



Integrating lifecycle asset management in the public sector

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Abstract Lifecycle management of assets is essential for cost-effective maintenance and long-term economic viability. Properly maintained infrastructure provides significant economic advantages. Neglecting maintenance leads to lower productivity and imposes costs on users. Furthermore, delayed maintenance significantly increases total costs associated with repair or replacement. Lifecycle asset management should be used in the public sector to manage large-scale assets such as transportation infrastructure in a cost-effective manner. Yet, state governments have had little incentive to provide proactive maintenance. To address the infrastructure capital investment backlog, particularly acute in transportation, government priorities need to be coupled with long-term economic accountability. In addition, funding and financial reporting mechanisms should be created to ensure effective and efficient lifecycle asset management decisions. Public-private partnerships (PPP) also need to be fostered to help address regional deficiencies in infrastructure.

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1. Public sector infrastructure

Lifecycle management of infrastructure is essential for all public sector assets. Public sector infrastructure is broadly defined to include capital assets affecting water, sanitation, environmental protection, education, and transportation. Emphasis should be placed on ensuring that public capital assets are safeguarded and maintained to achieve

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their effective and efficient economic and social contribution. Underinvestment in transportation infrastructure maintenance illustrates the failure to provide lifecycle management and forgo the full value of these assets.

2. Transportation infrastructure

Ongoing investment and innovation raises national competitiveness and enhances living standards. The quality of existing transportation infrastructure is viewed as a critical foundation for productive investment. Governments around the world are demonstrating a renewed focus on fiscal stimulus via transportation infrastructure investments (PwC, 2017). Yet, transport systems can quickly lose value if not maintained. Maintenance expenditures provide for the repair and safe operation of existing roads, bridges, waterways, and transit systems. Neglecting maintenance leads to lower productivity.

In the short term, poorly maintained transportation infrastructure imposes costs (e.g., delays, damaged vehicles, greater packaging requirements) on users. Over the long term, deficient maintenance markedly increases the cost of disposal and reconstruction (Wessel & Olson, 2017). In addition, the environmental impact of deficient transportation infrastructure, although underresearched, is thought to be significant.

Lifecycle asset management has been used by the private sector to manage assets with long, useful lives, but government agencies have not readily adopted this approach. This has led to inadequate repair and maintenance of infrastructure, particularly transportation infrastructure, in the U.S. and in many other countries. According to a U.S. Department of Transportation (2015) report, U.S. roads and bridges faced a capital investment backlog of \$836 billion in 2015. Although there have been attempts to get government agencies to better manage the maintenance of infrastructure, these efforts have mostly failed. In this article, we describe several levers to impose asset management discipline on the diverse agencies managing our transportation infrastructure. Before we describe the levers, it is important to explain prior attempts to bring lifecycle asset management into the public sector and analyze why it has not been widely implemented.

3. Lifecycle asset management

Lifecycle asset management is defined as the combination of management, financial, economic, engineering, and other practices applied over the full

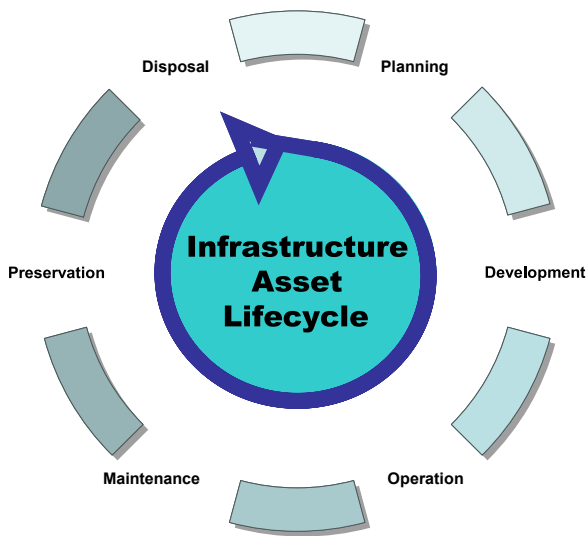
lifecycle of physical assets to provide the required level of service for present and future customers in the most cost-effective way (NAMS Group, 2006). Lifecycle asset management represents a systematic, holistic approach to asset development and preservation that ensures maximum service performance at minimum lifecycle costs (Federal Highway Administration, 2000; Lemer, 1999). Asset management encourages managers to consider trade-offs between deferred maintenance and preventive maintenance, between short-term fixes and long-term solutions, and between today's costs and tomorrow's benefits (Shewan & Kovacs, 1995).

