Public-Private Partnerships and Infrastructure Resilience
How PPPs Can Influence More Durable Approaches to U.S. Infrastructure
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How PPPs Can Influence More Durable Approaches to U.S. Infrastructure

By

Eric Boyer, Rich Cooper, and Janet Kavinoky
ABSTRACT

Of late, infrastructure has become a predominant topic for national investment. With crumbling roads, bridges, and other economic driving structures overstressed, in poor condition, and in need of dramatic improvement, there is little question that changes are needed in how we manage and develop infrastructure to improve the U.S. economic future. America’s current fiscal challenges, combined with failings in our existing infrastructure, are drawing increased attention to privately financed public-private partnerships (PPPs) and other less-traditional approaches to enhance and improve infrastructure delivery. With the private sector potentially taking on more responsibility for infrastructure services through PPPs in sectors traditionally financed by government, questions are emerging as to how private providers can help to address public-sector concerns like infrastructure protection and resilience. On July 19, 2011, the National Chamber Foundation, in cooperation with U.S. Chamber of Commerce’s Let’s Rebuild America initiative, hosted a Business Horizon Series event that brought together experts on infrastructure protection and resilience, as well as leaders in the infrastructure investment community, to discuss the role of private investment in infrastructure resilience. This paper builds on that event by investigating how a PPP approach to infrastructure delivery influences the potential for a facility to become more resilient to natural disasters or terrorist attacks. Conclusions suggest that even though PPPs are not a panacea for improving infrastructure resilience, they provide a number of structural conditions and incentives that, if properly leveraged, can influence the overall resilience and economic return of U.S. infrastructure facilities.

Research for this paper involved a literature review of more than 100 peer-reviewed academic articles, government reports, and published book chapters on topics related to infrastructure protection and resilience and infrastructure investment. Research also involved semi-structured interviews with more than 25 infrastructure experts from government agencies, consulting firms, financing institutions, and academia involved in various dimensions of infrastructure resilience and infrastructure investment (Table 3). Thanks to Eric Peterson and other reviewers of earlier drafts of this paper.
America’s infrastructure needs to be updated. Garnering public funds to address these needs is challenging, but it is also generating greater attention for innovative methods of investing in U.S. infrastructure. Physical infrastructure, the “facilities which are necessary for the functioning of the economy and society,” includes transportation networks, telecommunications systems, energy facilities, and water systems. It underlies all aspects of U.S. economic activity, serving as the life-giving organs that affect the distribution of goods and services, communications across businesses and with consumers, and resource and input generation for various modes of industrial production. The challenge is pursuing an investment strategy that can most effectively repair, upgrade, and expand America’s existing systems and, by extension, support the U.S. economy.

For nearly two decades, the American Society of Civil Engineers (ASCE) has produced a scorecard evaluating the state of America’s infrastructure. In its latest report card (2009), ASCE gave U.S. infrastructure an overall grade of “D,” based on perceived gaps in the capacity, conditions, funding, future needs, operations and maintenance, public safety, and resilience of facilities. This was not the first time that U.S. infrastructure received such poor marks; it also received a “D” grade from ASCE in 1998, 2001, and 2005.

To reverse this trend, ASCE estimates that more than $2.2 trillion needs to be invested over the next five years to improve existing facilities and expand current networks. In addition to the challenges of diminishing quality, U.S. infrastructure continues to fall short compared with that of other developed market economies. From 1970 to 2006, the United States invested less in infrastructure as a percentage of GDP than the average Organization for Economic Co-operation and Development (OECD) country.

The problem is there is little indication that public investment can address U.S. infrastructure’s full funding needs. State governments—those tasked with the highest burden of operating and maintaining much of the nation’s infrastructure—are dealing with the most challenging fiscal climate since World War II. Furthermore, the potential for federal funds to complement state efforts are bleak at best. With federal agencies preparing for their largest budget reductions in U.S. history, and current debates over U.S. debt escalating, the reservoir of political will to invest more public money in infrastructure is not as deep as the list of needs.

With fiscal constraints at both state and federal levels, public officials are increasingly seeking innovative financing options for large-scale projects. One model is public-private partnerships (PPPs). Dissatisfaction with U.S. infrastructure development has also generated a wealth of criticism of traditional modes of publicly financing infrastructure, drawing even more interest in PPPs. Although PPPs may not be appropriate for every infrastructure project, they offer an additional delivery mechanism for public officials seeking out innovative approaches for leveraging limited fiscal resources.
Contributions of Public-Private Partnerships for Infrastructure Investment

PPPs involve integrated interactions among public and private sectors, structured around agreed-upon performance standards that guide infrastructure outcomes. When a state-level department of transportation or tolling authority addresses an infrastructure need through a PPP, it agrees upon a set of service outcomes for the facility with a private partner. Unlike contracting with a construction firm to build a facility the government designs (as in traditional modes of infrastructure public financing), private developers, builders, financiers, and operators combine efforts in PPPs to provide a more integrated approach. The bundling of responsibilities into one contract for a PPP shifts more project risk from public to private sectors, and in doing so it challenges the subcontractors involved to consider their roles in respect to wider performance outcomes. This approach presents many benefits in developing, modernizing, and maintaining large-scale facilities through private financing.

