adjustments in commuters work schedules. (Milne, 1985)
15 Aug. 1985	New Hampshire Governor John H. Sununu announced his support for widening of Rt. 3. Sununu suggested a joint proposal with Governor Dukakis for federal funds to support the estimated $75-million project over 5 years. (Milne, 1985)
1990	Governor William Weld of Massachusetts received a recommendation from a Transportation Privatization Task Force that "the administration file legislation to permit private toll roads." (Palmer, 1993)
Sept. 1991	Construction began on the Central Artery/Tunnel Project.
25 Sept. 1993	James J. Kerasiotes, the Secretary of the Executive Office of Transportation and Construction, mentioned casually that Rt. 3 may be widened as a BOT project. Furthermore, Kerasiotes mentioned BOT

projects in California, Virginia, Mexico, France, and England and said that Perini Corporation had submitted an informal proposal to improve Rt. 3 with private funds. Kerasiotes believed that the financial requirements of the Central Arterial Project combined with a $400-million annual highway maintenance budget hindered the state's ability to finance the Rt. 3 improvements. The Boston Globe quoted Kerasiotes as saying, "If there is a need in the marketplace for new facilities, the private sector is probably the thing to fill the need." (Palmer, 1993)

29 Apr. 1998 Massachusetts Governor Paul Cellucci unveiled a plan to widen Rt. 3 to six lanes using a DBO contract and private financing.

May 1998 The Massachusetts Highway Department (MassHighway) issued a Request for Qualifications and Proposals to six proposers.

21 July 1998 The Massachusetts legislation session ended with no agreement on the Rt. 3 project. "Both the Senate and the House unanimously passed their own versions of the bill ... but the plan failed when neither body would accept the other's wording on the hiring of union employees." (Cole, 1998) The Senate supported a project labor agreement, while the House did not.

29 Nov. 1998 The Boston Globe reported that the six potential bidders had all supported negotiating a project labor agreement.

24 July 1999 The House and the Senate removed the project labor agreement from the Rt. 3 bill and passed the legislation.

12 Aug. 1999 Governor Cellucci signed legislation enabling the Rt. 3-improvement project to proceed. The project is estimated to range between $185-million and $225-million over 30 years. (Cole, 1999)

20 Sept. 1999 MassHighway pre-qualified three of the six proposers for the project.

17 Dec. 1999 MassHighway issued an RFP for the Rt. 3 project to the three pre-qualified bidders.

16 Mar. 2000	All three pre-qualified bidders submitted bids.
10 Apr. 2000	Oral presentations by the bidders are scheduled.
15 May 2000	Contract award is scheduled.
July 2000	Issuance of Notice to Proceed is scheduled.
1 Jan. 2004	Design and construction phase is scheduled to be complete.
1 Jan. 2034	Facility lease agreement is scheduled to expire.

6 METRO ORLANDO

Located in central Florida, Metro Orlando consists of Orange, Seminole, Lake, and Osceola Counties, and is one of the premier tourist destinations in the world. The main tourist attractions in this region include Walt Disney World and Epcot Center, and Universal Studios Florida. Although the population of Metro Orlando is projected to reach only 1.5-million in 2000, the region hosts nearly 40-million visitors annually. The economy of Orlando and the surrounding areas are driven by tourism. For this reason, effective transportation facilities are necessary to sustain economical prosperity and to nurture growth.

6.1 OOCEA

The Orlando Orange County Expressway Authority (OOCEA) is an Agency of the State of Florida responsible for the operations of the toll ways in Orange County. They have the authority to purchase property, construct improvements, collect tolls, lease or sell property, borrow funds, accept grants, exercise the power of eminent domain, and apply revenue to bond payments. Currently, OOCEA manages a toll system consisting of three state routes, SR-408, SR-528, and SR-417, totaling 79 miles, and 10 toll plazas. Appendix 6-A contains a map of the existing toll way system. To date, the system represents more than $1-billion in investments. The system is financially self-sufficient. All operations, maintenance, administration, and new construction costs are funded with toll revenues.

6.2 Increasing Traffic Demand

The estimated daily traffic through the toll way system in 1994 was 270,000 vehicles. This figure is projected to increase to 770,000 by the year 2014. This significant predicted growth is driving OOCEA to plan ahead and create programs that will keep an ever-increasing number of residents and visitors moving safely and rapidly through Orange County. Table 1 below shows a 5-year work plan that includes upgrades and expansions. Another method OOCEA has explored to increase its effectiveness is contracting out specific authority responsibilities to the private sector. Contract operations, it is believed, can bring innovative management solutions, flexibility, and

cost-savings (the result of efficiency, expertise, and the economy of scale) to the public sector.

OOCEA Five Year Work Plan ($000)s	1	2	3	4	5	Total
Improve exisitng systems	7,853	14,130	13,179	19,939	28,720	83,821
System expansion projects	36,401	43,535	12,000	0	0	91,936
Interchange projects	3,605	3,321	150	150	17,500	24,726
Toll facilities projects	3,348	6,150	2,379	200	200	12,277
Intelligent transportation systems	15,554	5,218	3,152	3,139	2,527	29,590
Signing and pavement marking	1,174	3,427	280	280	280	5,441
Renewal and replacement projects	4,441	3,694	2,221	1,251	3,723	15,330
Landscaping	426	1,012	1,000	1,000	1,000	4,438
Total from SR 429-Part A project	78,527	28,979	0	0	0	107,506
Totals	**151,329**	**109,466**	**34,361**	**25,959**	**53,950**	**375,065**

Figure 6-1 OOCEA Five Year Work Plan

6.3 Project Scope

On May 31, 1994 OOCEA issued a Request for Proposal (RFP) for toll operations services throughout its toll way system for a five-year concession period. Section 1-1.1 of the RFP described the objectives of the contract.

> The Authority intends to select a proposal that meets the following objectives: 1) efficient toll collection operation including a reduction in current operating costs, 2) sound financial accounting of revenues and assets, 3) responsive courteous customer service, and 4) serves the best interests of the people of Central Florida and the Orlando-Orange County Expressway Authority.

In order to obtain the objectives described earlier, OOCEA outlined numerous tasks throughout the RFP. Section 2.5.0 of the RFP described the scope of the contract:

> The services to be provided by the TOC (toll operations contractor) are summarized as follows: furnish all labor, materials, personnel, supplies and support services necessary to manage, operate and maintain the Authority's East-West Expressway, Central Florida GreeneWay and Bee Line Expressway plaza, ramp and site facilities 24 hours per day, seven days per week, 52 weeks per year.

Originally, the TOC was required to perform the above work for a Term of 3 years, but Addendum #1 extended the Term to 5 years. The RFP divided the scope into the following sections: mobilization planning, program management and administration, auditing and accounting procedures, toll operations, and maintenance of the tolling facilities. These sections are summarized below.

Mobilization Plan: The mobilization period was the time from the Notice to Proceed to the full operation. The RFP separated this period into seven phases. The entire process was scheduled to take approximately nine months. OOCEA's intent was to provide continuity in service and minimize the impact of the transition period on the public and on the current employees.

The TOC was required to submit a systems operations transition plan. This plan addressed the managerial, staffing, and equipment needs throughout the mobilization period. The plan included a detailed implementation schedule. The bidders were required to submit an outline of the plan with their proposal and submit a final draft for review within forty-five days after the contract was awarded.

Program Management and Administration: This section of RFP addressed the long-term managerial requirements of the contract. For example, it required the TOC to conduct periodic staff reviews and provide future staffing projections to the Authority. In addition, the TOC was required to break the staff into functional groups and assign specific tasks.

This section also addressed the requirements of the TOC operation office. The TOC was required to establish an office from which to manage the operations programs throughout the concession period. The office was to have ample training facilities and room for OOCEA staff members.

The RFP required the TOC to create and implement a manual of Standard Operating Procedures (SOP). This manual included a Human Resources Management Program, complete with employee benefits, a training program, a standardized public relations procedure, provisions to provide security in the tolling facilities, an emergency plan to insure continual operations, and a quality management program. The quality program

reflected the commitment of OOCEA to provide travelers with the highest possible level of service. It was to address customer and employee satisfaction, complaint resolution, and employee evaluations. Again, each TOC submitted an outline of the SOP with their proposal. The final draft was to be submitted forty-five days after the contract was awarded.

Auditing and Accounting Procedures: As previously mentioned, one of the goals of the privatization contract was to establish an effective financial management system. This section addressed the specific auditing procedures of this objective. For example, the RFP required the TOC to submit deposit and audit reports daily. This section also described the cost accounting procedures that were to be used throughout the five-year contract.

Toll Operations: OOCEA's toll way system includes several types of lanes including manual lanes, automatic coin machine lanes, e-pass lanes, manned ramp lanes, and automatic ramp lanes. This section of the RFP provided information regarding each of these lane types, and required the TOC to submit specific operations details for each in the SOP.

The TOC is also responsible for the OOCEA's Electronic Toll and Traffic Management (ETTM) system. ETTM is a computerized system that generates accurate reports on toll collection and processing and traffic management throughout the entire system. The TOC is responsible for operations of the system, while the OOCEA continues its maintenance.

The RFP also gave the TOC the responsibility of the ETTM's violation enforcement substation. This system takes pictures of toll violators. The TOC is responsible for data collection and its distribution to the authority, which then distribute notices and traffic citations.

Facility Maintenance: The RFP required the TOC to furnish all labor, material, and equipment needed to maintain the tolling facilities throughout the contract. This work included building and equipment maintenance, custodial services, pest control, and landscaping. All repairs under $1,000 were incidental to the bid, while larger projects

were to be billed on a time and material basis. Although this section was included in the original RFP, Addendum No. 5 removed all maintenance requirements from the project. The addendum created an operations and management contract instead of an operations and maintenance contract.

6.4 Existing Employees

Another key issue of the project was the fate of the existing facility employees. Section 1.1.12 of the RFP addressed this issue.

> The Authority facilities are presently staffed by Florida Department of Transportation career service (permanent) employees and other personnel services (OPS) (temporary) personnel under the direction of the FDOT Office of Tolls Operations. Additional toll collection personnel are provided by Norrell Services... Current Staffing (FDOT Career Service and Norrell) ... totals approximately 450 individuals (350 FDOT permanent employees and 100 Norrell contract employees) in a variety of job classifications...
>
> It is the expressed desire of the Authority to protect the employment of current FDOT career service employee... Accordingly, the selected firm shall provide first right of refusal for re-employment for comparable positions to those current FDOT employees. The reemployment of such career service employee shall be based on the employee obtaining permanent status in the Career Service system, and the employee obtaining a level of "achieves" or higher on his/her most recent Employee Performance Appraisal.
>
> The selected firm is encouraged to consider remaining FDOT and Norrell employees when filling available positions.

Additionally, the RFP required the TOC to structure an employee benefit package including vacation time, sick leave, a health plan, insurance coverage, and retirement benefits, which was comparable to the benefit package offered to full-time FDOT employees.

6.5 Proposal Evaluation

OOCEA received three proposals for this project. The RFP described the selection process as a best-value approach. Section 1-1.16 of the RFP addressed the evaluation process.

> A Selection Committee, hereinafter referred to as the Committee, will be established by the Authority to review and evaluate each proposal submitted in response to this RFP. The Committee will be comprised of at least five persons with background, experience, and/or professional credentials in the service area... The Committee will evaluate each proposal on its own merit without comparison to other proposals submitted.

The point system used by the Committee is summarized in Table 1. The contract was awarded to the bidder with the highest point total.

Criterion	Maximum Point Value
Qualifications Statement	60
Clear Understanding of Objectives	30
Proposed Approach	50
Professional Management Staff	50
Proposed Technical and Support Staff	20
Responsibility and Accountability	20
Work Program	10
Quality Control Program	10
Financial Control and Security Structure	10
Affirmative Action Plan	20
Price Proposal	120
Total Maximum Points	400

Figure 6-2 OOCEA Toll Evaluation Point System

6.6 Project Financing

The financial structure of the contract consists of direct funding from OOCEA to the TOC through monthly invoices. The TOC is responsible to collect tolls and transfer them to the Authority, but the agreement guarantees payment to the TOC regardless of the amount collected.

