

Risk Allocation and Sharing in Transportation P3s: State of Practice Report

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INTRODUCTION

Over roughly the last two decades, a number of public transportation agencies in the US have planned and implemented public-private partnership (P3) agreements that include various practices for risk allocation and sharing. P3s can adopt varying structures, but the two most prominent models are revenue risk and availability payment arrangements respectively; this report principally addresses these two models. Some of these practices have set precedents for subsequent projects to follow while others are often tailored to project characteristics or local conditions. The enacted Infrastructure Investment and Jobs Act (IIJA) requires procuring agencies to evaluate key terms, major compensation events and risk allocation during planning and development of a P3 project. Existing literature and reports tend to describe risk allocation practices generally or to focus on a subset of risks or a specific project. How risks are allocated can significantly influence project preparation studies such as Value for Money (VfM) analyses and project outcomes as P3s are procured and implemented. Consequently, a comprehensive state of practice report can inform public agencies as they contemplate and then execute P3s.

Hence, the purpose of this report is to capture the state of practice of risk allocation and sharing in transportation P3s in the United States by: (1) providing an overview of risks and risk allocation in transportation P3s; (2) presenting how risks have been allocated in recent P3 transportation agreements; and (3) sharing perspectives of practitioners about current risk allocation practices. The intent is to indicate where the market currently stands with respect to risk allocation, which will provide the basis for subsequent work to develop guidance for risk assessment and allocation during both project preparation and implementation.

ABOUT THE REPORT'S AUTHOR

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RISK ALLOCATION IN TRANSPORTATION P3S

P3s, along with other forms of alternative project delivery, are utilized for a variety of reasons: to accelerate project delivery, capitalize on private sector efficiencies, access private sources of financing (particularly private equity), improve lifecycle performance and transfer risks to the private sector. Indeed, the transfer of risk is often highlighted when P3s are contrasted with other models of project delivery. For instance, Table 1, which is adapted from FHWA (2012), is illustrative of such comparisons of risk transfer from a public agency to a private entity:

Table 1. Risk Transfer in Common Project Delivery Methods

Delivery Model	Design Risk	Construction Risk	Financing Risk	O&M Risk	Revenue Risk	Appropriations Risk ¹
Design-Bid-Build (DBB)	X*	X*				
Design-Build (DB)	X	X				
Design-Build-Finance (DBF)	X	X	X			
Design-Build-Operate-Maintain (DBOM)	X	X		X		
Design-Build-Finance-Operate-Maintain (DBFOM)	X	X	X	X	Yes, if toll concession	Yes, if availability-payment concession

**Owner may retain risks related to errors & omissions or constructability depending on contractual terms*

Further, risk transfer is a central tenet of the VfM proposition for P3s, although past work has emphasized the optimal transfer rather than the absolute transfer of risk (Hardcastle and Boothroyd 2003). The inappropriate allocation of risks can lead to project management inefficiency, high transaction costs (Dudkin and Vålilä 2006), high frequency of disputes (Bing et al. 2005), and can reduce participation of the private sector in P3s (Chou and Pramudawardhani 2015).

¹The likelihood and impact that legislative bodies will not approve and allocate budgetary funds for project payments over extended periods of time.

IDENTIFICATION AND CHARACTERIZATION OF P3 RISKS

A variety of reports and studies have identified and classified P3 risks. FHWA (2012) characterized 18 risks across the development, construction and operation phases of a P3 project. The baseline risks included in FHWA's P3-Value 2.3 Tool are shown in Table 2; users of this tool can augment or change these risks.

Table 2. Baseline Risks in FHWA P3-Value 2.3 Tool

Implementation Risks	Operations Risks
<ul style="list-style-type: none">▶ Design▶ Construction▶ Third Party▶ Environmental▶ Right of Way/Real Estate▶ Geotechnical▶ Hazardous Materials▶ Organizational▶ External▶ Latent Defects▶ Force Majeure▶ Insurance▶ Changes in Law & Policy	<ul style="list-style-type: none">▶ Latent Defects▶ Operations▶ Maintenance▶ Force Majeure▶ Insurance▶ Changes in Law & Policy

Barutha et. al. (2019) identified 45 risks from multiple literature sources and narrowed this list based on frequency of occurrence in the literature to 21 risks across four categories as shown in Table 3. Subsequently, they interviewed subject matter experts in the public and private sectors to ascertain the impact of each of these risks on VfM to calculate each risk's "importance index". They concluded that the private sector regarded governmental approval, environmental permitting, force majeure and changes in law as most important whereas the public sector regarded quality, geotechnical and subsurface conditions, demand and revenue below anticipation, inflation, force majeure, financial costs and availability, and environmental permitting as most important. Hence, their study suggests public and private perceptions of the significance and impact of P3 risks differ.