With regard to infrastructure, PPPs—

- Involve government contracting for longer-term projects (often extending beyond 30 to 40 years in length);
- Engage both public and private financing;
- Require private sector involvement in the provision of government services (bundling design, construction, and operations and maintenance responsibilities into a single contract); and,
- Establish risk-sharing among public and private organizations involved in infrastructure provision.

PPPs offer a method of infrastructure delivery that can leverage what fiscal resources public officials have, and also help to deliver more efficient services. PPPs foster greater efficiency through—

- Greater scrutiny and discipline throughout the procurement process for infrastructure;
- Greater sharing of project risks, which places greater responsibility on private providers for project outcomes; and
- Increased potential for innovation as private developers create their own approaches for achieving government outcomes.

PPPs also give access to financing beyond public sector resources. For example, the experience with private financing for infrastructure in countries like Australia and the United Kingdom demonstrates how private investment can accelerate projects that otherwise would not have been possible. Evidence in other parts of the world shows a similar trend, where governments are most likely to invest in infrastructure through PPPs when they face government debt burdens.
Past practice has shown that “PPP contracts may be presented (and quite often are actually presented) as a way to overcome budgetary constraints, delivering more projects with the same [government] resources available in the long term.”\textsuperscript{16} Although debt obligations in PPPs require repayment from future administrations and/or taxpayers, PPPs give cash-strapped governments additional options for pursuing projects that otherwise would not be possible. Private financing in PPPs therefore offers state and local governments not only an alternative to traditional financing but an alternative where no projects were possible before.

PPPs require public officials to consider the long-term costs of facilities. This creates greater discipline in the infrastructure procurement process. Rather than considering only the costs of construction when developing a facility (as is often done in traditional modes of public infrastructure investment), bids for PPPs consider the costs of construction with respect to long-term operations and the facility’s maintenance.\textsuperscript{17} This “lifecycle” approach to infrastructure investment makes the real costs of facilities more transparent and has been shown to “force the public sector to make choices about how services are to be delivered and paid for.”\textsuperscript{18}

PPPs also create incentives for completing projects on time, since private developers generally defer compensation until facilities have been completed (Figure 1). The benefits of this payment structure are apparent. The United Kingdom’s National Audit Office (NAO) found that PPPs delivered projects that were more often “on time and on budget” than their public sector counterparts.\textsuperscript{19}

![Figure 1: Structures of Payment for Traditional Procurement and Public-Private Partnership Procurement\textsuperscript{20}](image)
Finally, bundling responsibilities for multiple infrastructure service components transfers more risk to private partners and lowers overall cost. All infrastructure projects involve some level of risk, given the complex, long-term nature of physical investments. Table 1 outlines a list of sample risks involved in infrastructure investments.

PPPs require greater sharing of risks since private operators assume responsibility for the delivery of an agreed-upon standard of service over an extended time. Assuming this responsibility requires private operators to identify and quantify the value of numerous risks involved in the project. Transfers of project responsibilities also challenge government agencies to reconsider their roles in projects. Experience shows that “PPPs encourage the public sector to identify project risk and think about risk transfer in a way which has not been usual in conventional public-sector procurement.”21 The end result is a more economically efficient allocation of risk between the public and private sectors, which by extension brings down overall project costs.

Table 1: Sample Risks Identified for Infrastructure Projects22

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Technical risk (e.g., engineering or design faults)</td>
<td></td>
</tr>
<tr>
<td>Construction risk (e.g., faulty construction techniques)</td>
<td></td>
</tr>
<tr>
<td>Operating risk (e.g., higher operating costs than expected)</td>
<td></td>
</tr>
<tr>
<td>Revenue risk (e.g., demand, volatility of prices such as reductions in toll revenue)</td>
<td></td>
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<tr>
<td>Financial risk (e.g., financing costs)</td>
<td></td>
</tr>
<tr>
<td>Force majeure (e.g., acts of God like natural disasters)</td>
<td></td>
</tr>
<tr>
<td>Regulatory/political risks (e.g., changes in laws, political support)</td>
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</tr>
<tr>
<td>Environmental risks (e.g., regulatory requirements on private providers)</td>
<td></td>
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<tr>
<td>Project default (e.g., contractor failures)</td>
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Bundling project responsibilities into one contract among private developers, investors, builders, and operations and maintenance subcontractors also can generate greater innovations in infrastructure delivery.23 By focusing on the quality of services requested for a facility (e.g., rates of traffic congestion or safety standards for a roadway), private operators are given the flexibility to come up with their own materials and other innovative solutions. In various U.K. infrastructure sectors, for example, this flexibility has been shown to generate numerous innovations in infrastructure delivery among PPPs.24

Taking the general benefits of PPPs into consideration demonstrates why these forms of infrastructure delivery are likely to become more popular in the United States. The question is how the institutional changes embodied by PPPs—and the motivations that go with them—may
influence their potential to address resiliency and provide more durable approaches to U.S. infrastructure.