OOCEA included several bid forms in Section 4 of the RFP, including a form for each of the ten plazas and the TOC operations office for each year of the contract, and several summary sheets. The forms consisted of both lump sum and unit price bid items. The unit price of "man-months" was assigned to the Program Manager, Accounting/Audit Manager, and Toll Operations Manger. The unit "Man-hours" was assigned to the Plaza Managers, Toll Supervisors, Full Time Toll Collectors, and Part-Time Toll Collectors. The TOC was required to submit unit prices and quantities for each of these items. The

remaining items (Support Staff, Telephone, Supplies, Uniforms, Furnishings and Equipment, Vehicles, Mileage/Tolls, and Other Expenses) were classified as lump sum items for each location and each year of the term.

Section 3.2.2 of the RFP addresses the Authority's right to adjust the quantities of the unit price items throughout the term of the contract.

> Planned quantities shown on the Price Proposal Forms are approximate and represent adjustable requirements based on historical or known specific needs. Plaza Toll Operation Labor quantities are at the discretion of the proposers. Minimum lane staffing and 24-hour supervision requirements must be followed.
>
> The Authority reserves the right to increase or decrease the unit price pay item quantities at its discretion to accommodate facility and system operation requirements which may vary over the course of this Contract. The Authority, therefor, does not guarantee a requirement for a maximum or minimum quantity, and range of quantities, or exact quantities shown for each pay item.

The above language referred to the possibilities that the service requirements may change throughout the term, or that the Authority may experience budgetary constraints. The contract states that prices shall be adjusted if the actual quantity represents more than a 25% change from the original estimated quantities.

OOCEA assisted the proposers in their efforts to estimate the contract price by providing them with a list of the annual salaries of all the current employees, which totaled $7.7 million, and an estimated monthly phone service budget of $750.

6.7 The Winning Proposal

After reviewing three proposals, OOCEA awarded the contract to Florida Toll Services (FTS) on February 21, 1995. The total for the 5-year contract was $47,470,000. A summary of the contract totals and estimates provided by OOCEA are included as Appendix 6-B. OOCEA has estimated that this contract cut their operations budget by $1,000,000 annually.

The contract was awarded to FTS, a joint venture between Parsons Brinckerhoff (PB), Inc. of New York and Morrison Knudsen Corp. (MK) of Idaho. Both companies are

among the largest engineering and construction firms in the United States, and both have an extensive history in the design, construction, maintenance, and operations of transit systems throughout the country. Their proposal was based on systems that they had successfully used in similar projects. For example, at the time of the bidding, MK was operating the E-470 toll road connecting Denver to the Denver Airport. Following is a discussion of key aspects of the FTS Proposal.

The top four managerial positions, Program Manager, Toll Operations Manager, Manager of Quality Control, and Toll Audit Accounting Manager, are held by employees who at the time of the bidding, held similar positions at four toll roads across the country, including the Garden State Parkway in New Jersey, toll ways in Richmond, VA, the E-470 toll way in Denver, and the Dulles toll road in Washington D.C.

FTS submitted an abbreviated mobilization plan indicating that the initial transition period would start after the Notice to Proceed was issued on 11/14/94 and be complete by 1/26/95. By that time, FTS would be in full operations of the first two phases. Further transitions were scheduled to follow the benchmarks set forth in the RFP, which were discussed earlier.

Section C of FTS's proposal included the following organization plan for the project.

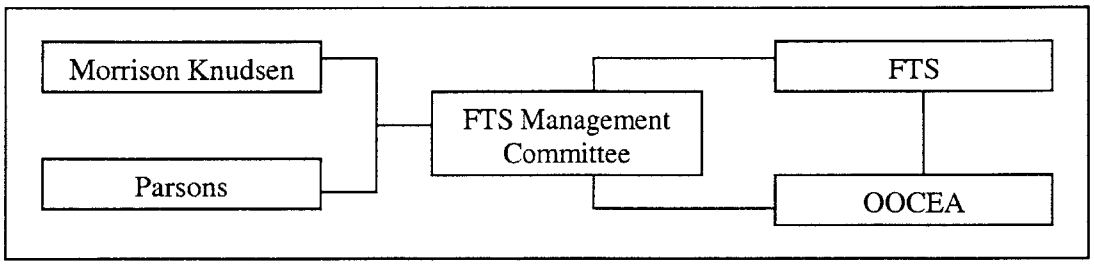

Figure 6-3 OOCEA Toll Project Organizational Chart

The Joint Management Committee, consisting of senior members of MK and PB, played an active role during the mobilization and transition period of the project. Since the conclusion of the transition phase, this committee has taken a more hands off approach, but still provides quality assurance and executive management services for the project.

At the top of the FTS sub-structure is the Program Manager (PM). The PM serves as the main contact between the management committee and the daily operations of FTS, and between OOCEA and FTS. The PM is authorized to make all decisions regarding the joint venture and has the power of attorney. Four functional managers report directly to the PM: the Quality Management/Training Manager, the Administration Manager, the Toll Operations Manager, and the Toll Audit and Accounting Manager.

Understanding that the main objectives of the OOCEA were to improve service, reduce operating costs, and implement an effective financial management plan, FTS included the following recommendations in their Proposal:

- Utilize a computerized employee-scheduling program.
- Introduce an employee incentive program that includes performance-based competitions, and rewards for worthwhile suggestions.
- Reduce the work force by expanding the duties of the managers and supervisors.
- Establish key performance indices to be used as benchmarks for future evaluations.
- Offer a comprehensive training program to a staff consisting mainly of current employees.
- Minimize emergencies and unscheduled work by maintaining a strong preventative facilities inspection policy.
- Maintain quality control of toll personnel through extensive supervisory inspection procedures.
- Expand the range of customer services required of personnel by changing the title of "Toll Collector" to "Toll Service Attendant".
- Address varying staff level requirements on an as needed basis through a contract with a temporary staffing firm in Orlando.

- Incorporate a comprehensive system for controlling project documents. At the time the Proposal was submitted, both firms had been working with the Florida Department of Transportation to standardize this system throughout the state.

6.8 Appendix 6-A

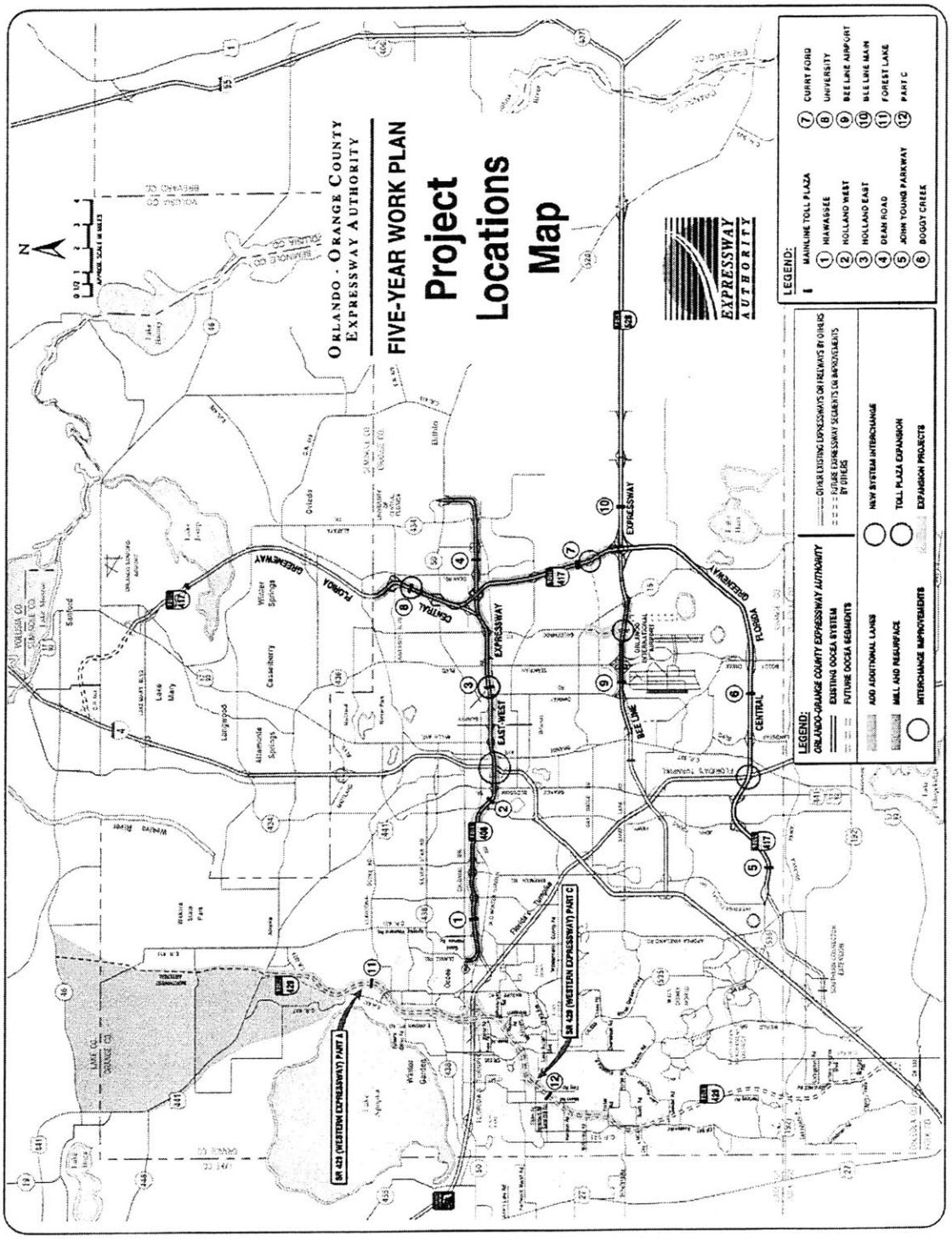

Figure 6-4 OOCEA Facility Plan

6.9 Appendix 6-B

FTS PROPOSAL ($000)s	1	2	3	4	5	Total
Labor	6,167	8,095	8,334	8,568	7,828	38,992
General and administrative	681	777	790	792	724	3,764
Mobilization	387	101	103	105	99	795
Management fee	651	808	830	852	778	3,919
Totals	**7,886**	**9,781**	**10,057**	**10,318**	**9,428**	**47,470**

Figure 6-5 OOCEA Proposal Summary

OOCEA Budget Information for Toll Operations Included in RFP
($000)s/year

Salaries:	7,700
Phone:	90
Suplies:	"General office supplies are provided" *

* Response to Question 131 of Addendum No. 1, page 27.

Figure 6-6 OOCEA Budget Information

7 HIGHWAY 407 ETR

7.1 Background

Highway 407 ETR is a major congestion-relief highway extending 69 kilometers along the north side of metropolitan Toronto. Completed in 1998, Highway 407 is the world's first fully electronic multi-lane toll highway. Frequent travelers are encouraged to reregister for a transponder that can be attached to their vehicles. The transponders are detected automatically as they pass through electronic tolling points at normal operating speeds. All other nonregistered vehicles are tracked by video cameras. License plate information is electronically sent to an off-site toll-processing center. At this center, tolls are assessed and bills are mailed directly to the owner of the vehicles. The automatic toll collection procedure significantly reduces the delays caused by the gates and booths of traditional toll ways.

Toronto is located along Lake Ontario's north shore. It is the economic center of the Province of Ontario. Before 1998, two east-west routes, Highway 401 and the Gardner Expressway, served the Greater Toronto Area (GTA). Population and commercial growth in the past three decades overloaded the capacity of the two routes. Congestion stifled the productivity of the GTA and was a major contributor to air-pollution problems. In an effort to address these problems, the Province of Ontario accelerated plans to construct Highway 407 in 1993.