Table 3. P3 Risks Identified in Barutha et. al. (2019)

Risk Type			
Political	Economic	Project Development	Operations & Maintenance
<ul style="list-style-type: none"> ▶ Changes in Law ▶ Government Project Approval 	<ul style="list-style-type: none"> ▶ Inflation ▶ Interest Rates 	<ul style="list-style-type: none"> ▶ Force Majeure ▶ Geotechnical and Subsurface Conditions ▶ Land Acquisition ▶ Environmental ▶ Permitting ▶ Design Liability ▶ Weather ▶ Existing Utilities ▶ Financial Costs and Availability ▶ Construction Cost Overrun ▶ Construction Schedule ▶ Completion ▶ Design Changes during Construction ▶ Default of Subcontractors or Suppliers ▶ Quality 	<ul style="list-style-type: none"> ▶ Operation and Maintenance Cost Overrun ▶ Frequency of Maintenance ▶ Handback Requirements ▶ Demand and Revenue Below Anticipation

Nguyen et. al. (2018) identified 30 risks in P3s, which were used to assess how risks were allocated in 21 U.S. highway P3 contracts. Table 4 lists and describes the majority of these risks.

Indeed, the risks identified in Tables 2-4 are not exhaustive and are organized differently, but many of the risks are identical or quite similar. For the sake of consistency, the risks listed and described in Table 4 will be referenced in the balance of this report.

Table 4. P3 Risks adapted from Nguyen et. al. (2018)

Risk	Category	Description
Financing	General	Arranging financial investors and/or favorable terms for the project developer and/or the sponsor for capital needs during a project's lifecycle.
Socio-political opposition and protesters		Opposition to the project by government agency or citizens, e.g., political issues, protests, strikes.
Change in Law		(a) the adoption of any law after the contract's effective date, or (b) change in any law or in the interpretation or application thereof by any governmental authority after the effective date. Discriminatory change in law is differentiated from other changes in law since a discriminatory change only affects the project or comparable projects or the project developer/contractor.
Refinancing		Conditions that the project developer and/or the sponsor may face when they want to change their current financial structures or agreements to better suit their needs (e.g. changes in interest rates, stricter agreement).
Inflation		Inflation drives up the cost of construction and operation while it reduces the real value of money.
Interest rates pre-financial close		Changes in interest rates after commercial close but before financial close.
Design	Construction	Inadequate or defective design impacts may emerge in the construction and operation phases.
Right of way & easements		Difficulties in acquiring necessary right of way (ROW) and easements for the project.
Additional properties		Any difficulty in acquiring properties outside of ROW but deemed necessary for the project.
Site geology/ conditions		Site geology may be different from what is known by the project developer and/or sponsor at the time of commercial close. The differences can among other things increase costs and cause delays.
Environmental risks		Presence of known or unknown environmental conditions (e.g., hazardous materials, contaminated site); these are exclusive of more general site geology conditions.
Archaeology, fossils, or protected species		Discovery of important archaeology, fossils or endangered species on the project site that may seriously delay construction or require revisions of the construction plans.
Access and adjustment to utilities		Difficulties in coordinating with third parties during utility adjustments and relocation, permitting, etc. throughout the project.

Risk	Category	Description
Permits		Difficulties and delays in getting general permits from authorities or other third parties.
Environmental (non-NEPA) permits		Difficulties and delays in getting environmental (non-NEPA) permits from authorities.
Commodity prices		Changes in commodity (i.e. materials, fuel, etc.) prices over time.
Changes by the Public Authority		Changes in project specifications, scope, schedule, etc. made by the Public Authority after financial close.
Performance		Project fails to meet milestones or fails to perform as specified.
Usage/demand risk	Operation	Demand may be lower than projections due to factors such as inaccurate forecasts of demand elasticity, onset of economic recession, or changes in local population/ demographics.
Network modifications		Unplanned or planned changes in transportation network (e.g., the building of competing roads) that may affect usage or performance of the project.
Payment for services		Failure of public authority to make timely payments according to contractual obligations (e.g. due to shortage of budgetary funds).
Availability and service		Facility fails to meet specified availability or service standards/measures.
Operation expenses		Increase in actual operation expenses.
Maintenance		Unscheduled maintenance that impairs availability or higher than expected maintenance costs.
Latent Defects		A fault in the facility that is not patent, i.e. the fault could not have been discovered ex ante through reasonable investigation.
Transfer of ownership/ contractual rights		Changes in organizational or financial structure of parties to the contract (e.g., change in ownership).
Project Company default		Termination due to project company default.
Force majeure		Unusual events that cause temporary interruption or irrecoverable damages to the project.
Hand-back		At end of contract duration, the facility (quality or value) does not meet specified requirements.