The private sector has used lifecycle asset management to manage large-scale assets in a cost-effective way for operations such as electric power plants, oil-drilling platforms, and refineries, many of which are valued in the billions of dollars. Such large-scale assets and facilities are intended to last anywhere from 25 to 99 years. Maintaining a state of good repair throughout these assets' service lives depends on the quality of design and construction, the proactive nature of maintenance and renewal, and the timely rehabilitation of critical features. If properly implemented, asset management principles should influence all aspects of the lifecycle, including planning, design, construction, maintenance, rehabilitation, and disposal/recycling or replacement. This is demonstrated in Figure 1. Much of the credit for private sector interest and use of asset management principles can be attributed to the dire consequences of asset failure in terms of lost revenues and profits.

Several research studies support infrastructure investment as supporting productivity growth. A study by the International Monetary Fund (2014) found that infrastructure investments raise economic output in the short and long term. Transportation infrastructure has improved business efficiency and reliability (PwC, 2017). A strong transportation infrastructure also attracts foreign investment in productive activities. Regions have seen an increase in employment, particularly in labor-intensive, blue-collar positions from ongoing transportation infrastructure maintenance investment. Carbon emissions from delays and damaged vehicles are mitigated with well-maintained infrastructure. According to World Bank (1979, 2005, 2007) reports, the returns on transportation infrastructure maintenance investment were almost twice those of new construction projects. Strong levels of transportation infrastructure maintenance expenditures enhance a country's growth rate.

Political attention has been given begrudgingly to the concept of lifecycle asset management as it applies to large-scale, long-lasting public sector

Figure 1. Sequential phases of lifecycle asset management



infrastructure assets such as highways, bridges, dams, and airports. Unfortunately, the stewards of our nation's highway system, state and local transportation agencies, did not recognize the risks of deferred maintenance for many years because the nation's highways were still in relatively good shape and largely functional. In addition, there were no perceived short-term financial risks, since motor fuel taxes generated adequate funding to keep the system going. In contrast, the tolling industry charged a price for using its facilities because they were financed by bonds accompanied by covenants that mandated adequate preservation efforts to keep facilities in a state of good repair.

In the U.S., several factors came together to promote the application of lifecycle asset management principles to infrastructure and, in particular, the Federal Highway System. They included:

1. Legislative support for asset management;
2. Financial reporting requirements relating to asset management; and
3. Government Accounting Standards Board (GASB) 34's influence on applying asset management.

3.1. Legislative impetus for applying asset management to highway infrastructure

The passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 mandated the development of six management systems for use by state departments of transportation (DOTs) to

ensure that transportation infrastructure would be managed and maintained effectively and that it would operate as efficiently as possible. However, only two of these mandated systems were actually developed: pavement management and bridge management. They were intended to track asset conditions concerning the operational, maintenance, safety, repair, and replacement needs of these facilities and provide input to the transportation planning and program development processes to ensure their continued viability. The other four—public transit facilities management, intermodal management, congestion management, and safety management—were oriented toward ensuring efficient performance of transportation networks and making management systems development and integration an important part of the overall transportation planning process. Congress repealed the mandates for the four other systems due to the lack of definitions of their intent or scope, and then later repealed the other two mandates. However, the Federal Highway Administration continued to support the two developed asset management systems through both training and technical assistance.