The Importance of Infrastructure Resilience

Infrastructure resilience refers to the potential for a given facility to “withstand an adverse event while continuing to function at acceptable levels or, if functioning is diminished, the speed by which an asset can return to the acceptable level of function.”\(^{25}\) Whether with respect to a roadway, power plant, or water distribution system, resilience means an overall ability to recover from disruptions caused by infrequent and damaging events.\(^{26}\) Recent infrastructure research and policy development calls for a greater understanding of how to develop facilities that can withstand the impact of a natural disaster or terrorist attack.\(^{27}\)

Resilient infrastructure is particularly important given the dramatic costs associated with natural disasters. The 2010 winter snowstorms on the mid-Atlantic coast, for example, “closed the federal government for five days at an estimated cost of $100 million a day.”\(^{28}\) In the same year, the eruption of Iceland’s Eyjafjallajökull volcano stalled commercial flights across the Atlantic for days and disrupted travel for thousands of passengers.\(^ {29}\) The aftermath of Hurricane Katrina in 2005 and the problems facing Japan and its Fukushima nuclear plant after the earthquake and tsunami of 2011 also revealed the vulnerabilities of many existing systems and the need for combined public and private sector efforts to address them.

The extent to which infrastructure systems can withstand disasters of this kind plays an important role in the ability of the wider community to rebound from such events.\(^ {30}\) Infrastructure provides the means by which people can travel in and out of affected regions, and provides drinking water, utilities, and other core services that communities must have to become vibrant again. How we develop and maintain infrastructure shapes the context of how we prepare for, and respond to, catastrophic events.

Understanding the scale and scope of resilience, and how it relates to infrastructure systems, involves a more holistic approach to perceiving and responding to threats. Aspects of resilience include—

1) **Robustness**, or the ability to withstand external demands;

2) **Redundancy**, or the extent of alternate options or substitutions for system processes;

3) **Resourcefulness**, or the capacity to mobilize resources rapidly in an emergency; and

4) **Rapidity**, or the speed at which operations can be restored to pre-incident levels.\(^ {31}\)
These four characteristics outline the practices, design decisions, and other aspects of facilities management that transcend preventive measures alone and instead include activities that come into play after an event has occurred.

Within the scope of disaster management, resilience builds upon activities devoted solely to protecting facilities. Resiliency-based approaches to infrastructure look beyond just preventing the impacts of disruptions to look at how facilities can regain normal levels or regular operations after a major event. Since preventing all disasters and their impact on existing systems is impossible, considering response and recovery strategies, along with preventive and protective measures, allows for a more strategic approach to minimizing the impact of largely unavoidable threats.32

**Government Role in Infrastructure Resilience**

The U.S. federal government has been the primary impetus for promoting infrastructure resilience. The U.S. Department of Homeland Security’s (DHS) Office of Infrastructure Protection (IP) coordinates a range of programs within the scope of the National Infrastructure Protection Plan (NIPP) and Presidential Policy Directive-8 (PPD-8).

The NIPP provides a framework for addressing infrastructure protection among federal, state, and local authorities, as well as among facility owners and operators. It outlines protection priorities and a network of “councils” for coordinating efforts among public and private organizations involved in infrastructure provision. As a matter of policy, PPD-8 reiterates the importance of protection-related efforts and emphasizes the significance of resilience as a component of DHS’s work in infrastructure facilities.33 To date, DHS IP has conducted a wealth of activities to help facilities considered “critically important” to economic and social development become more resilient to disasters. Examples of their efforts include assigning risk-based criteria to more than 4,000 chemical facilities; conducting 1,090 security surveys of facilities; and performing training sessions in explosive devices, surveillance systems, and soft target awareness to state, local, and tribal officials across the country.34

The overall government response to infrastructure protection and resilience has generally involved identifying and analyzing threats; coordinating public and private efforts at federal and sub-national levels; and mitigating risks and effects from disasters on infrastructure.
Priorities for Infrastructure Resilience and Potential PPP Contributions

A wide range of activities, programs, and policies influence the potential for providing more effective approaches to infrastructure resilience. Much of the challenge of promoting infrastructure resilience involves coordinating efforts with the many stakeholders involved in infrastructure delivery in the United States. Recent figures suggest that up to 80% of all U.S. infrastructure facilities are operated or maintained by the private sector. The implication is that the government agencies involved in infrastructure resilience depend on a range of activities and programs to align the private sector with government-led efforts in resilience.

In the United States, stakeholders involved in infrastructure resilience span government agencies at the federal, state, local, and tribal levels, as well as across the private sector. DHS plays the dominant role at the federal level, while emergency management offices at the state, local, and tribal levels coordinate regional efforts, bringing together law enforcement, first responders, and infrastructure owners and operators to prevent and respond to disasters. The overlapping roles and responsibilities of stakeholders involved in infrastructure resilience can be considered in terms of three intersecting spheres of influence: private sector owners and operators at the local level; state, local, and tribal governments; and the federal government (Figure 2). Aligning efforts within these disparate organizations illustrates some of the coordination challenges involved in promoting U.S. infrastructure resilience.

The challenge in addressing infrastructure resilience in the United States is that the public sector, the primary convener and driver of protection- and response-related activities, plays varying roles in developing and maintaining U.S. infrastructure. In the case of enabling water and transportation delivery mechanisms, state or local authorities generally oversee a spectrum of contracting agreements with private providers to ensure that they are safe and operable for use by the general public.
The most traditional approach to infrastructure delivery, particularly in transportation, is the design-bid-build approach. This method represents one side of the spectrum of government–private sector involvement by demonstrating the strongest role of the government in service delivery. Design-bid-build involves soliciting contracts for construction of facilities from the private sector, whereby the government drives “all decisions regarding the provision, production, and financing of assets as well as the operation and maintenance of the services.”

