TOOLKIT

Risk Assessment for Public–Private Partnerships: A Primer

Innovative Program Delivery

U.S. Department of Transportation
Federal Highway Administration

Notice

Quality Assurance Statement

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CHAPTER 1

Introduction

The Federal Highway Administration's (FHWA's) Office of Innovative Program Delivery (IPD) assists States and local governments in developing knowledge, skills, and abilities in innovative finance techniques. Public–private partnerships (P3s) are one form of innovative finance. IPD supports the research and development of tools to facilitate consideration and implementation of P3s, assists in building the capacity of practitioner communities, develops and implements Federal policy on P3s, and collaborates with State and local partners to communicate the various aspects of P3s to elected officials, transportation leaders, and the public.

A key IPD activity is the development of a series of primers to (a) assist in understanding P3s, (b) provide key considerations in establishing a P3 program, and (c) show how to compare a P3 procurement option with the conventional approach. This primer is part of the series. Supporting guides and a training program are also being developed. Other primers and a variety of P3 resources are available via the section devoted to P3s on IPD's Web site at http://www.fhwa.dot.gov/ipd/p3/index.htm.

This primer addresses the issue of risk assessment for P3s. Companion primers on the topics of Value for Money (VfM) analysis and financial assessment for P3s are also available as part of this P3 primer series. P3s, risk assessment, and VfM analysis are briefly described in the following sections.

What Are Public–Private Partnerships?

P3s for transportation projects have been drawing much interest in the United States for their ability to access new financing sources and to transfer certain project risks. P3s differ from conventional procurements in which the public sponsor controls each phase of the infrastructure development process—design, construction, finance, and operations and maintenance (O&M). With a P3, a single private entity (which may be a consortium of several private companies) assumes responsibility for more than one development phase, accepting risks and seeking rewards.

Design–build (DB) procurement—under which private contractors are responsible for both designing and building projects for a fixed price—is considered by some to be a basic form of P3. Further along the P3 spectrum, the private sector may also assume responsibility for finance and O&M, typically via a long-term concession (e.g., 30 years or more) from the public sponsor. This document, as well as the series of FHWA primers on P3s, is concerned primarily with forms of P3s in which the private sector partner (called the *concessionaire*) enters into a long-term contract to perform most or all of the responsibilities conventionally procured separately and coordinated by the government.

Public agencies pursue P3s for a variety of reasons, including access to private capital, improved budget certainty, accelerated project delivery, transfer of risk to the private sector, attraction of private sector innovation, and improved or more reliable levels of service. P3s, however, like conventional projects, require revenue to pay back the upfront investment. P3s are complex transactions, and determining that a P3 is likely to provide a better result than would a conventional approach is not simple. There are many factors that must be considered when determining the best procurement approach for a given project, including long-term costs, myriad uncertainties, risks both now and in the future, and complicated funding and financing approaches.[1] Public agencies may conduct VfM analyses to compare a P3 approach with a conventional approach.

1. For more information on P3s, refer to FHWA's primer, *Public–Private Partnership Concessions for Highway Projects: A Primer*, available at http://www.fhwa.dot.gov/ipd/p3/resources/primer_highway_concessions_p3.htm.

Public–Private Partnerships and Risk Assessment

Project risk must be identified, evaluated, and managed throughout a project's life for the project to be successful. Management of risks requires a public agency to proactively address potential obstacles that may hinder project success, as well as take advantage of opportunities to enhance success or save costs. P3s are considered to be a form of risk management as the public sector and private sector parties seek to achieve optimal risk allocation, thus allowing for the management of risks by the party best able to handle them.

Project risk management is an iterative process that begins in the early phases of a project and is conducted throughout the project's life cycle. It involves systematically considering possible outcomes before they happen and defining procedures to accept, avoid, or minimize the effect of risk on the project. Under a P3 transaction, risk allocation tends to be "by exception," so the concession agreement contains a finite list of "relief events" and "compensation events" that are tightly drafted and highly constrained. Everything else is allocated to the concessionaire. In contrast, under a conventional delivery approach, if a circumstance or situation arises that had not been contemplated up front, that risk (whether or not it could have been foreseen) is owned by the public sector.[2] Risk management follows a clearly identified process, which includes:

- Risk identification.
- Risk analysis.
- Risk response planning (including transfer of risks to the private sector).
- Risk monitoring, controlling, and reporting.

2. For more information on the risk management process for construction, refer to FHWA's *Guide to Risk Assessment and Allocation for Highway Construction Management*, available at http://international.fhwa.dot.gov/riskassess/pl06032.pdf. Another useful resource is the Transportation Research Board's *Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs* (NCHRP Report 658), available at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_658.pdf.

Risk analysis is used in the development of a P3 project for a number of reasons:

- To develop agreement provisions that optimize value for money (discussed in chapter 6).
- To calculate risk adjustments as part of value for money assessments.
- To help determine project contingency amounts.
- To identify and monitor mitigation actions (i.e., risk management).

Note, however, that P3s may be used to manage not only construction risk, but also to address pre-construction (development phase) risks, financial risks, and risks related to the project's life cycle.

Structure of This Primer

This primer is structured as follows: How the extent of risk transfer varies by type of project and type of P3 contract is discussed in chapter 2. The key types of risks faced in P3 projects are outlined in chapter 3. The analysis of project risks to assess their cost impacts is discussed in chapter 4, and how risks are optimally allocated between the public and private sectors to minimize total project life-cycle costs is explained in chapter 5. In chapter 6, there is a discussion of how costs of risks under conventional and P3 procurements may be incorporated into VfM analyses, which is often used to compare the two procurement options, and a summary and conclusion are provided in chapter 7.

CHAPTER 2

Project Risks in Public–Private Partnerships

Extent of Risk Transfer by Project Type

P3s can involve existing "brownfield" projects (i.e., the lease of an existing facility), or they can involve proposed new facilities, which are known as "greenfield" projects.

For brownfield projects, a public entity generates a capital inflow or debt payoff by transferring the rights, responsibilities, and revenues attached to an existing asset to a private sector entity for a defined period. Risks to the private entity are lower, because little or no new construction is involved, and traffic volumes and toll revenues can be more accurately projected based on existing traffic patterns.

In the case of a greenfield project, a public agency transfers all or part of the responsibility for project development, construction, and operation to a private sector entity. Greenfield projects generally present higher risks to both parties than do brownfield projects because of the greater uncertainty surrounding traffic forecasts, permitting, and construction. Given the complex role that revenue risk plays in a P3 deal, this particular risk is generally separated from other risks when considering whether to have a toll concession or an availability payment concession (discussed later in this chapter).

In the case of a hybrid project, an existing facility is in need of capital improvement (usually either extension or expansion), and a private sector entity is brought in to finance the necessary improvements and to operate the facility. Although traffic risks may be lower for a hybrid project relative to a greenfield project, they may still be significant because of difficulties in forecasting the users' willingness to pay any new or substantially increased tolls that may be proposed to cover the costs for the project. In addition, there may be contentious issues with regard to latent defects.

Extent of Risk Transfer by Type of Public–Private Partnership

P3s encompass a variety of contractual structures, with various degrees of risk transfer to the private sector. The extent of risk transfer in the most common forms of project procurement is illustrated in table 1.

Table 1. Procurement models and range of risk transfer to the private sector.

P3 Structure	Design Risk	Construction Risk	Financial Risk	O&M and Rehab Risk	Traffic Risk	Revenue Risk
Design–Bid–Build (DBB)		Partly				
Design–Build (DB)	X	X				
Design–Build–Finance (DBF)	X	X	X			
Design–Build–Finance–Operate–Maintain (DBFOM)	X	X	X	X	Yes, if toll or traffic-based payment	Yes, if performance-based payment

Note: P3 = public–private partnership, O&M = operations and maintenance, Rehab = rehabilitation.

The P3 structure with the lowest level of private sector involvement is DB. Under DB, the same firm is responsible for both the design as well as the construction of the facility, whereas under the conventional design–bid–build (DBB) approach, separate firms are responsible for design and construction. For both structures, the public agency remains responsible for financing and operating the project; however, a greater amount of risk is transferred to the private sector entity under a DB structure, because the contractor provides a maximum price for both design and construction. The principal reason that DB transfers significant risk away from the public owner is that many construction claims arise due to issues at the design–construction interface, including design errors and omissions and constructability problems. The DB form of contract eliminates the source for construction claims of this type by introducing single source accountability.

With a design–build–finance (DBF) structure, the private sector entity is in charge of financing and building the project but leaves the O&M of the facility to the public agency. Design–build–finance–operate–maintain (DBFOM) adds private financing to the design, construction, and O&M of the project (see figure 1). The public agency may have to provide a public subsidy to the project, which may require use of bond proceeds or budgetary authority, but the public agency will not usually finance the entire project under this P3 structure. This form of P3 is also called a *concession*.