ALLOCATION STRATEGIES

In both practice and literature, the principle of allocating a risk to a party that has the best ability to manage it is well-established (Beidleman et al. 1990). Yet, a number of scholars have indicated that P3 risk allocation is not optimal (Quiggan 2005; Chung et al. 2010).

When a party or stakeholder considers the allocation of risks in a P3 arrangement, one of four prevailing strategies may be adopted. First, a party may choose to *avoid* a risk; this is not uncommon since a public agency may choose another delivery model (that avoids a risk) or a private entity may not pursue a P3 based on its risk profile. However, if public and private parties decide to implement a P3 project (or a project delivered under any other method for that matter), then they must choose to *transfer, share or manage (i.e. assume)* each and every risk. Ultimately, the overall risk allocation strategy adopted will manifest itself within a project's contract.

RISK ALLOCATION IN US P3 TRANSPORTATION CONTRACTS

Over roughly the last 15 years, a number of state agencies in the US have planned and implemented P3 agreements for transportation projects that include various practices for risk allocation and sharing. Some of these practices have become market precedents over time while others are the result of a more tailored approach based on project characteristics or local conditions.

Recently, risk allocation practices were examined in multiple highway P3 projects where the principal source of data was the project contracts; the risks listed in Table 4 were assessed. A systematic methodology for analyzing the content of the contracts was developed; the results and methodology employed are described in Nguyen et al. (2018).

Table 5 lists the vast majority of P3 highway and transit projects implemented in the United States between 2006 and 2019. Those shaded were previously assessed to determine their risk allocation (Nguyen et al. 2018). The unshaded projects were assessed in this initiative following the same methodology in the prior study to determine their risk allocation. The content analysis of these P3 contracts provides a characterization of the current state of practice for risk allocation.

Table 5. Sample of P3 Highway and Transit Projects in United States (2006-2019)

Project	Jurisdiction	PPP Model	Commercial Close	Value (\$millions)
I-95 Express (FredEx)	Virginia	DBFOM (RR)	2019	830
I-75 Modernization Segment 3	Michigan	DBFM (AP)	2018	1,400
Gordie Howe International Bridge	Windsor-Detroit Bridge Authority	DBFM (AP)	2018	4,415
I-395 Express Lanes	Virginia	DBFOM (RR)	2017	554
Central 70	Colorado	DBFOM (AP)	2017	1,271
Purple Line	Maryland	DBFOM (AP)	2016	2,650

Project	Jurisdiction	PPP Model	Commercial Close	Value (\$millions)
Transform 66 - Outside the Beltway	Virginia	DBFOM (RR)	2016	3,724
EAGLE Project	Colorado	DBFOM (AP)	2011	2,043
SH 288 Toll Lanes	Texas	DBFOM (RR)	2016	425
Southern Ohio Veterans Memorial Highway (Portsmouth Bypass)	Ohio	DBFOM (AP)	2015	819
Rapid Bridge Replacement	Pennsylvania	DBFOM (AP)	2015	1,119
I-77 High Occupancy Toll (HOT)	North Carolina	DBFOM (RR)	2014	655
I-4 Ultimate Improvements	Florida	DBFOM (AP)	2014	2,323
Goethals Bridge Replacement	NY/NJ Port Authority	DBFM (AP)	2013	1,350
US 36 Managed Lanes—Phase 2	Colorado	DBFOM (RR)	2013	175
North Tarrant Express (3A and 3B) (NTE 3A-3B)	Texas	DBFOM (RR)	2013	1,350
East End Crossing	Indiana	DBFOM (AP)	2012	763
I-95 Express Lanes	Virginia	DBFOM (RR)	2011	923
Presidio Parkway (Phase II)	California	DBFOM (AP)	2011	362
Elizabeth River Tunnels	Virginia	DBFOM (RR)	2011	2,100
I-635 LBJ Managed Lanes	Texas	DBFOM (RR)	2009	2,600

Project	Jurisdiction	PPP Model	Commercial Close	Value (\$millions)
North Tarrant Express (1 and 2A) (NTE 1-2A)	Texas	DBFOM (RR)	2009	2,000
Port of Miami Tunnel	Florida	DBFOM (AP)	2009	651
I-595 Express Lanes	Florida	DBFOM (AP)	2009	1,760
SH 130: Segments 5 and 6	Texas	DBFOM (RR)	2007	1,380
I-495 Capital Beltway Express Memorial Highway (Portsmouth Bypass)	Virginia	DBFOM (RR)	2007	2,068
				39.710

DBFOM = Design-Build-Finance-Operate-Maintain; DBFM = Design-Build-Finance-Maintain

RR = Revenue Risk; AP = Availability Payment

RISK ALLOCATION RESULTS

Table 6 depicts how the risks identified were predominantly allocated in the contracts of the 26 P3 projects. The investigation uncovered whether these risks were: (a) retained by the public sector, (b) transferred to the private sector, (c) shared in some fashion between the parties or (d) addressed by an event mechanism (described subsequently); a risk was classified as being predominantly allocated if more than 80% of the contracts allocated it in the same way. Those without a predominant allocation were found to be mixed among the three classifications or roughly split between two classifications (as indicated in the table's "Comments" column). Alternatively, risks were initially addressed by an event mechanism.

