



# America's Infrastructure Strategy: Drawing on History to Guide the Future

KPMG LLP

Written in collaboration with Stanford University's Collaboratory for  
Research on Global Projects.

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## Photo Contributors

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# America's Infrastructure Strategy: Drawing on History to Guide the Future

Michael J. Garvin<sup>1</sup>

## Preface

This paper synthesizes concepts and research output from various endeavors that I have been involved with since 1998. Many of the main findings were developed while I was a PhD student at the Massachusetts Institute of Technology (MIT) in 1998–2001 and a member of the Infrastructure Systems Development Research Group, led by Dr. John B. Miller. My work with Dr. Miller prompted my curiosity about alternative strategies for infrastructure development and laid the foundation for my study of the topic. His book, *Principles of Public and Private Infrastructure Delivery*, provides an extensive review and analysis of infrastructure experiences in the United States and underpins the description of the pre–Great Depression infrastructure strategy described in this paper. Under Dr. Miller's supervision, other graduate students and I created a series of case studies about infrastructure projects that used innovative delivery systems. A number of these studies were published in a

textbook by Dr. Miller, *Case Studies in Infrastructure Delivery*, and details from several are presented here.

Since graduating from MIT, I have continued to investigate the evolution of private participation in infrastructure development, primarily through case-based research. Hence, the balance of the findings here are taken from this experience. Many issues that our MIT team identified remain quite salient today, though accompanied by new challenges. But when current concerns are cast against the complete backdrop of the U.S. experience with infrastructure, it becomes clear that these are hardly new issues. This paper assesses America's infrastructure strategy since the nation's founding through the turn of the 21st century and carefully examines the private sector's pivotal—and fluctuating—role in infrastructure development, finance, and management. By examining the past, it uncovers lessons to guide the future.

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## Executive Summary

When private investment in infrastructure makes the cover of *BusinessWeek* (7 May 2007), something big is clearly afoot. For example, the Chicago Skyway and Indiana Toll Road were recently leased to private consortia, sparking enormous interest but also raising concerns at all levels of government. As a result, some officials have sought to increase private participation in infrastructure—while others have worried that such deals put the public's interest at too great a risk.

Yet private participation is hardly new: the private sector has been involved in a variety of U.S. infrastructure projects, in a variety of ways, for more than 200 years. The public sector partners with the private sector for many reasons—including project financing, construction, and management—with the private sector often tapped for its potential to deliver value and innovation.

Still, uncertainty remains about when and where public-private partnerships make sense, and governments need to develop procurement and other systems that balance the stakeholders' risks and rewards so these arrangements are

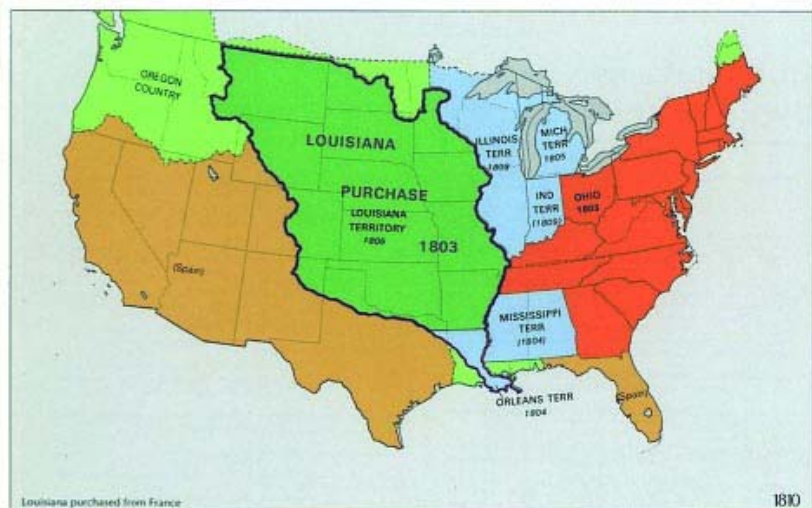
used effectively. Drawing on experiences with public and private infrastructure projects in the United States (and, to a limited extent, Canada) since the 18th century, this paper provides lessons for infrastructure development, with a focus on the requirements for successful private sector participation.

## The U.S. infrastructure experience—from the 18th to the 21st century

### America's infrastructure heritage: Independence to the Great Depression

After winning independence from Great Britain, the fledgling U.S. nation had limited financial resources and weak foreign credit ratings, constraining the capital assets that federal and state governments could finance directly. But the 1803 Louisiana Purchase, combined with the Indiana Territory, gave the federal government a rich repository of land to use to its advantage.

Between the late 18th century and early 20th century, Congress shrewdly supported national expansion and economic growth using a dual-track



strategy to develop and finance infrastructure—spending federal funds to “push” projects considered crucial for developing commerce and trade, and “pulling” projects from the private sector through indirect means such as land grants or franchises awarded to private parties. The first approach was mainly used to improve harbors and navigable rivers and to construct public buildings; the second targeted canals, railroads, and postal routes. For instance, the development of the National Road from Maryland to Illinois was pushed through direct funding by the federal government. Alternatively, the Illinois Central Railroad was pulled by issuing land grants to a private corporation that built and operated the railroad.

This two-pronged approach was both a leveraging strategy—since it allowed more development than could have occurred through direct funding alone—and a hedging strategy—since it allowed public funding to respond more flexibly to socioeconomic and political conditions. Governments at all levels used similar approaches to develop infrastructure deemed to be in the public interest.

### **Winds of change: The Great Depression to the early 1980s**

America’s priorities shifted in the 1930s and 1940s. The Great Depression made infrastructure an instrument of social policy, as President Franklin D.

Roosevelt’s New Deal invested heavily in public works projects to provide jobs to the unemployed. This new approach forever changed policymakers’ view of infrastructure, with projects now viewed as economic catalysts. On the heels of the Depression came World War II, which commanded the nation’s political, economic, and social will. When the war ended in 1945, the United States emerged from more than 15 years of massive challenges a changed nation—and a new world order was starting to establish itself.

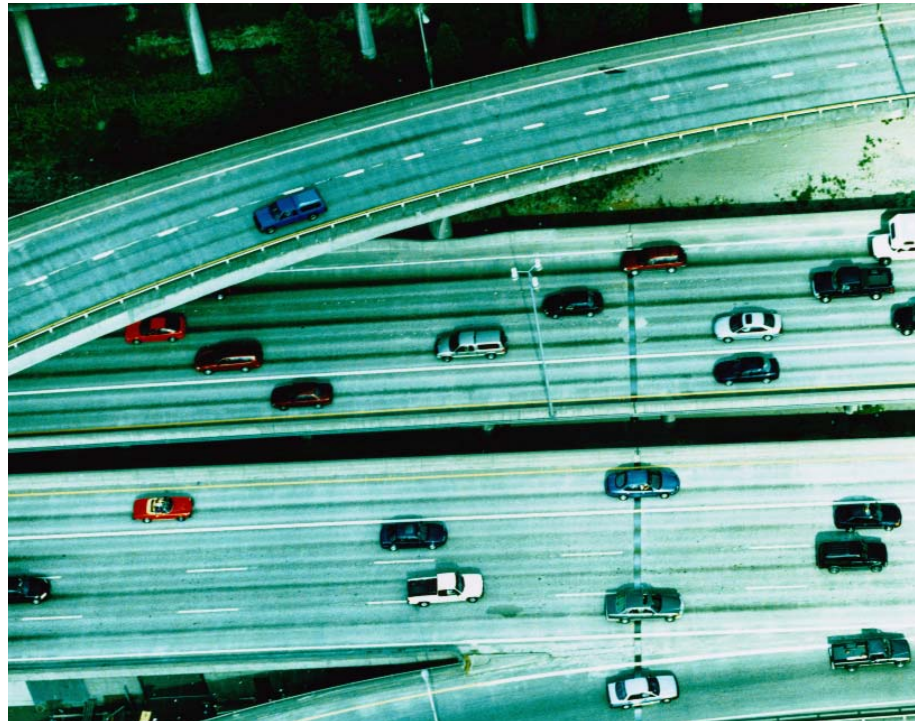
This new world order, which prompted the Cold War, brought an unprecedented focus on national defense. Among the most significant outcomes of this emphasis was the Interstate Highway System. The strategy used to build this \$40 billion national security and economic platform, coupled with changes in federal procurement requirements, eventually resulted in a national environment where “pulling” infrastructure projects from the private sector became virtually impossible.

**Crisis? The 1980s to the early 1990s**

In 1981, two economists, Pat Choate and Susan Walter, argued that U.S. public facilities were wearing out faster than they could be replaced and that reduced infrastructure spending was to blame for many of the country's recent problems—including the energy crisis and falling productivity. Though some of their findings were disputed, their work catalyzed an enduring litany of initiatives to identify U.S. infrastructure challenges and design strategies for resolving them. One refrain of these studies was the recognition that increased private participation, and more innovative funding methods were needed to reduce the backlog of infrastructure projects and confront future requirements.

**Infrastructure experiments: The 1990s into the 21st century**

In response to funding shortfalls and with the encouragement of national bodies and the executive branch, several state and local governments began involving the private sector in infrastructure development, management, and finance. Indeed, this shift can be seen as a return to the dual-track strategy. Similar developments occurred in Canada. Table 1 describes several recent experiments with public-private partnerships.



Project	Description	Procurement process	User fee structure	Comments
SR 91 express lanes	<p>One of four pilot projects resulting from California's AB 680 of 1989, which asked private consortia to propose, develop, finance, and operate transportation projects for 35 years. Installed four high occupancy toll lanes in the median along 10 miles of Route SR 91 at a cost of \$126 million. The concessionaire negotiated strict noncompete provisions to protect its asset. Ultimately, the local highway authority found these provisions unacceptable. Instead of challenging them in court, the local authority bought the express lanes for \$208 million.</p>	<p>Solicited "unique" proposal selected using generic evaluation criteria.</p>	<p>Concessionaire was allowed a base rate of return of 17%. Excess receipts were required to go to the debt principal balance or a state highway fund.</p>	<p>High occupancy toll lanes have wide appeal because they introduce a market that theoretically benefits those willing to pay as well as those who are not. They should also provide environmental benefits, because such projects are built in developed areas, and reduced congestion should lower vehicle emissions.</p>
Dulles Greenway	<p>A project authorized by the Virginia Highway Incorporation Act of 1988 to allow a private corporation to design, build, finance, and operate a tolled extension of the Dulles Toll Road from Dulles International Airport to Leesburg, Virginia. The Greenway was expected to be an attractive commuter route in the Washington, D.C. region. Financing and permit issues delayed opening until 1995. The project was immediately in financial distress because the projected demand did not materialize, and the concessionaire ultimately restructured its loans.</p>	<p>Unsolicited proposal followed by sole source negotiation.</p>	<p>User fees increase based on a predefined schedule through 2010, after which the concessionaire can increase them by 3.2% a year.</p>	<p>The state government's tenuous commitment to this project became clear when it began improving competing free routes during the project's development. Michael Crane, then-CEO of the concessionaire, said, "We wouldn't do it as a totally private infrastructure project, if we had to do it again. These projects are only successful as public-private partnerships. The developer must have the full support of the state" (Bailey 1996).</p>
Confederation Bridge	<p>In 1987, the Canadian government requested private proposals to design, build, finance, and operate a fixed link between the mainland and Prince Edward Island for 35 years. The link was to replace the federally run ferry service, which had become quite costly. The winning proposal was a reinforced concrete bridge with spans between multiple piers.</p>	<p>A three-stage procurement process was used. In the first, conceptual proposals were evaluated. In the second, bidders selected from the first stage submitted detailed technical proposals. Three were chosen to continue to the third stage, where financial proposals were assessed and a winner chosen.</p>	<p>User fees were initially the same as for ferry services and then were allowed to increase at an annual rate not to exceed 75% of the consumer price index.</p>	<p>The Canadian government included conditions that benefited both the public and private sectors. First, it promised to contribute a fixed annual payment to the revenue stream equal to the cost of its ferry subsidy. Second, the start of the concession period was set in advance; if the concessionaire did not have the bridge open by then, it would be required to operate the ferry service. Not surprisingly, the bridge opened six months ahead of schedule.</p>