PPPs alter the role of the public sector in infrastructure delivery by engaging the private sector in responsibilities that extend beyond the sole areas of construction. Variations of PPPs range from Design-Build Contracts, where the private sector assumes responsibility for both design and construction of facilities, to various forms of warranties, private financing, and agreements that shift greater responsibility to the private sector for long-term operations and maintenance of facilities. The increased roles of the private sector in PPPs shift more project risks onto private operators and cultivate incentives for the private sector to take a greater stake in the long-term operations of facilities.

The challenge, again, is understanding how the shifting roles of the public sector in various forms of PPPs influence their ability to achieve standards of resilience in infrastructure delivery. Determining the impacts of PPPs on infrastructure resilience requires an understanding of existing practices for designing and implementing more durable approaches to infrastructure delivery. Based on a review of the literature and interviews with experts in the field, three broad areas emerge as groups of practices and conditions vital for infrastructure resilience in the United States:

- Public-private cooperation improves relations among government protection offices and private owners and operators of facilities;
- Design decisions help develop more resilient structural solutions; and
- Risk assessment procedures assist in identifying the most pressing threats to facilities, as well as strategies for addressing them.

PPP incentives and structures can influence the achievement of each of these aims.

Public-Private Cooperation and Information Sharing

Public-private cooperation is one of the most important priorities for achieving greater resiliency in infrastructure. Federal policies such as the NIPP dictate the terms of government response to infrastructure resilience, but state, local, and tribal authorities are the most directly involved in coordinating disaster response and recovery efforts with facility managers.

Cultivating a shared vision of the facility’s goals and fostering information sharing are both critical to cooperation across public and private sectors. A good example is the Houston
Ship Channel in Texas.41 United by a shared interest in preserving the route in a disaster, a range of businesses, infrastructure owners and operators, and local government officials work closely with one another to preserve the facility.

Information sharing is also central to public–private sector coordination.42 Information sharing broadly refers to the communication regarding potential threats; disaster planning and response; and overall coordination among public and private stakeholders in infrastructure. One infrastructure specialist remarked that “information sharing is really the most important activity… [since private owners and operator of infrastructure] don’t know what they don’t know.”43 Owners and operators depend on the government for information related to the intelligence agencies, including any updates on the scope and scale of terrorist threats on particular facilities. At the same time, the government depends on knowledge of irregular behaviors around facilities to help address threats and to also identify best practices in facilities management that can be shared among owners and operators. Information sharing can foster “cross-pollination” between public and private sectors on these methods for improving protection and response-related activities.44

By their nature, PPPs cultivate a shared understanding of an infrastructure facility’s needs among the stakeholders involved. One infrastructure specialist remarked that “having a common language and having a common agenda is one of the thresholds for effective public–private cooperation in PPPs.”45 PPPs are developed around performance standards that public and private partners agree upon through contract negotiations and project selection. For example, a PPP for a toll road often involves a public authority (e.g., department of transportation, tolling authority) establishing expected service levels (e.g., congestion rates, safety standards) that the private owners and operators agree to achieve. The nature of designing the contract requires this level of coordination since “[both public and private sectors] really have to understand all of the possibilities for a project upfront” as well as the shared objectives for achieving them.46 Further, the distribution of risk across public and private sectors in PPPs ensures that all involved parties are invested in the facility’s success.47 In this way, the crafting and negotiating around service standards in PPP contracts can help establish mutual objectives between public and private stakeholders.

PPPs also can increase information sharing between public and private sectors. In addition to ongoing interaction between stakeholders, PPP contracts have inherent design flexibilities that allow the private sector to use cutting-edge technology. The reality is that “private partnerships generally have the money to install the most sophisticated approaches to provision. States and localities really don’t have the resources to implement a sophisticated approach to this type of work.”48 Examples include “EZpass” and other electronic tolling technologies, fiber-optic cables and cameras along roadways capturing more accurate vehicle flow rates,49 and other modes for more accurately monitoring traffic flows on PPP-managed roadways. Technology use through PPPs also allows for more information to be generated and documented within facilities, which can be used to help identify threats and PPP-managed facility disruptions and to ensure further revenue streams.
PPPs rely on ongoing communication between public and private organizations involved in infrastructure facilities to monitor performance outcomes. Past experience shows that "open communication" is one of the top success factors in PPPs for public works projects in the United States. Interviewees overwhelmingly indicated that the mechanisms inherent in PPPs create greater potential for public-private exchanges than those in other delivery models. The PPP contract is based on consistent performance outcome monitoring by the local authority, which adjusts incentives or penalties appropriately to ensure desired service levels. This ongoing communication, necessitated by the performance reviews, can help keep information flowing between sectors.

The potential benefits of PPPs, however, should not be considered too broadly. The development of a PPP necessitates some shared vision between the public and private sectors, but it is up to the procuring authority (the government) to ensure that resilience standards are included in that vision. As one infrastructure specialist noted, resilience, as a priority, “has to be laid out in the policy directive for the facility.”