In the case of a toll-based DBFOM concession, the private sector entity shoulders a considerable amount of risk linked to the uncertainty of traffic over the life of the project. The investment decision and the financing structure are determined based on traffic projections: If actual traffic is lower than projected, then the private sector partner is exposed to financial loss and to the risk of defaulting on project debt. If traffic and revenue are higher than expected, then the private partner could make super profits. To protect against this, a revenue-sharing clause is usually included in the P3 agreement. In some P3 agreements, the concessionaire may be protected from revenue shortfalls when lower than expected traffic is realized by allowing for "flexible term" concessions and "revenue bands." With flexible term concessions, the term of the concession ends when a specified net present value (NPV) of the gross toll revenue stream is reached. With the revenue band approach, upper and lower bounds of the expected toll revenue stream are set contractually. On one hand, if toll revenue is below the lower bound, then the public sponsor provides a subsidy to make

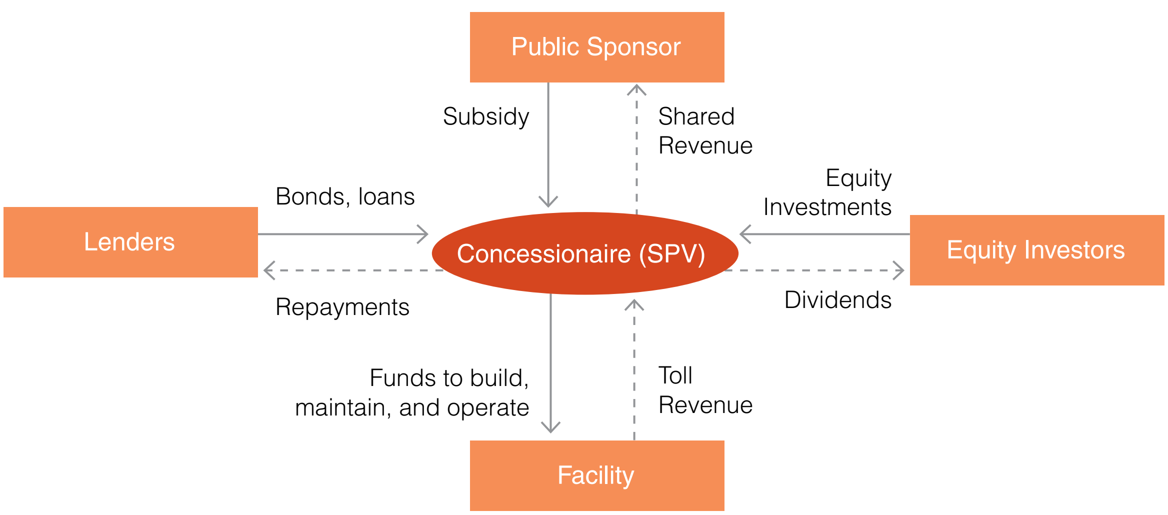

Figure 1. Public–private partnership structure under a design–build–finance–operate–maintain concession. Solid lines = cash flows into project. Dotted lines = cash flows out of project. SPV = Special Purpose Vehicle.

up some of or the entire shortfall. On the other hand, revenues in excess of the upper bound are shared with or turned over entirely to the public sponsor.

Excessive traffic risk can deter private sector entities or reduce their ability to secure financing. For greenfield projects, traffic volume is more difficult to accurately forecast than for already existing brownfield projects. Public agencies may therefore modify the P3 structure for greenfield or hybrid projects to offer guaranteed payments to the private sector partner. A *shadow toll-based concession* allows the public agency to compensate the private sector entity based in part on a "shadow toll" or fee[3] paid by the public agency for each vehicle that uses the facility. Such payments generally have a fixed component that guarantees partial revenue, even if traffic volume were to be below projections.

With an availability payment-based concession, the public agency retains the traffic risk by making payments directly to the private sector partner based on the availability of the facility rather than on the number of vehicles. Payments are contingent on achievement of pre-agreed performance standards; however, the private entity is exposed to long-term appropriations risk. Examples in the United States include the Interstate-595 express lanes in Florida and the Presidio Parkway in California.

3. A *shadow toll* is called a *pass-through toll* in Texas and is used primarily for interagency agreements rather than for concession agreements.

CHAPTER 3

Types of Project Risks

All projects, whether undertaken by using conventional procurement methods or by using a P3 approach, have known risks, "known–unknown" risks, and unknown risks. *Known risks* are risks that have been identified. Identified risks need to be proactively managed throughout the project life cycle by (a) identifying who owns the management of those risks and (b) determining what the risk entails, its triggers, and the contingency plans that would prevent those risks from occurring or that would lessen the impact on the project should they occur. At times, the risks may simply be accepted by a project if the cost to avoid or mitigate the risk is more than the cost of the potential consequences.

Unidentified risks can be known–unknown or unknown. *Known–unknown risks* are those that are known, but it is unknown how they could affect the project. For example, the probability of some risks occurring, such as changes in material costs and even natural disasters, can be calculated based on historical information. *Unknown risks* are totally unknown and therefore not possible to prevent or manage. Examples are certain unprecedented events, such as terrorist attacks, civil unrest, or natural disasters uncommon to a region. A challenge during the risk-identification process is to reduce the presence of unknown risks during the project life cycle. Known–unknown and unknown risks cannot be managed proactively and thus most often are addressed by allocating an acceptable level of general contingency against the project as a whole, which is adequate to manage a reasonable level of unknown risk.

Risk identification is an important component in the development of a P3 framework. The focus of P3s is on known risks that can be mitigated by allocation to one of the involved parties as well as by other methods, such as insurance and quality control. The most common risks of highway projects are listed in table 2. They are grouped by project phase and are detailed in the following sections.

Risks in the Development Phase

Planning and the National Environmental Policy Act Process Risks

The environmental review required under National Environmental Policy Act (NEPA) provisions is a time-consuming and costly effort, and environmental issues raised during the review process can threaten the viability of the project. Project alternatives that are considered during the NEPA process should be viable and financeable as a P3, taking into consideration the availability of public funds. NEPA is often a major constraint on a private entity's ability to offer Alternative Technical Concepts (ATCs), because any significant change can invalidate NEPA approvals. When a project is considered for procurement as a P3, there are various best practices that can ensure that the NEPA process is conducted in a way that allows efficiency for a future P3, for example, by avoiding over-specification of the project at the NEPA stage in a way that would restrict future innovation.

Although the role that the private sector can legally play in the NEPA process is severely restricted, the cost of the NEPA review can be shared between public and private partners. In addition to the NEPA requirements, certain States, such as California, have specific environmental requirements. One way to mitigate NEPA risks is for the public sector to have the environmental process near completion before releasing a P3 solicitation.

Table 2. Key types of project risks to public or private partners.

Phase	Type of Risk
Development phase	• Planning and environmental process. • Political will. • Regulatory. • Site. • Permitting. • Procurement. • Financing.
Construction phase	• Engineering and construction. • Changes in market conditions.
Operation phase	• Traffic. • Competing facilities. • Operations and maintenance. • Appropriation. • Financial default risk to public agency. • Refinancing. • Political. • Regulatory. • Handback.

Political Risks

To be successful, P3 projects must be supported by strong political will at all levels of government. This includes support from the legislative and executive branches as well as from the general public. A lack of political commitment is one of the critical risks during the project development phase. It can lead potential private partners to withdraw from the project if concerns arise surrounding the certainty of investment terms. Manifestations of political risk include the outright cancellation of projects by the public agency, the inability to reach an agreement between the public and private partners on the project structure, and the failure to appropriate funds necessary for the proposed project.

Cancellation of a project or failure to reach an agreement between the private and public partners due to lack of political commitment can make it more difficult to attract the private sector in future P3 projects that may be proposed by the public agency.

Political risk is heightened if State P3 legislation allows for a veto of the project by a State or local assembly. The uncertainty surrounding final approval of the project and the inclusion of local political pressures in the decisionmaking process are powerful deterrents to private sector investment.

Regulatory Risks

A clear prerequisite to the development of P3 projects is the existence of P3-enabling legislation. Regulatory risk exists when an inadequate P3 framework is in place. State and local P3 legislation must contain certain provisions to ensure that the P3 program can be attractive to the private sector while protecting the public interest. P3 regulations should provide sufficient guidance, striking the right balance between flexibility and certainty. This will encourage private sector interest.

Desirable provisions in P3 legislation include a requirement for clear procurement guidelines and decision criteria, flexible project eligibility criteria, and the ability to revise toll rates over the project's life (Hedlund & Chase, 2005). Overall, restrictive P3 statutes (e.g., restricting P3s to a pilot program or requiring multiple legislative approvals for a project) are less likely to attract private sector interest than are more flexible legislative provisions. Other regulatory restrictions may include limits on the type of procurement that is authorized, limitations on leasing, limitations on use of financing instruments (including mixing public and private funds on a given project), and restrictions on which public agencies are allowed to enter into P3 agreements (e.g., State departments of transportation but not local authorities). Restrictions on the type of projects and pilot program provisions are likely to be perceived by private sector entities as indicating a lack of long-term political commitment to P3s.

Site Risks

During the development phase, greenfield or hybrid P3 projects are exposed to a variety of risks related to the project site's ground conditions. Issues can arise with regard to the suitability of the site, including environmental contamination, poor geological conditions, and archeological remains. Community relations can also lead to site risks if there is a significant amount of local hostility toward a project. In these cases, site risk becomes closely tied to political risk, as local opposition to a project can jeopardize its political support.

Community relations issues can also lead to or worsen right-of-way acquisition risk. In some cases, the public agency will take responsibility for the acquisition of the required land, or the land will be Federal or State-owned land. On occasion, however, the private sector entity must acquire land (e.g., Dulles Greenway in Virginia) that not only allows for the possibility of a real-estate–related upside, but also increases the risk to the private sector. The State may need to use their condemnation rights in extreme cases.

Permitting Risks

The successful development of P3 projects is tied to the ability of the private sector entity to receive the required Federal, State, and local permits. Permitting issues that stem from a lack of preparedness or from difficulties caused by the project's design can cause considerable delays and additional costs. As with site-related issues, public agencies and the private sector partner can share the responsibility for permitting to varying degrees.