Please refer to the 1997 Infrastructure Development Systems Case Study entitled "Highway 407 ETR" for a full description of the procurement process. In short, the project was originally structured as a Build-Operate-Transfer contract with a 30-year concession period that was to be privately financed. After two proposals had been submitted, the government split the proposals into two parts, and selected the road portion from one and the tolling portion from the other. The project was divided into two separate contracts, one for the Design-Build of the road, and the other for the supply and operation of the toll system. Ontario financed both contracts with government funds. In the end, Ontario invested Cdn$1.5-billion (Cdn$1.00 = US$0.68) in the design

and construction of the toll-road in an effort to increase east-west capacity throughout the GTA.

7.2 The Re-Privatization of Hwy 407 ETR

Although the initial plan to fund the first 69 km of Highway 407 with private funds was abandoned, after another election cycle, government officials continued to discuss the feasibility of attracting private investors to the project. On February 20, 1998, the Province announced that they would lease 407 to a private investor. In return for the right to collect tolls, the winning consortium would take on the responsibility for (a) operating and maintaining the existing highway for a 99-year concession period, and (b) constructing, operating, and maintaining two extensions to the toll road. The two extensions, one to the west and one to the east, totaled 39 km. The extensions had been conceptually planned during the original design process, and were thought by the government and the public to be necessary for further congestion relief.

The government concluded that the leasing of Highway 407 had three distinct advantages. First of all, Ontario would receive a large sum of money up front, which could be used to pay off the debt incurred through the original DB contract, and apply the remainder toward other essential infrastructure projects. Secondly, the province would transfer the long-term risk of making a return on their Cdn$1.5-billion investment to the new leasor. And finally, Ontario and the GTA would enjoy the benefits of an additional 39-km of fully automatic toll-road at no additional costs.

7.3 The RFP

Ontario issued a RFP for the project on December 12, 1998. The RFP addressed several key elements necessary for a successful public procurement process including competition, a clearly defined scope of work, risk allocation, opportunity for substantial and reliable revenues, owner sophistication, and transparency.

Transparency of a procurement process guarantees that the actions taken by the owner are clearly understood and even predicted by bidders, government officials, and the public. It instills confidence to all interested parties that the contract will be awarded to the proposal that most efficiently and effectively meets the requirements of the request

for proposal (RFP). In order to create a transparent procurement process, the province provided a detailed, yet simple description of the toll structure, a process enabling bidders access to consistent information, a standardized legal agreement, and a single bid evaluation criterion, highest price. Following is a summary of key portions of the RFP.

Profit Projection Data: The contract granted the successful bidder the opportunity to make a return on an initial investment by collecting user fees (tolls) throughout the 99-year concession period. The RFP included information that enabled bidders to invariably evaluate the profit potential of the project. First of all, Ontario disclosed the revenues generated by the facility in the nine months proceeding the RFP. The bidders could use these figures as a foundation for their profit projections. A graph of these revenues is located in the Appendix. Secondly, the Province sponsored several independent traffic studies of the project including both historical traffic counts and future projections. The bidders had access to each of the studies. A graph of the traffic projections is also located in the Appendix. Finally, the RFP established the following toll structure to be used throughout the concession period:

1. The maximum toll for cars for the first year was set at Cdn$0.10 per km.
2. The toll could increase yearly for 15 years by inflation plus 2%, until it reached Cdn$0.13 per km.
3. The toll could increase yearly for the next 84 years by inflation only.
4. The toll could be twice the car rate for trucks and three times the car rate for multiple-unit trucks.
5. If the peak hour flows remained above 9,000 vehicles per hour(VPH), all rate restrictions would be dropped. This flow was the congestion goal set by the province.
6. Vehicles not fitted with a transponder could be charged an additional service fee of Cdn$1.00 per trip.
7. If traffic fell below 9,000 VPH while the rates were higher than limits described above, the operator would be penalized according to the following equation:

2* (actual rate - regulated rate) * (9,000 – actual VPH)

The province felt that by taking away toll regulations after 9,000 VPH, the toll price would be controlled by the market. If excessive tolls were charged, travelers would opt to use one of the other two alternate routes.

7.3.1 Access to Information

Ontario included the following measures in the RFP to assure that all bidders received consistent information. First, the bidders were required to submit all questions in writing. The questions were answered in writing, and circulated to all the bidders. Approximately 500 questions were dealt with in this manner throughout the three month bidding process. Secondly, the province appointed a single contact to handle all communications between the government official and the bidders. Several pre-bid conferences were necessary during the bidding process. When possible, these meetings were attended by all bidders. However, when one-on-one meetings were required, a third party process advisor confirmed that all questions and issues were uniformly addressed from meeting to meeting.

In addition, the Province established three data rooms to assist the bidders. The rooms contained a large collection of preliminary plans, as-built drawings, specifications, and reports. The RFP required the bidders to make appointments in order to visit the rooms and review the material.

7.3.2 Standard Agreement

Early in the bid process a standard agreement was distributed to all of the bidders. The bidders where then given time to review the agreement, address their concerns in writing, and recommend changes. The comments were collected and reviewed, and the agreement was modified accordingly, and redistributed. Once again, the bidders were encouraged to submit further comments. After two review cycles, the final agreement was issued to all the bidders. The RFP required that the all bids follow the final agreement, with no amendments.

7.3.3 Bid Evaluation

The province's establishment of a single bid evaluation criterion assured transparency in the assessment of the bids, and the subsequent award of the contract. Ontario made a thorough effort throughout the entire bid process to uniformly explain the details and requirements of the contract to all the bidders. Under the assumption that all issues had been consistently addressed, the only remaining variable in the bid was the final price. Therefor, much like a construction contract in a design-bid-build project, a single monetary value was used to select the winning bid. However, instead of awarding the contract to the *lowest* responsive responsible bidder, the Highway 407 privatization contract was awarded to the *highest* responsive responsible bidder.

After the pre-qualification process, Ontario was confident with the financial capabilities of the bidders. Therefor, when the bids were submitted, the financial assumptions, projections, and calculations were not required. Only the final price was reviewed. The simplicity of the evaluation process allowed Ontario to award and finalize the contract in a very short time, with the full sum of the contract amount due just days after the bid opening. The short time schedule combined with the large contract amount presented the bidders with a significant challenge, as they had to finalize all of their financial details and agreements at the time of submittal. These difficulties forced half of the pre-qualified bidders out of the competition. Only two bids were submitted on March 30, 1999.

7.4 Risk Assessment

ETR International obtained a letter from Standard & Poor's evaluating the project. The letter identified the following risks:

- Legal and business risks associated with an untested procurement process.
- Construction risks associated with the extensions.
- Pricing risks and performance risks associated with the long-term operation and maintenance obligations.

- Uncertain future traffic volumes are directly related to the ability to service the project debt.

The letter also described the strengths of the project that served to mitigate the above risks:

- The project is located in a region that has a stable political, legal, and economic environment.
- The technical and economic sophistication of the owner.
- A long concession period.
- The successful operational performance of the existing facility and tolling equipment.
- The facilities proven ability to produce revenues combined with substantial evidence that the traffic volumes will continue to grow.
- The technical requirements needed for the construction of the extensions are manageable.

In the end, the project received a single-'A' rating by Standard & Poor's.

7.5 ETR International Proposal

ETR International is a consortium led by Grupo Ferrovial of Madrid and SNC-Lavalin Group of Montreal. The group was one of four bidders pre-qualified by the Province of Ontario at the start of the procurement process. Of the four, two dropped out due to complications with their lending agencies. ETR's first bid totaled Cdn$2.95-billion, which was less than but within five percent of the second bidder's proposal. The RFP included a provision that a second round of bidding be held in the event that the top bids were within five percent of one another. The two groups were asked to examine their bids and submit their best and final offers in a second round of bidding the following week.

ETR came from behind to win the contract with a bid of Cdn$3.1-billion, which was more than double the province's initial investment for design and construction. The

proposal was based on a project-financing plan that consisted of private equity and debt. The equity was equal to the estimated design and construction costs for the two extensions. The remainder of the initial contract price will be covered with Senior Bank Bridging. Debt will be used to service the bridging and fund the design and construction of the extensions. The proposed debt structure consisted of a mixture of senior bonds, subordinate bonds, and convertible bonds, which will be sold in both the Canadian and US markets.

8 INTERSTATE-15 RECONSTRUCTION PROJECT

In June 1995, the International Olympic Committee announced that the 2002 Winter Olympic Games would be held in Utah's capital, Salt Lake City. At that time, a seventeen-mile stretch of Interstate-15, the city's major north-south freeway, was in dire need of reconstruction. An optimistic time estimate for this project using the traditional design/bid/build (DBB) process placed the completion date in the summer of 2003, well after the games. UDOT believed that postponing the project until after the Olympics was not feasible, and forcing hundreds of thousands of visitors from around the world to wait through construction delays was unacceptable.

8.1 Background

The need to reconstruct and add capacity to I-15 was identified in the early 1990s. When this stretch of I-15 was built in the 1960s, the projected life span was 25 years. The road was designed to provide for the transportation needs of a million residents, a mark that was surpassed in the 1980s. Currently, the average daily traffic on I-15 exceeds 200,000 vehicles per day (vpd) on the north end and 140,000 vpd on the south end. These figures are well beyond the capacity of the six-lane highway. Time, increased traffic flows, and Utah's seasonal climate have taken their toll on the expressway. In a few of the bridges, the concrete has deteriorated to the point where rebar is exposed. Other problems include out-dated structures that have low earthquakes resistance and low clearances. In February 1996, the Utah Legislature approved the Centennial Highway Endowment Fund, which established a $2.6-billion commitment for highway projects over ten years. The reconstruction of I-15 was the centerpiece of this legislation. A map of the project is attached as Appendix 8-A.

After the Olympic Committee's announcement, a thorough review of successful highway projects in California, Colorado, and Toronto gave UDOT confidence in the design-build (DB) procurement process. Then the results of a public opinion poll reassured them that they were on the right track. The poll concluded that the public preferred more inconvenience for a shorter time than less inconvenience for a longer

time. On December 27, 1995, UDOT made the final decision to pursue a DB fixed price contract.

After the decision to proceed with a DB contract, a corridor management team and an oversight team were formed. These teams, responsible for the execution of the project procurement, consisted of several UDOT officials, consultants from Parsons Brinkerhoff Quade and Douglas Inc., and a representative of the Federal Highway Association (FHWA). Their objectives included promoting the DB process to key parties such as politicians and local contractor organizations, obtaining FHWA approval for the project, prequalifing bidders, and drafting a Request for Proposal (RFP).

Since UDOT planned to use federal funds and a "non-traditional" procurement strategy for the I-15 project, they applied for FHWA approval as a Special Experimental Project in accordance with SEP-14 in June 1996. In their approval of the I-15 project, FHWA waved several requirements. Fist of all, UDOT gained approval to use a best-value evaluation process instead of a typical lowest cost evaluation. Secondly, due to the size and complexity of the project the FHWA waived the requirement that sub-contractors perform less than 70% of the work. Finally UDOT received permission to award stipends to unsuccessful bidders.

On May 1, 1996, UDOT issued a Request for Letters of Intent. This request was followed by a Request for Qualifications (RFQ) on May 30. The RFQ required interested parties to submit legal and financial information, a description of the organization of the firm, a summary of past experience and accomplishments, and a project approach. All three of the groups that submitted statements of qualifications were prequalified for the project.

After the groups were prequalified, they were issued a draft version of the RFP and were encouraged to review the package and offer recommendations. One of the key revisions that UDOT made to the RFP as a result of the review process was the adjustment of the project warranty period. This revision is discussed in detail in a further section.