Furthermore, even though the mechanisms inherent in PPPs necessitate greater communication among public and private sectors, information-sharing also depends on interpersonal relations. Past practice has shown that a number of factors, such as cultural differences or authoritative roles, can hinder communication across public and private sector partnerships. The implication is that public-private information sharing often depends not only on the formal mechanisms involved (such as performance monitoring), but also on the nature of relations among the public and private managers involved. Considering both dimensions is essential for ensuring effective information sharing among public and private sectors in PPPs.

It is also important to recognize that any protective measures recommended for a facility must be considered within the PPP business model. At their core, PPPs are a model for reconciling debt obligations with projected revenue. The costs of protective measures therefore need to be considered within a project’s revenue streams.

Finally, increased interaction between private operators and state or local authorities involved in performance monitoring is valuable, but it does not guarantee interaction with federal authorities involved in infrastructure resilience issues. One infrastructure specialist raised the question: “Can you really say that the California state DOT [Department of Transportation, presumably the public partner in a given PPP] is better equipped to communicate with the CIA [Central Intelligence Agency] and related intelligence community?” In other words, does interaction with a state, local, or tribal-level procurement authority mean that private operators will be kept abreast of current threat information from federal authorities? Public-private interactions are likely to increase between private operators and procurement authorities at the local level through PPPs, but those interactions need to be considered within the wider sphere of relations among federal authorities, state and local authorities, and private infrastructure operators.
Facility Designs

An infrastructure facility design plays an important role in determining the structure’s ability to withstand natural or manmade disasters. Buildings in hurricane-prone regions, for example, are often constructed with roofing angles and structural adjustments that minimize the impacts of high winds. Similarly, earthquake-resistant structures are common in many regions of earthquake-prone southern California.

The challenge is ensuring that disaster-related technologies are implemented into infrastructure facility designs. Often, the priority for local governments is to build the infrastructure, regardless of whether they factor in potential threats. Even though building standards play some role in guiding infrastructure design, some critics suggest that standards are often too broad to specify the actual materials or structural requirements needed to achieve resilient designs.

PPPs can contribute to the development of more resilient infrastructure designs through pressuring private operators to consider long-term operations costs in their facility designs; focusing attention on design issues demanded in planning stages of PPP procurement; and scrutinizing facility designs by multiple stakeholders in the private sector.

Bundling responsibilities for infrastructure provision in PPP contracts requires a private concessionaire to consider design decisions and construction in light of the long-term facility operations and maintenance. For example, private concessionaires involved in PPPs in the United Kingdom have deliberately adjusted the positioning of windows in schools and of hallway intersections in prisons to reduce their respective cleaning and heating costs. As they are responsible for long-term upkeep of their projects, contractors are incentivized to pay closer attention to design decisions in PPPs.

One infrastructure specialist remarked, “the private sector will look for innovative approaches more aggressively than the public infrastructure officials,” presumably because they are accountable for the long-term costs associated with operating them. Another expert from an international engineering and development firm stated:

“If I’m a P3 owner/operator I will consider life-cycle issues more thoroughly; this is different from design-bid-build costs [as used in traditional government contracting], which is selected by construction costs alone. If I have to design, build, operate and maintain it – I’m financially incentivized to reduce costs in the operating phases.”
It is this consolidation of responsibilities over the life cycle of an infrastructure facility that pressures the private sector to take greater interest in the long-term viability of designs, a concern that could increase their attention to structural alternatives that provide more resistance to natural or manmade threats.

Additionally, the bundling of responsibilities in PPPs means that private concessionaires are paid only when services are provided. If a natural disaster wipes out a roadway developed through a PPP, the private concessionaires will not be able to collect revenue from the facility. One specialist from a global engineering firm remarked that “if we build a toll road that could not withstand an interruption, we lose out with the ability to design and develop a solid project that can keep the lifecycle approaches.”62 The responsibility for services delivered by the private sector in PPPs thus creates additional pressure for them to consider design decisions that can ensure the continuity of service, despite outside threats.

The PPP planning process thoroughly reviews a facility’s structures, bringing attention to design with respect to long-term operations, whether for a new facility or the rehabilitation of an existing facility. This facilitates design adjustments that are more resistant to outside threats during the beginning of the project. Contracting for infrastructure projects where operations and maintenance costs are included forces these long-term considerations before services are provided.63 In this way, design changes during planning are more efficient than large changes once a facility has been built.

One infrastructure specialist noted that “it is much more expensive to retro-fit structures to what you need [in terms of resilience]. Planning early is much easier than trying to figure it out when you are already into construction.”64 One of the real benefits of PPPs, therefore, is the level of planning that goes into design decisions in a project’s early stages.

PPPs bring financial scrutiny, as well as engineering and technical scrutiny. A number of financiers, developers, builders, and operators from the private sector are often aligned into a single contract for a PPP (see Figure 3). PPPs involve the creation of a separate legal entity, such as a special purpose vehicle (SPV)65 or Project Company66 to represent the private consortium of investors and subcontractors involved in the partnership (Figure 3). The creation of a Project Company of this kind, generally represented by the various subcontractors, requires each party to consider their contributions within the wider scope of performance outcomes, or whole-life costs.67 In other words, designers consider their plans with respect to the facility’s long-term operations and maintenance needs, and during building or renovation the construction subcontractors consider design decisions that could affect long-term operating costs. The result is a structure of market-based mechanisms developed to hold private sector partners accountable to the goals of the project.