Procurement Risks

Procurement risk refers to the risk of failed or flawed procurements. This includes fewer proposers than anticipated, affordability threshold exceeded by lowest bid, procurement award successfully challenged, or noncompliant or low-quality bids submitted. Procurement issues can be caused by general market conditions, but they most often stem from flaws in the design of the procurement process or unsuitable project structures/risk transfer expectations. It is important that public agencies not be constrained in their procurement practices by regulations that require that they award contracts to the lowest price bidder rather than to the bidder presenting the best value. There are often valid reasons for conducting a lowest price competition with a quality threshold, and many proposers prefer this arrangement. In best value procurements, technical or financial quality plays a significant role in the award decision. The public owner needs to understand the value associated with the quality factors (Scott, Molenaar, Gransberg, & Smith, 2006).

P3 legislation or guidelines often include procurement procedures for P3s that specify evaluation criteria for P3 proposals, including technical, financial, and innovation criteria; however, procurement issues can arise from a lack of clarity in response requirements, excessive financial commitment requirements, insufficient protection of design and proprietary information, or a lack of transparency in the selection criteria. The procuring agency's track record with P3s and other procurements also influences bidders' perception of procurement risk. Procurement risk for private entities seeking to bid on a project can be significant, because it is very expensive to prepare a proposal.

Financing Risks

Risks associated with financing for P3 projects can result in the inability to reach financial close or can lead to default on project debt during the operating period. Inaccurate or overly optimistic traffic projections and underestimated project costs can lead to the development of pro forma financials that appear to justify the investment decision but that do not reflect the project's actual ability to repay debt or to meet equity investors' return requirements. On project cost estimates, both equity investors and commercial lenders will look to achieve realism in the estimates and will subject them to similar stress tests. Lenders may, however, take a more conservative view of traffic volume projections, and their conclusion on the viability of the project might differ from the more aggressive outlook of the private sector entity. This could make financing difficult to obtain on reasonable terms.

Both commercial and public lenders make their decisions based not only on the intrinsic risk of project default, but also on external factors. Transportation projects have high capital costs and long-term revenue streams and are therefore generally financed over 20 or 30 years. With constrained financial markets since 2007, however, banks have become reluctant to have outstanding repayments for such lengthy periods of time. Commercial lenders have demanded more stringent terms, including higher minimum debt service coverage ratios and shorter loan life terms, tighter dividend distribution covenants, higher margins, mandatory refinancing and cash sweep provisions, and requirements for multiple reserve accounts (e.g., for debt service, O&M, and capital improvements).

Many P3 projects today achieve a significantly reduced cost of capital through government loan programs, such as the Transportation Infrastructure Finance and Innovation Act (TIFIA) program, to provide long-term subordinate debt. The availability of TIFIA financing depends on the project's eligibility, the amount of budgetary authority available to TIFIA, and the successful mitigation of project risks. Financing risk exists even for projects with strong economics due to the limited amount of credit available from private and public sources.

Financing risks can also be related to regulatory risks. For example, if the tax treatment is not clearly outlined by the P3 regulations or the concession agreement, private lenders are likely to be unwilling to accept the risks. This reinforces the importance of transparency and predictability in P3 legislation, policies, and guidelines.

Risks in the Construction Phase

Engineering and Construction Risks

Engineering risk encompasses several sub-risks, including design risk, construction cost risk, and latent defect risk. *Design risk* refers to the potentially negative effects to the project resulting from flaws in the design work. Design flaws can lead to delays and cost increases, as well as produce environmental and safety issues, both during the construction and during the operations period of a project.

Construction costs are an important risk area for P3 projects, because they can be affected by increases in labor and material costs, as well as by delays and the cost of performance bonds. Construction costs are estimated during the design phase and can be locked in through lump-sum turnkey contracts (DB), which allow for fixed costs and penalties in case of completion delays. Performance bonds and completion guarantees can also be written into the construction contract to further incentivize the construction contractor to complete work on time and to reduce risk, although this practice can result in a higher contract price.

Latent defect risk is a form of risk linked to a project's construction that is present after the completion of construction. It is the risk of flaws in the infrastructure that are not apparent until operation of the facility begins. Most construction contracts make the DB contractor liable for such defects, and they include penalties and damages to compensate the owner and operator against lost revenue caused by the underperformance or lack of availability of the facility. It is only possible to lock the DB contractor into a relatively short warranty of the work following final acceptance. Major defects that arise several years after the DB contractor has finished will not generally be resolved through recourse to warranty provisions within the original DB contract. This is the reason why a P3 DBFOM provides an effective long-term hedge against latent defects in a way that a DB cannot; however, in hybrid greenfield–brownfield projects, in which the concessionaire takes responsibility for existing assets, latent defects are a very contentious issue.

It is important to note that construction cost risk is the only risk that is typically transferred under conventional procurement, although not always successfully. It is typical that under conventional procurement with DBB, the designer cannot consider all of the contractor's construction methods. The design is therefore not optimized to suit a specific contractor's sequencing, methods, equipment, and preferences. The DBB process requires the public owner to manage design and construction interfaces, which often results in claims and inefficiencies compared with DB, which has a single point of responsibility. The desire to control cost overruns is a key motivator for the public sector, but for the private sector, managing construction costs is a key risk, which the concessionaire usually handles through a DB contract with another private firm.

Change in Market Conditions During the Construction Phase

Once the final investment decision has been made by the public agency and private sector entities and the P3 agreements have been signed, significant costs are incurred for the permitting, financing, design, and construction of a project. Although it is possible to lock in engineering costs, other market conditions can change during the construction period and negatively affect the project. Changes in macroeconomic conditions can affect inflation rates, as well as projected material and labor costs. A public agency can protect itself from construction cost increases by requiring the concessionaire to submit a fixed price contract. The private sector entity will normally add an inflation factor into its final bid, which "expires" after a certain time period to protect against changes in market conditions. As an alternative, indexing approaches may be used to address inflationary cost increases.

Risks in the Operation Phase

Traffic Risks

Traffic risk (for toll-based concessions) refers to the risk that, over the life of a project, actual traffic levels do not reach projected levels. This would negatively affect the project's cash flows and the ability of the concessionaire to repay debt and generate sufficient equity returns. Traffic risk is often the core component of toll-based concessions, and its allocation defines the project and determines the remainder of the contractual arrangements. Traffic risk is present in any revenue-generating facility. It is borne either by the public agency (in the case of availability payments), by the private sector entity (in the case of toll-based or shadow toll-based concessions), or may be shared by both.

Traffic risk can be influenced by several factors, including the quality of the initial traffic projections, changes in the macroeconomic environment, the existence of alternative routes, and the level of user fees. Initial traffic projections are subject to a thorough vetting by lenders. This vetting can include requiring a review of the initial projections by an independent expert, lowering the risks associated with the quality of the projections.

Competing Facilities Risks

Competing facilities present revenue risk for toll-based P3 projects. Existing or planned competing facilities can be integrated into traffic and revenue projections, and diversion from the proposed toll facility can be modeled; however, calculating the risk of new (i.e., not previously planned) competing facilities built during the operation phase of a P3 project is less straightforward. Some P3 agreements include a non-compete clause whereby the public agency agrees not to grant permits to a competing facility or to compensate the concessionaire if a new competing facility is constructed that negatively affects revenue from the existing P3 facility. The burden of proof typically lies on the private party to demonstrate harm. The public sector may identify planned facilities that are exempt from qualifying as "relief events" or cause for compensation.

Additional risks in the operations phase include technology risk, toll violation and toll collection enforcement risks, and risks related to toll escalation with policy caps. Positive impacts from facilities built by the public sector must also be taken into account. In Texas, the concession agreements specify that construction of facilities that induce traffic on the P3 facility and the net effect must be considered.

Operations and Maintenance Risks

O&M risk may result from actual physical issues with facilities or by an increase in O&M costs. O&M risk can also translate into loss of revenue if the facility needs to be closed for an extensive overhaul or if its capacity is reduced during maintenance activities.

O&M costs forecasted at the time of the project's development generally include cost increases based on inflation or other predetermined factors. Costs can, however, increase beyond the anticipated level, for example, in cases in which labor costs increase above expectations.

Insufficient maintenance can lead to a deterioration of the condition of a project and can ultimately lead to closures, which in turn will cause a loss in revenue (either from tolls or from availability payments) and damage the public's perception of the project. Loss of availability due to natural disasters and similar events is, however, generally considered to be caused by force majeure events and may be insured or designated as a risk to be shared by the public and private partners. For hybrid greenfield–brownfield projects in which the concessionaire takes responsibility for existing assets, latent defects represent a significant risk that can raise contentious issues.

Appropriations Risks

Appropriations risk is the risk that the public agency is incapable of meeting its financial obligations to the project, because funds for the project fail to be obligated to its budget. Appropriations risk can affect P3 projects in which the public agency is expected to make payments, either as lump sum payments during the construction period or as availability payments during the life of the project. This risk can be caused by political issues (if there is strong local opposition to the project) or by a change in economic conditions affecting public sector revenues.

Financial Default Risks to the Public Agency

Financial default risk is the risk borne by the public entity that the private sector entity will have financial difficulties that will prevent it from performing its duties according to the P3 contract's terms. Unless there are flaws with the project itself, projects for which a private partner is in financial difficulty can generally be sold to another private sector entity or to a government entity, which allows for continuity of operations. An example is the South Bay Expressway P3 project in San Diego, CA, which went into bankruptcy and was sold to the San Diego Association of Governments, a government entity. In normal circumstances, a P3 agreement would be set up to allow for lender step-in rights prior to the private sector entity's default. The lenders would then be able to manage the project while ensuring that the public agency is fully involved in the process.