Table 6. Predominant Risk Allocation in Sample of US P3 Highway and Transit Projects

Risk	Public	Private	Shared	Event Mechanism	Comments
<i>General</i>					
Financing		X			
Socio-political opposition and protesters				X	
Change in law				X	
Refinancing		X			
Inflation		X			Some AP projects adjust payments by indexing
Force Majeure				X	
Interest rates pre-financial close	X				Credits spreads are shared in some projects
<i>Construction</i>					
Design		X			
Right of way & easements	No Predominant Allocation				Mixed allocation
Additional properties	No Predominant Allocation				Mixed allocation
Site geology/ conditions				X	
Environmental risks				X	
Archaeology, fossils, or protected species				X	Recent contracts retained by public
Access and adjustments to utilities	No Predominant Allocation				Private or shared
Permits				X	

Risk	Public	Private	Shared	Event Mechanism	Comments
Environmental (non-NEPA) permits				X	
Commodity prices		X			A few employed indexing
Changes by the Public Authority	X				
Performance		X			
<i>Operations</i>					
Usage/demand risk		X			Retained by public in AP arrangements; some have upside revenue sharing and/or downside protection
Network modifications				X	Retained by public in AP arrangements
Payment for services		X			
Availability and service		X			
Operation expenses		X			
Maintenance		X			
Latent defects	No Predominant Allocation				Private or Shared
Transfer or ownership/contractual rights		X			
Project Company default			X		
Hand-back		X			

RISKS PREDOMINANTLY RETAINED BY PUBLIC SECTOR

As shown in Table 6, the public sector predominantly retained two risks: *interest rates pre-financial close and changes by the public authority*; both *usage/demand and network modification* risks were retained by the public sector in availability payment P3s due to the characteristics of these arrangements, which were half (50%) of the projects examined. This outcome is not surprising and confirms the overall risk transfer tenet of P3s.

A public agency should retain *changes by the public authority* since an agency should bear the impacts of adjustments after financial close in project scope or conditions that it directs. While the public agency predominantly held *the risk of interest rates pre-financial close*, credits spreads were shared in many cases; however, the public agencies tended to take more of the credit spread risk than the private sector.

RISKS PREDOMINANTLY BORNE BY PRIVATE SECTOR

The principal risks for project development and management under a P3 arrangement are transferred to the private sector: construction (*design, performance*), finance (*financing, refinancing*), operation (*availability and service, operation expenses, maintenance*), project company ownership (*transfer of ownership/contractual rights*) and handback (*handback*). Once again, this is expected given the nature of P3s where the private entity is responsible for lifecycle activities and financing arrangements. Further, if the private entity elects to refinance the project, then it must bear this effort and cost; most contracts also required the private entity to share refinancing gains with the public sector (if the refinancing was not prescribed in the project's proposal) as illustrated by this provision from the Transform 66 contract in Virginia:

The Developer will pay to the Department 50% of any Refinancing Gain from a Refinancing that is not an Exempt Refinancing. The Refinancing Gain will be calculated after deducting payment of (i) the Department's Allocable Costs under Section 7.08(e) and (ii) the Developer's Allocable Costs directly associated with the Refinancing (Section 7.08d)

Project company ownership was also treated similarly across the contracts. Public agency scrutiny of the controlling stakes was made clear in the contractual transfer provisions. Although I-495's contract is one of the earliest in the contract set, its provisions here were representative of the vast majority of the contracts: "From time to time during the term of this Agreement, the Concessionaire has the right, at its sole cost and expense, to pledge, sell or otherwise transfer solely the Toll Revenues available for Distribution in connection with a Permitted Securitization." Yet, this right was limited by the public agency: "The Concessionaire shall not Transfer, or otherwise permit the Transfer of, any or all of the Concessionaire's Interest to or in favor of any Person (a

‘Transferee’) during the Lockup Period” [the 10-year period commencing on the concession’s closing date and ending on the 10th anniversary of the closing date] and “following the Lock-up Period, the Concessionaire shall not Transfer, or otherwise permit the Transfer of, any or all of the Concessionaire’s Interest to or in favor of a Transferee, unless the Department has approved” (I-495, Section 20.01).