8.2 RFP Highlights

To meet quality and budget objectives of the project, UDOT proposed a combination of performance specifications and prescriptive specifications. Performance specs. required the contractor to meet a certain level of service or quality, but do not provide a specific means to meet these criteria. For example, the I-15 RFP included performance specs. to address the maintenance requirements after construction. In general, performance specs. provided bidders with the freedom to propose innovative solutions that may lead to savings in cost or time, or to improvements in quality. On the other hand, prescriptive specs., such as the I-15 requirement to install a UDOT standardized Portland Cement Concrete roadway, provided UDOT with confidence that key aspects of the project will retain their integrity well beyond the warranty period.

The RFP required the contractor to replace every stretch of pavement, interchange, and bridge along a 17-mile stretch of I-15. The existing six lanes were to be replaced with twelve widened lanes. In the end, each direction will have four general-purpose lanes, a carpool lane, and an auxiliary lane. The project included the reconstruction of 144 bridges, including 38 railroad crossings and 10 interchanges. Pictures of three major interchanges are attached as Appendix 8-B. The proposed Advanced Traffic Management System included variable message signs, video cameras, ramp-meters, and coordinated traffic signals. The project also included the complete reconstruction of the several sections of local roads running under I-15. The work required on these sections included the relocation of sanitary sewer, storm sewer, water, gas, power, telephone, and irrigation lines, in addition to the installation of curbs and gutters, sidewalks, striping, and traffic signs. A typical cross-section of this work is included in Appendix 8-C. The project was to be designed and constructed for a minimum life span of 50 years, except for the bridges, which were to have a 75-year life span. At the time the RFP was issued, the estimate for the entire project was nearly $1.4-billion.

Approximately fifteen percent (15%) of the design was complete before UDOT issued the RFP and was made available to the bidders. The plans included the complete designs of key facilities necessary for the traffic management plan. These designs were planned to allow the contractor to begin work immediately after the contract is awarded.

8.3 Evaluation Criteria

The bids were be evaluated using a best-value process. A best-value evaluation considers both price and quality. Table 1 below summarizes the evaluation divisions. Section 3.5.5 of the RFP describes the specifics of each criterion.

The table shows that the cost and technical sections carry equal weight. Under "Technical Proposal", "Technical Solutions" had the highest weight of the four factors. The remaining subdivisions were each weighted equally relative to the other factors on the same level. For example, Pavement had the same weight as Geotech, while Aesthetics had the same weight as Roadway Geometrics.

Evaluation Factors	Relative Weight by Level
Price	Equal Weight
Technical Proposal	
Organizational Qualifications	4
Management	3
Work Plan and Schedule	2
Technical Solutions	1 (highest)
Maintenance of Traffic	Equal Weight
Geotech	
Pavement	
Structures	
Maintainability	
Other	
ATMS	Highest
Drainage/Water Quality	
Roadway Geometrics	
Aesthetics	Intermediate
Lighting/Traffic Signals	
Concrete Barrier	Lowest
Hazardous Material Removal	

Figure 8-1. I-15 Evaluation Criteria

A Technical Evaluation Board (TEB) assigned a rating of exceptional (E), good (G), acceptable (A), susceptible to becoming acceptable (S), or unacceptable (U) to each factor in the Technical Proposal. In addition the board had the option to subdivide the ratings further, as in A+ or A-. A separate Price Evaluation Board (PEB) evaluated each Cost Proposal without knowing the identification of the respective bidder. Each of the sixty-

four evaluators was required to attend a training session to learn the details of the sections that they will be evaluating. The board was instructed to avoid technical leveling. Technical leveling occurs when a proposal goes beyond the requirements of the RFP, and subsequent proposals are evaluated in comparison with the first bid instead of with the RFP. For this project, all bids were compared to the standards set forth in the RFP, not to the other proposals.

The initial review process was designed to lead to questions and requests for clarification regarding the proposals. These comments were forwarded to the bidders with a request to submit a Best and Final Offer (BAFO). The BAFOs were evaluated using the same procedure described above. At the end of the evaluation process, the results from the TEB and PEB were combined, and the contract was awarded to the bidder offering the best value for the project.

8.4 Quality Assurance

Typically, the owner of a project loses some control over quality of the construction process when they switch from a DBB contract to a DB contract. In order to provide UDOT with the means to control the reconstruction of I-15, the RFP included several quality-related requirements.

First of all, the RFP required that the winning bidder to obtain ISO 9000 within a year after the award. ISO certification forced the contractor to internally review and improve the quality of their design and construction programs without placing additional responsibilities on UDOT. Among its long list of stringent requirements, the ISO 9000 process requires applicants to create and maintain programs for internal quality audits, management reviews, and formal training. The ISO application also addresses the contractor's abilities to track the quality of sub-contractors and material suppliers. Although ISO certification can cost companies a great amount of time and money, the process gave UDOT added confidence in the contractor's work.

In addition to the ISO certification requirement, the contractor was required to appoint a Project Design Quality Assurance Manager to be the responsible for the design quality. This practice is traditionally performed by UDOT, however for this project, UDOT

provides only periodically checks for compliance with the project specifications. This arrangement allowed portions of the design to be released for early construction or as otherwise required to avoid construction delays without the direct approval by UDOT. For the construction phase of the project, the contractor was required to retain an independent Project Construction Quality Assurance Manager to perform all inspections and tests. Again, UDOT has traditionally performed these tasks in previous projects. Despite these requirements, UDOT maintains an "over the shoulder" project management philosophy. They retain responsibility for overseeing the construction schedule, reviewing progress payments, and controlling construction documents.

Due to the complexity and size of the project, the RFP provided a $950,000 stipend for each responsive unsuccessful bidder. A responsive bidder was defined as one who submitted a bid meeting all requirements of the RFP. A stipend is a mechanism to motivate bidders to submit a bid despite the large amount of time and money required to draft a proposal. It was estimated that the stipend would cover between a half and a third of the costs associated with preparing a proposal for the I-15 project. By paying stipends, UDOT retained the right to incorporate ideas and concepts from unsuccessful proposals into the project.

The RFP established an award system that is based on programs that have been successfully administered during past federal projects. It described dozens of milestones through out the course of the project. At each milestone, the contractor had the opportunity receive bonuses for fulfilling requirements throughout that stage. There are nine awards spaced at even six-month intervals throughout the construction period. The review criteria for the bonuses include work quality, risk management, schedule progress, efficient traffic control, and successful public relations. The incentives for the project total $50-million. Of this total, more than half, $26-million, is related to time requirements. For example, the contractor will earn a $5-million bonus if the project is completed three months ahead of the original schedule. On the other hand, the RFP makes the contractor liable for liquidated damages of up to $100-million if the project is not complete by the October 2001 deadline. The damages are based on daily uncompleted lane-kilometers.

The final quality assurance measure in the RFP was a warranty requirement. Originally, the RFP required the winning contractor to perform maintenance for 20 years. After reviewing the objections of the prequlaifed bidders described earlier, UDOT reduced the warranty period to five years and retained the right to extend the period to ten years through five annual options. The original warranty plan included all maintenance and snow removal. However, after the bidders' objections were reviewed, UDOT revised the RFP by removing the general maintenance and snow removal requirements. The warranty period is scheduled to begin when the contractor gains final acceptance for the project. Each bidder was required to submit an annual maintenance fee in their proposal. The maintenance fee was scheduled to be adjusted annually by the Federal-Aid Highway Construction Index.

Throughout the warranty period, the winning bidder is contractually obligated to finance all work that surpasses the maintenance budget, except for work caused by settlement. Due to poor soil conditions, and the schedule requirements of the project, the contractor is only financially responsible for half of this work. UDOT understood that the schedule pressures of the project do not provide the contractor ample time to utilize standardized methods for dealing with poor soil conditions. For example, in these soil conditions, traditional construction techniques would require years of surcharging in order to allow the soil to settle before major structures are erected. However, UDOT is unwilling to take full responsibility for these future failures, which they will assume to be part settlement related and part quality related.

8.5 Risk Mitigation

The I-15 risk mitigation plan identified the potential risks, and assigns responsibility to either the owner or contractor. Following is a description of the main risks addressed in the RFP.

Force Majeure: The RFP listed several force majeure events for which UDOT bares the risk. These events include major earthquakes, unknown hazardous material conditions, epidemics, wars, sabotage, law suits that seek to delay construction, legislation and regulation changes, increases in asphalt or fuel costs, and unknown cultural resources. The contractor is responsible for events that are not listed above.

Utilities and Railroads: The I-15 project will affect more than thirty-six utility owners. It was estimated that of the 1,500 utility crossings, six-hundred are potential conflicts. UDOT is responsible for obtaining all Rights-of-Way and forming agreements with the utility and railroad companies. At the time that the RFP was issued, UDOT had identified an additional one-hundred parcels to purchase. The RFP included a list these parcels and a proposed procurement schedule. UDOT bears the risk of following this procurement schedule. If additional ROW is necessary as the result of the contractor's design, the contractor is responsible for the schedule and budget ramifications.

The contractor is responsible for financing and coordinating all utility work. UDOT agreed to pay additional compensation if the project impacts a utility that is not described in the RFP. In addition, UDOT planned to work with the contractor to resolve disputes with the utility providers and grant time extensions for delays associated with utility relocation.

Unforeseen Site Conditions: Before issuing the RFP, UDOT had significant knowledge regarding unfavorable site conditions throughout the project. Due to complex conditions and a requirement of applying for federal support, UDOT retained the risk of unknown site conditions. However, the contractor is responsible for settlement that occurs during construction.

Additional Risk Issues:

- The contractor is responsible for design defects and for the overall constructability of the design, unless the defect was inherent in UDOT's preliminary design.
- The RFP required the contractor to submit a performance bond for $250-million and a payment bond for $150-million.
- The RFP described an owner controlled insurance program (OCIP) that will be used for the project. In essence, this policy bundled a majority of the project's insurance policies into one policy that UDOT will purchase. It was estimated that cost of the OCIP will be at least $20-million lower then a comparable policy sponsored by the contractor. However, the contractor was

required to obtain additional insurance for off-site work, and submit a work safety plan. As a further safety incentive, the contractor is scheduled to receive a portion of insurance premiums rebated at the end of the project.

- Due to the long construction time frame, the RFP includes a Fuel Price Adjustment Clause. This clause adjusts the construction costs by a designated factor if fuel prices shift more than 25% from the price at the time the proposals are submitted.

8.6 Independent Engineering Check

One method that UDOT used to facilitate a faster DB process was to require the winning bidder to secure a contract with a firm of their choice to provide a third part engineer check, which was called a Project Design Quality Insurance Manager in the RFP.

The main disadvantage of this scenario is that the owner loses an aspect of control over the project. However, this loss of control is advantageous if it is viewed as the elimination of UDOT's micro-management of the project. Passing the quality assurance responsibility to the private sector, UDOT frees up staff that can work on portfolio issues and pre-construction activities for other projects. At the same time, an impartial and reputable engineering firm can double check the work of the producer and increase the chances of providing public safety throughout the project. An additional advantage is that the contractor had the flexibility to select a firm that they have an ongoing relationship with. It is likely that this relationship will facilitate a faster approval process than if the state was involved.