Refinancing Risks

Financing risk remains present during the operating life of a project. Depending on the initial financing terms, P3 projects can be exposed to interest rate risks, especially if the concessionaire has entered into a floating rate loan and has opted not to hedge. Loan agreements can also carry mandatory refinancing provisions; this provision exposes a project to financing risk when it seeks to refinance its existing loan. To maintain similar debt service coverage ratios—and therefore the same level of default risk—private partners must be able to secure a loan of the same amount as the outstanding principal at the time of refinancing for a sufficient loan repayment period and at an equally or more favorable interest rate.

The availability of debt at the time of the mandatory refinancing (associated with bullet maturities) cannot be known to the concessionaire at the time of the initial financing, making refinancing risk difficult to estimate accurately. In the past, the private entity has benefited from refinancing, though less so recently. Many recent P3 contracts have provisions that require that the private party share any gains from refinancing with the public agency.

Regulatory Risks

During the operations phase, relevant Federal or State statutes may change. For example, laws governing high-occupancy toll (HOT) lanes may be revised, such as vehicle occupancy requirements for toll-free service or minimum speed requirements. The public and private partners will need to address these risks in the P3 agreement by stating that discriminatory changes in law qualify as relief events.

There are also risks associated with how contract performance standards are interpreted and overseen by the public agency. One risk considered by the private sector is that a new political administration will come in that is hostile to the deal and will seek a more stringent interpretation or enforcement of certain standards to undermine the private partners' credibility. There are also regular changes to State Department of Transportation (DOT) policies regarding technology, asset management, and maintenance practices with which the private sector may be expected to conform.

Handback or Residual Value Risks

Handback risk or *residual value risk* is the risk that facility conditions are worse than anticipated at the end of the project. Handback provisions include the terms, conditions, requirements, and procedures governing the condition in which a private partner is to deliver an asset to the public sector upon expiration or earlier termination of the P3 agreement, as set forth in the contract. Contracts need to be structured so that there are financial incentives at the end of a contract to encourage the private partner to make the investments necessary to hand back the facility to the public agency in suitable condition.

CHAPTER 4

Risk Valuation Methods

Risk analysis is used in the development of a P3 project for a number of reasons:

- To develop agreement provisions that optimize value for money (discussed later in this primer).
- To calculate risk adjustments as part of VfM assessments.
- To help determine project contingency amounts.
- To identify and monitor mitigation actions (i.e., risk management).

For major projects in the United States, a series of risk workshops is generally conducted to develop a project *risk register,* also known as a *risk matrix*, which is used to manage risks throughout all phases of the project. An example of a risk register is presented in table 3. The risk register will usually comprise the following components:

- *Risk Category*—Type of risk (as discussed in chapter 3).
- *Risk Topic*—Identifies the specific risk.
- *Risk Description*—Includes a summary of the potential loss if the risk event occurs.
- *Risk Probability*—Likelihood of a risk occurring (e.g., high, moderate, or low).
- *Potential Consequence*—Effect of the risk should it occur.
- *Allocation of Risk*—Whether the risk will be transferred to the private sector, be shared, or be retained.
- *Treatment Options*—Actions that can reduce the likelihood or consequences of a particular risk (i.e., risk mitigation).

The risk matrix may also include the results of risk valuation, that is, either a qualitative priority ranking or a

Table 3. Example of a risk register.

	Example 1
Risk category	Right of way (ROW)/Utilities
Risk topic	ROW acquisition
Impact phase	Construction
Risk description	The project is to be constructed in an area that is developing rapidly, so land prices are highly volatile. As a result, the cost of ROW acquisition could be significantly higher than in the current estimate.
Consequence of risk	Higher prices in the future would result in an increase in project costs.
Ability to transfer risk	It may be possible to transfer this risk in a PPTA contract, but a high-risk premium may be included by offerors if they feel unable to control or influence the underlying economic drivers. It may be more cost-effective for the agency to accept this risk and try to mitigate it.

Note: PPTA = Public–Private Transportation Act.
Source: From *PPTA Risk Analysis Guidance* (p. 46), by the Virginia Office of Transportation Public–Private Partnerships, September 2011, Richmond, VA. Copyright 2011 by the Virginia Office of Transportation Public–Private Partnerships. Adapted with permission.

quantitative estimate of the potential financial cost or "risk premium" based on the consequence and likelihood of a risk occurrence. This chapter focuses on risk valuation methods.

Qualitative Risk Analysis

Qualitative risk analysis includes methods for prioritizing the identified risks for further action. It assesses the priority of identified risks by using their probability of occurrence, the corresponding effect on project objectives if the risks do occur, and the role of other factors, such as the time frame and risk tolerance of the project.

A typical qualitative assessment based on the process used by the Virginia DOT is discussed in this section. Workshop participants are asked to conduct a qualitative risk valuation for each risk by using their professional judgment and experience from previous projects. If available, historic data from similar previous projects and details of specific risk events are used to inform the risk assessment. The valuation is conducted by categorizing risks based on their probability of occurring and cost and schedule impact, as noted in the following paragraphs.

Probability Range—Any risk event that has a probability of occurring of 90 percent or above would be included in the cost estimate and not on the risk register. One of the following options is selected to define the probability of the risk occurring:

- Greater than 70 percent (and below 90 percent).
- 40 percent to 70 percent.
- 20 percent to 40 percent.
- 5 percent to 20 percent.
- 0 percent to 5 percent.

Cost Impact—One of the following options is selected to define the cost impact as a percentage of the baseline project cost estimate:

- Greater than 25 percent.
- 10 percent to 25 percent.
- 3 percent to 10 percent.
- 1 percent to 3 percent.
- Less than 1 percent.

Schedule Impact—One of the following options is selected to define the schedule impact in terms of the period of time that the project would be delayed (or expedited) if a particular risk event were to occur:

- Greater than 52 weeks.
- 16–52 weeks.
- 4–16 weeks.
- 1 week–4 weeks.
- 0–1 week.

Expected risk impact for cost and schedule are automatically categorized based on the rating scales detailed in tables 4 and 5. At this stage of assessment, the impact is classified as *very high*, *high*, *medium*, *low*, or *very low*.

The appropriate impact and the color code associated with the risk impact are automatically populated in the risk register once the probability and consequence are selected.

Table 4. Qualitative assessment of cost impact of risk.

Probability		Cost Consequence				
		Greater than 25%	10%– 25%	3%–10%	1%–3%	Less than 1%
	Scale	**5**	**4**	**3**	**2**	**1**
Greater than 70%	**5**	Very High	High	High	Medium	Low
40%–70%	**4**	High	High	Medium	Medium	Low
20%–40%	**3**	High	Medium	Medium	Low	Low
5%–20%	**2**	Medium	Medium	Low	Low	Low
0%–5%	**1**	Low	Low	Low	Low	Very Low

Note: Yellow = very high to high risk. Light Yellow = medium risk. Green = low to very low risk.
Source: From *PPTA Risk Analysis Guidance*, by the Virginia Office of Transportation Public–Private Partnerships, September 2011, Richmond, VA. Copyright 2011 by the Virginia Office of Transportation Public–Private Partnerships. Adapted with permission.

Table 5. Qualitative assessment of schedule impact of risk.

Probability		Schedule Consequence				
		Greater than 52 weeks	16–52 weeks	4–16 weeks	1–4 weeks	0–1 week
	Scale	5	4	3	2	1
Greater than 70%	5	Very High	High	High	Medium	Low
40%–70%	4	High	High	Medium	Medium	Low
20%–40%	3	High	Medium	Medium	Low	Low
5%–20%	2	Medium	Medium	Low	Low	Low
0%–5%	1	Low	Low	Low	Low	Very Low

Note: Yellow = very high to high risk. Light Yellow = medium risk. Green = low to very low risk.
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Quantitative Risk Analysis

Quantitative risk analysis is performed on risks that have been prioritized by the qualitative risk analysis process as potentially and substantially impacting the project. Quantitative risk analysis is conducted to quantify risks in terms of both cost and time impact. Two alternative levels of quantitative risk analysis may be undertaken:

- *Formula-based analysis*, which uses a simple formula to calculate average risk impact for each risk by using minimum, maximum, and most likely cost and schedule impacts.
- *Monte Carlo simulation*, which uses specialized software for Monte Carlo simulation of expected cost and schedule impacts for each risk to obtain a range of aggregate risk values along with their probabilities.

A risk workshop is an effective tool for gaining expert insight into the quantification of risk probability and potential impact. Quantitative risk analysis allows an agency to conduct a VfM assessment during the preprocurement phase, as well as after bids are received. A quantitative risk analysis may also be helpful in developing key contract terms. The approaches used by Virginia DOT for quantitative analysis are discussed in the following sections.

Formula-Based Quantitative Risk Analysis

With this risk assessment approach used by Virginia DOT, workshop attendees determine specific values for:

- The probability of occurrence (between 5 percent and 90 percent) of each risk.
- A minimum (*Min*), maximum (*Max*), and most likely (*ML*) cost impact of the risk in terms of dollars.
- A minimum (*Min*), maximum (*Max*), and most likely (*ML*) schedule impact of the risk in terms of months.