Project	Description	Procurement process	User fee structure	Comments
Highway 407 Express Toll Route	<p>This project had two phases. In the first the Ministry of Transportation, Ontario (MTO), requested proposals to design, build, finance, and operate a tolled express route that would bypass downtown Toronto. One consortium submitted a good road plan using standard tolling technology; the other submitted an adequate road plan using innovative tolling technology. So, MTO signed separate contracts with the designer and builder from the first proposal and the technology supplier and operator from the second. Once opened in 1997, the project was the world's first fully electronic multilane toll highway and was highly successful. A second phase began in 1998 when the government decided to lease the road to the private sector for 99 years in exchange for a winning bid of C\$3.1 billion.</p>	<p>The first phase solicited proposals from two preselected consortia. Though technical specifications were vague, MTO did indicate that it was looking for innovative tolling technology. The second phase began with prequalification of interested parties, then followed an iterative process where concession agreements and technical requirements were issued to the qualified consortia for review and comment. Selection was based on a single criterion—the highest bid.</p>	<p>In the first phase, user fees were controlled by MTO. In the second phase, a market-based approach was established for peak travel periods, with penalties if the concessionaire fails to balance throughput and the market price. A detailed schedule governs fees in off-peak periods.</p>	<p>In the first phase, the market did not provide a proposal with a good road plan and innovative tolling technology. The process used in the second phase was transparent and fair. Whether leasing an infrastructure asset for 99 years is appropriate, however, is arguable.</p>
Pocahontas Parkway	<p>One of the first projects resulting from Virginia's 1995 Public-Private Transportation Act. A nonprofit (63-20) corporation, the Pocahontas Parkway Association, was established to finance the facility. A private team provided design and construction services, while the Virginia Department of Transportation operated the facility on its completion. Once opened in 2002, traffic volume was far less than expected. By 2004, the road was generating only half the expected revenue. In 2006, Transurban agreed to lease the parkway for 99 years for more than \$600 million, which was used to retire the project's debt and reimburse the Department of Transportation for operating costs.</p>	<p>Unsolicited proposal for development of the parkway; sole source negotiation for the lease.</p>	<p>Initially, a schedule for user fees was set for the first two years, after which the Department of Transportation held the right to adjust tolls subject to covenants in the bond indenture.</p> <p>A specific tolling schedule is defined in the lease agreement through 2016. After that, Transurban can increase annual toll rates by the greater of the rise in GDP, consumer price index, or 2.8%.</p>	<p>The Public-Private Transportation Act was later amended to require solicitation of interest and competing proposals if an unsolicited proposal is received. With the lease, Transurban obtained its first asset in the United States.</p>

Project	Description	Procurement process	User fee structure	Comments
Tolt Water Treatment Plant	Fluctuating turbidity in the Tolt River water supply prompted Seattle Public Utilities (SPU) to plan for a new treatment facility. In 1993, SPU chose to pursue a design-build-operate delivery strategy. Before doing so, it commissioned an engineering firm to develop a benchmark design and lifecycle cost estimate, and provided this information to potential respondents. The winning proposal is expected to save SPU \$70 million during the construction phase during 25-year operating period.	Solicited proposals; to be considered, respondents had to submit proposals with present value lifecycle costs 15% below the benchmark cost estimate. A weighted additive scoring system was then used to select the winning team.	User fees are controlled by SPU.	The mandated 15% savings might be considered the public sector's risk premium for trying a new approach. The benchmark design served several purposes. It helped SPU determine what it considered a minimum standard as well as its expected cost. It also helped respondents, since they could evaluate where they could improve on the benchmark technically, financially, and environmentally.
JFK AirTrain	The Port Authority of New York and New Jersey solicited a light rail transit system to provide services from the outskirts of Manhattan to JFK Airport. The system was to be delivered using a design-build-operate strategy; the operating period was five years with renewable one-year options. This strategy was chosen in response to pressure from both states' governors, since it was expected to expedite service availability. A request for proposals was issued in 1996, but the AirTrain was not operational until 2003 due to various delays.	Solicited proposals, with the winner selected using a long, very discretionary process.	User fees are controlled by the Port Authority of New York and New Jersey.	The discretionary nature of the procurement was among the factors that delayed project completion. Initially, five consortia submitted proposals. The Authority rejected all five and asked two respondents to submit again, with an instruction for lower bids.



## Lessons of experience

The projects in Table 1 offer many lessons for improving private participation in infrastructure in the United States.

### Securing value

One pervasive goal of using a public-private partnership is to obtain value. Three of the seven projects in Table 1 were the result of unsolicited or unique proposals. In two of the three, the government made no effort to determine whether it was receiving a reasonable value—much less the best value. The international community has established intricate processes for determining whether public-private partnerships deliver value for money. But this assessment is often made before deciding on a public-private approach. In such cases, the main concern is whether a public-private strategy delivers better value than a conventional one. This consideration is understandable. But a subjective, preliminary appraisal of this sort is susceptible to abuse. Moreover, the conclusion that a public-private approach is a better option does not guarantee that the expected marginal value will materialize.

Two of the other four projects, in particular, show that generating value from public-private partnerships requires carefully defining project scope and ensuring competition during procurement. In the Confederation Bridge and Tolt Water Treatment Plant projects, clearly defined scopes of work and competitive procurement produced clear value in terms of price, service availability, system operability, and environmental impacts.

### Fostering innovation

Aside from value, another reason to involve the private sector in infrastructure is the potential for innovation. Unfortunately, this rationale is used less often. Certainly, innovation might be viewed as part of the value equation, but the potential for innovation that public-private models offer is worthy of particular consideration. One of the limitations of the design-bid-build project delivery system is that the owner only sees the architectural and engineering solution of one service provider, with one combination of cost, quality, and time attributes. But a single provider is never in a position—technically or financially—to fully consider and compare all alternatives for design, technology, initial costs, or lifecycle costs. As a result, the service provider's limitations become the owner's.

Moving procurement of a private service provider upstream in the project lifecycle enables an owner to review multiple design possibilities. The design-build, design-build-operate, and design-build-finance-operate project delivery systems, as well as their derivatives, increase the amount of conceptual and functional design done by proposing parties. Thus, in a competitive procurement, the owner can assess and rank several design concepts. Moreover, each of these delivery systems integrates the lifecycle tasks of infrastructure production to varying degrees. For instance, a consortium responsible for designing, constructing, and operating a facility is likely to account for constructability and operational ease during design.



### Encouraging transparency

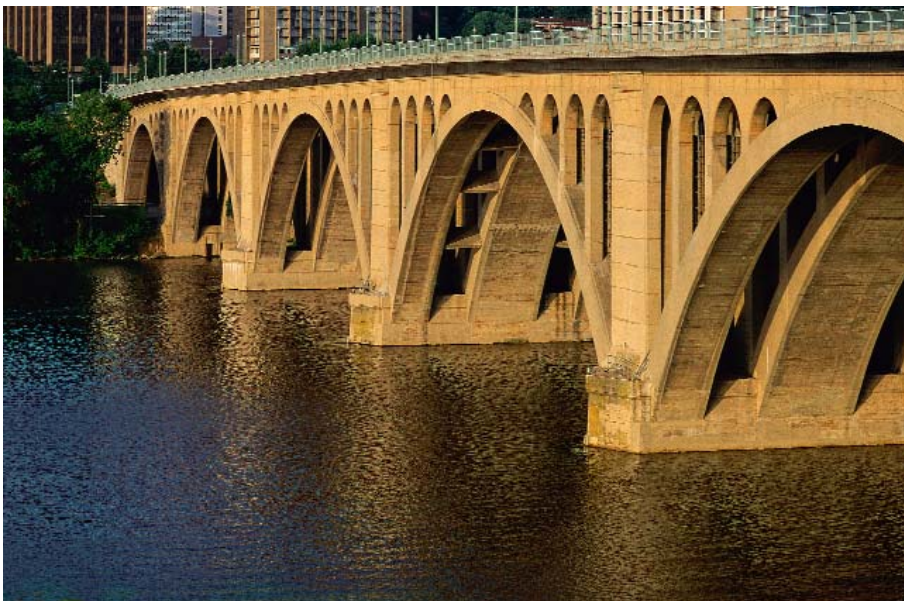
One of the strengths of the design-bid-build project delivery system is its clear criteria for selection, focused on the lowest, most responsive, responsible bid. Indeed, the transparency of this system's procurement process—the attributes that make it stable, reliable, and predictable to actual and potential participants and to procurement officials, legislators, and the public—is rock solid in the public sector.

The case studies in Table 1 suggest a different story for public-private arrangements. Only three of the seven demonstrate desirable levels of transparency: Confederation Bridge, Highway 407 Express Toll Route (second phase), and Tolt Water Treatment Plant. The importance of transparency cannot be overstated; the long-term success of a government's procurement system depends on it. If government does not treat private sector respondents fairly and consistently, they will likely provide their services elsewhere—and public agencies risk losing the confidence of citizens and elected officials.

### Managing user fees

In Greenfield public-private projects, the introduction and management of user fees are likely the main political and social hurdles. In other situations (such as Brownfield projects) where user fees were already in place, opposition to a new fee should be lower—unless the new fee is much higher than the previous one.

The locus of control for user fees depends on the public-private partnership model used. In a design-build-operate system, the public sector retains control over user fees and their associated risks. In privately financed arrangements, the public and private sectors must agree on a user fee strategy. In such cases, the first challenge is to institute fees that are affordable, considered fair, and sufficient to generate the revenue required by the project's financing and operation model. The second challenge is to create a plan for fee increases acceptable to the private provider, citizens, and elected officials. Unfortunately, best practices for managing user fees have yet to emerge.



### Assessing facility competition

Competing facilities create a conundrum for revenue-driven, public-private partnerships. Prohibiting or limiting competing facilities is important for mitigating revenue risk, while allowing them can diffuse concerns about disenfranchising sectors of the public—especially low-income citizens. Although noncompete provisions in public-private agreements may seem too restrictive, they may be needed to initiate a privately financed project. Still, recent research suggests a compromise. With toll roads, for example, a 5–10 year noncompete period might strike a reasonable balance between easing private sector revenue risk and ensuring public sector flexibility in transportation planning and development, since traffic behavior and revenue growth tend to stabilize within that time.

### Implications—for today and the future

So how should the United States move toward an infrastructure strategy that meets society's demands and improves an aging system? Over its history, the nation has used a rich variety of approaches to infrastructure development, financing, and

management—an approach that must be rekindled. Neither the public nor private sector alone can fulfill America's needs for infrastructure expansion, modernization, and restoration. But if the two sectors work in concert, the task is far less daunting.

Establishing effective public-private partnerships requires understanding when certain project delivery systems make sense and instituting appropriate procurement systems for soliciting and selecting infrastructure service providers. With procurement, the trick is to balance two goals: protecting government interests while attracting meaningful participation from potential private vendors. Lessons from U.S. history and recent experiments with public-private partnerships suggest several procurement principles that can help achieve these dual objectives:

- *The public sector's procurement system must be consistently transparent; the litmus test for transparency is whether it is possible to fully understand how and when an award will be made before the process begins. Without transparency, the system has no credibility, which*



erodes public confidence and deters private participation.

- *The public sector should provide reasonable definitions of the scope of services desired.* Otherwise, public agencies essentially yield their duties as executives of the electorate. Furthermore, they will have missed an opportunity to focus competition, and they will also find it difficult to award and defend public-private contracts.
- *All procurements should be competitively awarded, absent an extremely compelling rationale.* Competition encourages the best value from respondents and promotes accountability. If a competitive process is not utilized, the public sector should fully disclose the justification for a noncompetitive award.

- *The public sector must understand all of the risks and transaction costs of the public-private model being considered, and manage them to optimize and balance the risks and rewards of all stakeholders.* Given the complexity of public-private partnerships, failures can have dramatic and cascading effects.

An open approach to infrastructure development, financing, and management—one where all delivery options are available—capitalizes on the differences between the public and private sectors by recognizing that each can contribute in ways that reflect their inherent strengths. Together, the public and private sectors must strive to improve U.S. infrastructure assets using fair, transparent, straightforward procurement systems and suitable project delivery models.



## America's Infrastructure Strategy: Drawing on History to Guide the Future

Only rarely has infrastructure garnered the attention that it is currently receiving in the United States. The recent leases of the Chicago Skyway and the Indiana Toll Road to private consortia have created quite a stir amongst citizens, government, industry, and nongovernmental organizations. Indeed, the exchange of billions of dollars of upfront capital for cash flow and operating rights between the public and private sectors is worthy of such attention; however, the infrastructure lease arrangement is but one strategy among a continuum of approaches to deliver and finance necessary infrastructure services. Moreover, the infrastructure delivery and financing dilemma – created by weak public and political support for tax increases or user fees and a persistent doubt of private development and management of infrastructure – is as old as the nation itself. The description of a council meeting in New York City in 1786 is testament to this condition.

*The idea of entrusting the management of the water works to private enterprise had encountered strong opposition. At a council meeting on April 19th, the alderman and assistants reported that they had conferred with many of the citizens in their respective wards, and it appeared to be the sense of a majority of these that the city ought not to grant the privilege of supplying water to individuals, but that this*

*service ought be undertaken by the municipality itself . . . As usual in the history of American cities, the taxpayers were groaning under their burdens, and politicians had to calculate the risks of creating a large municipal debt (Blake 1956).*

Despite this consistent, bilateral condition at all levels of government, the U.S. federal government, in particular, routinely used a two-pronged strategy to develop infrastructure prior to the Great Depression. One track relied upon direct federal funding of projects such as harbor and navigable rivers improvements while a second track relied upon indirect and private funding of projects such as canals, post roads, and railroads. Miller (2000) suggested that this dual-track approach had two distinct advantages. First, it was a *leveraging* strategy, since it allowed more development than could have occurred via direct funding alone, and second, it was a *hedging* strategy, since it permitted public funding appropriations to respond more flexibly to prevailing socioeconomic and political conditions.