RISKS PREDOMINANTLY ADDRESSED BY EVENT MECHANISMS OR SHARED

Event Mechanisms

Many risks were addressed by an event mechanism: relief events, delay events and/or compensation events.² Relief or delay events usually extend a project’s construction schedule or its operations period while compensation events typically involve monetary payment for damages incurred by a party. These event mechanisms have contractual provisions, which outline a process that the parties will follow once a qualifying event occurs to determine whether and what type of relief will be granted. In other words, once a risk materializes the parties will follow the relevant provisions in the contract to determine whether entitlement to compensation and/or additional time is warranted; neither party knows at the time of contract formation (ex-ante) whether the related risk will surface nor which party will bear it. It could wind up being either (or both). Article 15 of the Portsmouth Bypass contract stipulated a representative Relief Event procedure, which is long and complex but is summarized as follows:

- ▶ The concessionaire must: develop a “time impact analysis”, prove that the event affected the project’s critical path, prove that the event could not be avoided by reasonable efforts, and provide evidence of the causes of the event;
- ▶ The government then reviews the information and decides whether and how to grant relief;
- ▶ If the concessionaire agrees with the government’s decision, then the decision is followed; if the concessionaire disagrees with the government, then the provision indicates:

If the Parties cannot agree on the extent of any delay incurred or relief from Developer’s obligations under this Agreement, or the Department disagrees that a Relief Event has occurred (or as to its consequences), or that Developer is entitled to relief under this Article 15, the Parties shall resolve the matter in accordance with the Dispute Resolution Procedures. (Portsmouth Bypass, Section 15.3).

While characteristic event mechanism provisions have a variety of stipulations, these are procedural rather than categorical; hence, the parties will expend considerable effort ex-post to address and remedy the situation.

²Some contracts classified these event mechanisms as “Supervening Events”.

Table 6 identifies those risks that were predominantly treated by an event mechanism. Several risks in the Construction category (site geology/conditions; environmental; archeology, fossils, or protected species; permits; environmental (non-NEPA) permits) and some risks in the General (sociopolitical opposition, change in law, force majeure) and Operations (network modifications) categories were handled this way.

Risk Sharing

In many instances, risks treated by event mechanisms would also include a risk sharing approach if a risk materialized. A number of risk sharing methods were uncovered in the contracts. One frequently used sharing approach was the deductible. A deductible is a specified quantity that a party must bear before it can ask for compensation or damages from the counterparty. For example, the Central 70 contract stated:

With respect to any Compensable Costs incurred by Developer in respect of any Relevant Event (other than any No-deductible Event, to which this Section 15.7.1 shall not apply) that occurs during the Construction Period, if the aggregate amount of such Compensable Costs directly resulting from the occurrence of such event is greater than \$20,000 (any such event, a “Compensable Construction Period Event”), then, subject to Section 15.7.3, the Enterprises shall compensate Developer... (Section 15.7.1)

Table 7 provides a summary of the various sharing methods uncovered during the contract investigation. The methods are generally listed by their frequency of usage along with their typical corresponding risks. For instance, the I-75 Modernization contract provides an example of the proportion/proration sharing method that was employed for interest rates pre-financial close:

If Developer has complied with the submittal requirements under Section 5.7.4 of the ITP, MDOT will adjust the Base MAP to offset a portion of the impact of fluctuations (increases and decreases) in the Baseline Credit Spreads that have occurred during the Interest Rate Protection Period. Subject to the limitations described in Section 5.7.4 of the ITP and Schedule 18 (Update to the Base MAP), the credit spread risk/benefit sharing between MDOT and Developer will be implemented on an 85:15 basis, with MDOT assuming 85% of the fluctuation in Baseline Credit Spreads and Developer assuming 15%. (Section 3.7.2)

Table 7. Risk Sharing Methods Identified in US P3 Highway and Transit Projects

Sharing Method	Brief Description	Typical Corresponding Risks
External Reference	Impacts are calculated at the time a risk occurs or at a time agreed by the parties by referencing an external factor such as the Consumer Price Index	<ul style="list-style-type: none"> ▶ Inflation ▶ Interest rates before financial close
Force Majeure Event	Events with negative impacts that are highly unpredictable such as natural hazards or civic unrest that potentially entitle the contracted party to schedule/time adjustments	<ul style="list-style-type: none"> ▶ Socio-political opposition ▶ Natural hazards ▶ Terrorism ▶ Conflict/war
Further interpretation	Instances where risks materialize and counterparties must investigate to determine how impacts will be treated or shared	<ul style="list-style-type: none"> ▶ Change in law ▶ Environmental conditions (i.e. hazardous materials)
Negotiation	Counterparties state the intention to negotiate based on impacts of risk and an amendment to contract is not anticipated	<ul style="list-style-type: none"> ▶ Change by public authority ▶ SPV default ▶ Termination by owner
Extension	Employed in Relief/Delay Events where provisions explicitly state that contract will be extended to mitigate contracted party losses	<ul style="list-style-type: none"> ▶ Permitting ▶ Site geology/conditions ▶ Socio-political opposition
Deductible	Typically, the contracted party must bear a specified amount of impact/loss before other sharing methods become applicable	<ul style="list-style-type: none"> ▶ Force majeure ▶ Site geology/conditions ▶ Access/adjustment of utilities ▶ Environmental conditions (i.e. hazardous materials) ▶ Latent defects
Proportion/Proration	Counterparties share the losses (or gains) on a proportional or pro rata basis	<ul style="list-style-type: none"> ▶ Right of way acquisition/ issues ▶ Interest rates before financial close (credit spreads)