3.2. Financial reporting impetus for asset management

The second major impetus for asset management was the decision by the Governmental Accounting Standards Board (GASB) to approve Statement Number 34 (GASB, 1999). This standard, commonly referred to as GASB 34, instituted a requirement that infrastructure assets be recognized in the annual financial statements of the state and local governments that own these long-lived facilities. Under GASB 34, public agencies such as state DOTs could determine the current value of their infrastructure assets for reporting purposes in their annual financial statements based solely on the depreciable value of the assets at the time of reporting. Alternatively, GASB 34 permitted these agencies to use a modified approach that recognized the impacts of lifecycle asset management on the effective service life and current value of these assets. These infrastructure reporting requirements of GASB 34 resulted in a growing interest in understanding asset management and how it could be used to better manage escalating infrastructure costs.

3.3. GASB 34's influence on applying asset management

In 2004, the Transportation Research Board issued a report that surveyed the status of compliance with

GASB 34 among the 50 state DOTs, plus transportation agencies in Washington, D.C. and Puerto Rico (NCHRP, 2004). The study found that only 21 out of the 52 transportation agencies studied had adopted the modified approach that required the application of asset management principles, practices, and systems to report on their transportation infrastructure. The remaining 31 agencies chose the depreciation approach to reporting. The reasons cited for using the depreciation method included the following:

- Simpler to implement;
- State and agency financial officials better understood the depreciation approach;
- Difficulty in estimating costs of achieving defined condition targets for their reported classes of infrastructure assets;
- Additional requirements and obligations associated with the modified approach;
- Easier to favorably portray the agency's stewardship of its infrastructure assets with less jeopardy to future funding levels;
- Concern that the modified approach might jeopardize future funding levels if reported asset conditions far exceeded defined performance targets; and
- Concern that candid reporting of asset conditions using the modified approach might suggest the agency had not prudently preserved its infrastructure assets.

In essence, most of the state DOTs turned away from the reporting approach that would have used asset management to give them better information and tools to manage their infrastructure assets more cost-effectively over their lifecycles. Instead, they chose the easier approach that avoided revealing the true nature of the conditions and remaining service lives of their transportation infrastructure facilities.

Some of the agencies that chose the modified approach ended up developing condition targets that were either the same or significantly lower than the current conditions of their infrastructure assets, thereby making it easier to show compliance each year with the condition assessment results. In most cases, complying with GASB 34 meant determining the historical costs of their assets—looking backward instead of forward. Many of these states

also had difficulty estimating the costs or level of effort to maintain the condition of their infrastructure assets (primarily pavements and bridges). Hence, most U.S. transportation agencies decided to pass on the opportunity to implement asset management programs by using the modified approach permitted by GASB 34 and instead chose the depreciation approach to financial reporting of infrastructure assets. Despite continuing efforts to develop the knowledge base for asset management in this country and to promote its broader application by public stewards of infrastructure assets, its application remained limited.

4. Little incentive to take advantage of lifecycle asset management

The dreadful condition of much of the nation's public use infrastructure is due to the failure of government agencies to take adequate care of these assets over their service lives. Public officials may be predisposed to defer infrastructure maintenance, as the timeframe for these assets to show irreversible effects of deferred maintenance is likely longer than the officials' terms in office.

Lifecycle asset management is not prioritized for a number of reasons. Elected officials find it easier to issue new debt or secure federal dollars to replace an asset than to maintain it. Construction of new assets has a strong political constituency in most political jurisdictions (e.g., various construction trade organizations), while maintenance has weak political support. In a similar vein, the media pays attention to new projects rather than routine maintenance.

The federal highway program focused on infrastructure development and construction for over 40 years while largely disregarding long-term maintenance and preservation. The Federal-Aid Highway Act of 1956 set the pattern for highway financing by establishing a pay-as-you-go plan that placed receipts from federal excise taxes on fuel, tires, and trucks into a Federal Highway Trust Fund to pay for the Interstate System of Highways. The resulting funds were paid back to the states as eligible highway projects were completed. The original program provided ample federal funding to cover much of the cost of building the system.