8.7 Appendix 8-A

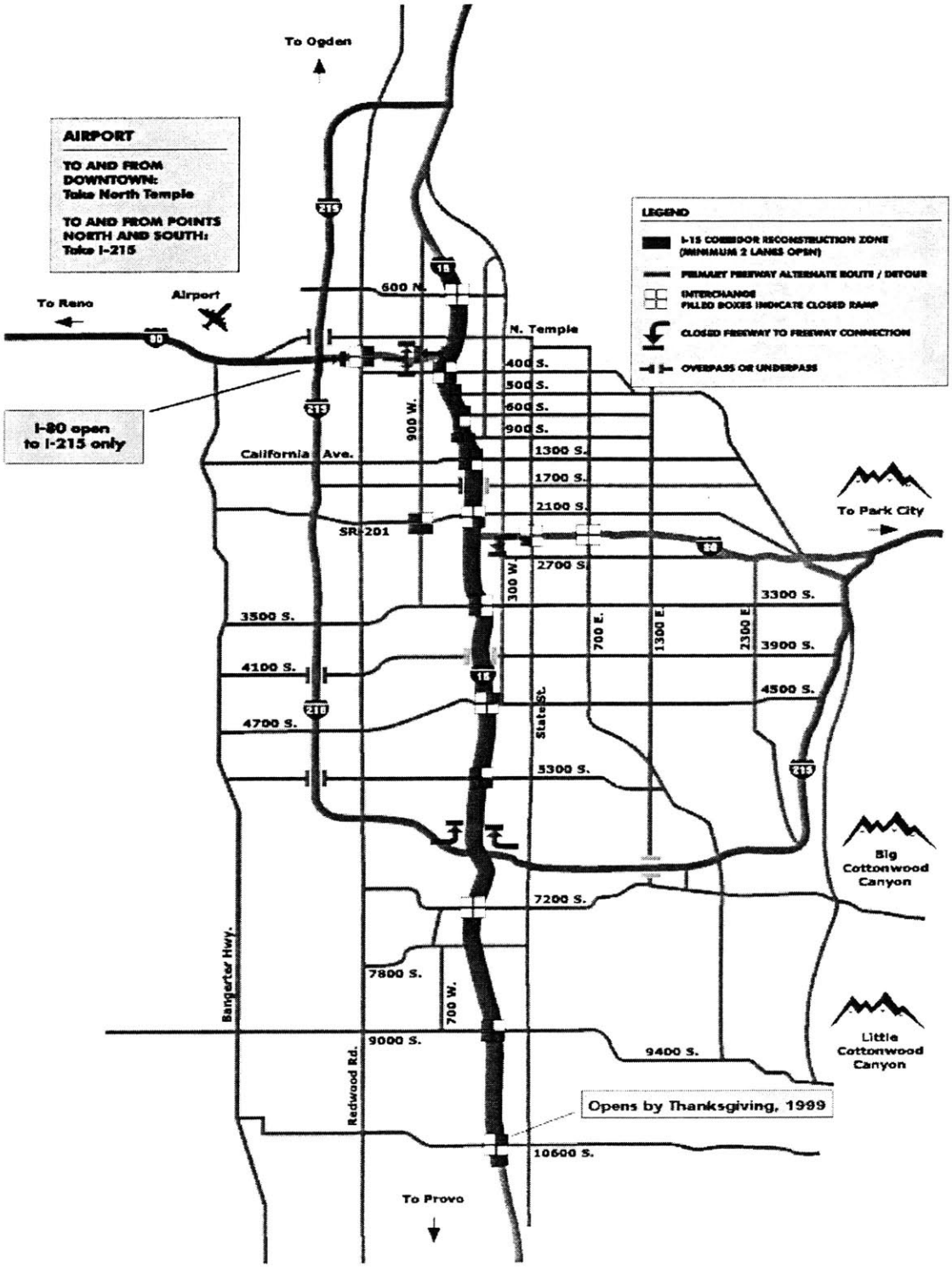

Figure 8-2 I-15 Project Map

8.8 Appendix 8-B

Figure 8-3 Artist's Rendition of the Junction of I-15 with I-215

Figure 8-4 Artist's Rendition of the Junction of I-15 and I-80 with Downtown Access

Figure 8-5 Artist's Rendition of the Junction of I-15, I-80, and SR-201

8.9 Appendix 8-C

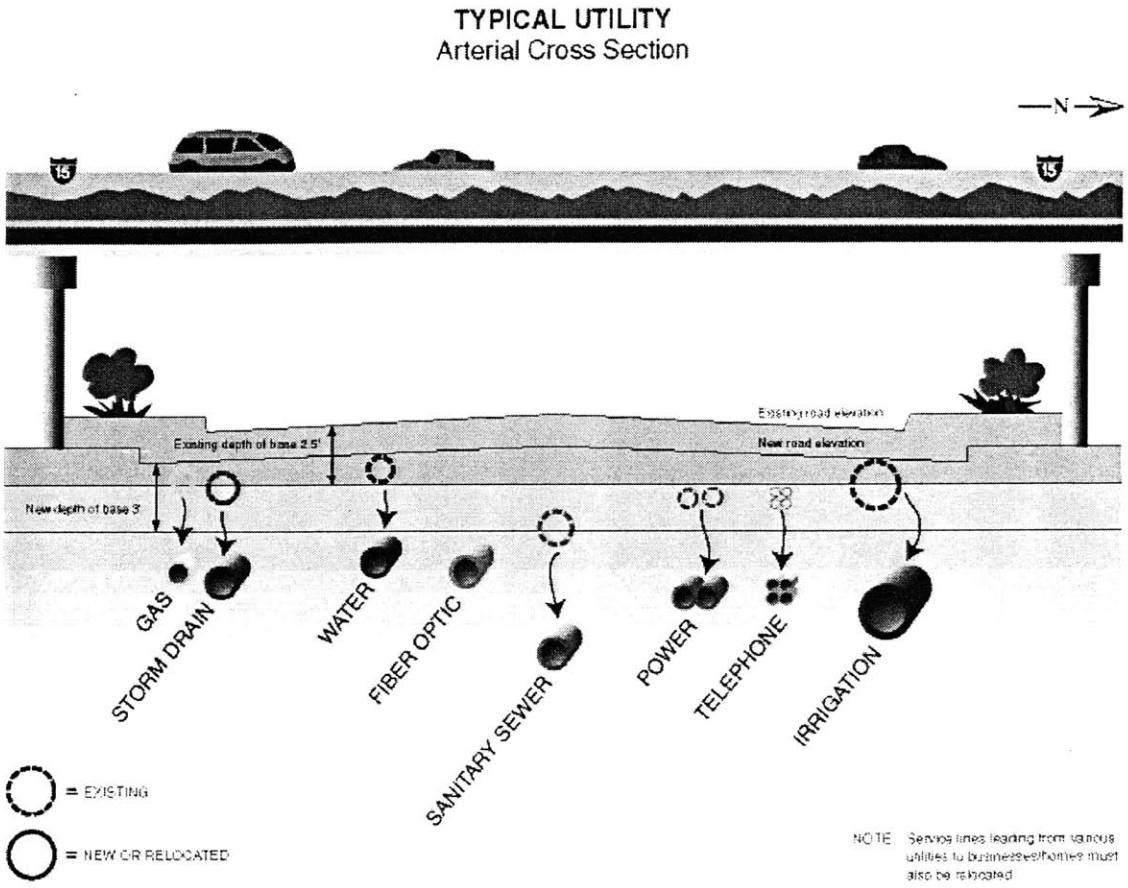

Figure 8-6 I-15 Utility Cross-section

9 CASE STUDY CONCLUSIONS

9.1 Quadrant Analysis

The case studies illustrate the advantages of using nontraditional delivery methods which can be plotted in quadrants I, II, and IV of Miller's framework. Figure 9-1 below summarizes the location of the projects.

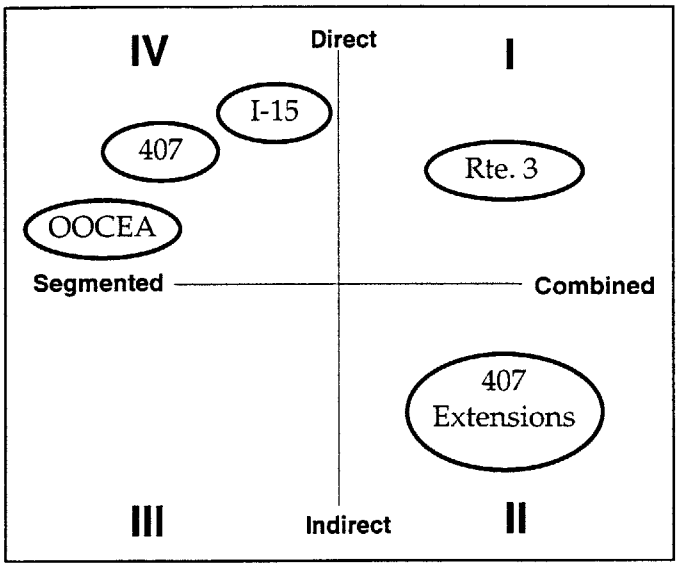

Figure 9-1 Case Study Delivery Summary

OOCEA - The operations procurement is above the horizontal axis because the project is funded entirely by the owner, even though the funds are generated from tolls only. Since operations are separated from design, construction, and maintenance the procurement is to the left of the vertical axis. The procurement fits into quadrant IV.

407 ETR - The 407 ETR procurement can be split into two separate projects. The first is the operations and maintenance of the existing facilities. Even though the operations and maintenance are to be funded by user fees, the government funded the original construction. Therefore, the project is positioned above the horizontal axis. This portion of the project is to the left of the vertical axis because the design and construction of the project is separated from the operations and maintenance. Therefore, the project is in quadrant IV.

The second project included in the contract consists of the design, construction, operation, and maintenance of two roadway extensions. These extensions will be funded completely by the private sector. Therefore this portion of the 407 ETR contract is below the horizontal axis. Since a single developer is responsible for all aspects of the project, this portion of the 407 ETR project is located to the right of the vertical axis. The procurement fits in Quadrant II.

Interstate-15 - The I-15 project is a DB project. The I-15 procurement is above the horizontal axis because the project is funded entirely by the owner. The project combines design, construction, and up to 10 years of maintenance together with the exclusion of operations. Therefor, the procurement is to the left of but very near the vertical axis. The procurement fits into quadrant IV.

Mass Rte. 3 - The Rte. 3 project was a DBO project. The Rte. 3 procurement is above the horizontal axis because the project is funded entirely by the owner. The project combines design, construction, and operations. Therefor, the procurement is to the right of the vertical axis. The procurement fits into Quadrant I.

This project is a good example of how the owner's ability to meet the public's needs is related to the number of procurement options made available to them. Although, a nontraditional procurement is proposed, other methods may have led to the same result in a shorter amount of time. For example, in light of the state's budget constraints, MassHighway could have developed this project into phases. They could have contracted for the complete design in one year and then bid the construction in phases. Upon completion of design, they could have combined operations and maintenance for each segment with construction, or held a separate competition for O&M after all of the construction was complete. A second option would have been to compete the project in Quadrant II by creating a BOT funded by tolls.

9.2 Vertical Integration

Figure 9-1 below is a summary of OOCEA's value system. This quasi-public agency has overall responsibility for the design, construction, administration, financial management, operations, and maintenance of the toll ways in the Orlando region. The

tasks that are performed in-house are highlighted. The remaining tasks are contracted out. The case addresses OOCEA's option to contract out the operations of a specific portion of their facilities, the tollbooths. Porter's criteria can be used to examine the administrative and economic ramifications of decreasing the level of integration. The analysis below is done from OOCEA's point of view when they were in the process of deciding whether of not to contract out operations. While only the key issues are discussed, a complete list of the strategic advantages and costs of vertical integration is included in Chapter 2.