Sharing Method	Brief Description	Typical Corresponding Risks
Extra work costs or delays	Monetary or time impacts on the contracted party that exceed original estimates	<ul style="list-style-type: none"> ▶ Force majeure ▶ Owner changes ▶ Environmental conditions (i.e. hazardous materials)
Insurance	Transfer of impacts to third party to bear in exchange for paying insurance premium; local conditions dictate the types of insurance required	<ul style="list-style-type: none"> ▶ Force majeure
Cost adjustment	Counterparties agree to adjust project costs when actual exceed estimated by a margin set in contract	<ul style="list-style-type: none"> ▶ Inflation ▶ Payment for services
Maximum Reimbursement	Monetary compensation is provided to contracted party until an agreed value is reached	<ul style="list-style-type: none"> ▶ Network modifications ▶ Site geology/conditions ▶ Environmental conditions (i.e. hazardous materials)

PRACTITIONER PERSPECTIVES OF RISK ALLOCATION AND MANAGEMENT IN P3S

OVERVIEW

Following the review of P3 contracts to examine risk allocation, interviews with practitioners were conducted to **obtain *their perspectives on risk allocation in P3s***. More specifically, the purpose of the interviews was to receive input about: (1) the most challenging or problematic risks in P3s, (2) advantages and disadvantages of current risk allocation and management practices, and (3) recommendations to improve the market.

A total of 14 interviews were conducted over the course of about three months. Each interview lasted between 45-60 minutes. Interviewees held senior leadership positions in public agencies, consulting firms, legal firms, infrastructure development firms, and construction firms. All interviewees had over 10 years of experience in alternative project delivery and nearly all had been involved with multiple P3 projects. Notes or transcriptions from the interviews were used for review and analysis. Data from the interviews were then synthesized into four areas: (1) general issues, (2) most problematic risks, (3) risk sharing methods, and (4) recommendations for improvement.

The following sections present the synthesis in each area. It is important to emphasize that these are the perspectives shared by the interviewees as interpreted from the interview data, *which is a representative, but not exhaustive, view by practitioners of risk allocation in P3s*.

GENERAL ISSUES

During the course of the interviews, a variety of issues were raised about the state of the P3 market and practice.

Fixed Price, Date Certain Structure. Many interviewees commented that the fixed price, date certain contractual structure for the design and construction phase of P3s is at the root of many challenges in the contemporary market. This structure is particularly troubling when the risks being transferred: (a) cannot be effectively managed by the concessionaire or the design-build joint venture (DBJV) or (b) have a potential magnitude that exceeds what a concessionaire or DBJV can reasonably bear. Not surprisingly, several interviewees indicated that these circumstances will lead to significant contingencies being included within a proposal, which may make a proposal uncompetitive, or a decision by a proposer to withdraw from a procurement. Either case is detrimental to achieving best value in P3s since contingency pricing may outweigh the anticipated benefits of risk transfer or competition for a project will decrease. Longer term, the effects are more drastic – private participants may decide to withdraw from the market altogether. In 2019, *Engineering News-Record* documented concerns by major industry players such as SNC-Lavalin, Fluor and Granite about the

commercial structure of P3s, specifically their pervasive use of fixed-price design-build contracts (Rubin and Powers 2019). A subsequent *Engineering News-Record* article about the troubled Purple Line Rail P3 in Maryland reiterated this issue:

Robert Alger, former CEO of Lane Construction, a member of the Fluor-led design-build joint venture Purple Line Construction Partners, told ENR that the “current P3 model based on lump sum turnkey projects is broken. All the risk is being pushed down to the contractor level with no ownership of the risk at the owner or concession level. This is not sustainable. These mega projects are simply too large to price the risk effectively” (Parsons and Rubin 2020).

Consequently, major industry players have become far more selective about the sectors or projects that they will pursue.