The following formula is then used to calculate the risk value of each individual risk:

$$\text{Risk Value} = \text{Probability of Occurrence} \times (Min + Max + 4 \times ML)/6$$

The formula presumably attempts to replicate very simply the result that might be obtained with a more sophisticated analysis that uses simulation (discussed in the next section). A contingency amount may be added to account for unknown risks.

Many risk events are likely to have an impact on both cost and schedule. Schedule impact is quantified in units of time, but delays also have a cost associated with them. The direct cost impacts of risk events are accounted for under the analysis of cost risk, but indirect costs from delays are not. Indirect costs from delays include the added interest costs of financing and the cost of running site offices, utilities, and the time cost of engineers, inspectors, and administration staff. Indirect costs include agency indirect costs (including independent oversight/construction management) and the contractor's indirect costs. The total cost of delay is the sum of the agency indirect costs and the contractor's indirect costs. In addition, in the case of a tolled facility, there will be a loss of revenue that will also need to be accounted for.

To get a complete picture of total potential project cost, the agency can calculate the dollar value of schedule impacts by calculating a "per week" value for indirect costs and by multiplying this unit rate by the expected schedule impact/delay associated with the risk event. An average rate may be used for risk events during construction, and a second value may be used for risk events during operations. Historic data may be used to verify the amounts.

Sensitivity analysis may be used to evaluate financial outcomes when critical assumptions are changed. This can help decisionmakers to better understand how assumptions shape the expected outcomes of a project and to anticipate the types of conditions that might trigger remedial actions. Sensitivities on key financial and operating conditions may be undertaken through a number of likely scenarios, such as low-, middle-, and high-risk cases. This will provide a more accurate reflection of the potential spread of the total cost to the public agency.

Quantitative Risk Analysis by Using Monte Carlo Simulation

A Monte Carlo simulation (named after the Monte Carlo casino where the uncle of one of the creators of the technique gambled away his money) produces a deterministic sample set of likely project outcomes and the probabilities of their occurrence. The sample set is then used to develop distributions and ranges for aggregate cost and schedule impacts. The simulation provides a range of aggregate risk values that the agency may choose from, depending on what confidence threshold is required. This is not possible with a formula-based analysis.

Monte Carlo methods, however, require knowledge and training for their successful implementation. Input to Monte Carlo methods also requires the user to know and to specify exact probability distribution information, including mean, standard deviation, and distribution shape. The process is as follows:

1. Quantify probability, cost, and schedule impact as per the formula-based analysis described previously.
2. Select a distribution type (also known as an *assumption curve*) according to the nature of the risk being analyzed. Risk-modeling software allows the selection of many different assumption curves.
3. Perform a Monte Carlo simulation of cost risk and schedule risk by using specialized software.

Examples of assumption curves are shown in figure 2. The curves are probability distributions with different mean

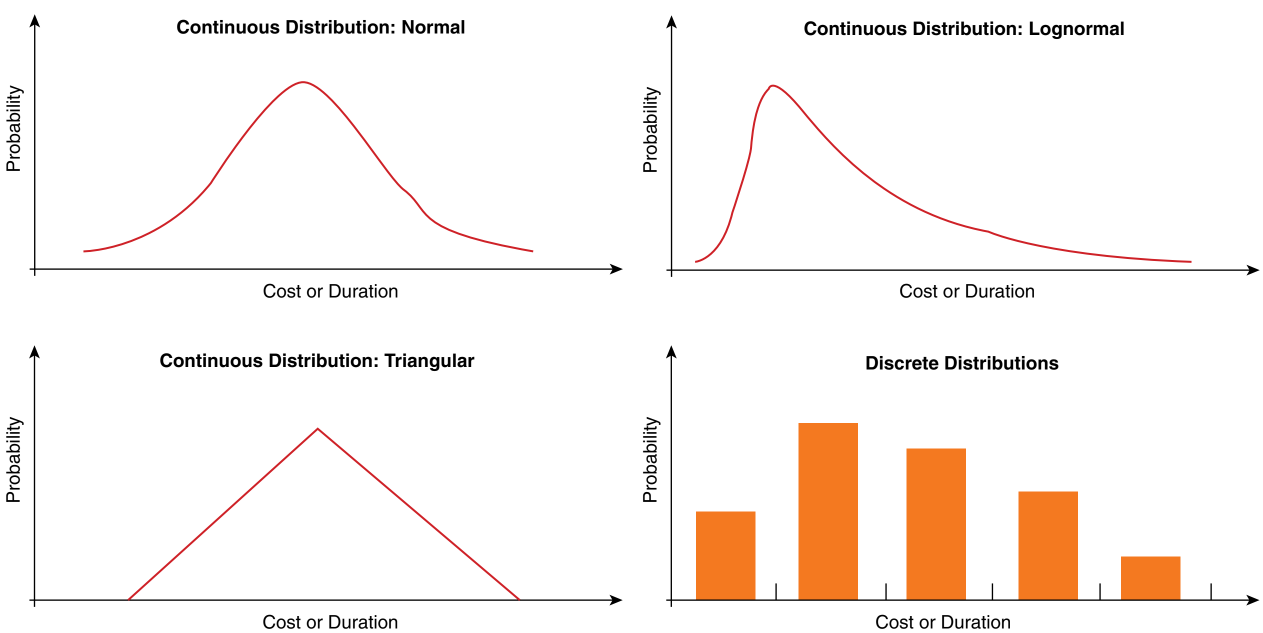

Figure 2. Distributions for risk analysis. From *Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs* (NCHRP Report 658), by Molenaar, A., Anderson, S., & Schexnayder, C., 2010, Washington, DC: Transportation Research Board. Copyright 2010 by the Transportation Research Board. Adapted with permission.

values and different standard deviation values. All four distributions have a single high point (the mode), and all have a mean value that may or may not equal the mode. Some of the distributions are symmetrical about the mean, whereas others are not. Selecting an appropriate probability distribution is a matter of which distribution is most like the distribution of actual data. For transportation projects, this is a difficult choice, because historical data on unit prices, activity durations, and quantity variations are often difficult to obtain. In cases in which data are insufficient to completely define a probability distribution, one must rely on a subjective assessment of the needed input variables.

The main output of the simulation is total values for retained, transferred, and shared risks. Several types of charts may be generated automatically by the Monte Carlo simulation software. Examples of impact distribution graphs are presented in figures 3 and 4. Aggregated risks through the use of a histogram are displayed in figure 3, and an alternative method of displaying cumulative risks with an S-curve is shown in figure 4.

The S-curve allows values to be used based on the confidence level required for the project. In figure 4, the 50th percentile (also known as the P50), mean, and 80th percentile (P80) are shown because these are the most commonly reported statistics. The mean represents the average of all generated outputs, which is not the same as the P50 unless the distribution is symmetrical. The confidence level selected will depend on the stage of assessment, confidence in cost estimates, and complexity of the project. The P80 is widely used by public agencies in risk analysis at earlier stages, when project information is less well-developed, to show a confidence level of 80 percent that risk costs will not exceed the estimated value. It should be noted that the public and private sectors have different preferences with regard to the confidence level. For example, a risk-averse public agency may use P90 as its confidence level preference, whereas private entities may be more comfortable using a P50 confidence level.

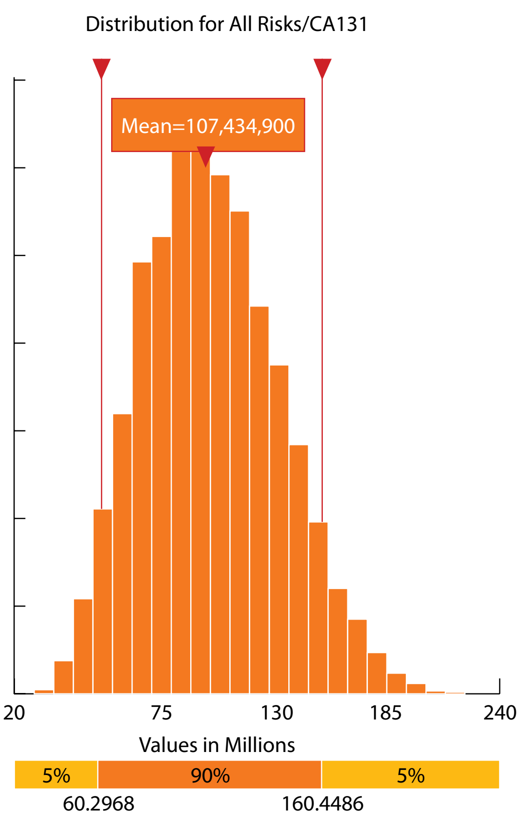

Figure 3. Risk distribution histogram. CA131 = California State Highway 131. From *PPTA Risk Analysis Guidance* (p. 23, figure 6) by the Virginia Office of Transportation Public–Private Partnerships, September 2011, Richmond, VA. Copyright 2011 by the Virginia Office of Transportation Public–Private Partnerships. Adapted with permission.