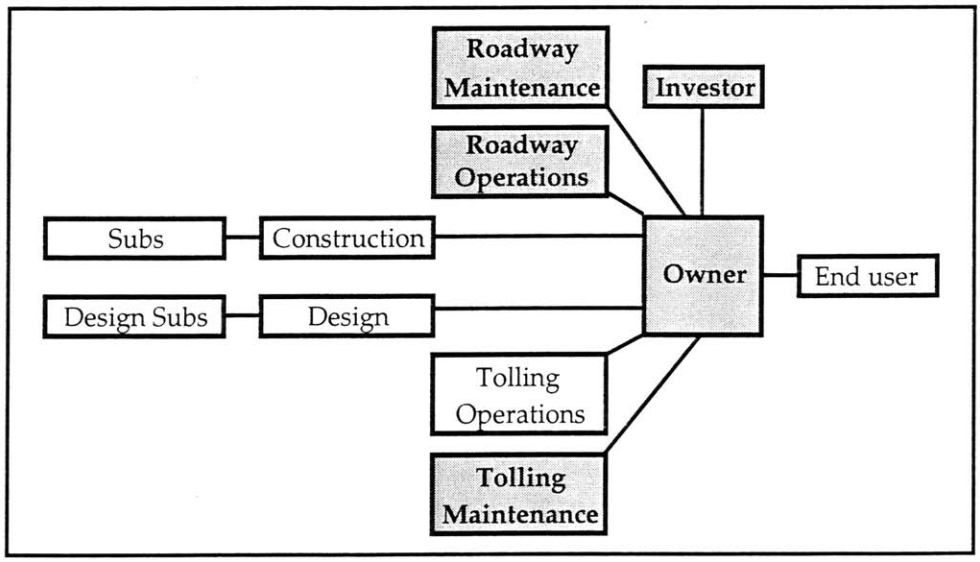

Figure 9-2 OOCEA's Value System

9.2.1 OOCEA Integration Advantages

There are several strategic advantages of performing the tolling operations in-house. The first advantage is a decrease in the cost of internal control and coordination. There is a high level of coordination required between the operations and maintenance staff. In addition, coordination among several agencies is a major concern during states of emergency. There is an additional cost in time and money associated with the addition of another party. The second strategic advantage of integration is the cost savings made possible by avoiding the market. Performing operations in-house will save the needed administrative costs needed to develop and oversee a procurement process. In addition to these internal costs, the winning firm will charge OOCEA for the costs of submitting a proposal. Finally, for this system of toll ways, there are economies of stable

relationships. In the case, the length of the time, ten months, scheduled for the transition process is an indication of the challenges of transferring responsibility from the OOCEA to a private firm while maintaining a constant level of service. There are redundant administrative and labor costs associated with this transition period.

9.2.2 OOCEA Integration Costs

There are also several strategic costs associated with keeping operations of the tollbooths in-house. First of all, integration increases the operation leverage of the OOCEA. When integrated, the agency has the added risk of cost fluctuations. If a contract is signed, the operational costs are known for the life of the contract. This information removes a variable in the agency's planning and programming process. The second cost is a reduction in the flexibility to change. When the agency maintains responsibility for operations and if it is not able to incorporate technological and managerial changes as readily as the private sector, the end users will pay more for this service than they would if change was rapid. Another strategic cost is dulled incentives. This cost is increased in the public sector because the pay scale of the employees is not typically tied to performance. Replacing a quasi-public agency with a private firm introduces financial incentives to continually strive for increased efficiency. The final cost of vertical integration for the OOCEA is that there are different managerial requirements for collecting tolls than for any of the agency's other responsibilities.

9.2.3 Integration Conclusions

This integration analysis is useful for two reasons. First of all, it is a powerful tool for identifying the positive and negative ramifications of integration decisions. It could aid managers as they strive to identify the optimal level of vertical integration for their agency or department. From the above discussion, the costs associated with performing tolling operations appear to outweigh the strategic benefits.

Secondly, if the decision is made to contract out a service, the owner can use the analysis to structure the contract and procurement process in such a manner as to mitigate the highlighted disadvantages. For example, in the OOCEA case, two of the major disadvantages of outsourcing are the added costs of transition periods and procurement

processes. These costs can be mitigated if they are spread out over a longer contract term. These costs have the potential to be a key issue in a five-year contract in which the transition period almost lasts the entire first year. In addition the advantage of efficient internal coordination between the operations and maintenance inherent in a integration strategy could be preserved by including the maintenance of the tolling facilities in the same contract. This combination of services was the intent of the original RFP. However, the maintenance requirements were dropped in part because of the challenges associated with providing the bidders with the information necessary to submit a price for this service.

9.3 Five Forces Analysis

Porter's analysis for industry competitiveness has been applied to three of the cases on a project specific basis to show the applicability of this framework to infrastructure development. The results are summarized in Figure 9-3 below. This analysis illustrates that owners can adjust the attractiveness of a project in an effort to improve their chances of success.

Project	Threat of New Entrants	Supplier Power	Buyer Power	Threat of Substitution	Rivalry among Competitors
I-15	Low	Low	Moderate	Low	Moderate
407 ETR	Low	High	Low	Moderate	Moderate
Rte. 3	Low	High	High	Moderate	Moderate

Figure 9-3 Five Forces Summary

9.3.1 Interstate-15

The Threat of New Entrants was low even though a $950,000 stipend cut the cost of competing by an estimated 33%, because the prequalification of three bidders.

The Suppliers' Bargaining Power was low. First of all, the maintenance fee is tied to the Federal-Aid highway Construction Index. Secondly, a fuel price adjustment clause allows for variance in the construction costs if fuel price fluctuate by more than twenty-five percent (25%) throughout the life of the contract. Finally, UDOT retained the risk of increased asphalt costs.

The Buyer's Bargaining Power was moderate for several reasons. By combining the design and construction of the project, UDOT decreased their power because they have less control of the project if they would have chosen a DBB procurement. UDOT's annual options to extend the five-year maintenance period year five to year ten increases their power significantly, because they can stop the relationship if they are losing money and continue the contract if it is in their favor financially. The pay scale is tied to the contractor's performance throughout the contract. The use of an independent engineering check decreases the owner's power. The contractor is only financially responsible for half of the damage caused by settlement. Sharing this risk lowers the buyer's power. Finally, UDOT retained the risk for unforeseen site conditions.

The Threat of Substitution was low because there is state legislation backing the project and the high traffic congestion and the sub-standard conditions of the existing road take away UDOT's option of doing nothing.

The Rivalry among Existing Competitors was moderate. The use of performance specifications increased the threat of new technologies. The use of a best-value evaluation forced the bidders to compete on the basis of quality and price. A transparent procurement process created a level playing field that was likely equally attractive to all of the bidders. Despite the competition created by these policies, the rivalry was kept in check by the low number of bidders and the practice of comparing the proposals to the RFP requirements instead of against one another.

9.3.2 Highway 407 ETR

The Threat of New Entrants was low because only four bidders were prequalified.

The Suppliers' Bargaining Power was high because there were no clauses in the contract that passed these risks to the owner. The long term of the contract adds to the severity of these risks.

The Buyer's Bargaining Power was low. The owner used a single procurement to select a firm for the next ninety-nine years. The province retained control of the toll structure, but profits are market driven after a certain threshold of demand is exceeded. Also,

bidders participated drafting the agreement before the contract was awarded. Finally, even though all risks were passed to the bidders, S&P reviewed the project and gave it an "A" rating.

The Threat of Substitution was moderate because while the successful contractor has a monopoly on operations and maintenance for an extremely long term, the providence balked on their last major contract for these facilities. Therefore, before the contract was awarded, there was a potential that another alternative would be selected.

Although the Rivalry among Existing Competitors was furious because of the transparency and the creation of a level playing field throughout the procurement process, the low number of bidders kept it lower than a project open to all bidders. Therefore, the rivalry was moderate.

9.3.3 Mass. Rte. 3

The Threat of New Entrants was low because the RFQ was issued to only six bidders, and only three were prequalified.

Again, the Suppliers' Bargaining Power was high because there were no clauses in the contract that passed these risks to the owner.

The Buyer's Bargaining Power was high. On one hand, the owner combined design, construction, financing, and long term maintenance in to one contract. But on the other hand, the local municipalities retained control of the right-of-way usage through zoning ordinances. This local bargaining power among several owner entities has the potential to substantially impact the winning developer's financial package.

The Threat of Substitution was moderate because even though the project was backed by state legislation, the project has to be revisited by the legislature because the bids exceeded the limits provided for the maximum design/build and annual costs.

The Rivalry among Existing Competitors was moderate because the low number of bidders offsets the use of a best-value selection, the importance of financing in the evaluation criteria, and the moderate transparency of the overall process.

9.3.4 Five Forces Conclusions

The above analysis leads to the identification of a couple of patterns regarding the owner's policies as they relate to the attractiveness to the private sector. First of all, each of the cases shows the impact of the process of prequalification. Narrowing the number of bidders competing for a contract creates an impenetrable entry barrier ending the threat of new entrants. A low number of bidders also keeps the rivalry among existing competitors to a manageable level. It is in the owner's best interest to foster competition. Limiting the number of participants through prequalification is a powerful tool for attracting quality bids even when there is fierce competition among the bidders.

Secondly, Miller's argument that sponsor commitment impacts the success of procurement can be explained with Porter's "Threat of Substitution" force. This threat is higher in the 407 ETR and Rte. 3 projects than in the I-15 procurement for this reason. In addition, the 407 ETR project illustrates that the perception of owner commitment is cumulative rather than project specific.

The analysis also shows the impact on the bargaining power of suppliers of owners that retain the unknown risk of fluctuations in labor and material costs for long-term contracts. However, it is noted that there are also firm-specific strategies, such as quotations and labor agreements, in addition to owner sponsored initiatives that can be used to mitigate this force.

The combination of operations in a contract with design and construction, such as in a DBO contract, rather than the procurement of operations after a DBB or DB contract effects two of the five competitive forces. First of all, DBO contracts decrease the threat of new entrants by creating an entry barrier related to a firm's ability to perform the additional work or partner with a firm that can. For example, in the Rte. 3 procurement, three of the six bidders that submitted statements of qualification were not prequalified because each had a weak maintenance component. Secondly, DBO contracts decrease the owner's negotiation power because they select all of the service providers at the same time instead of selecting each one on their own merits.

Finally, it should be noted that the optimal level of private sector attractiveness is project-specific. It is not the intent of this thesis to suggest that a procurement that is structured in such a way that all of the forces are optimized for the private sector is always superior to one in which they are more evenly balanced. However, it is important to understand that the five forces do apply to project procurements. In the end, once an owner understands these relationships, it can use this tool to analyze each project to determine the optimal mixture of industry competitive advantage in terms of the public's best interest.

9.4 Porter's Diamond

Porter's Diamond can be applied to the case studies in two different ways. First off all, a comparison of the 407 ETR and OOCEA projects highlights the impact of government influence and policy on the diamond factors and the ability to predict an owner's ability to continue increasing the efficiency in which they can maintain the facilities for which they are responsible. Secondly, an in depth analysis of the I-15 illustrates the impacts of that project on the diamond factors of construction firms and other industries throughout the Salt Lake City region.

9.4.1 Comparison between OOCEA and 407 ETR

The application of the Diamond framework to the projects sponsored by the OOCEA and Ontario illustrates the consequences of two vastly different tolling strategies. The two owners share a common goal to increase the efficiency of toll collection on their facilities. The following discussion revolves around the government element of the Diamond framework. According to Porter (1990), one of the main objectives of a government is to unleash and amplify the diamond factors.

In brief, the OOCEA cut costs and improved services by contracting out their toll collection services to a private firm for a predetermined fee for a five-year term. This case highlights the trade-off between short-term and long-term policies. With traditional toll collection techniques, cutting the cost of labor will lead to an immediate cost savings, and improving the management techniques may lead to an eventual increase in the quality of services. However, these advantages will eventually peak and

the opportunity for future improvement will be nonexistent. At this time, the agency's ability to continue to improve this regionally important factor condition will stop. Also, the set payment plan may be viewed as a type of stipend because it assured and it does not motivate the contractor to maintain or improve their services. Much like the environment that likely existed when the OOCEA collected tolls, there is no financial motivation to strive for improvement.

In contrast, Ontario contracted full operations and maintenance to the private sector for a ninety-nine year term without government payments. The contractor's fee is collected from the end users, and is therefor tied to their performance. The Providence of Ontario is driving technological advancement by creating an agreement in which the contractor's payments are determined by the amount of end-users. Ten years down the road, if a new toll collection is available, the private firm will incorporate the improvements into the existing system at no cost to the citizens if it is in their best interest financially. The effects of fostering innovation are that (1) the contract will remain in contact with and perhaps be a driving force in related industries that are developing new systems, and (2) new technologies will likely improve the effectiveness of this important factor condition.