Today, the public sector in the United States finds itself still struggling with financing infrastructure, although the scale of this generation's problem is greater since: (a) development or expansion requirements are matched by

equally substantial modernization and restoration needs and (b) the role that the private sector plays in infrastructure development, finance, and management is more complex since multinational companies are often amongst those vying to participate. This situation is exacerbated by the public infrastructure development paradigm that emerged in post-World War II America. A series of legislative initiatives culminating with the Brooks Act of 1972 and two massive federal infrastructure investment initiatives, the Interstate Highway System Program, and the U.S. Environmental Protection Agency Construction Grants Program, firmly entrenched a publicly funded and segmented project delivery system, design-bid-build, as the default approach for infrastructure projects at all levels of government (Miller et. al. 2000).<sup>1</sup> Despite tremendous criticism regarding its inefficiencies, the design-bid-build

system is well-understood by all stakeholders, has proven quite capable of creating infrastructure, and has kept responsibility for capital formation and operations in public hands. Given these conditions, the doubts that arise when alternative strategies are proposed or piloted are understandable.

Nevertheless, reliance upon a single strategy for infrastructure development, management, and finance fails to capitalize upon the strengths of alternative approaches. Indeed, alternative strategies are not without their own shortcomings or risks, but neither is the traditional system. Accordingly, this paper has several objectives. First, it will quickly characterize the tasks involved in infrastructure development and illustrate alternative combinations of task structure, finance, and management. Second, it shall briefly describe the

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<sup>1</sup> Interestingly, design-bid-build is typically referred to as the “traditional” project delivery approach in the United States even though it really did not emerge as the dominant strategy for public infrastructure projects until after World War II.

American infrastructure experience prior to the Great Depression to historically illustrate the richness of the strategies used in our nation's past. Third, it will explain how this richness was diminished by a series of legislative and executive actions. This dimension of our heritage is important to appreciate since initiatives that were certainly well-intentioned wound up having unintended long-term consequences. Fourth, it will present several "mini-case studies" from the 1990s in the United

States and Canada where alternative project delivery strategies were utilized to illustrate a continuum of private sector involvement and to highlight the opportunities and challenges associated with each strategy. Finally, it will discuss the lessons learned from this recent experience to inform on-going public policy and debate regarding private participation in infrastructure development, finance, and management.

## Characterizing infrastructure and its development

The term "infrastructure" is somewhat ubiquitous, and users of this moniker often presume that their audience understands what they mean even though this may not be the case. Not surprisingly, the definition of this term has evolved in recent times and has surprisingly different connotations, as illustrated in Table 1.

**Table 1: Various Infrastructure Definitions Over Time**

Source	Definitions
Congressional Budget Office (1983)	Facilities with the common characteristics of capital intensiveness and high public investment at all levels of government. They are, moreover, directly critical to activity in the nation's economy.
Council of State Planning Agencies (1984)	A wide array of public facilities and equipment required to provide social services and support private sector economic activity.
U.S. Congress (1984)	Any physical asset that is capable of being used to produce services or other benefits for a number of years to include roadways or bridges; airports or airway facilities; mass transportation systems; wastewater treatment or related facilities; water resources projects; hospitals; resource recovery facilities; public buildings; space or communication facilities; railroads; and federally assisted housing.
Executive Order 13010 (1996)	The framework of interdependent networks and systems comprising identifiable industries, institutions (including people and procedures), and distribution capabilities that provide a reliable flow of products and services essential to the defense and economic security of the United States, the smooth functioning of government at all levels, and society as a whole. Certain national infrastructures are so vital that their incapacity or destruction would have a debilitating impact on the defense or economic security of the United States.
American Heritage Dictionary (2000)	The basic facilities, services, and installations needed for functioning of a community or society, such as transportation and communication systems, water and power lines, and public institutions, including schools, post offices, and prisons.
Department of Homeland Security (2003)	America's critical infrastructure sectors provide the goods and services that contribute to a strong national defense and thriving economy. Moreover, their continued reliability, robustness, and resiliency create a sense of confidence and form an important part of our national identity and strategic purpose. They also frame our way of life and enable Americans to enjoy one of the highest overall standards of living of any country in the world.

Inspection of these definitions suggests that infrastructure is broadly defined as the physical assets that facilitate the delivery of both social and economic services. Interestingly, the definitions have evolved from an emphasis upon

operation, and maintenance, which involves a number of production activities throughout its lifecycle – most of which are interdependent. Figure 1 broadly depicts these activities.<sup>2</sup>

**Figure 1. Infrastructure Lifecycle Activities**



public works and their adequacy to critical infrastructures and their security (Moteff and Parfomak 2004). In addition, the characterization of infrastructure as purely public systems has clearly diminished with time. The significance of the characterization will become very evident later in the paper when discussion regarding the contemporary role of private participants is more fully examined.

Whichever way the term is defined, infrastructure is “physical” – society can see and usually come in contact with it – and “deliberate” – society develops and uses it for some purpose; it is not arbitrary. Thus, it requires creation,

These are the *tasks* necessary to develop the asset so that it may provide its service, and history has proven that the *organization* of these tasks can vary tremendously – as subsequent examples will testify. In addition, these tasks must be *financed and managed*. Indeed, the nature of these *tasks* and their *organization* will influence the amount to be *financed* and the processes to be *managed*. Thus, they are certainly correlated with one another, and yet, multiple variations in task organization, finance, and management are quite feasible – these alternative combinations are known as *project delivery systems*. For instance, a public owner of an infrastructure facility

can assume responsibility for financing an asset while contracting with a private enterprise to provide detailed design, construction, and commissioning services; the public owner could then retain responsibility for all other lifecycle tasks. This is a project delivery system referred to as *design-build*. Typically, the public owner also has various options for financing an asset itself ranging from the use of cash on hand to tax-backed securities to user fees (tolls).

Alternatively, the public owner can opt to allow a private contractor to raise all of the capital necessary to create and operate the asset for a period of time. In such a case, the public owner must typically grant the private contractor the right to collect user fees associated with the asset. This is a project delivery system that may be referred to as *build-operate-transfer*. The bottomline is that many combinations of task organization, management, and financing exist and throughout history, one will find an abundance of models.

<sup>2</sup> The infrastructure lifecycle is often portrayed linearly for illustrative convenience. In reality, many causal loops within and between activities often exist and concurrent tasks are also not uncommon. In addition, the start of this depiction presumes that “needs assessment & identification” has already occurred.

## American infrastructure experience prior to the Great Depression

Early America is fraught with examples of variety in infrastructure development, financing, and management approaches. Once independence was won from Great Britain, a fledgling U.S. nation found itself with very modest financial resources and weak credit ratings abroad. These circumstances combined to limit what capital assets both federal and state governments could directly finance. By 1803, the federal government had acquired the Louisiana Territory from France at about 3¢ per acre. This land, combined with the Indiana Territory, which was organized by an Act of Congress in 1800, gave the federal government a rich repository of property to utilize to its advantage, and the resources west of the Appalachian chain clearly fueled the nation's efforts to expand into these territories. The Congressional strategy to support expansion and economic growth throughout the 19th century was rather ingenious, although it was not without its faults. Miller (1995; 2000) characterized the approach as a "dual-track strategy." One track used what federal funds were available to "push" specific projects that Congress saw as expedient and necessary mechanisms to support the development of commerce and trade. Federal appropriations were made to improve harbors and navigable rivers, to provide navigation aids, to construct territorial and military roads, and to raise public buildings. The other track "pulled"

projects from the private sector indirectly through means such as the award of land grants or franchises to private parties. This strategy was employed to develop most of the nation's canals, post roads, railroads, telegraph and telephone, and power infrastructure. It is not a coincidence that these types of projects are amenable to granting contiguous property rights to the developer or charging users of the services a fee. In the absence of a federal income tax, which did not become a permanent fixture of American government until 1913, Congress used its resources rather wisely to bolster the nation's economic growth and prosperity. In fact, governments at all levels throughout the nation utilized similar concepts and techniques to develop infrastructure that it deemed in the public interest as the examples that follow will demonstrate.

### "Pushed" projects

#### **River and harbor Improvements**

The U.S. Constitution granted Congress the power to regulate commerce with foreign nations and among the several states. Accordingly, Congress made direct federal appropriations to facilitate navigation consistently during this era. Beginning with an act in March 1797 to provide buoys in Boston Harbor,<sup>3</sup> Congress routinely provided direct support to states to improve harbors and rivers. By 1827, the Congressional process had reached "the point that each time Congress agreed to improve rivers and harbors, the list of funded projects usually included sites in all

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<sup>3</sup> 1 St 518

states” (Miller 2000). Following the Civil War, the trend of directly funding navigational improvements continued and grew. In 1869, Congress appropriated \$2 million to improve the nation’s rivers and harbors. By 1930, Congressional appropriations had risen substantially.

### **Erie Canal**

Begun in 1817 and completed in 1825, the Erie Canal was the first initiative by an American state to directly finance and control a *major public works project* as opposed to ceding this responsibility to the private sector (Miller 2000). New York’s geography gave it a tremendous strategic advantage over other states in the general quest to establish a waterway from the eastern seaboard to the Great Lakes – it is the only state in the East with land on both sides of the Appalachian Mountains and a natural waterway through it, the Mohawk River. Governor De Witt Clinton argued that the state needed an interior route to the Great Lakes to exploit growing western markets. Initially, the state lobbied the federal government for the resources to build the canal but failed on multiple occasions to attain this aid. Finally, the New York legislature passed “An Act for Improving the Internal Navigation of This State” in April of 1817. Financing was obtained through a series of loans backed by the state and its citizenry. The canal and the Hudson River provided a waterway connection between New York City and the Great Lakes and undoubtedly played a pivotal role in cementing New York City as the

economic center of the United States.

### **Illinois and Michigan Canal**

For years, Native Americans and European fur traders had traversed what was known as the “Chicago Portage” to travel between the Chicago River, which connects to Lake Michigan, and the Illinois River, which drains into the Mississippi River just above St. Louis, Missouri. As early as 1810, a proposal was made to Congress to build a canal to replace this portage (Conzen and Carr 1988). Following the War of 1812, Congressional interest in such a project, which would improve national security, intensified. In 1827, Congress granted over 284,000 acres of land to the state’s Canal Commission to help finance the canal’s construction. Sales of the property as well as loans from eastern U.S. and British investors finally produced enough capital for construction to begin in 1836. The Canal Commission hired a professional engineer to supervise construction, and contractors were hired to build the canal. Finally completed in 1848, a waterway connection was now in place between Lake Michigan and the Gulf of Mexico. Not surprisingly, however, the commerce from Illinois and Wisconsin flowed through Chicago since New York City was the principal draw for goods headed to European (as well as Eastern U.S.) markets (Miller 2000).

### **The National Road**

The National (or Cumberland) Road was the first U.S. highway built entirely with federal funds. In 1806, Congress

authorized the President to contract three disinterested commissioners to lay out the road, and thus began a five decade saga. In its initial authorization, Congress appropriated \$30,000 for this purpose while also detailing the general route of the road (from Cumberland, Maryland to the Ohio River just south of the town of Wheeling in what is now West Virginia) and its technical specifications (four “rods” wide, 4 x 16.5 ft., a maximum grade of 5%, a raised middle, drainage ditches on both sides, and plain marks were to be made on trees, stakes, or monuments every one-quarter mile).

The original plan had been to fund construction through proceeds from Ohio territory land sales. When these proved insufficient, Congress appropriated additional funds for construction. Construction commenced in 1811 and was completed in 1818. Political controversy surrounded the road, centered upon two questions.

- Did the federal government have the Constitutional authority to construct improvement projects in the nation’s interior or was this power vested in the states by the Tenth Amendment?
- Should the federal government use federal tax dollars to build a road that clearly benefited Maryland and Virginia, but not necessarily other states?

The arguments around the second question were particularly heated given the fact that New York had been denied

federal assistance repeatedly for construction of the Erie Canal (Miller 2000). In 1820, Congress reacted to this political pressure by authorizing the appointed commissioners to only conduct a survey for extension of the road; states could then extend the road from Wheeling on to the Mississippi River as they saw fit.

By 1825, Congress resumed making appropriations for additional construction, reversing its decision to leave construction to the states. This trend continued through 1829; however, construction progress was meager, and the continued controversy forced Congress to change the description of its appropriations to “preservation.” This was more politically palatable, and the reality was that preservation work was conducted eastward, while expansion continued westward. Soon, the idea of reaching the Mississippi was abandoned, so the road would stop once it reached Vandalia, Illinois. In 1834, Congress made its “final” appropriations for extension (\$450,000) and repairs (\$300,000); additionally, once final disbursements were made, the entire road was to “be surrendered to the states through which it passes.”<sup>4</sup> In spite of this intention, Congress made additional appropriations through 1838. Ultimately, Congress transferred the federal interest in the National Road to Indiana, Ohio, and Illinois by 1856. Over the several decades, Congress allocated nearly \$4 million for the road’s construction (Miller 2000).