Federal funds were restricted to pay for capital costs associated with designing and constructing interstate highways and other portions of the National Highway System. State and local gas taxes, motor vehicle registration fees, and driver's license fees were used to match available federal funds for new construction. For the first 2 decades of the program,

proceeds from the Federal Highway Trust Fund could only be used for new construction, with a 5%–10% match required from state and local governments. In addition, those governments were required to pay for all maintenance or rehabilitation of the National Highway System. Unfortunately, mandated levels were not specified. This created a strong, inherent bias toward new capital projects, with state and local transportation agencies limiting maintenance efforts to conserve local resources.

Deferring road and bridge maintenance and preservation efforts led to the premature deterioration of the nation's highway infrastructure. State transportation agencies assumed that adequate federal funds would eventually be made available to help pay for the rehabilitation and replacement of these assets. Essentially, local efforts to leverage federal funding for highway capital projects described above masked the harmful long-term consequences of deferred maintenance.

In the mid-1970s and 1980s, Congress recognized the growing costs of road repair. Federal legislation was enacted to help fund and maintain interstate highways in a state of good repair. Resurfacing, rehabilitation, and reconstruction were added to the list of federal funding-eligible activities aimed at extending the life of the national system of highways, with a particular focus on bridge rehabilitation and replacement. In 1983, Congress significantly increased the federal gas tax while reducing the federal share of certain highway project costs.

State and local agencies' lack of accountability for infrastructure assets led to premature deterioration. With a singular focus on capital project programming to ensure the commitment of all available federal funds, once a project's development phase was completed state highway officials turned their attention to the next capital project. Furthermore, state and local governments could omit highway infrastructure assets from their balance sheets since there was no mechanism to hold state or local governments accountable for how they maintained or preserved these critical assets. Without having to demonstrate the consequences of deferred maintenance, state and local governments could skimp on maintaining highway infrastructure assets while awaiting future payments from the Federal Highway Trust Fund.

One example of the perils of this short-term approach is the Longfellow Bridge, which spans the Charles River in Massachusetts and connects Boston to neighboring Cambridge. One study published by Pioneer Institute, a Boston-based think tank, found that taxpayers would have saved more than \$80 million if the state had performed routine maintenance on the bridge rather than just allowing it to deteriorate (Westerling & Poftak, 2007).

4.1. Funding forecast

Despite growth in government funding for transportation infrastructure, available public resources are expected to be inadequate to address the need fully. This is especially so given congressional aversion to raising the motor fuel tax, which has remained at 18.4 cents per gallon for cars since 1991 and 24.4 cents per gallon for trucks since 1997. A shift to electric vehicles will exacerbate the funding shortfall. After 2020, Congress and the White House will once again face the prospect of needing much larger budget offsets to keep the transportation trust fund solvent unless changes are made to the gas tax or other significant funding sources are identified. After 40 years, the problems of deferred maintenance and lack of resources have become more evident, with almost all available highway program funding directed toward long-overdue maintenance and rehabilitation efforts needed to forestall system failure. This has left little funding for capital replacement or expansion, which has put an increasing drag on the nation's economic growth and stifled productivity as commuters and motor carriers struggle with increasing congestion and travel delays.

5. Using public-private partnerships to increase funding

The U.S., along with many developed countries, has an eroding business environment due to various weaknesses, including those in transportation infrastructure. Many of these are in areas driven by federal policy (Porter, Rivkin, Desai, & Raman, 2016). We need leadership that couples government priorities with long-term economic accountability. We need the creation of funding mechanisms to ensure effective and efficient lifecycle asset management decisions. We see business-government partnerships as an important force in addressing several of the challenges faced with current transportation infrastructure and the adoption of lifecycle asset management. Business leaders should recognize that it is in their strategic interest to use their influence and resources to help address regional deficiencies in infrastructure. This can include collaborating with industry, civic groups, and government agencies to prioritize expenditures. It also can include alerting local media and publicizing when and where infrastructure maintenance is inadequate.