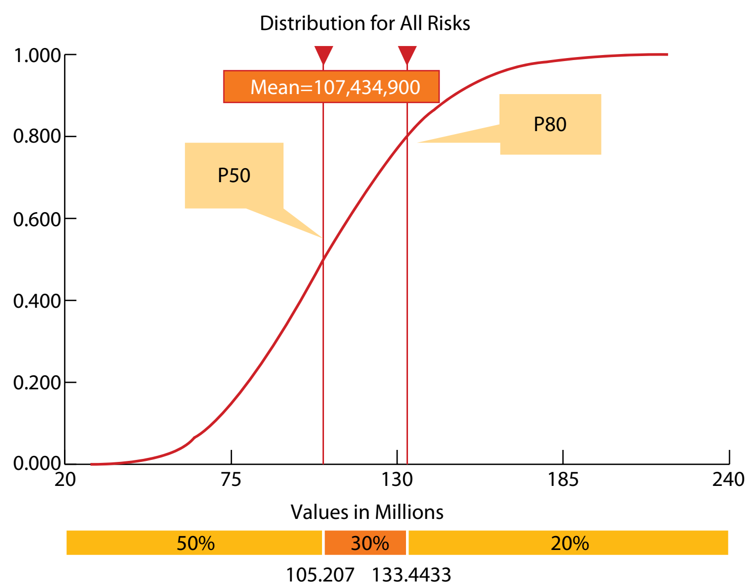

Figure 4. Risk distribution S-curve showing confidence levels. P50 = 50th percentile, P80 = 80th percentile. From *PPTA Risk Analysis Guidance* (p. 23, figure 7), by the Virginia Office of Transportation Public–Private Partnerships, September 2011, Richmond, VA. Copyright 2011 by the Virginia Office of Transportation Public–Private Partnerships. Adapted with permission.

CHAPTER 5

Risk Allocation Strategies

Risks identified in a risk register (as discussed in chapter 4) may be categorized in one of three ways:

1. *Transferrable risks*—Risks fully transferrable to the private sector.
2. *Retained risks*— Risks for which the government bears the costs, for example, the risk of delay in gaining project approvals.
3. *Shared risks*—Risks that are shared based on a combination of the above two allocations due to the nature of the risk.

Risk allocation is at the core of P3s, which are structured around the sharing of risks (and rewards) between the public agency and private sector entity. It is the transfer of risks that provides incentives to the private entity to innovate in the approach it takes to delivering a project under a P3. One study of 17 P3 projects found that risk transfer valuations accounted for 60 percent of the total forecast cost savings under a P3 approach (Andersen & Enterprise LSE, 2000). This may be due to the private entity's ability to manage a specific risk more efficiently or due to its acceptance of a lower confidence level in the valuation of the risks (as discussed in chapter 4).

Transferring too little risk to the private sector would constrain the value for money that could be achieved. In contrast, transferring too much risk (e.g., risk that the private sector is unable to manage) will result in high risk premiums, making the project more costly and driving down the value for money.

Projects with P3 agreements lend themselves to a wide range of strategies for allocating risk. This chapter examines risk allocation strategies most commonly used in managing risk for highway projects.

Risk Allocation Process

Prior to allocating risks between the public and private sectors, the risks must be identified and analyzed, as described in chapter 4. Although some level of project risk is an objective fact, the public agency and the private sector entity often have different assessments of risk from their dissimilar points of view and priorities. A comparison of differing risk assessments is an important step in achieving not only the optimal allocation of project risks among parties, but also maximum value for money. For example, the public sector may have less appetite for financial risk because it is difficult for the public agency to insulate the rest of its budget from the consequences of a default or bankruptcy. P3 partners create special purpose ventures that generally limit the liability of partners to the amount invested.

To determine the optimal allocation of risk, an agency compares the public sector's ability and willingness to manage each risk to the ability and willingness of a potential private partner to do the same. Risks that the private sector is more capable of managing are transferred; risks that the public agency is more capable of managing are retained. Where possible, the party with responsibility for managing the risk will seek to mitigate or avoid that risk. If a risk is difficult to assess or manage, it may be appropriate that it should be shared between the public and private sectors. An effective risk allocation should create incentives for the private sector to supply quality and cost-effective services.

Although the concept behind optimal risk allocation is clear, the practice of how agencies allocate risks is more of an art than a science. In a typical scenario, the public sector will be expected to take on regulatory risks. Site risks—for example, utilities, ground conditions, or hazardous materials—may be transferred or shared. The private sector will be expected to take on risks arising from the building, operation, finance, and management of the project. The concessionaire may choose to transfer risks to other private parties by selling equity stakes, holding subcontractors responsible for performance, and/or insuring against certain risks.

Public Sector Standpoint

From the public agency's standpoint, P3 projects are considered to be a means for transferring the project risks to the private sector; however, transferring all of the risk to the private sector entity does not necessarily produce the optimal outcome, particularly if there is no potential upside for the private sector entity. In such cases, transferring all of the risk will only increase the private sector entity's required return on investment as it will not be able to efficiently manage all of the risk transferred to it. In addition, the private sector entity may lose interest in the project during the development phase, leading to failed bids. If the private entity does accept excessive risk, it could face financial difficulties during operations, leading to default and potentially to an interruption or decline in service. Risk allocation is better envisioned as the practice of finding an equilibrium point where the level of risk to be borne by the public agency and the private sector entity is acceptable to both.

P3s are structured on the basis of risk–reward trade-offs. Both the public and the private sectors have tolerance levels for risk and required returns (see figure 5). P3s must contain a balanced risk–reward profile to be considered attractive by the public and private sectors.

Private Sector Standpoint

From a private entity's standpoint, P3 projects need to adequately balance risks and rewards. In other words, if there is a risk of loss (downside risk), there should be an opportunity for higher gains (upside risk) to compensate. For example, private sector entities will not accept excessive traffic risk if tolls are capped at relatively low levels.

The private sector entity's willingness to accept a particular risk also depends on its ability to manage the risk, the existence of sufficient rewards to compensate for the risk, and the clarity of the contractual dispositions transferring the risk. Private sector entities have a risk–return tolerance level above which their investment decision becomes positive. The shape and position of this risk tolerance (see figure 5) can change over time as the cost of capital and return requirements change.

Optimal Risk Allocation

A successful P3 arrangement allocates risk in an optimal manner that is acceptable to the public agencies and private entities alike. Each risk is allocated to the party best suited to manage or mitigate it.

Optimal risk allocation can be graphically represented as the area that is within the acceptance level of both parties (see figure 5). This area forms the boundaries for the negotiations of P3 agreements. Public agencies strive to ensure that this optimal allocation is achieved at the lowest possible cost for taxpayers, whereas private sector entities attempt to maximize their returns within the acceptable boundaries. Under an optimal risk allocation scheme, risks are generally allocated (as shown in table 6), which shows how risk allocation differs for DBFOM projects relative to conventional procurement (DBB) and DB. Note that there is a significant level of detail not shown in table 6. For example, even though it is a starting point to transfer all permit risk to the private sector under a P3, it is often a more complex risk allocation in practice: The public sector takes on the risk of the initial permits, but the private sector takes on the risk of any permit amendments associated with detailed design.

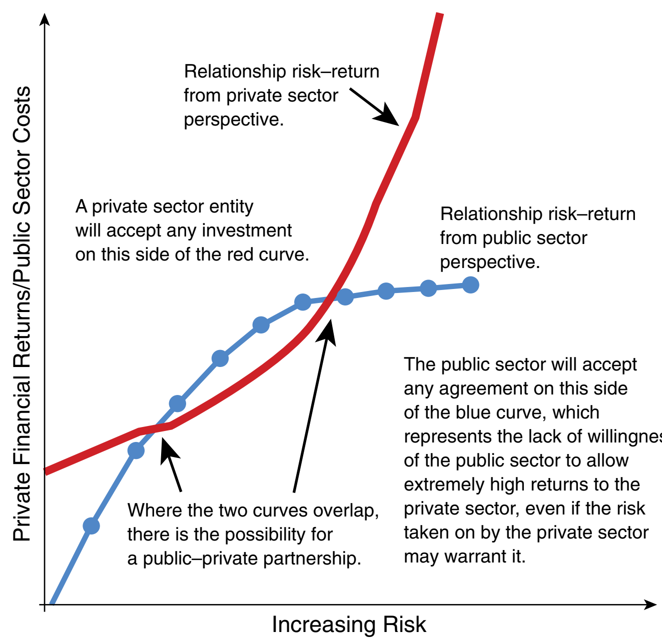

Figure 5. Optimal risk allocation in public–private partnership projects for both the public and private partners.

Table 6. Common risk allocation under conventional and public–private partnership procurement.

Risk	Design–Bid–Build	Design–Build	Design–Build–Finance–Operate–Maintain
Change in scope	Public	Public	Public
National Environmental Protection Agency approvals	Public	Public	Public
Permits	Public	Shared	Private
Right of way	Public	Public	Shared
Utilities	Public	Shared	Shared
Design	Public	Private	Private
Ground conditions	Public	Public	Private
Hazmat	Public	Public	Shared
Construction	Private	Private	Private
Quality assurance/Quality control	Public	Shared	Private
Security	Public	Public	Shared
Final acceptance	Public	Private	Private
O&M	Public	Public	Private
Financing	Public	Public	Private
Force majeure	Public	Shared	Shared

Note: O&M = operations and maintenance.
Source: From *PPTA Risk Analysis Guidance* (p. 18, table 4), by the Virginia Office of Transportation Public–Private Partnerships, September 2011, Richmond, VA. Copyright 2011 by the Virginia Office of Transportation Public–Private Partnerships. Adapted with permission.

CHAPTER 6

Incorporating Risk Into Value for Money Analysis

Role of Risk Assessment in Evaluating Public–Private Partnerships

VfM analysis has been used in many countries to help government officials ensure that when entering into a P3 agreement, they are in fact getting a better deal for the government than they would through conventional approaches to procure the same project. VfM analysis is used to compare the aggregate revenues and the aggregate costs of a P3 project procurement against those of the conventional public procurement alternative. An assessment of project risks is a key input into VfM analysis.