<sup>4</sup> Act Continuation & Transfer of the National (Cumberland) Road, 4 St 680, 6/24/1834.

## “Pulled” projects

### Zane’s Post Road

Ebenezer Zane was a settler who blazed a trail while migrating from Fort Pitt (now Pittsburgh) to the mouth of Wheeling Creek on the Ohio River. He founded a town called Zanesburg (now Wheeling) in what is modern-day West Virginia (Miller 2000). Zane proposed to extend his trail into the Ohio valley following an Indian trace that crossed the Muskingum, Hocking, and Scioto Rivers and would eventually wind south to meet back up with Ohio River at what is now Maysville, Kentucky (Schodeck 1988). In 1796, Zane petitioned Congress for assistance with the project, requesting landing sites at each of the three river crossings and money to survey the route. In response, Congress offered only a conditional grant of land in tracts one-mile square at each river crossing as well as a franchise opportunity.<sup>5</sup> Zane would be allowed to establish and operate ferries at each of the river crossings on the condition that: (1) he conduct the route survey at his own expense, (2) submit plans with his survey results to the government, and (3) within six and a half months produce proof that the road was complete and open and that the ferries were operating at all three sites. If these conditions were met and Zane provided security that the ferries would be maintained, then Congress would issue deeds to the land at the river crossings (Miller 2000). Congress also stipulated that two judges of the Northwest Territory would set the ferry tolls. Zane took the offer and his road and ferries helped open up the interior of Ohio. Today, his route still

exists, having been replaced by both federal and state highways.

### Illinois Central Railroad

In 1847, U.S. Senator Stephen Douglas of Illinois introduced a bill in Congress requesting a direct grant of land to Illinois to construct railroads from the town of Cairo, which is at the junction of the Ohio and Mississippi Rivers, to both Chicago and Galena, which is at the northwestern corner of Illinois. Not surprisingly, the bill failed in the House of Representatives since other states and jurisdictions saw little benefit in this endeavor for them. In 1850, Douglas expanded the concept to build both a central Illinois railroad and a railroad from Cairo to Mobile, Alabama. This time the legislation passed, and Congress authorized land grants for the Chicago to Mobile Railroad (Stover 1975). Robert Rantoul, leading a group of investors from Boston and New York, submitted the following proposal verbatim to the state of Illinois:

*The Legislature should create a corporation and surrender to it the federal land-grant. In return, the incorporators agree to build a railroad equal in all respects to the railroad running between Boston and Albany, with such improvements thereon, as experience has shown to be desirable and expedient; to complete the road by July 4, 1854; and to pay the state ( )% of gross receipts for the land (MacGill et al. 1948).*

<sup>5</sup> Act to Authorize Ebenezer Zane to Locate Certain Lands in the Northwest Territory, 6 St 27, 5/17/1796.

After some negotiation, a rate of 7% for the gross land receipts was established, and the Illinois legislature accepted the proposal. Subsequently, the Illinois Central Railroad was incorporated in 1851. Rantoul's group originally planned to finance the railroad by selling bonds to European finance houses using the land grants as security. Not until \$6 million in bond proceeds were raised domestically did bond buyers in London purchase \$5 million worth at 6% (Miller 2000). While construction proved more difficult than expected and more capital had to be raised, the Illinois Central Railroad was completed in 1856. This linked the interior of Illinois to Chicago and ultimately paved the way for a Chicago to New Orleans connection by 1890.

#### **New York City Subway**

In 1888, Mayor Abram Hewitt of New York City proposed that the City construct a rapid transit railroad or subway, similar to the one that had opened in London in 1863. The original intent was that the rapid transit system would be government owned and financed but privately constructed, managed, and operated by a franchisee (Hood 1993). Hewitt believed that a subway was essential for New York City to remain the dominant city in North America (Hood 1993). Hewitt's vision moved toward realization when the New York Legislature passed the Rapid Transit Act of 1894, which directed that the Rapid Transit Commission (RTC) would oversee the project. In 1895, the RTC made adjustments to the proposed system to reduce costs since the Act

required that the total cost be less than \$50 million.

The RTC took until March 1898 to complete the approval requirements established by the Act and finally issued a request for proposals for a design-build-finance-operate franchise. The request included a functional description of the system and wanted proposals to build, equip, and operate the system for 50 years, renewable for 25 years. Proposals were submitted and opened on November 13, 1899. The RTC accepted a proposal from August Belmont, Jr., head of his own investment house and the American agent for the Rothschild houses of London and Paris. Belmont and the RTC agreed to the following terms. The RTC would pay Belmont a lump sum of \$35 million for construction, which it would raise by selling bonds. The RTC would also purchase the land for subway stops and terminals at a cost of \$1.5 million. Belmont would furnish, install, and maintain the subway cars, signal systems, and other ancillaries from his own funds. Once the subway opened, Belmont would pay the City annual rent to reimburse it for its capital expenditures. The rent would equal the interest on the RTC's bonds plus an additional amount to establish a reserve fund for the RTC; Belmont would retain the balance of the fare revenues. Belmont formed two companies to execute his part of the bargain – one to design and build the system, the Rapid Transit Construction Company, and one to operate it, the Interborough Rapid Transit Company (IRT).

In October 1904, the subway opened for service. The subway lines ran from the Brooklyn Bridge north to 145th Street. The impact of the subway was significant. The popularity of this mode of transit forced the IRT to extend the lengths of its platforms, increase the number of cars per train, modify the cars to add a door, and to improve signaling to reduce headway times. Unsettled areas of the Bronx and Northern Manhattan were rapidly developed. In 1905, the RTC, recognizing the potential that the subway provided for growth, proposed 19 additional lines. Belmont, however, resisted such expansion since his private financing depended upon fare revenues, which required reasonably full trains. Belmont knew an extensive system built to connect downtown with undeveloped areas would not produce the return on investment he needed. Not surprisingly, Belmont moved aggressively to acquire complementary systems to consolidate his position as the rapid transit provider in the City. In 1907, the New York Legislature passed a bill creating the Public Service Commission (PSC) for New York City and abolishing the RTC. The PSC was granted substantial powers and Belmont's franchise disappeared with time as competing, publicly developed routes were introduced.

#### **Keokuk Power Plant and Dam**

The Des Moines Rapids at Keokuk, Iowa are the steepest drop in elevation along the Mississippi River, falling 23 feet in 12 miles. In keeping with its focus upon

directly funding navigation improvements, Congress consistently appropriated funds to overcome the navigation challenge posed by these rapids through the construction and maintenance of canals and locks; however, as early as 1836, Lieutenant Robert E. Lee of the U.S. Army Corps of Engineers reported to the War Department another aspect of the Rapids – the tremendous water power available (Miller 2000). The advent of commercial electrical energy in the latter half of the 19th century produced tremendous interest in converting hydraulic energy into electricity. In 1882, the nation's first hydroelectric plant was constructed in Appleton, Wisconsin (Schodeck 1988). While interest in harnessing the power of the Des Moines Rapids existed, it was not until 1899, when a group of businessmen formed the Mississippi River Power Company, that a concerted initiative did materialize. In 1901, the Company obtained from Congress a franchise to construct and operate a wing dam and canal for generating electricity from the hydraulic energy (Miller 2000). The original plan, though, was altered in 1905 when the company presented a new proposal to Congress – to dam the entire river and to build a replacement canal and lock system. Congress approved the altered arrangement, and the planning process began that year.

The Company arranged contracts with the United Railways Company, the Laclede Gas Company, and Union Electric for sale of the power to the St.

Louis region during 1907 and 1908. Several additional contracts were established that were contingent upon completion of the project. Then, the Stone & Webster Engineering Corporation of Boston invested in the company and was appointed to oversee the construction effort. In fact, Edwin S. Webster of Stone & Webster was made President of the Mississippi Power Company. Construction commenced in 1910 and the project was complete by 1913. Electricity from the plant flowed into the St. Louis area for the first time on the evening of June 30, 1913 (Miller 2000). At the time, the Keokuk Dam was the largest hydroelectric dam in the world, and it made cheap, abundant energy available to the region.

#### **American infrastructure experience after World War II**

The 1930s and 1940s saw America's priorities shift with the arrival of the Great Depression and the outbreak of World War II. The Depression brought new light upon infrastructure – it became an instrument of social policy as Roosevelt's New Deal invested heavily in public works projects as a means to put unemployed Americans to work. Notwithstanding the civil works achievements of this era, this new aspect of infrastructure changed the political view of it forever. Infrastructure projects in and of themselves were now seen as significant economic catalysts. On the Depression's heels came World War II, which understandably commanded the entirety of the nation's political, social, and economic will.

When V-J Day finally arrived on August 15, 1945, America emerged from over 15 years of challenges a changed nation and a new world order was starting to establish itself.

This world order, which prompted a half-century Cold War, brought an unprecedented focus upon national defense. One of the most significant

outcomes of this emphasis was the Interstate Highway System. The strategy adopted for constructing this \$40 billion national security and economic platform, coupled with a marked change in the federal infrastructure procurement philosophy in 1947, initiated the creation of a national environment where “pulling” infrastructure projects from the private sector would eventually

become impossible. Moreover, the Environmental Protection Agency’s \$60 billion Construction Grants Program, which began in earnest in 1975, further reinforced a fixation upon publicly “pushing” projects at all levels of government.

**Key legislative and executive actions**

Years before the nation surfaced from its experiences during 1929–1945 Congress began to slowly alter its infrastructure acquisition approach. Table 1 summarizes these changes. In 1893, Congress allowed the Secretary of the Treasury, which at the time controlled funding for construction of federal buildings, to separately procure the services of architects to prepare plans and specifications. In many respects, this was the first federal recognition of the potential value of a design specialist over a “master builder.” In 1916, Congress appropriated the first cash grants to State Highway Departments to improve rural post roads. Congress permitted 50% federal reimbursement of construction costs upon completion of rural post road projects as long as the projects followed federal guidelines. A key guideline was the requirement of advance federal approval of a complete set of plans and specifications for each project. In effect, this grant program started the utilization of the design-bid-build project delivery system, which had never truly been employed before in the United States, in its implementation (Miller 2000). An additional step was taken in 1926 when the Public Buildings Act required prior preparation of plans

**Table 1: Acts that Impacted Federal Procurement 1893–1972**

Act	Description
Act for Separate Procurement of Architectural Services of 1893	Allowed the Secretary of Treasury, which at the time controlled funding for construction of federal buildings, to separately procure the services of architects to prepare plans and specifications.
Act for Federal Aid to State Highway Departments for Rural Post Roads of 1916	Offered 50% reimbursement by federal government of construction costs upon completion of rural post road projects as long as the projects followed federal guidelines. A key stipulation was the advance federal approval of a complete set of plans and specifications.
Public Buildings Act of 1926	Required prior preparation of plans and specifications by federal employees of the Treasury Department before federal building construction could begin.
Armed Services Procurement Act of 1947	Allowed substantial flexibility for the procurement of design services but required prior advertising for all supplies and services – including construction of public works and buildings – through specifications and invitations for bids to encourage competition.
Federal Property & Administrative Services Act of 1949	Created the General Services Administration (GSA) and transferred to GSA all of the functions of the Bureau of Federal Supply, the Commissioner of Public Buildings, and the Public Road Administration. Procurement requirements were identical to the Armed Services Procurement Act.
Brooks Act of 1972	Created a comprehensive selection process for architects and engineers based upon their experience, qualifications, and abilities to perform the design tasks being advertised. Statutorily made design-bid-build the only delivery system possible for federal projects.

and specifications by federal employees of the Treasury Department before federal building construction could begin. The act did, however, allow private architects and engineers to be engaged to assist.

After World War II, Congress changed the procurement process for the armed forces and all other civilian agencies entirely with the enactment of the Armed Services Procurement Act of 1947 (ASPA) and the Federal Property and Administrative Services Act of 1949 (FPASA). ASPA allowed substantial flexibility during the procurement of design services, but set forth the requirement for prior advertising for all supplies and services – which included construction of public works, buildings, and facilities – through specifications and invitations for bids to encourage competition. Awards were to be made to “that responsible bidder, whose bid, conforming to the invitation for bids, will be most advantageous to the Government, price and other factors considered.”<sup>6</sup> Contracts could be of any type as long as they promoted the interests of the government. FPASA created the General Services Administration (GSA) and transferred to GSA all of the functions of the existing Bureau of Federal Supply, the Commissioner of Public Buildings, and the Public Road Administration. The procurement procedures established by FPASA were carbon copies of the ASPA requirements.