9.4.2 Interstate-15

The I-15 project that UDOT sponsored is an excellent example of the way in which a infrastructure project effects the entire diamond.

Factor conditions: The large scope of the I-15 project, which spans several years and costs $1.4-billion, requires the contractor to train a significant workforce. The quality of training will be high because the state is paying for the winning bidder to obtain ISO certification. In addition, infrastructure improvements, such as added travel lanes and increased overpass clearances, will improve the efficiency of the industry by increasing travel times to and from job sites. These improvements in the construction industry's factor conditions will benefit UDOT in future projects. The project will also drive the efficiencies of all industries that rely on the transportation of goods. In addition, the project will improve the quality of life of commuters throughout the region.

Related and supporting industries: The size and breadth of the reconstruction project will significantly increase the demand for labor, construction materials, legal services, and engineering consultants. It is noted that a portion of this added demand will be passed to other regions through sub-contracts, but it is likely that the majority will remain in this due to logistical constraints.

Firm structure, strategy, and rivalry: The DB procurement process will force changes in the structure and strategy of companies that were previously based solely around providing design or construction services. Because of the breadth of the I-15 project, new strategic partnerships have been given the opportunity to work through all of the initial difficulties involved in partnering. There is a learning curve for this process. Therefor, UDOT can expect to see lower bidding costs for future DB projects.

UDOT has also protected and increased the competition between the firms in all of the ways that were discussed in the previous section. In addition, they have fostered innovation through the use of performance specs.

Demand conditions: Increased capacity on the main north south highway through Salt Lake City will likely lead to increased traffic throughout the metropolitan region. Therefor, feeder and local roads will have more traffic, and require transportation work. In addition, these increased factors conditions will create opportunities for development throughout the region. New development directly increases the demand for the construction industry and for the region in general.

9.4.3 Diamond Conclusions

Porter's Diamond is applicable to transportation projects at two levels. First of all, the framework can be use do examine the impacts of a project on a region's Diamond factors. Secondly, the Diamond can be used to analyze an owner's influence on its ability to operate efficiently in the future. The main assumption in this conclusion is that if the Diamond is favorable for the firms that produce infrastructure, the benefits will be passed on to the owner and to the tax payers and end users who fund the projects. In this way, the specifics of the project and the owner's general policies can be analyzed.

At the first level, the most important element of the diamond is obviously factor conditions. The facility in each case was directly tied to the regions economic performance. Therefore, it is unlikely that a project would be selected only on the basis of the remaining factors. However, the additional factors are useful to identify a more complete list of project benefits. The framework provides a "big picture" view of the project ramifications. It should also be noted that the since the factor conditions influence each other. A significant increase in factor conditions will likely lead to advantages throughout the entire Diamond.

The second level of application appears to yield more useful conclusions. For example, in terms of delivery method selection, it is clear that nontraditional contract requirements significantly impact the bidder's structure. Therefore, if an owner uses a delivery method such as DBO only once, local bidders will spend time and money restructuring and forming alliances for the first time. Therefor, the bids are likely to be higher than if the process is repeated several times. A second example of a project-specific policy that directly impacts the diamond is maintaining openness to technology. The opportunity for innovation may potentially lead to increase demand conditions, incentives for related and supporting industries, provide producers with new opportunities for developing a low-cost or differentiated strategy, and increase the efficiency of a specific factor condition.

9.5 Interest Group Liberalism

The Rte. 3 case illustrates that IGL exists in the Massachusetts planning and programming process. The local planning agencies and other entities involved in the transportation planning process fit Lowi's definition of special interest groups because (1) they are composed of geographically specific and there-by potentially biased "experts", (2) their power and authority is backed by higher legislation efforts, and (3) they are mainly self-policing. The advantages and disadvantages of IGL at the state and local levels are discussed below. Generally, these issues are inherent in the TEA-21 legislation because the state's policies are in line with federal requirements.

State Advantages: (1) All interested parties have the opportunity to contribute to the planning process, but state officials have the responsibility for final approval. (2) The

process assures that the regions and cities perform some sort of project by project evaluation and develop a long-term plan before asking for money.

State Disadvantages: (1) There are added administrative costs associated with redundant approval requirements. (2) Federal regulations unintentionally hinder the efficiency of local and state departments. (3) There are significant political pressures involved in the process of passing out larger portions of cumulative funds to specific regions or projects than to others. (4) There is a false assumption that a pluralistic structure is synonymous with planning.

End users Advantages: (1) All interested parties have the opportunity to become involved in the planning process. (2) There are continuities with process at regional and local levels. Every town is not solely responsible for key corridors.

End User Disadvantages: (1) The disadvantage of the opportunity to remain involved in the process is that efficiency decreases as more parties are brought to the table. (2) Furthermore, this opportunity may be a false sense of security because state officials and then federal officials make the final decisions. In the end, they do not have control over how or where their taxes are spent. (3) Federal and state requirements can hinder the efficiency of local or regional use of tax revenues.

10 RECOMMENDATIONS FOR TEA-21

10.1 The Prevalence of Interest Group Liberalism

The development of federal government involvement follows the process described in Chapter 3 for the development of interest group liberalism. Since 1956, the federal government has established a monopoly of the Interstate System through financial domination. The government spent more than $129-billion on new construction. As construction of the system neared completion in the mid-1990s, the National Highway System was established. This action nearly quadrupled the number of road miles controlled by the federal government.

The federal government retained control through the distribution of funds, which can be summarized as follows. (1) Users pay a federal tax of 4.3 cents per gallon at their local gas station. (2) The federal government collects the funds and added them to the Highway Trust Fund. (3) States apply for the money by proving that they have met federal requirements. (4) Upon approval, each state receives at least 90.5% of the revenue collected from the gas stations in their state. The remaining 9.5% of the funds are applied to other state's appropriations, overhead costs, and payment on the general budget.

After gaining control of the country's major highways, vague powers were passed down to smaller and smaller agencies and groups through a structural hierarchy summarized in Figure 4-1. The underlying principle in this process is that regional and local transportation goals are best identified and obtained by regional and local parties. In addition, public participation is required because many of the effects of transportation planning and programming, such as economic, social, and environmental, reflect community values that are not quantifiable. Despite this objective of flexibility, the FHWA and FTA have the responsibility for establishing selected guidelines within which these groups must operate. The federal administrations assure compliance with these standards by controlling the distribution of less than forty-five percent (45%) of the annual expenditures for the NHS.

10.2 The Pros and Cons of Federal Involvement

A fundamental question that underscores the above process is whether or not federal control of the National Highway System is still warranted. Even though the system only represents 4% of the country's road mileage, it handles 43% of all travel (FHWA 1998). For this reason, the National Highway System, much like other factor conditions, is a vital ingredient of the nation's security, economic prosperity, safety, and overall quality of life. There are three key issues in the discussion of federal control: (1) the consequences of IGL, (2) a shift in government focus over the last sixty years, (3) and the tradeoffs between control and efficiency.

The disadvantages of IGL at the state and local levels have been discussed in the previous chapter. The main consequences of the IGL nature of the TEA-21 legislation at the national level include a lack of transparency at all levels of the hierarchy structure, an absence of public accountability by decision-makers, and the replacement of planning with collective bargaining.

The second issue is a shift in transportation focus over time. When the Interstate System was established, government agencies and the private sector focused on construction. At that time, Keynesian economics, which called for government spending to increase aggregate demand, was very popular. Since then, construction of the system has been nearly completed and focus has changed to maintaining systems and balancing budgets (Kane 1999). This shift towards fiscal responsibility strengthens the need for improved financial decisions and life cycle management. One example of a TEA-21 regulation that hinders the ability of states to make this shift is a restriction of funding for maintenance projects. Davies and Sorenson (2000) have shown that an effective preventative maintenance program is financially more efficient than a reactive strategy that relies on costly rehabilitation and reconstruction projects. However, in this period of heightened interest in effective financial management and of sub-par ratings for transportation facilities, federal funds can not be used for general maintenance work.

Finally, there is a clear trade-off between federal government control over the nation's highway system and the amount of flexibility that states have to optimize the limited amount of resources to which they have access. One advantage of federal control is that

the FHWA and FTA have the responsibility to assure that states and local agencies are meeting the national transportation objectives and that they are realizing their own local goals and objectives. However, the down side of this redundant policing action is the administrative and overhead costs incurred by these agencies as they both approve fifty customized sets of planning objectives, selection criteria, and programming procedures. Additional advantages of federal involvement include control of provisions for emergency relief, earmarked funds for projects that are not priorities of state agencies such as those in the National Parks or Indian reservations, and collective research or safety efforts.

As already stated, the main disadvantage of the current transportation regulations is that they hinder the state's ability to optimize their resources with respect to the life-cycle costs of their entire portfolio. Although one of the aims of TEA-21 was to provide added flexibility, its regulations restrict financial strategies, delivery method options, and strategies based on portfolio analysis.

In terms of control and flexibility, one extreme alternative is for the federal government to keep 9.5% of the federal fuel tax and redistribute the remainder to the states unconditionally. This strategy would minimize federal control and optimize state and local flexibility. The other extreme is for the federal government to micromanage infrastructure planning and development by developing a comprehensive set of guidelines, leaving states without flexibility. Currently, TEA-21 is in the middle of these two strategies, unwilling to give up power to the extent of the former and unwilling to restrict flexibility to the extent of the latter. However, because the disadvantages inherent in the current strategy, it appears as though an opportunity exists to make a major shift in the balance between federal control of the nation's transportation system and local flexibility. However, given the overwhelming support for increasing the federal sphere of influence from the Interstate System to the National Highway System in 1995, a drastic shift in power is unlikely. Rather, a more practical approach would be to make refinements to TEA-21's weaknesses defined above. Following is a list of recommended amendments to the transportation planning and programming process that stem from the tools and case studies described throughout this thesis. There are two types of recommendations: those that increase the control of the federal

government and those that increase the flexibility of the local planning agencies. It is assumed that neither extreme control nor extreme flexibility is desired and that the right mix must be analyzed on a issue by issue basis.

10.3 Policy Direction

The seven objectives provided in TEA-21, which are listed in their entirety in Chapter 4, revolve around creating and maintaining a transportation system that fosters increased traffic capacity, economic growth, environmental enhancement, and public safety. Consequently, they reflect only one element of Porter's Diamond, factor conditions. However, the entire diamond drives the public sector's ability to efficiently create these factor conditions. Federal, state and local governments should strive to drive all the determinants in the transportation industry. Expanding the objectives in TEA-21 to address (1) firm strategy, structure, and rivalry, (2) demand conditions, and (3) related and supporting industries would increase the chance of success of efficiently obtaining the original seven criteria.

In addition to increasing the number of "high level" objectives, it would likely be necessary to go a step further and provide detailed guidelines on driving the elements of national and local competitive advantage that can used at the project level. The I-15, 407 ETR, and OOCEA case studies illustrate project specific actions that both unleash and erode the diamond factors and show the long term effect on the Owner. In addition, the I-15 case study illustrates project specific clauses that effect the five forces of competitive advantage for the private sector. The five forces framework is a key component of the firm strategy, structure, and rivalry element in the diamond. The I-15 project is an example of how an Owner can look at a project from the viewpoint of the bidders and use this insight to create a procurement process that fosters fierce competition.