Closing the expected shortfall in public infrastructure funding will require sustained infusions of public sector revenues augmented by private

sector investment capital. Financing public use infrastructure through public-private partnerships (PPPs) will require state and local agencies to radically change the ways in which such infrastructure is procured and managed. A PPP is a contractual arrangement between a public agency and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. Each party shares in the risks and rewards potential in the delivery of the service and/or facility.

The advent of PPPs in the form of long-term concessions, joint development agreements, or other contractual vehicles offers the best opportunity for asset management techniques to be effectively applied to optimize the performance of major infrastructure assets in this country—both by public sponsors of infrastructure facilities and by the private providers of infrastructure development, financing, operation, and preservation services. By including asset performance measures, PPPs have the potential to bring together disparate groups involved in supporting infrastructure programs. These include finance, engineering, construction, maintenance, and operations personnel, who have traditionally functioned independently of each other. [Table 1](#) provides a list of keys to successful PPPs as provided by the [National Council for Public-Private Partnerships \(2017\)](#).

What is often overlooked in the discussion of infrastructure financing and the role of PPPs is that private firms are incentivized to maintain the asset in a state of good repair. Every PPP involves risks for the private participant, which reasonably expects to be compensated for accepting those risks. Thus, it is essential that the partnership is constructed to provide benefits for both sides. There are frequent misconceptions about partnerships and their value to the public. Well-informed spokespersons and regular communications with relevant interest groups can minimize misunderstandings.

Since the late 1980s, public agencies in certain countries overseas have developed and implemented asset management systems for their capital assets as a consequence of outsourcing the management and operations of these assets ([Sheffield, 2000](#)). Common among these initiatives is the importance of holding the contractor accountable for keeping assets in a state of good repair during the period of the contract. Private corporations with major infrastructure assets are more likely to apply preventive maintenance and preservation techniques to ensure that their major facilities remain in top operational form and are not prone to costly unscheduled service outages.

Table 1. Public-private partnerships

Keys to successful public-private partnerships
(1) PUBLIC SECTOR CHAMPION: Recognized public figures should serve as advocates for the project and the use of a PPP.
(2) STATUTORY ENVIRONMENT: There should be a legal statutory foundation for the implementation of each partnership.
(3) PUBLIC SECTOR'S ORGANIZATIONAL STRUCTURE: The public sector should have a dedicated team for PPP projects. This unit should be involved from conceptualization to negotiation, through final monitoring of execution of the partnership.
(4) DETAILED CONTRACT: Need a detailed description of the responsibilities, risks and benefits for all partners. Contract should include a clearly defined method of dispute resolution.
(5) CLEARLY DEFINED REVENUE STREAM: There must be an identifiable revenue stream sufficient to retire this investment and provide an acceptable rate of return over the term of the partnership.
(6) STAKEHOLDER SUPPORT: It is important to communicate openly and candidly with all stakeholders to minimize potential resistance to establishing a partnership.
(7) PICK YOUR PARTNER CAREFULLY: The best value (not always lowest price) in a partnership is critical in maintaining the long-term relationship that is central to a successful partnership.

Source: Adapted from [National Council for Public-Private Partnerships \(2017\)](#)

In the case of PPPs, lifecycle asset management serves different purposes for each partner. For the public sponsor of the facility, asset management is used to value the facility, structure contract terms, and ensure contractor accountability for compliance with these terms over the life of the contract. For the private sector partner (members of a concession team, for example), asset management is an essential tool to value the asset and manage its stewardship in the most cost-effective manner over the life of the contract and potentially the effective service life of the asset.