Because lending is generally provided by investors, the private sector will also require facility designs that can preserve service continuity, along with the revenues required for paying
project debt. Together with the scrutiny of public and private sector engineers reviewing PPP designs, “due diligence is another form of quality control, where some assurance is made that the equity, along with the debt, can withstand an earthquake [or some other form of disaster].”

This level of PPP design review provides one more step in ensuring that facilities are designed to provide services over the long term, potentially bringing attention to structural choices that may better resist future disruptions.

Though PPPs bring greater attention to design durability, it is important to recognize that this awareness is not guaranteed to address all structural choices that would improve resilience. PPPs are essentially a business model in which involved parties are trying to recoup a rate of return on their investment. A number of infrastructure specialists remarked that even though private sector concern generally increases for the long-term sustainability of assets in PPPs, private operators are going to prioritize the bottom line. The implication is that private partners may factor in decisions only for risks to disruption that they assume responsibility for. If the costs of controlling for the risks of service disruptions from catastrophes are too high for them to bear, the private sector may not control for them.
Furthermore, there is some concern over the balance between the aesthetic quality of designs and their security implications. With adequate review of designs by the public sector involved in PPPs, "you [may] have a greater level of polish in your facility if private designers get to dictate the approach. [But] in terms of the issue of resilience and security, it doesn't change the dynamic."

Understanding the potential for facility designs to improve through PPPs demands attention to the public and private motivations in these deals. As one specialist put it, “You have to understand the balance: the public sector wants policy objectives, and the private sector wants to earn money.” Striking this balance means understanding the incentives that the private sector considers for the facility design operational needs over the contract term and the distribution of project risks among public and private sectors, while at the same time ensuring that aesthetics do not take priority over resilience.

**Risk Assessment**

Another key dimension of cultivating resilience for infrastructure provision involves quantifying and estimating the risks of potential disasters. Rather than attempting to guard against all kinds of disasters that may disrupt operations within a given facility, risk assessments reveal the types of threats that deserve the most attention in mitigating disaster outcomes. It is the ability to identify the most likely threats to facilities that allows infrastructure managers to more strategically address their disaster plans and responses.

The value of more deliberately allocating resources toward the most likely threats has led some to identify risk assessment as the principal method for improving resilience. One challenge to making the most of a risk assessment involves getting infrastructure stakeholders to see the value of preparing for high-consequence, low-probability threats. Recognizing the inherent value of risk assessment processes, agreeing on risk methodologies, and understanding the wider system within which threats are identified and responded to can help illuminate the importance of risk assessment methodologies.

PPPs can help identify and mitigate potential risks through the forms of risk assessment that underlie their procurement processes. A fundamental process for developing project proposals for PPPs involves developing a “risk register” that flushes out all possible long-term risks to service delivery. More than half of the PPP specialists interviewed for this paper remarked that PPPs generally demand more attention to long-term risks than traditional modes of government procurement. One specialist stated, “In PPPs there is far more rigorous assessment of risk than in traditional modes of public procurement. You are not just looking at design and construction [related risks], you are looking at operations and maintenance [risks] over time.”
All infrastructure projects involve risk. In traditional procurement, which focuses primarily on construction costs with less attention to long-term operations costs, taxpayers bear the long-term risks associated with costs regardless of whether the risks are identified. One of the benefits of PPPs, therefore, is a more transparent disclosure and monetization of risks associated with infrastructure projects. This occurs because of the private operators’ interest in maintaining service levels over time. A specialist from an international engineering firm involved in PPPs remarked, “We worry about things that they don’t worry about. There is a market value for risk. The public side works under a different kind of model. There is a different kind of risk that they are willing to take on in projects, which later generations need to deal with.” Those who coordinate PPPs pay attention to the inherent risks in long-term infrastructure provision to help identify the sort of low-probability, high-impact threats that could disrupt services.

Despite PPPs’ increased disclosure and consideration of project-related risk, it is still important to point out that such processes are not guaranteed to accurately capture all potential outside threats. The reality is that the risk assessment formulas for facilities used by DHS and related government agencies are generally different from the financial estimations used by investors involved in PPPs. Many methodologies exist for addressing infrastructure resilience, but at least two approaches have seen increased field use:

- The risk analysis and management for critical asset protection (RAMCAP), developed by the American Society of Mechanical Engineers (ASME); and

- The DHS risk management framework outlined in the National Infrastructure Protection Plan (NIPP).

Figure 4 describes each risk assessment approach. One specialist working for an international engineering and investment firm involved in PPPs remarked, “There is nobody doing security assessments better than DHS—they do an amazing job.” The challenge for public officials involved in PPPs is integrating the DHS-types of methodologies into their PPP assessments.

Additionally, identifying risks in PPP planning does not guarantee that the private sector will adopt plans to deal with them. The threats of natural disasters, generally referred to in contracts as *force majeure* (acts of God), are often extremely expensive. Since PPPs depend on a business model, the high costs of certain risks will determine whether they will be transferred from public to private sectors. Disasters, once identified and considered, may prove too high a cost for the private sector to bear.