While ASPA and FPASA may have encouraged the design-bid-build delivery system, the Brooks Act of 1972

statutorily mandated that this approach would be used on all federal construction and related projects. The act created a competitive selection process for architects and engineers based upon their experience, qualifications, and abilities to perform the design tasks required for the project being advertised. “Between 1949 and 1972 at least, federal agencies were permitted, but not required, to employ architects and engineers through negotiation and based upon qualifications. After the Brooks Act, the permissive use of professional designers became mandatory.” (Miller 2000). Effectively, this act mandated the separation of the designer from the builder, and the ASPA and FPASA required advertisement for construction services. Combined, these three statutes instituted design-bid-build as the only delivery system allowed for federal construction projects. By default, public financing became the dominant funding strategy.

#### **Federal infrastructure investment programs**

The Interstate Highway System was constructed following criteria established by the Interstate Highway Act of 1956. The Act authorized up to 90% of the cost of urban, primary, and farm-market roads to be paid for by the federal government. In order to receive this federal share, however, states were required to follow the procurement rules established by the legislation. Federal engineers were commissioned to plan and oversee construction of the entire system, and state and city officials could not eliminate portions of the federal

<sup>6</sup> 62 St 21, The Armed Services Procurement Act of 1947, 2/19/1948.

system or change roadway alignments without federal approval. Consequently, design had to be funded separately from construction. Certainly, the over forty thousand mile interstate system in place today is an engineering achievement; however, the construction cost per mile rose from \$4 million to \$20 million between 1959 and 1979 (Lewis 1982). Moreover, one by-product of this initiative was the solidification of segmented delivery and public financing for highway projects.<sup>7</sup>

The Environmental Protection Agency's Construction Grants Program further entrenched the segmented delivery and public financing paradigm for all infrastructure projects in the United States. This program was a result of the Federal Water Pollution Control Act of 1972, which made \$60 billion in federal grants available to local jurisdictions for the construction of wastewater collection and treatment systems. Indeed, the need to improve the water quality of the nation's waterways through creation and improvement of municipal wastewater systems was clear. The federal government would provide up to 75% of system design and construction costs while most states typically provided an additional 15%. Thus, municipalities only had to find 10% of the funding necessary. Acceptance of federal funding came with substantial restrictions such as: (a) plans and specifications had to obtain

federal approval prior to construction; (b) only certain treatment technologies were permissible; and (c) municipalities were required to follow standard federal cost principles and include several specific contract clauses in both design and construction contracts.<sup>8</sup>

The appropriation process and procurement requirements had interesting and longstanding effects. Early movers used the vast federal resources to substantially over-build treatment plants (Stiefel 1994). This left late movers, such as the Boston metropolitan region out of the funding stream since resources were exhausted by the time this region acted. Jondrow and Levy (1984) also found that the generous federal share of the Construction Grants Program diverted two dollars of previously programmed local funds for wastewater projects to other uses for every one federal dollar provided. Further, the trickle down of federal project development and contracting standards embedded these elements in future municipal public works initiatives, for better or worse.

#### **The infrastructure "crisis"**

Meanwhile, America trudged through the 1970s as it backpedaled from the Vietnam War and confronted an energy crisis. Further, the nation experienced serious reductions in economic productivity beginning in 1973 that continued for over a decade. While most

economists did not consider the possibility that the public capital stock played any role in this economic slow down until the late 1980s (Aschauer 1989; Gramlich 1994), two political economists, Choate and Walter, suggested in their treatise, *America in Ruins*, that America's public facilities were wearing out faster than they could be replaced and indicated that the decline in infrastructure spending was to blame for many of the previous decade's problems in 1981. While their evidence was considered somewhat suspect (Pursell 1984), the work was a catalyst for a two-decade litany of initiatives to characterize the nation's infrastructure "system" and to design corresponding strategies to address identified challenges and deficiencies.<sup>9</sup> One refrain in these studies was the recognition that greater private sector participation and financing innovations would be necessary to reduce the existing backlog and to confront future requirements. In 1991, Congress enacted the Intermodal Surface Transportation Equity Act (ISTEA); an element of this legislation made federal contributions toward several pilot projects using innovative delivery or private financing. By 1992, this notion reached a bit of zenith with the issuance of Executive Order 12803, which stated:

<sup>7</sup> Certainly, other by-products such as suburbanization resulted but these aspects are beyond the scope of this paper.

<sup>8</sup> 40 Federal Register 20232, May 8, 1975.

<sup>9</sup> See: AWWA (1983), U.S. Congress (1984), NCPWI (1987), NRC (1987), NCPWI (1988), OTA (1991), NSF (1993), NRC (1993), NRC (1994), NRC (1995), EPA (1997), FHWA (1999), and ICIS (2002).

*“ . . . in order to allow the private sector to provide for infrastructure modernization and expansion, State and local authorities should have greater freedom to privatize infrastructure assets . . . User fees are generally more efficient than general taxes as a means to support infrastructure assets.”*

### Private participation and financing experiments in the 1990s

With the encouragement of the President, Congress, professional organizations, and expert panels, several state and local governments acted to involve the private sector more heavily in infrastructure development, management, and finance. Indeed, this shift could be characterized as a return to the “forgotten” dual-track strategy. North of the border, Canada was experiencing similar infrastructure issues and also began to rely more heavily upon the private sector for infrastructure. These “experiments” in North America during the decade of the 1990s are full of lessons for the contemporary situation in the United States.

#### California’s AB 680 Projects<sup>10</sup>

In 1989, California launched one of the United States’ first P3 initiatives since World War II to confront transportation funding shortfalls. Bob Poole of the Reason Foundation, among others, suggested that California might consider

having the private sector propose and finance transportation projects (Poole 1988). Soon after, Assembly Bill 680 (AB 680) was enacted; in sum, the bill gave the California Department of Transportation (CalTrans) the authority to award up to four demonstration franchises to private firms. At least one project each had to be located in Northern and Southern California. The franchises would grant exclusive rights to finance, design, construct, and operate toll transportation facilities. A proposed project could not utilize any state or federal government funds in the financial package. Finally, franchise holders would be allowed to receive a ‘reasonable’ rate of return, although a definition of ‘reasonable’ was not given by the legislation. Any monies beyond this would be required to be applied toward debt principle balances or paid into a State Highway Account.

Subsequently, CalTrans developed a procurement process to solicit interest, qualifications, and conceptual proposals from respondents. In 1990, CalTrans received eight conceptual proposals and selected four projects: (a) the SR 91 Express Lanes, (b) the Santa Ana Viaduct Express (SAVE), (c) SR 125, and (d) the Mid-State Tollway. The SR 91 Express Lanes was the only project to proceed quickly. By 1995, the project had installed 4-lanes within the median strip of 10 miles of SR 91, an existing 8-lane state route, at a cost of \$126

million; the base rate of return expected by the project’s developers was 17%. These lanes functioned as High Occupancy Toll (HOT) lanes, where passenger cars with a single driver can pay to utilize the express lanes while high occupancy vehicles can use the lanes free of charge. Interestingly, the project’s developers obtained a very favorable “no-compete” provision in the concession agreement, which prevented the Orange County Transportation Authority (OCTA) or CalTrans from making any transportation improvements within a specified region. By 2001, OCTA began to view this no-compete provision as a tremendous constraint to transportation service in the region. Instead of legally challenging this provision, OCTA purchased the Express Lanes back from the developer in 2002 at a price of \$207.5 million.

Of the remaining three projects, only SR 125 survives. It is a \$411 million project to construct a 4-lane toll road in the San Diego metropolitan area, with an anticipated return on investment of 18.5%. After a lengthy process to obtain environmental permits and political consensus, construction began in May 2003 with an expected completion date of June 2006. Construction delays have pushed the anticipated opening date to June 2007, and the developer has requested that CalTrans extend its concession period from 35 to 45 years to facilitate obtaining “a reasonable

<sup>10</sup> See Miller’s *Case Studies in Infrastructure Delivery* for a more detailed description of this project.

return on its investment.” CalTrans has yet to officially grant this request.

### **Virginia’s Dulles Greenway<sup>11</sup>**

The Dulles Greenway was another highway project in the United States to be delivered by a BOT franchise arrangement. The Greenway was an extension of the existing Dulles Toll Road from Dulles International Airport into primarily undeveloped reaches around Leesburg, VA. The extension provided a more attractive commuter route than existing state roads from northern Virginia into the Washington, D.C. metropolitan area, and it was regarded, in part, as a catalyst of property development in outlying areas.

The Virginia Department of Transportation began planning the extension in 1987. In the following year, in the face of a \$7 billion transportation needs deficit, the Virginia General Assembly passed the Virginia Highway Incorporation Act authorizing the private development of toll roads.<sup>12</sup> Thereafter, a private consortium secured the right to develop the extension as a toll road from the state. As a completely private venture, the extension (dubbed the Dulles Greenway by the development consortium) would provide some 40 years of cash flows to its investors and debt holders, without public subsidies. Revenues would depend almost exclusively upon toll receipts.

Initial projections by the consortium forecast approximately 20,000 vehicles

per day for the first year of operation at a fixed toll rate of \$1.50, with traffic increasing to 34,000 vehicles per day by 1995 at the same toll rate. Estimates of total capital costs were approximately \$279 million. Equity investors contributed approximately \$40 million while long-term fixed rate notes provided the balance of the financing. The project was originally scheduled to start construction in 1989 and operations in 1992, but difficulties in securing financing and environmental permits caused delay. During the four-year schedule slip, the consortium revisited their financial model and subsequently adjusted it by increasing traffic projections for the first year of operation to the daily ridership forecast of 34,000 expected by 1995 in the original estimate – thus neglecting the time actually required to build up traffic demand (Pae 1995). In addition, the plan was to start with a toll rate of \$1.75 and to raise this rate to \$2.00 shortly thereafter. Construction finally commenced in September 1993, proceeded flawlessly, and ended six months ahead of schedule in September 1995.

Within six months of opening, the project, however, was in financial distress. Average daily traffic demand was an abysmally low 10,500. The toll rate was not raised to \$2.00, but was reduced to \$1.00 in March 1996. Future toll hikes were deferred in an attempt to increase ridership. By July 1996, road usage increased to 21,000 daily

travelers, averaging 1% to 2% monthly growth. However, the net effect on projected revenues was marginal, as decreased toll rates offset the increase in traffic. To make matters worse, the Virginia Department of Transportation began improving Route 7, a competing free road, exacerbating the project’s situation. Indeed, the government’s commitment to the project had been marginal from the outset. Michael Crane, CEO of the private concessionaire, commented, “We wouldn’t do it as a totally private infrastructure project, if we had to do it again. These projects are only successful as public-private partnerships. The developer must have the full support of the state.” (Bailey 1996). The project’s sponsors began discussions with the project’s creditors in the summer of 1996 to work out a plan for deferring debt payments and restructuring loan contracts (Bailey 1996).

### **Canada’s Confederation Bridge to Prince Edward Island<sup>13</sup>**

When Prince Edward Island became a part of Canada in 1873, the Canadian government agreed to provide continuous, year-round transportation between the mainland and the island as a condition of entry. For years, Canada had fulfilled this obligation by subsidizing ferry services. By the 1980s, complaints regarding the level of service provided by the ferries and the cost of the subsidies to the Canadian government prompted serious discussions about

<sup>11</sup> See *Miller’s Case Studies in Infrastructure Delivery* for a more detailed description of this project.

<sup>12</sup> Extensive lobbying by several interested parties also contributed to this Act’s passage.

<sup>13</sup> See *Miller’s Case Studies in Infrastructure Delivery* for a more detailed description of this project.

establishing a fixed link. While such a concept was certainly not novel (in fact the government had received several proposals over the years to do just this), the Canadian government invited the private sector to participate in the development of the link in 1987. The acquisition/procurement process was conducted in multiple stages.

In Stage I, the government issued a request for conceptual proposals from the private sector to design, build, finance, and operate a fixed link for 35 years in exchange for the right to collect tolls from the link's users and to receive a fixed government payment to help facilitate long-term financing. The fixed payment would equal the government's subsidy amount of ferry operations at the time of the execution of the franchise agreement. Seven respondents were selected to proceed to Stage II; six proposed a bridge while one proposed a tunnel. In Stage II, detailed technical proposals were submitted and analyzed against stated technical evaluation criteria. Three proposals for bridges were chosen to proceed further. In Stage III, the financial proposals of the three remaining teams were evaluated, and Strait Crossing Development, Inc. (SCDI) was granted the franchise. Environmental concerns raised regarding the impact of the bridge delayed closing the agreement. Following a substantial public review process, the scope of the project changed to accommodate local concerns, and the agreement was finally signed in October of 1993.

The period of the franchise would commence in June 1997 and run for 35 years, regardless of whether the bridge was open for service or not. If the bridge was not open by that time, SCDI would be responsible for operating the existing ferry services at their own expense. Once the bridge opened, publicly supported ferry services would cease, and SCDI was given the right to collect tolls for use of the bridge. In the first year of operation, the tolls were not to exceed the rates charged by the existing ferry service. Thereafter, the concessionaire could escalate the tolls at an annual rate not to exceed 75% of the consumer price index (CPI). The technical requirements set by the Canadian government required that the facility have a 100-year design service life, not delay the breakup of ice in the straight for more than two days once in 100 years, and meet specific traffic capacity, design requirements, and levels of service standards. At the end of the 35-year period, the bridge will automatically transfer to the Canadian Government for a nominal amount of C\$ 1.00.