6. Innovative infrastructure solutions

Because the repair need is so great and the government can no longer solve the problem on its own, several innovative solutions must be considered. We recommend:

1. Strengthening GASB 34;

2. Removing infrastructure funding decisions from the political realm;
3. Creating a mandatory depreciation reserve; and
4. Requiring lifecycle asset management in bond covenants.

6.1. Strengthening GASB 34

First, strengthen GASB 34. Currently, trillions of dollars in public infrastructure are generally underrepresented in state and local government financial statements. As a result, these assets are considered sunk costs that drain the maintenance budgets of state and local infrastructure agencies. Highway assets should instead be viewed as tangible assets with inherent value that can be used to stimulate additional economic activity. The potential consequences of GASB 34 include significant reductions in long-term costs of highway programs and opportunities for innovative financing for highway infrastructure renewal and development. State and local jurisdictions that structure their reporting around the needs of both infrastructure managers and users will reap significant benefits in terms of extended highway service lives, reduced replacement costs, and better information with which to manage these critical assets.

6.2. Removing infrastructure funding decisions from the political realm

Second, removing infrastructure funding decisions from the political realm is one way to ensure that assets are appropriately maintained. Asset management provides state and local governments the opportunity to demonstrate stewardship of their highway infrastructure. Asset management also provides the impetus for establishing innovative techniques for financing highway infrastructure development, preservation, and documentation. Lifecycle asset management has a critical role to play in demonstrating prudent stewardship of infrastructure and facilitating private sector confidence in public use infrastructure investments. The ability of asset management techniques to extend infrastructure service life and reduce total lifecycle costs offers significant incentives to both public sector owners and private sector operators of infrastructure. These long-term benefits are generally valued more highly by private sector decision makers with a longer strategic view than by public sector officials whose vision typically extends only to the next election cycle.

Traditional highway funding arrangements have favored capital expenditures for new construction by leaving maintenance funding responsibilities to state and local governments. The availability of relatively cheaper federal capital funds inadvertently encouraged state and local governments to defer maintenance on their highway systems over the past 40 years. This has produced higher lifecycle expenses for highway infrastructure when compared to the costs of proper asset preservation. Adding to the problem is the fact that maintenance is usually funded from general operating revenues and must compete for resources with higher visibility services that have powerful constituencies. It is an easy budget item to cut or constrain, especially since the effects of such action are unlikely to become apparent for several years.

Politics often influence decisions about infrastructure maintenance spending. The long time-frame needed to demonstrate the benefits of asset management and preservation leads many decision makers to be reluctant to embrace its tenants and principles. This is particularly true for elected and appointed officials of state and local governments, whose terms of office often limit their ability to focus on future consequences. This is why it is essential to find a way to realize the long-term benefits of asset management throughout the service life of the asset, not just at the replacement cycle.

6.3. Creating a mandatory depreciation reserve

Third, the creation of a mandatory sinking fund or depreciation reserve could be required as a condition of receiving federal capital funds in order to mitigate the political temptation to divert funds in a maintenance account for other operating purposes. The funds would initially be capitalized by modifying federal grants to ensure that a portion of the grant money be dedicated to maintenance. This would mitigate the resource allocation problems created by the capital bias of federal dollars. By requiring payments to such funds, the financial gains from the longer life of infrastructure assets provided by effective maintenance would become clear. Some states are addressing the maintenance problem, but they are the exception rather than the rule. Utah prohibits funding of new projects until enough money is appropriated to maintain existing assets. Missouri sets aside 1% of its general fund revenue in a maintenance reserve fund.

Agencies could be required to spend a specific percentage (e.g., 2% annually) of the replacement

value of their assets on maintenance. Performance measures could also be used to encourage government owners of infrastructure assets to fund maintenance properly. In addition to typical metrics like travel time, data points that measure quality of lifecycle management such as road quality and level of maintenance funding could be included in performance data made available to the public.