Finally, risk assessments for PPPs are not inherently designed to identify community-wide supply-chains and related infrastructure systems that support a given facility. Assessing infrastructure risk requires an understanding of the interdependencies between a given facility and the surrounding related infrastructure. Whether an electrical plant continues operations
RAMCAP Plus®

The RAMCAP Plus approach requires measures of each perceived threat (by envisioning possible events), evaluating the likelihood of damage or consequences from the event, and calculating the expected damage of the event. The formula is as follows:

\[ \text{Risk} = (\text{threat}) \times (\text{vulnerability}) \times (\text{consequence}) \]

**Risk**: “probability of loss or harm due to an unwanted event”

**Threat**: “likelihood that an adverse event will occur within a specified period of time”

**Vulnerability**: “probability that, given an adverse event, the estimated consequences will ensue”

**Consequence**: “outcomes of an event occurrence, including...direct and indirect losses and effects”

NIPP Risk Management Framework

This diagram displays the essential purpose of sector-specific plans. These plans are intended to (1) set security goals; (2) identify assets, systems, networks, and functions; (3) assess risk based on consequences, vulnerabilities and threats; (4) establish priorities based on risk assessments; (5) implement proactive programs; and (6) measure effectiveness.
after being struck by a tornado depends on the extent to which surrounding roadways were
damaged during the storm, the degree to which telecommunications infrastructure was disrupted,
and a host of other factors inherent in the surrounding infrastructure systems. Risk assessments,
therefore, transcend calculations about a facility’s technical capabilities or financial safeguards;
they also require an understanding of the surrounding infrastructure as well as the inputs and
outputs that drive facility operations.84

The overall implication is that while PPPs generate an increased amount of attention on
infrastructure provision risks, they do not inherently address or control all risks related to natural
disasters or terrorist attacks. Controlling for a wider range of threats requires greater influence
by the public procurement process on incorporating security-related assessments into project
development, additional steps to determine how PPP parties are bearing the risks related to
threats, and efforts to understand the system-wide interdependencies that influence facilities’ risk
status within their own regions.

Conclusions and Implications

For too long, the distinct communities of infrastructure investments and those who seek
to protect infrastructures from a range of threats and make them more resilient have avoided
interaction with one another. Such siloed approaches are not in the interests of either community.
Greater understanding of each other’s goals and approaches will go a long way toward satisfying
not only the parties’ individual aspirations but also the greater ones that extend far beyond them.

With the potential for greater private sector involvement in infrastructure, a number
of factors point to the potential for public–private partnerships to also contribute to building
and sustaining more resilient infrastructure. As demonstrated by experiences with PPPs in the
United States and abroad, introducing private sector procurement has the potential to force
major changes in how infrastructure facilities are developed. Moreover, this form of infrastructure
development and partnership alters the responsibilities of the actors involved and transforms how
public officials think about facility resilience over the long term.

Much of the focus on infrastructure resilience to date has focused on the importance of
aligning the priorities of state and local authorities with those of DHS, as well as efforts to align
DHS priorities with those of private owners and operators involved in arms-length contracts or
regulated relationships with local authorities. A review of PPPs as a unique delivery mechanism
for infrastructure provision reveals the institutional changes inherent in this model, and the ways
that it transforms roles between public and private sectors, as well as their views toward the long-
term needs of invested facilities.
The overwhelming benefit of PPPs for improving infrastructure resilience is the attention that procurement processes bring to the long-term sustainability of facilities. The introduction of whole-lifecycle costing forces the public sector to take a more long-term approach to infrastructure delivery by addressing the operational needs of facilities in their design. Developing performance standards, introducing private sector innovations, considering facility designs with respect to long-term operating needs, and increasing transparency on project risks all bring greater attention to long-term facility durability. Rather than simply considering the best plans for constructing a facility, PPPs challenge public officials to consider those plans with respect to their operations over lifecycles of up to 30 years or more. The implication is that PPPs’ overall transparency, discipline, and attention to long-term costs can change the ways in which public officials consider the needs of their infrastructure over time. This change offers great promise for improving attention to infrastructure resilience and the myriad activities that help facilities mitigate the impacts of disasters. Having more durable and sustainable infrastructure makes more than operational common sense; it also makes the investment in infrastructure more profitable and rewarding over the longer term. In infrastructure, durability means profitability, and public and private executives may need to change their approaches to infrastructure provision to see the link between resilience and returns on investment.

A closer look at these benefits, however, reveals that it is difficult to expect PPPs to provide comprehensive benefits to resilience on their own. By their nature, PPPs are business arrangements that prioritize a return on investment for the private financiers, operators, designers, and builders involved in their development. Responding to market pressures in PPPs creates incentives for increased scrutiny on project outcomes over the long term of facility management. However, financial pressures in PPPs may not capture all of the design decisions that would mitigate the impacts of natural and manmade disasters. In PPPs, the costs of responding to such challenges may prove too expensive for private partners to bear. Harnessing the potential that these incentives offer requires attention to how they transform the approach that public managers take in developing and maintaining infrastructure.

PPPs’ need to adhere to a business model also reveals what may be possible in developing resilient infrastructure. One of the great advantages of private sector involvement in infrastructure delivery is the monetization of project costs that may not otherwise be disclosed through project procurement. Risk assessments by private investors help quantify the costs of insulating against many of the threats to infrastructure facilities by factoring in the probability of such events and their potential costs. The result is a more accurate understanding of project risks by public officials.