The SCDI team responded to the project and concession requirements with a very innovative plan. The integration of design, construction, and operations was evident in the base design, the construction process, and in its operating features. The reinforced, post-tensioned concrete bridge is comprised of four basic components: a pier base, a pier shaft with an ice shield at water level to aid in ice break-up, box girders,

and a deck/surface system. To combat the harsh winter and marine conditions, the majority of the construction took place upon land where sophisticated casting and assembly yards looked more like manufacturing lines as opposed to a construction site. The team included a utility corridor of not less than 21.5 square feet through the interior of the entire bridge to protect these systems from the elements and to allow access to the total bridge from the inside. The 12.9 kilometer, C\$840 million facility was financed using a debt-equity structure, and it opened in the spring of 1997 ahead of the required date of service set. Since, the bridge has been a financial success and has received numerous engineering achievement awards.

#### **Canada's Highway 407 Express Toll Route (ETR)<sup>14</sup>**

One might describe the development of the Highway 407 Express Toll Route (ETR) in Canada as a "tale of two procurements". Public officials had recognized the need for a bypass of Toronto's city center as early as the 1950s. Highway 401, which runs through downtown, is the major east-west arterial in the region. Over time, this route became one of the most congested highways in North America. Despite the real need to provide an alternative, multiple administrations in Ontario had failed to raise the capital necessary for construction. Early in 1993, the provincial government under the control of the Liberal Party decided to accelerate development of Highway

<sup>14</sup> See Miller's *Case Studies in Infrastructure Delivery* for a more detailed description of this project.

407 by developing it as a toll road. It created the Ontario Transportation Capital Corporation (OTCC) to complete large transportation projects by working in partnership with the private sector.

Working in concert with OTCC, the Ministry of Transportation, Ontario (MTO) issued a request for qualifications in May 1993 to two preselected consortia for a build-operate-transfer arrangement for 407 ETR. Part of this process included a \$1.5 million contract for each consortium to conduct value engineering assessments to identify potential alternatives to existing MTO design and construction standards. Based upon these assessment reports, MTO issued a very broad set of design and construction standards for the 407 project; these standards were silent regarding the number of lanes, the wearing surface, the lighting requirements, and the toll collection system for the highway. A request for proposals followed in September for the finance, design, construction, maintenance, and operation of 407 ETR as a toll road for 30 years. Each team was instructed to submit “segregable” proposals – one for the roadway and one for the toll collection system. In addition, the RFP placed emphasis upon tolling technology.

In December of 1993, the two teams submitted their tenders. Essentially, one group offered a high quality road and a proven tolling technology and system while the other offered a basic road and an unproven tolling technology and

system – a technology which would not require any toll collection booths but instead would rely upon video-tracking technology developed for military applications. In the spring of 1994, MTO announced that it would enter into a design-build contract with the design and construction arm of the first consortium to obtain the high quality road, and it would also enter into a design-build-operate contract with the tolling and operating arm of the second consortium to acquire the fully electronic tolling system. Both contracts would be publicly financed, and each team would receive direct payments from the government for services rendered. Highway 407 ETR opened in 1997 as the world’s first fully electronic multilane toll highway with no toll booths and no speed reductions associated with toll transactions.

Following an election and an administration change in the Ontario Province, the “new” government announced plans in February 1998 to lease the highway for 99 years to a private party through a competitive process. In exchange for the right to collect tolls on the highway, the private entity would: (a) provide a lump-sum payment to the government upon execution of the agreement, (b) operate and maintain the highway according to established standards, and (c) construct, operate, and maintain east and west extensions to the highway. The procurement process utilized had multiple stages. It began with prequalification of interested parties.

MTO then issued a request for proposals to those short listed. The RFP included a draft concession agreement, a detailed description of the scope and quality of services expected, detailed information about the traffic and revenue history of the highway since its opening nine months prior, a detailed description of the toll rate structure that would be implemented, and the sole criterion for selection – highest lump-sum payment offered. MTO also paid for several independent traffic studies and made this and all other information about the highway available to the bidders through an information sharing system.

Qualified teams were given the opportunity to review and assess the information and conditions, and then they were required to submit written questions or comments through the project’s information sharing system. MTO reviewed the responses and amended the requirements and conditions as it saw fit and reissued them. The teams were given a second opportunity to review and comment. Notably, MTO reduced the length of the east extension based upon potential respondents’ feedback. Finally, MTO issued its definitive requirements and conditions for the lease agreement. Respondents understood that submission of a bid constituted affirming compliance with all conditions established. Ultimately, the lease was awarded to 407 ETR Concession Company Limited for a bid of C\$3.1 billion.

The tolling structure established by the government is worthy of further discussion. MTO set a peak hour congestion capacity for the highway of 9,000 vehicles per hour (VPH). Essentially, this capacity served as MTO's target for the proper level of service on the highway during peak usage. When capacity is below this amount, the lessee is obligated to follow a stipulated rate structure.

- In the first year of operation, the maximum car toll could be C\$0.10 per km.
- During the first 15 years, the annual toll rate for cars could increase by the sum of an independent inflation index plus 2%; however, tolls could never exceed C\$0.13 per km for cars.
- During years 16 through 99, the car toll could only increase annually at the rate of the inflation index.
- Toll rates for trucks could be up to twice the rate for cars; toll rates for multiple-unit trucks could be up to three times the rate for cars.
- Vehicles without transponders could be surcharged an additional C\$1.00 per trip.

If peak hour flows were above 9,000 VPH, all rate restrictions would not apply. This would allow the lessee to adjust fares as high as the market would bear to maintain throughput at the target rate. However, if peak hour flows fell below 9,000 VPH during a peak period and the tolls being charged were higher than the rate limits, then the

lessee would be penalized through an established formula.

This strategy would encourage market pricing during peak hours since the lessee would have the power to adjust rates upward whenever volume exceeded 9,000 VPH. Presumably, higher rates would discourage some drivers from using the highway during peak hours, limiting users to only those who: (a) were willing to pay the market rate or (b) had no choice but to use the roadway during peak hours. This structure encouraged the lessee to establish and maintain the peak hour market price, which theoretically would be the maximum price it could charge and would therefore result in the maximum revenue possible. It also provides additional incentives such as conducting repairs during off peak periods and handling disabled vehicles or accidents effectively and efficiently.

#### **Virginia's Pocahontas Parkway<sup>15</sup>**

Virginia's Public-Private Transportation Act (PPTA) of 1995 led to one of the state's more notable projects, the Pocahontas Parkway. Plans for the roadway began as early as 1980 when state transportation officials began considering the extension of an existing arterial roadway to provide an east-west connection between I-95 and I-295 south of Richmond. In 1983, an alternative limited access route, designated as Route 895, was approved by the Commonwealth Transportation Board (CTB). Concurrently, the Federal Highway Administration tentatively

<sup>15</sup> See Garvin's Pocahontas Parkway Case Study for a more detailed description of this project.

approved federal funding for the project as a toll-free route which allowed interstate designation. Design activities for the route began, but progress stalled in the late 1980s when both federal and state funds for the project did not materialize.

Following passage of the PPTA, a joint venture team of Fluor Daniel and Morrison Knudsen submitted an unsolicited proposal to the Virginia Department of Transportation (VDOT) for development of the route. A comprehensive agreement was executed between VDOT and the FD/MK Limited Liability Company. Ultimately, the development plan included: (a) tolling the roadway's users, (b) a fixed price design-build contract between VDOT and the FD/MK Limited Liability Company, (c) the creation of 63-20 Corporation, the Pocahontas Parkway Association (PPA), to issue tax-exempt bonds to finance design, construction, and operations, and (d) VDOT assuming responsibility for operations and maintenance of the route upon completion. The Parkway was only the second transportation project in the United States to be financed through a 63-20 Corporation.

While the bonds provided the majority of the financing, the State Infrastructure Bank also provided an \$18 million loan and the FD/MK LLC provided a \$5 million line of credit. Toll revenue would first pay back the bond holders and then pay VDOT for its operations and maintenance expenses. Toll rates were

defined for the first two years in the project's comprehensive agreement. Thereafter, VDOT would hold the right to adjust the tolls subject to covenants in the bond indenture. Demand projections expected an initial average daily traffic of 15,000 vehicles with trucks accounting for 10% of this volume.

The FD/MK team agreed to complete the project by April 2002 for \$324 million, and construction commenced in October of 1998. In 1998, PPA raised \$354 million through the sale of tax-exempt bonds. The 8.8 mile route began opening in stages in May of 2002 and was fully complete by September at a reported cost of \$314 million (Regimbal 2004). A two-week free usage period was granted to encourage use of the route. Once tolls were imposed, the demand expected did not materialize. By 2004, only 16,000 vehicles per day were using the route, generating half the revenue expected by that time.

In 2006, after 18 months of negotiation, Transurban executed an asset purchase agreement with PPA and entered into an amended comprehensive agreement with VDOT to effectively lease the Parkway for 99 years. Thus, Transurban had acquired its first transportation asset in the United States and obtained sole rights to enhance, manage, operate, maintain, and collect tolls on the Parkway. Transurban is also expected to develop and manage an airport connector route, contingent upon the receipt of a \$150 million TIFIA loan. Transurban raised approximately \$615

million in support of the arrangement; \$195 million in equity and subordinated debt provided by Transurban; and \$420 million in senior debt provided by a conglomerate of European banks. The capital raised: (a) retired PPA's existing debt, (b) reimbursed VDOT for its costs to operate and maintain the Parkway to date, (c) established a \$90 million reserve and contingency fund, (d) earmarked \$8 million for operational enhancements and \$2 million for a major maintenance fund, and (e) set aside the remainder for development fees and transaction costs. A specific tolling schedule is defined in the agreement through 2016. Afterwards, Transurban may increase annual toll rates by the greater of the rise in GDP, the CPI, or 2.8%.

### **Seattle's Tolt Water Treatment Facility<sup>16</sup>**

Early in the 1990s, Seattle Public Utilities (SPU) began to investigate solutions to a nagging problem. The City of Seattle has two primary sources of water, the Cedar River watershed in the south and the Tolt River watershed in the north. Approximately, two-thirds of the City's water is provided from the Cedar River with the balance coming from Tolt. Unfortunately, the Tolt supply experiences tremendous fluctuations in turbidity, and the existing production facility did not possess the technology to handle the higher levels of turbidity which limited the water supply system's flexibility and reliability. Accordingly, the

City planned to construct a new treatment facility to remedy the situation.

Initially, the City expected to deliver the new facility by DBB; in fact, they had completed a conceptual design of a new 120 million gallon per day (MGD) facility and established a preliminary cost estimate of \$156 million for the construction of the plant and 25 years of operation and renewal. Following enabling legislation passed in 1994, however, the City began exploring the possible use of a design-build-operate (DBO) arrangement for delivery. City officials felt that DBO proposals in response to a well-defined functional description of the project could allow the private sector the most flexibility to implement innovative solutions at a lower life cycle cost. After some discussion and debate, the City decided to request DBO proposals; however, to be considered responsive, a proposal had to meet the conditions specified in the RFP and produce a minimum savings of 15% over the estimated cost of pursuing the project through DBB. The RFP required respondents to submit one package based upon technical criteria that would allow compliance with current drinking water standards (Proposal A) and a second package based upon criteria that would allow compliance with future drinking water standards that could be reasonably anticipated (Proposal B).

<sup>16</sup> See Miller's *Case Studies in Infrastructure Delivery* for a more detailed description of this project.

Original proposals were received at the end of 1996, and best and final proposals were submitted from four teams in February of 1997. By March, Seattle's City Council formally authorized proceeding with the award of a DBO contract since all best and final proposals met the project's technical requirements and substantially exceeded the required 15% savings mark. By May, the City concluded negotiations with the winning joint venture team, at a final cost of \$101 million for the Proposal B package. With an estimated conventional delivery cost of \$171 million for Proposal B, the City expects to save approximately \$70 million over the project's life cycle.

In December of 2000, the design and construction of the new facility were substantially complete, so the operations phase of the project is underway. Time will tell if the anticipated savings of \$70 million become real or not, but preliminary indications remain positive. Seattle's procurement demonstrates how profound an impact that a reconfiguration of the elements of delivery and management can have, if approached intelligently. Seattle first developed a functional design and cost estimate that allowed them to craft a well-defined scope for the project and establish technical and quality criteria. Additionally, the functional design and estimate served as a benchmark to compare the DBO proposals received against. Throughout the process, the City also retained the services of an engineering consultant to act as its

independent agent to advise the City and to assist with the evaluation of incoming proposals. In the end, the City knew what it expected to receive and what level of savings it wanted while it allowed the private sector the flexibility to respond with different alternatives of design and technology that fulfilled the project's requirements. Consequently, the City has received a state-of-the-art facility and can plan to redirect the expected savings to other areas in need of financial resources.