6.4. Requiring lifecycle asset management in bond covenants

Fourth, capital markets could also be a source of discipline for the public sector. Typically, the only bonds that include asset management requirements are those associated with toll roads. Requiring governments to include money for maintenance and replacement in bond covenants would create a strong incentive for acting responsibly. For revenue bonds issued by state and local governments secured by revenues from a specific source (e.g., specific user fees), the price should be set at a sufficient level to cover the payment of principal and interest on the debt as well as funding a maintenance account to keep the infrastructure asset in a state of good repair. Also, if general obligation bonds are issued to build, operate, and maintain an infrastructure asset, an account should be created and funded to (1) support ongoing operations and maintenance in order to cover depreciation of the infrastructure asset from normal wear and tear, (2) fund capital improvements to the infrastructure asset in an intellectually honest fashion, and (3) capture the true lifecycle costs of the infrastructure asset.

Currently, state and local governments must compete for general federal tax revenues with a host of other taxpayer-supported services that often have greater political appeal. The aforementioned approach would enable state and local governments to end their dependence on the annual government budget appropriation process.

7. Moving forward

It is evident that the sooner steps are taken to repair, maintain, and rehabilitate existing roads, bridges, waterways, and transit, the lower lifetime costs of the asset will be. As noted in [Table 2](#), there are additional significant benefits through lifecycle asset management.

Yet, in the face of short-term political realities, the public sector too often lacks both the capability

Table 2. Benefits of lifecycle asset management

- Much longer-lasting assets
- Reduced time asset is kept out of service for rehabilitation
- Reduced incidence of crashes and fatalities caused by deteriorating infrastructure
- Reduced lifecycle cost of asset by up to 70%
- Enhanced ability to budget preservation efforts & costs over life of asset
- Ideal basis for linking payments to performance indicators
- Preserve most of asset's value on entity's financial books
- Provide basis to securitize infrastructure assets using tax-exempt bonds
- Greater transparency and accountability between asset developer and asset patron over performance of asset and cost of using the facility
- Applicable to private sector developers of green field, large-scale infrastructure assets who have greater access to patient capital and ability to value long-term asset management benefits

Sources: [Martin and Roper \(1997\)](#); [NCHRP \(1996\)](#)

to realize the full benefits of lifecycle asset management and the patience to stick to its principles except as a contract administration tool. Consequently, U.S. government leaders must provide inducements for state and regional political figures and agencies to make infrastructure decisions and take actions they might otherwise defer. Private sector involvement in the development, financing, and preservation of highway infrastructure may be the primary driver for using asset management principles, practices, and tools to guide the cost-effective stewardship of critical infrastructure.

In a carefully crafted long-term concession contract for infrastructure development, operations, maintenance, and preservation incentives are aligned properly. The concessionaire has the ultimate incentive to preserve the asset in a state of good repair and return the asset in the same condition in which it was delivered for operation. Failure to do so means the concessionaire does not get paid. The necessary incentives for long-term asset management can be realized through a long-term concession contract between a public-sector sponsor/agency and a private-sector service provider/concessionaire. Front-end financing of infrastructure development through public-sector availability payments or bonds can provide additional incentives to attract private-sector commitment to a long-term preservation-based concession involving lifecycle asset management approaches and systems.

The growing willingness of the private sector to enter into partnerships with the public sector to expedite the development or expansion of needed infrastructure offers an important opportunity.

Nurturing PPPs to address the challenges facing our nation's infrastructure systems will require concerted and collective efforts that go beyond traditional approaches to infrastructure funding and development.

Moving forward, the nation must emphasize the lifecycle management of its major infrastructure assets. Furthermore, senior leaders and program managers need to hold their staffs accountable for applying asset management principles and practices to these infrastructure assets. Only by changing the traditional ways of doing business and embracing such innovative techniques will public agencies responsible for infrastructure attract the level of private investment needed to meet both present challenges and future needs.

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