PPPs are far from a panacea for infrastructure resilience, but their nature reshapes how public and private sector infrastructure entities relate to each other as well as the overall conditions for addressing resiliency. **The overwhelming value of PPPs is found in the introduction of market-based incentives for more cost-effective solutions throughout the procurement process.** The challenge for PPPs with respect to resilience is to ensure that market incentives push for more resilient infrastructure solutions. Table 2 provides a summary of some of
the potential benefits and challenges of PPPs, along with a series of recommendations. Although the nature of infrastructure facilities will alter the potential risks and danger of disasters (e.g., airports have greater terrorist attack risks than a toll road), the table provides some general guidance for professionals engaging in this work.

With the potential for PPPs to be used more widely in infrastructure sectors traditionally dominated by public finance, an understanding of PPPs and their contributions to resilience will prove even more important for future projects.
### Table 2: Potentials of Public-Private Partnerships for Improving Infrastructure Resilience

<table>
<thead>
<tr>
<th>Potential Advantages</th>
<th>Potential Challenges</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public-Private Cooperation</strong></td>
<td></td>
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<tr>
<td>• Creation of a shared understanding of the priorities of an infrastructure facility through the development and agreement of performance standards for infrastructure services.</td>
<td>• A common vision for an infrastructure facility may not necessarily include resilience-related priorities in its development.</td>
<td>• Ensure that resilience-related priorities are incorporated into requests for proposals for PPPs, as developed by public procurement authorities.</td>
</tr>
<tr>
<td>• Incorporation of innovative technology that could further information gathering at facilities.</td>
<td>• Protection-related models for facilities must be considered within business models for PPPs, which may prove too expensive for the private sector to bear.</td>
<td>• Ensure that public procurement authorities coordinate with DHS and related federal authorities to improve federal involvement in information sharing with infrastructure facilities involved in PPPs.</td>
</tr>
<tr>
<td>• Ongoing interactions among public procurement offices and private operators of infrastructure are required through regular performance monitoring.</td>
<td>• Interactions between state or local authorities and private operators do not guarantee involvement with federal authorities like DHS or related authorities at the national level.</td>
<td></td>
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<tr>
<td><strong>Facility Designs</strong></td>
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<td></td>
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<tr>
<td>• Attention to lifecycle costs in PPPs requires attention to design issues that consider long-term durability.</td>
<td>• Design decisions involve a balance between aesthetics and security, and security will not always be prioritized on its own in PPPs.</td>
<td>• Ensure that disaster-related design requirements are included in the contracts for PPPs.</td>
</tr>
<tr>
<td>• Due diligence, conducted on behalf of private investors, can bring greater scrutiny to the long-term operability of facility designs in PPPs.</td>
<td>• The allocation of risk between public and private sectors for service disruptions caused by disasters can influence private sector concern for designs solutions that can withstand disasters.</td>
<td>• Regardless of whether private operators bear the risks for disasters in PPPs, identify those risks and evaluate the costs of insulating against them in facility designs.</td>
</tr>
<tr>
<td>• Lifecycle cost considerations in PPP planning can address long-term design needs before facilities are built.</td>
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<td></td>
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<tr>
<td><strong>Risk Assessment</strong></td>
<td></td>
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<tr>
<td>• Long-term risks to infrastructure provision are generally more transparent in PPPs.</td>
<td>• Risk assessments in PPPs may not necessarily address the same kinds of security threats identified by methodologies used by the security community.</td>
<td>• Build security-related risk assessments into risk assessments for PPPs by including methodologies (such as RAMCAP) in PPP procurement processes.</td>
</tr>
<tr>
<td>• The private sector point of view on risks can provide a more complete understanding of project risks related to the operation of large-scale infrastructure projects.</td>
<td>• Risk assessments for PPPs may not address the interdependencies among facilities and their local environments.</td>
<td>• Ensure that public procurement teams consider regional interdependencies in assessments of risks for PPP projects.</td>
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</tbody>
</table>
Table 3: Semi-Structured Interviews Conducted with Specialists Involved in Infrastructure Resilience and Infrastructure Investment

**Specialists Involved in Infrastructure Resilience**

<table>
<thead>
<tr>
<th>Current Employer (Public or Private)</th>
<th>Public Experience (yrs)</th>
<th>Private Experience (yrs)</th>
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<td>1 Private</td>
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<td>10 Private</td>
<td>27</td>
<td>3</td>
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<tr>
<td>11 Private</td>
<td>27</td>
<td>20</td>
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Average Years: 24 17

**Specialists Involved in Infrastructure Investment**

<table>
<thead>
<tr>
<th>Current Employer (Public or Private)</th>
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<th>Private Experience (yrs)</th>
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<td>7</td>
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</table>

Average Years: 10.3 16
Public-Private Partnerships and Infrastructure Resilience:
How PPPs Can Influence More Durable Approaches to U.S. Infrastructure

(Endnotes)


3 American Society of Civil Engineers (ASCE), America’s Report Card for Infrastructure (Washington, DC: ASCE, 2009).

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10 The development of a business case, value-for-money assessments, or public-sector comparators offer methodologies for determining whether an infrastructure project is appropriate as a PPP.

11 Interestingly, PPPs are more popular in infrastructure sectors such as transportation or water provision, which are most often financed by the government.


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