Under the conventional DBB procurement process, although contractors assume significant risks—such as labor supply and weather risks—public agencies typically retain a significant portion of the risks associated with a project. When public agencies take on major projects under a conventional procurement process, they do evaluate risks, but budget and schedule estimates are often uncertain. In addition, the full life-cycle costs of a project are typically not considered.

P3 procurement processes require a transparent accounting and valuing of risks, because the risks transferred to the private sector will generally be factored into the costs of bids as a risk premium. The bid price accounts for risks that the public sector may not normally consider but must nonetheless be managed. For example, *force majeure*—a natural event that may significantly damage the project or reduce the number of users—is a risk that will have an impact on the revenues of the project. The private sector proposal will reflect the expected value of that risk, which may be affected by the availability in the market of business interruption insurance, whereas the pricing for the conventional public sector approach typically does not (although the risk is considered if bonding of toll revenue is sought by the public sector).

Through a VfM analysis, the public sector can understand the totality of a project's costs and can make certain risk cost adjustments to get an "apples-to-apples" price comparison of different procurement options. VfM analysis can help answer the question, "Is it worth paying a price premium to a private concessionaire to take on certain project risks in return for establishing a reliable fixed cost in the future?" The methodology for conducting a VfM analysis basically involves:[4]

- Creating a Public Sector Comparator (PSC), which estimates the life-cycle cost (including operating costs and costs of risks, which are not typically considered in conventionally procured projects) of procuring the project through the conventional approach, in terms of Net Present Value (NPV).
- Estimating the life-cycle cost of the P3 alternative (either as proposed by a private bidder or a hypothetical "shadow bid," which attempts to predict the bidder's costs, financing structure, and other factors at the preprocurement stage).
- Completing an apples-to-apples comparison of the costs of the two approaches.

A PSC is first developed as a baseline against which a P3 project, either hypothetical or as proposed by a private bidder, will be compared. A favorable comparison, in which the P3 achieves the same outcome for lower overall costs than does the PSC, shows the P3's ability to generate value for money. An unfavorable comparison is evidence that the P3, as imagined or proposed, may be unwarranted.

The PSC estimates the hypothetical risk-adjusted cost if a project were to be financed, implemented, and operated by

4. See FHWA's *Value for Money Analysis: A Primer*, February 2014.

the public sector. The PSC is generally divided into five elements: the "raw" PSC, financing costs, competitive neutrality, retained risk, and transferable risk. The *raw PSC* includes all capital and operating costs associated with building, owning, maintaining, and delivering the service over the predetermined term of the P3 agreement. *Competitive neutrality* removes any competitive advantages or disadvantages that accrue to a public sector agency, such as freedom from taxes, and is discussed in the following paragraphs. *Retained risk* refers to the value of any risk that is not transferable to the private sector, and *transferable risk* refers to the value of any risk that is transferable to the private sector.

Competitive neutrality removes any competitive advantages and disadvantages that accrue to a public sector agency by virtue of its public ownership, such as freedom from taxes. Taxes are costs that ultimately result in revenues to the public sector. It might be possible to distinguish among the various levels of government to whom taxes are paid, so that taxes paid to the Federal Government are treated differently from State or local taxes. A similar adjustment is required with respect to insurance. When the government chooses to self-insure, there is a perception that the government has saved on insurance premiums. In fact, the government is taking on risks otherwise covered by insurance, and the government should account for this additional risk. An adjustment is made to the PSC by adding an amount equivalent to the premium otherwise paid by the private sector under a P3 to account for the additional risks. Examples of public sector disadvantages include the additional costs associated with accountability, public scrutiny, and reporting requirements. A private company may sometimes have fewer of these costs when pursuing the same project.

Once established, the PSC's overall cost is used as a benchmark against which the costs and risks to be borne by the government under a P3 agreement are compared. The P3 option is analyzed for its whole-life total cost to the government, including the NPV of the project's direct costs and the value of any retained risks not transferred to the private sector. Generally speaking, as shown in figure 6, a P3 proposal must cost less than the PSC to be preferable to a conventional procurement approach.

The example depicted in the bar chart in figure 6 portrays a comparison between a public procurement with a baseline present cost of $60 million and a P3 shadow bid for which the baseline present cost (net of financing costs) is $65 million. Although the baseline P3 cost is $5 million more and imposes an additional $6 million in ancillary and financing costs, the $13-million reduction in the cost of risk, due to transfer of some risks to the private sector and $8 million in competitive neutrality adjustments, overcomes these cost differences and results in a net savings to the government of $9 million overall, offering 8 percent in value for money. This example illustrates the central tradeoffs that often characterize P3 procurement: The government trades away significant risks in exchange for higher baseline and financing costs in the P3 scenario.

Risk Cost Adjustments for Value for Money Analysis

Once risks have been quantified and allocated as discussed in chapters 4 and 5, their value (i.e., the likely cost of these risks should they occur) needs to be incorporated into the VfM analysis in order to compare procurement models on a risk-adjusted basis.

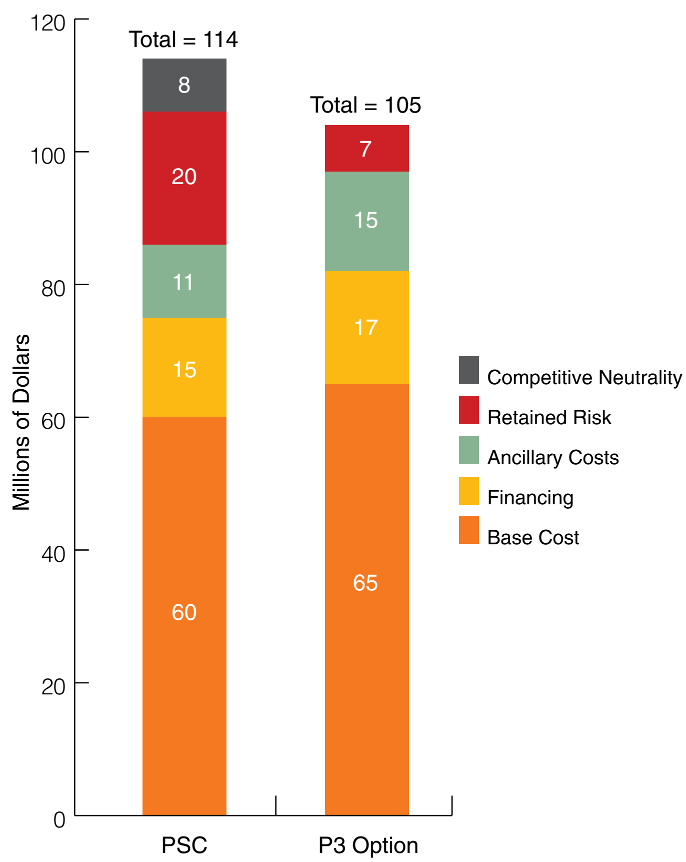

Figure 6. Calculating quantitative value for money. PSC = Public Sector Comparator, P3 = public–private partnership.

For the VfM assessment undertaken at the preprocurement stage, the main steps in the analysis are as follows:

1. Develop quantified risk assessments for both PSC and shadow bid options. The main difference in cost will be due to risks transferred to the private sector in the shadow bid option, under which the expected cost of transferred risks will be lower.
2. Sum up the present values of retained, transferred, and shared risk costs, allocating the cost of shared risks between transferred and retained risk costs by using a ratio of 50:50, unless specific allocations are available.
3. Apply the total values of retained and transferred risks to the PSC and shadow bid base estimates. A range of values may be used in a sensitivity analysis, resulting in a range of VfM analysis results.

After bids are received, if the P3 alternative will be based on an availability payment structure, the preferred proposal may be compared to the PSC. The PSC estimate of costs and revenues will need to be risk-adjusted by using updated procurement phase information. If the P3 will be a tolled concession, the preferred proposal may be compared with either the shadow bid or the PSC.

Risk Adjustments to the Public Sector Comparator

Because the purpose of the PSC is to estimate the cost of a project to the owner if it were procured conventionally—with no transfer of risks to the private sector as under a P3—the expected value of these retained risks must be added to the cost of the PSC.

The incorporation of risk into the PSC can be accomplished in one of two ways:

1. By calculating the aggregated expected value of risks during the development, construction, and operational phases and then discounting them to a net present cost (NPC) to be added to the overall project NPC, as shown in table 7.
2. By adjusting the annual cash flows in the development, construction, and operating periods to appropriately account for the risks, thereby making the project cash flows risk-adjusted, as shown in table 8. When the risk-adjusted cash flows are discounted to calculate the NPC of the project, the resulting NPC will also be risk-adjusted.

Retained risks are quantified, where possible, by using the methodologies explained in chapter 4, with the resulting

Table 7. Calculating aggregate expected value of risk.

Year	Risk Adjustment	Discount Factor	Discounted Risk Value
1	10	1.000	10.00
2	2	0.9434	1.89
3	3.5	0.8900	3.12
4	0.5	0.8396	0.42
5	0.5	0.7921	0. 40
Total	**16.5**		**15.83**

Note: Discounted Risk Value = Risk Adjustment × Discount Factor.
Source: From *The Public Sector Comparator: A Canadian Best Practices Guide,* by Industry Canada, 2003, Ottawa, Ontario, Canada. Adapted with the permission of the Minister of Public Works and Government Services, 2013. The Government of Canada is not responsible for the accuracy, reliability, or currency of information contained in this document.

Table 8. Illustrative cash flow example including risk adjustments.