#### **NY/NJ Port Authority's JFK AirTrain<sup>17</sup>**

Traveling to and from JFK International Airport in New York City by automobile has long been difficult. Traffic on the congested highways in the area often causes the trip from Manhattan to JFK to take up to two hours. Moreover, a taxi trip is not an inexpensive proposition (currently JFK to Manhattan is a flat rate of \$45 while Manhattan to JFK is the metered rate). Many projects have been proposed through the years to alleviate this situation, but early in 1996, the governors of New York and New Jersey mandated that New York/New Jersey Port Authority (the Port Authority) settle upon a solution. Facing this pressure, the Port Authority, which had been considering a rail connection for several years, began to act quickly. Later that year, it announced that it would proceed with the development of an 8.1 mile light rail rapid transit system between the airport's terminals, its parking areas, and the Jamaica and Howard Beach stations of existing rail networks in Queens. The Jamaica

<sup>17</sup> See Garvin's JFK AirTrain Case Study for a more detailed description of this project.

station provides connections between the New York City subway and bus system and the Long Island Rail Road, and it is the fourth largest transit hub in the New York City area. The Howard Beach station is served by the Rockaway line of the subway. Upon completion, the rapid transit system would provide travelers from New York City and Long Island the possibility of traveling to or from JFK without driving.

To accelerate completion, the Port Authority chose to develop the project using a design-build-operate delivery strategy. Bonds to finance the capital cost of the system would be secured primarily by federal passenger facility charge revenue, which is a \$3.00 fee collected from every outbound flight ticket. The Port Authority issued its RFP for the light rail system in the fall of 1996. The scope of work included the design, construction, procurement, installation, testing, commissioning, operations, and maintenance of the rail system. The system consisted of rail cars, several stations, track work and track structures (which were mostly viaducts, although some sections are at-grade or subgrade), and supporting signaling and operating systems. The operations and maintenance period would be for five years with 10 additional one-year options, at the Port Authority's discretion.

The Port Authority established an intricate multistage procurement process for the project. The first step involved an initial screening for responsiveness and then the establishment of a "competitive range." Respondents were required to fulfill published management, price, technical,

and operations and maintenance criteria, which were substantial and quite subjective in nature. The Port Authority's selection team would assess the proposals against the criteria and assign a numerical score to each proposal. A price calculation would then be made where two net present value (NPV) computations, termed, NPV1 and NPV2 would be combined to establish the final value (NPVT). NPV1 represents the present value of payments by the Port Authority to the Proposer over the life of the project. NPV2 represents payments the Port Authority would need to make to other parties for any scope items the Port Authority's selection team deemed that a respondent had excluded. The selection team would then array the numerical scores and NPVT amounts for all proposals. Respondents with low scores and high NPVT values could either be excluded from further consideration or asked to modify their proposals. The Port Authority retained full authority and discretion over this matter.

The next step could have multiple potential outcomes. First, the Port Authority could reject all proposals and issue a revised RFP. Second, the Port Authority could make an award based upon the proposals received. Third, the Port Authority could choose to enter into negotiations with any respondent within the established competitive range or thought to be capable of entering the competitive range. If the Authority chooses the last option, it would enter into competitive negotiations with selected respondents and then call for best and final offers (BAFO). The final stage would be an evaluation of BAFO's and contract award. The selection team

would score and recalculate NPVT for each BAFO received and forward this information to the Port Authority Commissioners. The Commissioners retained the right to award the contract to the respondent who, in their opinion, could perform the work in the best interests of the Authority.

Despite the complexity and discretionary nature of the procurement process, five consortiums initially submitted proposals. The Port Authority rejected all five proposals and decided to short-list two consortiums, JFK Link and Air Rail Transit. The Authority directed both to submit lower bids. After winning a court battle with the airlines over the legality of using the passenger facility charge revenue for construction of the rail system and lengthy negotiations with the two proposers, the Port Authority awarded the contract to Air Rail Transit in May of 1998. Design and construction of the "JFK AirTrain" soon commenced. Unfortunately, station design proved to be a major conflict between Air Rail Transit and the Authority. The technical provisions stated

that ". . . the Contractor shall address these aesthetic issues with the same degree of care that will be given to the more easily evaluated technical aspects of the System. This means including good architects, signage and graphic designers, site planners, and others on the design-construct team that will contribute to the aesthetic quality of the end result." Little else to describe the aesthetics of the stations was provided. Air Rail Transit's station design did not meet the aesthetic standards of the Port Authority and a conflict developed. Eventually, the designs were finalized after significant delays and negotiation.

Tragically, the project's largest delay occurred during commissioning when a test train derailed, killing the operator. Although the trains were designed to be automated, common practice includes an operator on board during testing. The event was investigated, and the accident was attributed to operator error. Finally, the \$1.9 billion dollar system opened for service in December 2003, one year behind schedule. Today, the AirTrain's operating expenses exceed its fare

collections, but the Port Authority indicates that the system was intended as a service to the community as opposed to a source of revenue.

### Summary

Each of these projects has its own characteristics as well as its own lessons. Table 2 summarizes particular aspects of each project to provide a comparative representation. Despite the differences between the seven projects, an overriding element is common. In each case, the government chose to pursue an alternative delivery approach primarily due to a need to address a very particular challenge or issue. In many cases, this challenge was a lack of public funding; in others, it was need to accelerate project delivery. Are these rationales justified? Moreover, were expectations realized? And finally, were the interests of the public maintained? These questions are addressed subsequently.



**Table 2: Summary of Infrastructure Project Experiments from the 1990's**

Project(s)	Delivery System	Market and Project Conditions	Acquisition and Procurement Process	Concession and Contract Management	Comments
AB 680 Projects	Design-Build-Finance-Operate	SR 91 Express Lanes – established demand; “Brownfield”  SAVE – Greenfield  SR 125 – Greenfield  Mid-State Tollway – Greenfield	Solicited, Unique Proposals  Evaluated based upon general criteria published by CalTrans  One project required in Northern CA; one required in Southern CA	Negotiated based upon each project's conditions	HOT Lanes generally provide win-win; introduce market/choice, do not “disenfranchise” anyone; free route users benefit since those willing to pay opt off and congestion declines  No-compete provisions for SR 91 Express Lanes became too restrictive for local transportation authority; ultimately, local authority bought the Express Lanes back  SR 125 is only franchise still alive, but service is not yet available
Dulles Greenway	Design-Build-Finance-Operate	Greenfield	Unsolicited Proposal enabled by special legislation	Negotiated	Demand did not materialize as expected  Project in financial distress from outset; loans renegotiated  Limited government commitment from outset
Confederation Bridge	Design-Build-Finance-Operate	Established demand; “Brownfield”	Solicited Proposals for a “Fixed Crossing”	Requirements established in RFP  Clear expectations regarding level of service and time of availability  Clear provisions for toll rate escalation	Replaced antiquated, government operated ferry service  Fixed annual government payment heightened project's creditworthiness  Opened early  Marvelous example of design-construction-operation integration
Highway 407 ETR	Phase I: Design-Build and Design-Build-Finance-Operate  Phase II: Lease	Phase I: Greenfield  Phase II: Brownfield, but limited traffic history	Phase I: Solicited Proposals from two preselected consortia; RFP “signaled” gov't might break up proposals; gov't took what it liked from each proposal  Phase II: Lease arrangement; high bid wins	Phase I: Original intent altered, so new contracts issued  Phase II: Conditions acceptable to public and private sectors established through iterative process; clear provisions for technical requirements and user fee management	Phase I could be considered an example of unfair treatment of private sector  Phase II followed a transparent and objective process for selection and establishment of concession conditions

**Table 2: Summary of Infrastructure Project Experiments from the 1990's (continued)**

Project(s)	Delivery System	Market and Project Conditions	Acquisition and Procurement Process	Concession and Contract Management	Comments
Pocahontas Parkway	Phase I: Design-Build-Finance Phase II: Lease	Phase I: Greenfield Phase II: Brownfield	Unsolicited Proposal in both phases	Phase I: Negotiated; organizational structure and responsibilities somewhat complex  Phase II: Negotiated; clear provisions for technical requirements and user fee management	Phase I: Another example of poor demand forecasts put 63-20 Corporation in distress from outset  Phase II: Appears Transurban acquired lease/asset to gain a foothold in United States
Tolt Water Treatment Facility	Design-Build-Operate	Demand for water already established; new facility needed quickly to counter local environmental conditions	Solicited Proposals; to be responsive, proposals had to have a present value cost 15% below established benchmark; winning proposal selected based upon a weighted additive scoring system	Clear performance standards established in RFP  Contractor to be paid annual fee for services adjusted annually for certain pass through costs	In many respects, the 15% standard represented the public sector's "risk premium" for proceeding with a nontraditional approach  Winning consortium achieved lifecycle cost savings by replacing mechanical flocculation system and conventional sand filtration in the base design with hydraulic flocculation system and an innovative filtration system
JFK's AirTrain	Design-Build-Operate	Greenfield; in many respects, a "social" infrastructure project  Feasibility depended largely upon winning battle to use "passenger facility charge revenue" as security for bonds for capital cost	Solicited Proposals; very complex and discretionary process limited transparency and lengthened process	Clear operating standards established  Poorly defined station design requirements resulted in dispute over station "aesthetics"  Short operating period (five years) limits flexibility of private contractor during this time; essentially, this element of arrangement becomes a commodity	Port Authority's desire to accelerate delivery may not have been realized due to structure of procurement process and scope of work issues

## Lessons from the 1990s

Without question, the most often used rationale for inviting private participation in the development of infrastructure is the lack of available public funding. Indeed, Miller (2000) identified this as a fundamental tenet – leveraging – of America’s pre-Depression infrastructure strategy. Without much question, the private sector can provide additional financial resources and often has far more agility when accessing capital. Yet, this argument alone fails to fully address the complexity of the issues involved, and it sells the private sector short, in many respects. Given the right conditions and incentives, the private sector can become much more than the expedient solution for a “lack of capital.” Indeed, governments should demand more. If they do not, it is quite likely that their citizens will do so with time, and such a social backlash can quickly unravel what often takes substantial effort to initiate and sustain.

Using the seven case studies just presented as the backdrop, “lessons learned” are presented. These recent cases should help us to understand how to exact the most from the private sector while also ensuring that the public interest is served. In truth, is this not a central objective of public policy?

### Value, scope, and competition

In three of the seven cases presented, the projects were the result of unsolicited, noncompetitive proposals. In two of the three cases, the government made no effort to

determine whether or not it was receiving at least a reasonable value, much less the “best” value.<sup>18</sup> Certainly, the international community has established intricate processes to determine whether or not a P3 strategy delivers “value for money.” In many instances, however, this assessment is made before deciding upon a P3 approach. In such cases, the pervasive concern is whether or not a P3 strategy delivers better value than a conventional approach. Certainly, this consideration is understandable. A subjective and preliminary appraisal of this sort does have its benefits; however, it is also susceptible to abuses as Russell and Nelms (2006) have indicated. Moreover, the conclusion that a P3 approach is a better option, following such an evaluation, clearly does not guarantee that the marginal value expected will materialize.

What the remaining cases demonstrate is the importance of *scope definition* and *competition* to **generate value** in P3 acquisition and procurement processes. For instance, in both the Confederation Bridge and the Tolt Water Treatment Plant projects, a clearly defined scope of work combined with a competitive procurement process produced evident value in terms of price, service availability, system operability, and environmental impacts. The Confederation Bridge opened before the government imposed deadline and was designed to minimize operations and maintenance requirements. Moreover, the on-shore construction and

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<sup>18</sup> Contentious public vs. private delivery comparisons were made in the case of the Dulles Greenway.

assembly techniques minimized disruption of the marine environment. When compared to the baseline design, the Tolt Water Treatment Plant proposed and constructed by the private consortium is expected to yield a 40% lifecycle cost savings, eliminated mechanical systems which will reduce energy requirements, and had a much smaller footprint so less of the natural environment was disturbed. No doubt, the government must decide by some means whether or not to proceed with a P3 arrangement, but once it does, the cases studied suggest that proper scope definition and competitive procurements are effective mechanisms for promoting value from private respondents. Unquestionably, assessing value outside of the marketplace is a difficult proposition. The AB 680 Projects in California provide a case in point. Each proposal received was unique. While each proposal had its merits, CalTrans did not attempt to thoroughly confirm whether or not the individual proposals provided the “best value” or even a reasonable one. Even if the agency had done so, this would have been a very challenging *ex ante* subjective exercise, which would certainly have been scrutinized.

#### **Innovation**

An argument less often used as a rationale for greater involvement of the private sector in infrastructure development, financing, and management is the potential for innovation. This is unfortunate. While innovation might certainly be considered

an element of value, the potential of alternative delivery systems to prompt private sector creativity is worthy of special consideration. One of the recognized limitations of the design-bid-build project delivery system is that the owner only sees the architectural/engineering solution of a single designer with one combination of cost, quality, and time attributes. A single designer cannot possibly consider all alternatives. The designer is never in a position either technically or financially to fully compare options for layout, technology, life-cycle cost, or initial cost among various alternatives. Consequently, the designer’s limitations automatically become the owner’s.