In addition, the objectives provided to the state DOTs and local planning agencies are vague and conflicting. For example, supporting the economic vitality of a region will not always lead to enhancement of the environment. When the impacts of a project do not coincide with all of the objectives, it is important for planning agencies to know which goals take precedence. Also, the vagueness and breadth of the objectives as written could be used to support almost any transportation related project. Providing

specific guidelines would improve the efficiency with which states meet the objectives that are most important to the federal government and create a more transparent of the planning and programming process required by TEA-21. Allowing each state and MPO the authority to establish their own evaluation criteria and programming process relies heavily on the pluralist notion that group bargaining will lead to an end that is in the best interest of the whole. The Route 3 case study illustrates the pitfalls of this assumption. This project, which was planned and programmed according to vague federal guidelines, had been in dire need of development for more than fifteen years.

An alternative recommendation is to translate the seven objectives and goals into specific planning elements such as planning criteria, prioritization factors, and program tradeoff criteria. There are two advantages to this recommendation. First of all, there are economies of scale in the planning and programming process. Once the overall goals and strategy are defined and the program elements are established, the actual process can be quickly repeated as necessary. In addition, there are vast similarities between the components and needs of regional transportation networks. It is understood that guidelines set at this level would not match the exact requirements of all local agencies, but given the core similarities and the seven key objectives already established by the federal government, the advantages of local flexibility with respect to establishing program elements are unclear. Secondly, standardization improves the transparency of the entire process. Transparency is important because federal funds are distributed from a common highway trust. Taxpayers throughout the country should be able to understand where and why their money is being spent. Details of these guidelines are addressed in the following section. Here it is important only to note the overall benefits of establishing specific policies up front.

10.4 Planning

10.4.1 Multiple Delivery Methods

Figure 10-1 below demonstrates the location on Miller's Quadrant Framework of the current and proposed options addressed in TEA-21. Currently, only projects in Quadrant IV are permitted. TEA-21 authorizes the unlimited use of DBB and the use of DB on an approval basis. The DB method is permitted for projects that cost more than

$50-million and for projects that include an ITS that cost more than $5-million. The advantage of financial based hurdles for approving DB projects is unclear.

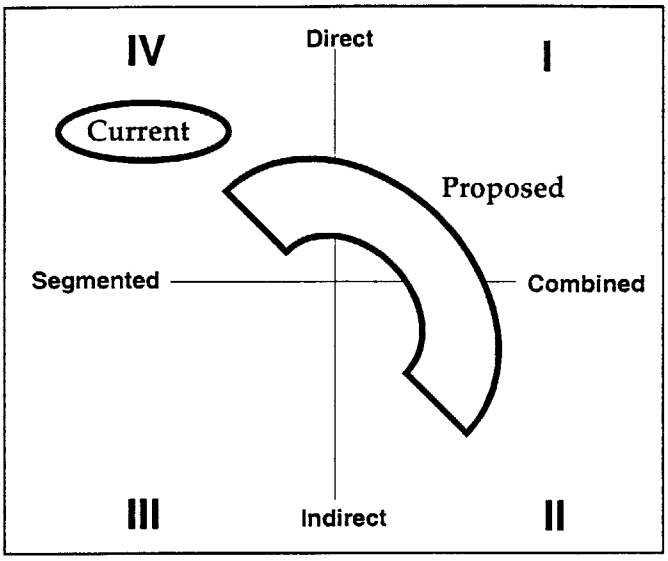

Figure 10-1 TEA-21 Delivery

Changes are recommended to TEA-21 that permit and even encourage planning agencies to include projects in Quadrants I and II in addition to IV, and that the restrictions on DB projects be removed. The 407 ETR and Route 3 case studies have shown the clear advantages of procuring transportation projects in Quadrants I and II. In addition, the 407 ETR case illustrated the advantages of utilizing multiple delivery strategies within a single contract. The I-15 case study illustrates the major advantages, mainly time savings and openness to new technologies, of using a DB approach for a transportation project. In all of these cases, public owners were able to procure projects that were badly needed and that would have been delayed further had they settled on a traditional DBB strategy in Quadrant IV.

10.4.2 Removal of Funding Restrictions

In order to facilitate projects in Quadrant I, the restriction on funding the general maintenance of transportation facilities with federal funds should be removed. When work on the Interstate System began, the policy of funding only construction projects, and passing maintenance responsibilities to the states provided the most leverage for federal funds. However, as state and local agencies make the shift from a construction

orientation to a preservation orientation, the current advantages of placing constraints on the uses of federal funding are unclear.

10.4.3 Vertical Integration Analysis

Once the funding restrictions are removed, planning agencies will have more freedom to analyze their entire value system. The OOCEA case study illustrates the advantages of using Porter's integration analysis framework by public planning agencies as they analyze "make or buy" decisions concerning operations and maintenance. These criteria introduce a different point of view in the planning process that looks at the strategic interrelated advantages and disadvantages of performing design, construction, operations, and maintenance in-house. Introducing the concept of vertical integration into the planning process would enable public owners to identify and implement an optimal mixture of public and private sector strengths.

10.4.4 Standardized Planning Elements

The need for a standard set of planning elements has already been discussed. It is recommended that TEA-21 establish a detailed planning process including a list of prioritization factors and trade-off criteria. Massport's approach, which was discussed in Chapter 2, could be used as a foundation for the transportation sector. In summary, Massport separates projects into three types based on cost, range of alternatives, social ramifications, and environmental impacts. For each project type, there are standard guidelines, including documentation requirements and evaluation criteria. The evaluation process consists of transforming criteria, such as a project's impact on the agency's goals and life-cycle cost, into a numerical value, the sum of which can be compared to other alternatives. TEA-21 should include a complete list of criteria along with their relative weights, but also provide state and local planning agencies the flexibility to develop additional factors that are geographically specific. Justifying decisions through documentation is important because of the subjective nature of evaluating trade-offs.

10.5 Programming

In minimizing the life-cycle costs of several infrastructure projects, the advantages of analyzing the entire systems at the portfolio level have been discussed in Chapter 3. Programming based on portfolio analysis, as done with CHOICES©, uses delivery method and pace as variables and assumes that the sources and uses of funds are common for the entire portfolio of projects. There are three federal policies that inhibit portfolio analysis for transportation projects. The first two, reliance on the DBB and DB methods and the restrictions on funding have already been addressed. The third is the tolling policy. Section 1216 (b) of TEA-21 establishes a Interstate System Reconstruction and Rehabilitation Pilot Program. This program passes responsibility to the Secretary to approve the use of tolls. There are three regulations in this section that restrict the widespread use portfolio management. First of all, the number of approved projects is limited to three. Secondly, the toll projects are restricted to the Interstate System. Finally, tolls collected can be applied only to project specific uses. This policy restricts the ability of planning agencies to supplement funds from revenue generating projects for projects that are financial losers. They are constrained to performing a project by project financial analysis instead of looking at the collective sources and uses for the entire transportation portfolio.

The alleviation of these restrictive policies would foster an iterative process between the programming and planning process. The planning process described in Chapter 2 includes selecting projects from a list of alternatives and establishing the work scope. The selected projects are then prioritized and scheduled based on financial constraints in the programming process. However, if the agencies had complete flexibility in terms of procurement method, financial strategy, and pace, the variables in the programming process would be much more advantageous yet complicated. In this scenario, information from the programming stage, such as variations in the sources and uses feedback generated by CHOICES©, would augment the selection criteria used in the planning process. Therefore, project selection and work scope determination would occur after several iterations between the planning and programming phases. This combination of planning and programming would increase the efficiency in which state

and local agencies achieved the goals established by TEA-21. This advantage can not be realized with the current policies.

10.5.1 Standardized Programming Elements

Much like the planning elements, the Massport programming guidelines could serve as the basis for a standardized transportation programming process. Standardization would improve the transparency of state and local decisions. Massport uses a combination of strategic, social, environmental, and economic benefits for project comparison. A complexity of the programming process is the evaluation of trade-offs between several projects and programs. This process would be more transparent at the local and state level if TEA-21 included a prioritized specific list of prioritized criteria. An additional advantage of making these decisions at the federal level instead of at state agencies is that the decision-makers are accountable to voters for their actions. The evaluation of the benefits and costs of transportation projects should reflect the priorities of constituents. In addition to standardized criteria, TEA-21 should permit the inclusion of local programming concerns.

10.6 Budget Review and Approval

One method that Lowi suggests for addressing the disadvantages of IGL is to include sunset clauses in legislation. Such a clause is inherent in TEA-21 because funding projections are set until 2003. After that time, new legislation is required to approve new target budgets. Lessons learned from this six-year period can be incorporated into the new legislation much like TEA-21 amended the guidelines in ISTEA. It is recommended that this policy is continued in subsequent legislation and that a second sunset clause is added that addresses federal responsibility for the Interstate System and National Highway System. Continual changes in the economy fueled by technological advances and in the nature of governmental fiscal policy justify planned reconsideration of the backbone of federal transportation legislation.

The final recommendation addresses the firewall between transportation funding and the reminder of the general budget. TEA-21 established a percentage of transportation revenues that is guaranteed for use in transportation projects. It is recommended that

this measure is continued and enhanced. Given the shortfall in funding needed for transportation projects, one hundred percent (100%) of user fees, including revenues from the tax on gasoline, should be invested back into the system.

10.7 Summary of Recommendations

- The seven objectives established for TEA-21 should clarified, prioritized, and expanded to include all of the factor conditions in Porter's diamond framework.

- Use of the diamond and five-forces frameworks by states and local planning agencies should be explained and encouraged.

- In order to insure optimal and uniform conditions throughout the entire NHS, congress should pass a set of performance specifications that describe a minimal level of service and public safety for transportation facilities. It is understood that the details of such a set would most likely be complied by the secretary of transportation. But upon completion, they should be passed into law. One way to avoid the pitfalls of micromanagment in this process is to create a system that separates regions of the NHS into various levels depending on population or a relevant economic indicator. Each level could then have different specifications.

- The current system of the federal government collecting the gasoline tax and redistributing the funds back to the states should be maintained. However, two improvements should be made to this system. The federal government should only keep the money required to cover its transportation costs, and the distribution to the states should be dependent on compliance with the performance specifications described above.

- Restrictions on delivery methods should be removed, enabling projects in quadrants I, II, and IV of Miller's framework.

- The restriction on funding the general maintenance of transportation facilities with federal funds should be removed. The gasoline tax should be made available for states to apply to any portion of the life-cycle costs of a project or program.

- Project revenues should be made available for use in any project in the transportation portfolio. With this amendment to TEA-21, financial winners could be used to supplement the costs of projects that are not financially self-sufficient.

- Porter's vertical integration analysis should be introduced into the planning process as a powerful tool for planners to evaluate "make or buy" decisions.

- The current transportation hierarchy structure, which includes federal agencies, states, and MPOs, should be maintained. In the transportation planning and programming process, the benefits of a structure that facilitates the transition of federal policies into a coherent program of geographically specific projects outweighs the pluralistic pitfalls inherent it. In addition, many of the recommendations described herein would lessen the impacts of these problems.

- Federal legislation should include standardized planning elements including prioritization and weighting factors. For example, if cost and environmental impacts are both important, the federal government should decide which is more important and how much more important it is. These policies should be made at this level so that the decision-makers are held accountable to voters. When this standardized criteria is made available, states and local planning entities will be able to defend their evaluation of a set of project alternatives. Further more, the process will be transparent and consistent with the decisions being made throughout the entire country.

- The federal government should also develop a standardized set of programming elements so that states and local entities can transparently evaluate the costs and benefits of several different projects in order to create a defendable capital program that is in line with federal goals and objectives.

- The current mindset that the planning process precedes the programming process should be replaced with the concept of an iterative process that combines both planning and programming. Such a process would yield results that more efficiently meet national objectives than those of the current method would.

- The current sunset policy regarding the budget should be expanded to include the set of performance specs, the improved list of legislation objectives, the standardized set of planning criteria, and the programming evaluation criteria. Each of these policies should be revisited and updated on a regular basis.

- Transportation legislation should establish an impenetrable firewall between one hundred percent (100%) of the revenues generated by the gasoline tax and the general budget.

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