Project Preparation in Competitive Procurements. A common refrain was that many P3 projects move into procurement without sufficient due diligence. Signals of issues include inadequate feasibility studies (such as traffic & revenue), incomplete geotechnical investigations, limited design development, inadequate outreach to key stakeholders, or insufficient coordination with third parties; such issues drive unrealistic assumptions about a project’s revenues or costs. The status of environmental or statutory clearances is another indicator of a project’s readiness; these need to be sufficiently advanced, so proposers understand a project’s footprint or boundaries. One interviewee commented on the outreach to key stakeholders in a revenue risk arrangement: “What type of outreach and information does the public agency have about tolling schemes and strategies? What concerns have been expressed about issues such as affordability within the community or by elected officials?” The extent of such outreach and its availability/accessibility provides a proposer an indication of the potential for sociopolitical opposition (or support). Another interviewee summed the project preparation issue up succinctly: “One of the main challenges today is submitting a competitive price based on incomplete plans and information.” Clearly, project preparation impacts competition; a project that is not ready may fail to attract sufficient interest.

Reliance. Several interviewees described challenges associated with reliance on information provided by owners in a procurement; examples include information related to geotechnical conditions, existing facilities or hazardous materials. These interviewees described frustration with conditions in procurement or contractual documents that provide either limited or no reliance on the information provided by the owner. Certainly, pragmatic matters may constrain the extent of investigations that an owner might carry out prior to a procurement or information about existing facilities or site conditions that an owner might have. Yet, interviewees felt that these constraints should not lead to an expectation that a concessionaire or DBJV will conduct their own extensive investigations or simply assume the risks that might arise based on their interpretation of the

information provided, particularly since they face similar practical challenges in conducting such investigations prior to submitting a proposal. Further, they must determine whether additional investigations after award are necessary.

Relief/Compensation Events and Dispute Resolution. As explained previously, relief/compensation events are a common mechanism employed in P3s to reconcile events that occur during project construction or operation. Interviewees from both the public and private sectors explained that the complexity and scale of P3s makes determination of whether relief is entitled difficult. Additionally, convoluted and complex contractual language often exacerbates the process associated with relief events. Interviewees described various situations that can occur. In one, the owner is given notice about an event but the developer itself is not certain whether relief is warranted. In another, the owner is given notice but it is unclear to the owner whether the basis of entitlement has been established. Either situation is problematic; in the former, neither party knows where the situation is headed while in the latter the parties are at odds with one another. In these situations, both parties may begin to accrue costs associated with investigation and/or monitoring. Some private sector interviewees indicated that meanwhile the developer (or more specifically the DBJV) is often expected to continue to fund and advance construction while such issues are resolved; if not, the DBJV risks missing a project's completion date and having liquidated damages imposed. Likewise, public sector interviewees expressed frustration with the reluctance of developers at times to present evidence sufficient to meet the entitlement threshold.³ Remedies for these circumstances might be found in alternative dispute resolution methods or new contractual provisions, which are discussed subsequently.

Owner/Agency Experience. Several interviewees pointed out that public owner experience and sophistication with P3s remains a problem. This is not a new concern (Eno Center 2015). Among the interviewees, the top issue in this area was lack of timely decision-making. One interviewee commented that public owners do not fully appreciate the implications of acting slowly. In particular, delayed decisions by the owner are more significant in P3s since they can cascade to impact a project's overall financial position, which affects equity investors and debt service providers as well as the DBJV who can have liquidated damages imposed by the concessionaire. Further, public owners are supported in P3s by a host of consultants that provide necessary commercial, legal and technical assistance in these arrangements; however, some interviewees noted that some owners rely too heavily on these consultants whose stakes and sense of urgency are not as high, which can contribute to prolonged decision processes.

Developer and DBJV Relationship. Some interviewees mentioned the relationship between the

³Interestingly, the relief event contract language from the Portsmouth Bypass project presented previously appears to anticipate that the parties will disagree about a relief event.

developer and DBJV as a source of challenges. In particular, the developer passes many risks down to the DBJV, so the DBJV must manage them. If an issue arises, the DBJV typically first brings these to the developer's attention, and the developer decides whether to escalate it to the owner. A few interviewees indicated that since the developer has a longer-term relationship with the owner it may exercise some discretion over what issues to escalate. Another problem raised was the difference between the liquidated damages imposed by the owner to developer and the liquidated damages imposed by the developer to DBJV; the latter are typically higher since the impacts of delays to the developer are more substantial. This can create an environment for conflict between the developer and DBJV when schedule issues arise. Additionally, interviewees from the public sector expressed some frustration with the level of quality assurance (QA) provided by developers during design and construction, which may require a public agency to "force" such oversight. In theory, the developer should have a strong interest in the quality of the constructed asset since this will impact both service and maintenance. Yet, this inherent incentive is seemingly insufficient, so public agencies should consider inclusion of adequate incentives in the developer/DBJV agreement so the developer performs acceptable QA.