If an owner moves the procurement of a private vendor upstream in the project lifecycle, then the owner can have the opportunity to review multiple design possibilities. The design-build, the design-build-operate, and design-build-finance-operate project delivery systems, as well as their derivatives, increase the extent of conceptual and functional design done by proposing parties. Thus, in a competitive procurement, the owner has the opportunity to assess and rank several design concepts. Moreover, each of these delivery systems integrates the lifecycle tasks of infrastructure production to varying degrees. For instance, one would expect that a consortium responsible for the design, construction, and operation of a facility to logically account for constructability and operational ease during design – a

promising consequence since initial design and technology choices commit infrastructure owners and operators to the resultant cost of maintenance and operations for at least three to five decades. Further, an integrated delivery strategy encourages innovation since the responsible organization has greater ability and incentive to innovate during the design phases compared to a segmented approach where the designer cannot foresee who will build the project and has little reason to propose unproven technologies for construction or operations.

Once again, the Confederation Bridge and the Tolt Water Treatment Plant projects are good examples of the innovation that can result when the owner requests integrated services from the private sector in a competitive environment. Interestingly, the RFP for the Confederation Bridge asked for a “fixed link”; it did not request a bridge. Moreover, the RFP made substantial use of performance criteria for the project as opposed to descriptive ones. The limited functional description combined with performance criteria for the facility provided the private sector ample room for ingenuity without sacrificing the owner’s capacity to adequately compare responses received. This is a very important lesson. An owner does not necessarily need to provide an extensive description of a facility to maintain comparability of proposals as long as the owner can specify its needs through performance standards. The winning proposal has received numerous awards

for engineering excellence and design innovation. In the Tolt case, the benchmark design served multiple purposes; it allowed SPU to define its functional needs and expectations, to estimate the lifecycle cost of the benchmark proposal, and, most importantly, to make this knowledge transparent to competitors. Potential respondents were then able to assess the provided baseline design and determine where improvements in both processes and cost were possible. As discussed previously, the winning proposal’s design had several features that were quite different from the benchmark.

One might argue that a strength of the AB 680 P3 strategy in California was the creativity that it prompted from the private sector. This contention is difficult to deny. For instance, the Santa Ana Viaduct Express (SAVE) proposal utilized an existing stormwater drainage channel for nearly 80% of the highway segment’s route. By selecting this alignment, the SAVE consortium eliminated the time, cost, and politics associated with right-of-way acquisition. Certainly, the benefits of the selected route were somewhat offset by the cost of a viaduct, but the other two benefits are unequivocal. Similar resourcefulness was found in the other proposals; however, a public owner choosing to adopt a similar P3 program strategy must weigh whether the benefits of such innovation is greater than the political and social costs associated with unique proposals generated by the private sector.

### Acquisition and procurement processes

One of the strengths of the design-bid-build project delivery system is its clear criteria for selection – lowest, responsive, responsible bid. Indeed, the transparency – those attributes of the procurement process that make it stable, reliable, and predictable to actual and potential participants, to procurement officials implementing the process, to legislators evaluating the process, and to the rate/tax paying public who see and use the results – of this system’s acquisition and procurement process is rock-solid within the public sector. The case studies suggest an entirely different situation for P3 arrangements. The procurement process for Phase I of Highway 407 ETR could be characterized as an instance of exploitation of the private sector. Two consortia formed to respond to the government’s solicitation. When the government did not receive the type of road and tolling technology that it wanted from a single consortium, it canceled the procurement and entered into separate agreements with the enterprises that had proposed what it wanted. The other partners in the competing consortia were left out, absorbing the substantial transaction costs customary for these sorts of projects. Ultimately, the Provincial Auditor evaluated the procurement process and while it did not condemn the government of Ontario’s actions, it did issue several recommendations for improvement including suggestions for improving the clarity of the design and operating criteria for the project and

increasing the number of respondents. Interestingly, Phase II of Highway 407 ETR is an example of very well-conceived and executed acquisition and procurement approach. The provincial government prequalified potential respondents, and then followed an iterative process with the qualified teams to establish the conditions for the lease arrangement. Selection was based upon a single criterion – highest bid.

The procurement approach utilized in the JFK AirTrain project can best be described as a complex, lengthy, and vague process where the NY/NJ Port Authority retained as much discretion as possible to make its selection. The RFP even went so far as to say that the “Port Authority reserves the right, in its sole and absolute discretion, to select any Proposer in the competitive range, regardless of that Proposer’s overall score or ranking within that competitive range . . .” In addition, the selection criteria were segregated into four major groups with subgroups within each major group. In total, over 90 criteria were subject to evaluation, and many of these were very subjective requiring the Authority’s assessment team to appraise the “quality and completeness” of numerous conditions. When one contrasts this process with the approach used in the Tolt Water Treatment Plant project or Phase II of Highway 407 ETR, it is not difficult to discern which procurements were more transparent. The significance of transparency cannot be overstated. The long-term success of a government’s

acquisition system depends upon it. If the government does not consistently treat potential private sector respondents in a fair and reliable fashion, then these participants are likely to elect to provide their services elsewhere, and public sector agencies risk losing the confidence of their citizenry and elected officials. Furthermore, “the perception of potential competitors is of greater importance than commonly recognized. This is because the quality of the services and goods the government acquires cannot be better than the pool of private sector firms willing to participate in the acquisition process.” (Miller et al. 2000).

In the case of sole-source unsolicited proposals like the Dulles Greenway and the Pocahontas Parkway, the transparency issue remains, but its nature changes significantly since these arrangements are negotiations between the public and private sectors as opposed to competitive procurements. Achievement of transparency in a two-party negotiation, however, is quite challenging if not impossible since the “rules of the game” are generally not established beforehand, but are rather made as the process proceeds. The best that the public sector can do in this situation is to broadcast the steps and outcomes of the process as fully as possible.

### User fees

The user fee subject is a twofold issue. First, the nature of the project, whether it is Greenfield or Brownfield, is correlated with the potential level of social and/or political opposition. In Greenfield projects, the imposition and management of user fees is likely the most dominant political and social hurdle in a P3 project. In other situations

(Brownfield projects), if a user fee was already in place, then the potential social or political opposition to a alternate fee should presumably be reduced, unless the alternate fee is exceedingly higher than the existing one. Second, the locus of control and management depends upon the P3 model employed. In a design-build-operate system (or in an availability model), the public sector

retains control of user fees and their associated risks. In privately financed arrangements, the public and private sector must agree upon a user fee strategy. In these cases, the imposition challenge is to institute fees that are affordable, perceived as fair, and sufficient to provide the revenue required by the project's financing model. The management challenge is to establish a term structure plan to regulate fee escalation that is palatable to the private sector and to citizens and elected officials.

**Table 3: Summary of User Fee Strategies**

Act	Description
<i>AB 680 Projects</i>	A regulated rate of return model was utilized where receipts collected in excess of stipulated rate of return were required to contribute to the debt principle balance or a state highway fund.
<i>Dulles Greenway</i>	User fees followed a predefined schedule of escalation through 2010; thereafter, the concessionaire could escalate the fees at an annual rate of 3.2%.
<i>Confederation Bridge</i>	The initial user fees were set at the same rates as the existing ferry services and then permitted the concessionaire to escalate the tolls at an annual rate not to exceed 75% of the consumer price index (CPI).
<i>Highway 407 ETR</i> Phase I	User fees controlled by MTO.
Phase II	A market-based approach was established during peak travel periods with penalties for failure of the concessionaire to balance throughput and the market price and a detailed schedule governed user fees in off-peak periods.
<i>Pocahontas Parkway</i> Phase I	A schedule for user fees for the first two years was established; thereafter, VDOT held the right to adjust the tolls subject to covenants in the bond indenture.
Phase II	A specific tolling schedule is defined in the agreement through 2016. Afterwards, Transurban may increase annual toll rates by the greater of the rise in GDP, the CPI, or 2.8%.
<i>Tolt Water Treatment Plant</i>	User fees controlled by SPU.
<i>JFK AirTrain</i>	User fees controlled by NY/NJ Port Authority.

The cases illustrate a variety of user fee approaches as illustrated in Table 3. Despite the variety depicted, best practices for user fee structure and management have yet to truly emerge.

### Competing facilities

The competing facilities issue is quite a conundrum for revenue driven P3 projects. On the one hand, the absence or minimization of competing facilities is important to mitigate the revenue risk. On the other, the presence of competing facilities can diminish or eliminate social arguments about disenfranchising sectors of the populace, particularly low-income citizens. While no-compete provisions in P3 agreements may seem too constrictive, they may be necessary to initiate a privately financed project. The sponsors of the SR 91 Express Lanes clearly thought this protection was necessary to safeguard this asset and its investors. As previously mentioned, however, this provision became too

great a constraint for the local transportation authority, so it bought the asset back. Alternatively, the lack of no-compete provisions in the Dulles Greenway exacerbated a project that was in financial distress from the outset. Shortly after the road opened, VDOT began improving competing free routes, which only discouraged commuters from using the tolled facility. Neither of these situations should be desirable.

Recent research suggests, however, that long-term no-compete provisions may be unnecessary. Polakovic and Bain (2005) demonstrated that a toll road has a transitory period after it opens to traffic where demand builds, a ramp-up phase. Wibowo (2005) showed that the ramp-up stage usually lasts from two to eight years (with an average of five) and is followed by the development of a steady flow of traffic. Lessard and Miller (2000) and Guasch (2004) have also demonstrated that the market or revenue risk is most pronounced in the early stages of large-scale infrastructure projects. These observations suggest that a predefined no-compete period in a concession agreement might be a reasonable compromise between private sector revenue risk mitigation and public sector transportation planning and development flexibility since traffic behavior and, therefore, revenue growth has a tendency to stabilize during a five to 10-year range.<sup>19</sup>

### **Implications for contemporary and future arrangements**

The ideology behind allowing the public sector to use all available project delivery strategies is based upon the conviction that the public and private sectors can collectively provide the best services to meet the growing needs of American infrastructure. So how does the nation move toward an open strategy where the delivery method is indeed a variable for management and optimization? Foremost, the history of infrastructure in this country vividly illustrates that an array of strategies is essential to fulfill the nation's infrastructure needs. Both sectors must work in concert; public-private partnerships are not a panacea, but rather a complement to conventional infrastructure strategies. For this complement to work, however, the acquisition and procurement system used to solicit and select infrastructure service providers must: (1) advance and preserve the interests of the government and (2) attract the participation of potential private vendors. These are competing objectives since a slant toward one can dramatically impact the realization of the other. Hence, the trick is to find the point where the two objectives are relatively balanced.

<sup>19</sup> Of course, the "lifting" of a no-compete provision could certainly disrupt this stability, but this could be easily observed and provisions could be defined to handle such disruptions equitably.

Lessons from American history and recent P3 experiments suggest several procurement principles, which can promote achieving this balance:

- *The public sector's acquisition and procurement system must be consistently transparent; the litmus test for transparency is whether it is possible to fully understand how and when an award will be made before the process begins.* Without transparency, the credibility of the system is lost, which erodes public confidence and deters private participation.
- *The public sector should take responsibility for providing a reasonable definition of the scope of services and work desired.* If this is not done, then public agencies have essentially yielded their duly appointed roles as executives of the electorate. Furthermore, they will have missed an opportunity to focus competition, and they will find it quite challenging to both make and defend P3 awards.
- *All procurements should be competitively awarded, absent an extremely compelling rationale.* Simply put, competition encourages best value from respondents and promotes accountability in the process. If a competitive process is not utilized, the public sector should fully disclose the justification for a noncompetitive award.

- *The public sector must understand all of the risks and the transaction costs of the particular P3 model under consideration, and it should manage these to optimize and balance the risks and rewards of all stakeholders.* Otherwise, P3 failures often have dramatic and cascading effects due to the complexity and coupling of most P3 arrangements.

An open approach to infrastructure development, financing, and management where all delivery options are available capitalizes upon the differences between the public and private sectors by recognizing that each can contribute in ways that are amenable to their inherent strengths. The public sector can best:

- identify public needs and projects
- align economic and infrastructure strategies
- establish government commitment to viable projects and delivery processes
- provide a fair competitive environment for private sector participation
- establish reliable commitments for infrastructure financing
- impose and manage market externalities such as permitting and environmental protection.

The private sector can best:

- contribute efficient competencies that are managed and honed in competitive markets
- develop and introduce innovations in technology, design, construction, and operation processes
- provide independent competitive checks of the technical and economic viability of projects
- provide an alternative source of financing when projects are potentially self sufficient (Garvin 2003).

Together, the public and private sectors must strive to improve the quality of national infrastructure assets via suitable project delivery models and transparent, straightforward, and fair acquisition and procurement systems. This will allow striking a proper balance between preserving the public's interest and attracting private participants.

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