Year	Capital	Operating	Indirect	Disposal	Risk Adjustment	Total	Discount Factor	Discounted Cash Flow
1	100		4		10	114	1.000	114.00
2		20	4		2	26	0.9434	24.52
3	10	20	4		3.5	37.5	0.8900	33.38
4		20	4		0.5	24.5	0.8396	20.57
5		20	4	–50	0.5	–25.5	0.7921	–20.20
Total	**110**	**80**	**20**	**–50**	**16.5**	**176.5**		**172.27**

Note: Discounted Cash Flow = Total Cost × Discount Factor.
Source: From *The Public Sector Comparator: A Canadian Best Practices Guide,* by Industry Canada, 2003, Ottawa, Ontario, Canada. Adapted with the permission of the Minister of Public Works and Government Services, 2013. The Government of Canada is not responsible for the accuracy, reliability, or currency of information contained in this document.

expected value being equivalent to the government's expected cost of self-insuring them. A contingency fund, reflecting the value of these retained risks, may be included in the financial assessment and in the agency's project budget and funding analysis. The process used to value transferred risks is discussed in the next section.

Calculation of Risk Premium for the Shadow Bid

For VfM assessments undertaken at the preprocurement stage, the shadow bid includes the cost of bearing transferred risks in its costs of financing as well as in its contingencies relating to both construction and operating budgets.

An important consideration in the quantification of risk is that the potential financial impact of a risk event is determined from the perspective of the party retaining the risk. A risk that is transferred to a private partner who is better able to avoid or mitigate that particular risk would have a lower value under the shadow bid than under the PSC. For example, in the absence of the discipline imposed by at-risk equity finance under a P3, costs associated with the potential for construction delay risk might be considered more likely (higher) under conventional procurement in which the incentives to achieve construction schedule are less significant. Because the most qualified firms will be attracted to the project, they will be best able to manage the risks without adding a large premium.

Risk premium value may be affected by market forces. For example, it would be low if there are few projects relative to the number of contractors looking for work. The analyst team determines the value to be included for the risk premium, and this value is added to the shadow bid estimate.

If a risk can be insured, the cost to obtain the insurance (i.e., the insurance premiums) is used to value that risk in the shadow bid rather than in the expected value of the outcome of the risk if it were to occur. Such insurance typically includes (among others) construction and contractor insurance, third-party liability, business interruption, equipment failure, and technology-related risk. The premiums represent the actual cost to the private partner of bearing the underlying transferred risk. In the case of the PSC, the value of these insurance premiums is also used to represent the value of these risks if they are retained by the public sector. Risks that are not transferred to the private sector are considered retained by government and represent a cost to the project regardless of the procurement model selected.

CHAPTER 7

Summary

Risk is a key characteristic of P3s, influencing project structure and cost, and the assessment of risk is a critical task in developing, negotiating, evaluating, and managing P3 projects. Risk assessment assists in overall project evaluation, supports the design of technical requirements and commercial terms prior to procurement, assists in negotiations with proposers with regard to the allocation of risk, and is a prerequisite in the development of risk management plans.

Under the conventional DBB procurement process, public agencies typically retain a significant portion of the risks associated with a project. When public agencies take on major projects under the conventional procurement process, they tend to undervalue those retained risks. As a result, budget and schedule estimates are often optimistic, and the full life-cycle costs of a project are rarely considered. P3s derive much of their value by structuring contract agreements to transfer to the private sector many of the risks that are conventionally retained by the public sector.

P3 procurement processes require a transparent accounting and valuing of risks, because the risks transferred to the private sector will generally be factored into the costs of bids as a risk premium. To ensure the best value for the public, the procuring agency needs to perform a thorough risk analysis to determine which risks it should manage internally and which risks it should transfer to the private sector.

Risks are identified and assessed through workshops, that is, formal meetings where project team members, subject matter experts, and others responsible for estimating the costs and schedule of a project work together to identify and analyze risks. Risk workshops result in a "risk register" that describes significant risks, assessments of risk probability and impact, and preliminary risk response plans.

Agencies may use the risk register to assign a monetary value to each risk. This can help a public agency decide which risks to transfer to the private sector, which to retain, and which to share. By calculating the NPV of the risks transferred to the private sector under a P3 procurement model, a public agency can compare the risk-adjusted NPC of procuring the project under the conventional procurement method to that of a P3 procurement in order to assess value for money. A key criticism of risk valuation pertains to the validity of the calculations. A sensitivity analysis to test the effect of key assumptions is therefore essential.

The goal of a P3 is not to transfer all project risks, rather it is to transfer those risks that the private sector can manage most efficiently and that meet the overall goal of the project. For each risk transferred, there is a premium that the project owner must pay to the private entity. A risk may be priced differently by the public and the private sector, depending on their capabilities. It may be financially inefficient to transfer risks that the private sector will have a difficult time managing.

Glossary

Bidder—A respondent to a Request for Expressions of Interest or an invitation to submit a bid in response to a project brief. Typically, a bidder will be a consortium of parties, each responsible for a specific element, such as constructing the infrastructure, supplying the equipment, or operating the business. The government normally contracts with only one lead party (bidder), who is responsible for the provision of all contracted services on behalf of the consortium.

Brownfield—Projects that focus on improving, operating, and/or maintaining an existing asset (contrast to greenfield). P3 brownfield projects in transportation typically are long-term operation and maintenance contracts or lease concessions. Blended greenfield–brownfield projects also exist, for example, improving an existing asset by adding new capacity (e.g., more lanes).

Concession Period—Total construction and operating periods.

Concessionaire—Private entity that assumes ownership and/or operations of a given public asset (i.e., train station, bus operation) under the terms of a contract with the public sector.

Contingency—An allowance included in the estimated cost of a project to cover unforeseen circumstances.

CPI—Consumer Price Index.

DB—Design–build. Under a DB, the private sector delivers the design and construction (build) of a project to the public sector. The public sector maintains ownership and operations and maintenance of the asset. *Build* refers to constructing the project, which includes reviewing conditions at the building site, providing construction staff and materials, selecting equipment, and when necessary, amending the design to address problems discovered during the construction phase.

DBFOM—Design–build–finance–operate–maintain. Under DBFOM, the private sector delivers the design and construction (build) of a project to the public sector. It also obtains project financing and assumes operations and maintenance of an asset upon its completion.

Debt Tranche Interest-Only Period—Interest-only period for project bond.

Debt Tranche Maturity—Maturity date for project bond.

Discount Rate—Percentage by which a cash flow element in the future (i.e., project costs and revenues) is reduced for each year that cash flow is expected to occur.

Discount Rate Nominal—Discount rate that factors in the inflation rate.

Discount Rate Real—Discount rate that does not account for inflation.

DSCR—Debt service coverage ratio.

Finance—Phase or delivery aspect of the project that includes providing capital for the project, which may include issuing debt or equity and verifying the feasibility of plans for repaying debt or providing returns on investment.

Greenfield—Projects that focus on developing and/or building a new asset (contrast with brownfield). Many P3 structures are available for greenfield projects, including design–build, design–build–operate–maintain (DBOM), design–build–finance–operate–maintain/manage (DBFOM), and others. Blended greenfield–brownfield projects also exist.

Inflation Consumer Price Index—Used as a base rate for inflation assumptions.

IPD—The Office of Innovative Program Delivery (IPD), a part of the Federal Highway Administration, provides tools and expertise in use of different public–private partnership (P3) approaches.

Leveraging—Degree to which an investor or business is utilizing borrowed money.

Maintenance—This phase includes keeping the project in a state of good repair, which includes filling potholes, repaving or rebuilding roadways, and ensuring the integrity of bridges and highways.

Net Present Cost (NPC)—Estimated present value of expected future cash flows associated with PSC and shadow bid analysis without considering revenues.

Net Present Value (NPV)—Present value of the expected future revenues minus the net present cost.

Private Activity Bond—New type of financing that provides private developers and operators with access to the tax-exempt bond market, lowering the cost of capital significantly.

Public Sector Comparator (PSC)—Represents the most efficient public procurement cost (including all capital and operating costs and share of overheads) after adjustments for competitive neutrality, retained risk, and transferrable risk to achieve the required service delivery outcomes. This benchmark is used as the baseline for assessing the potential value for money of private party bids in projects.

Retained Risk—The value of those risks or parts of a risk that government proposes to bear itself under a partnership arrangement.

Revenue Leakage—Assumed annual revenue losses for a tolling facility.

RFP—Request for proposal.

ROW—Right of way.

Risk Allocation—The process of assigning operational and financial responsibility for specific risks to parties involved in the provision of services under P3. See also *risk transfer*.

Risk Transfer—The process of moving the responsibility for the financial consequences of a risk from the public to the private sector.

Routine Maintenance—Work that is planned and performed on a routine basis to maintain and preserve the condition of the highway system or to respond to specific conditions and events that restore the highway system to an adequate level of service.

Technical Risk—Risks arising from deviations from the project's original technical assumptions, specifications, or requirements.

T&R—Traffic and revenue.

Transportation Infrastructure Finance and Innovation Act (TIFIA)—This program provides Federal credit assistance in the form of direct loans, loan guarantees, and standby lines of credit to finance surface transportation projects of national and regional significance (FHWA, 2013).

Transferrable Risk—The value of any risk that is transferrable to the bidder.

Value for Money (VfM) —The procurement of a P3 project represents VfM when—relative to a public sector procurement option—it delivers the optimum combination of net life-cycle costs and quality that will meet the objectives of the project (Virginia Office of Transportation Public–Private Partnerships, April 2011).

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