Project Context. Some interviewees emphasized the need for greater appreciation of each and every project's context by all key stakeholders. One interviewee stated: "Just because a developer or contractor was willing to accept a risk in a previous project does not mean that it can accept the same risk in another project – its chance of occurring, its impact or both may be different." In other words, precedents set in the market may not readily translate from project to project.

Communication and Contract Language. Nearly all interviewees emphasized the need for greater and more transparent communication about risks among key stakeholders in P3s. Such communication should start prior to procurement and continue throughout a project's duration. One interviewee noted: "You may not have firsthand experience with a risk or appreciate your counterparty's perspective. So, you need to listen to what they have to say." The issue related to communication extended to the language and structure of contracts. Several interviewees emphasized using plain language and reducing complex provisions.⁴

MOST PROBLEMATIC RISKS

Each interviewee was asked to identify the most problematic risks in P3s. After offering their initial input, the interviewer probed other risks not mentioned to elicit additional perspectives. The risks discussed are presented in three areas: (1) general risks, (2) construction risks, and (3) operations risks.

⁴The representative sharing provisions presented previously provide an indication of the contractual language problem; these provisions have multiple terms defined elsewhere or reference other sections in the contract, so a reader must review many parts of a contract to comprehend a provision. Certainly, some cross-referencing is unavoidable.

General Risks

Inflation. Several interviewees identified the effects of inflation as a major challenge, particularly in the current environment with its supply-chain challenges and overall economic conditions. One interviewee commented owners need to bear some amount of inflation risk given the current volatility of prices to avoid bankrupting contractors. While indexing or escalation provisions for commodities like fuel or petroleum-based products are common, some suggested that an expansion to other commodities like steel or cement may be prudent. At the very least, developers and contractors have and will continue to pay closer attention to inflation risk.

Sociopolitical. Some interviewees noted that sociopolitical risks are omnipresent in P3s. Changes in the executive branch or legislature, direct involvement of political leaders, or lobbyists for special interests can alter a project's trajectory. Similarly, opposition from citizens, businesses or other entities in the community can also impact a project. The lawsuit over tolling in the Elizabeth River Crossing project exemplifies the consequences of such sociopolitical issues. Some protections may be afforded in a contract's force majeure provisions, but these tend to include only extreme cases of sociopolitical unrest such as war, violence or obstruction.

Change in law. During probing by the interviewer, interviewees indicated that handling of a change in law in P3s has settled into discriminatory versus non-discriminatory changes where the former often entitles the developer to compensation. However, some noted that the distinction between discriminatory and non-discriminatory is not always clear. One interviewee gave an example of modifications in regulations for tunnel safety in a jurisdiction, which might get interpreted either way.

Construction Risks

Third-Parties. Every interviewee mentioned third parties as a significant challenge in P3s; these include utilities, railroads, adjacent property owners and other entities/agencies with approval or permitting authority. Both public and private sector interviewees concurred that coordination and performance of third parties is crucial for successful project implementation. Effective mitigation practices include securing Memorandums of Agreement (MOAs) prior to procurement and establishing expectations or milestones for third-party performance. Yet, the vast majority of interviewees indicated that performance by third parties remains difficult since they are not vested in the project. Moreover, a contract must include clear provisions for relief when third parties do not meet expectations. These could take the form of expectations for developer/contractor coordination with third parties coupled with milestone dates or time periods for third party performance; if

the developer/contractor makes reasonable efforts to coordinate or once milestone dates or time periods expire, then appropriate adjustments for time and/or cost would be granted.

Site/Geology Conditions. Unprompted, more than half of the interviewees identified site/geology conditions risks. The issues discussed revolved around lack of reliance granted to the developer or contractor for provided geotechnical/site data and the penchant of owners to transfer differing site conditions risk. Nearly all of the private sector interviewees described this risk as one where liabilities could be uncapped, which is unacceptable.⁵

Hazardous Materials. In many respects, hazardous materials risk is a subset of site/geology conditions risks. In fact, most of the interviewees who identified site/geology conditions also mentioned hazardous materials among them. The issues here are comparable, except hazardous materials are not necessarily present in each and every project. Problems can arise when undisclosed hazardous materials are encountered, so determination of the source and responsibility for remediation is not always clear. One interviewee suggested that a provision for discovery and handling of undisclosed, pre-existing hazardous materials should provide an adequate framework for addressing most unknown hazardous materials' situations. Others indicated that establishing whether the materials are pre-existing or not is difficult on occasion.

Right-of-Way. Opinions varied with regard to right-of-way acquisition. Some indicated that this should be the responsibility of public agencies since they have the necessary powers, and property owners will view them more favorably. One interviewee from the public sector commented that its unit responsible for ROW acquisition is highly effective and efficient, so it makes more sense in their case to retain this responsibility as long as the agency coordinates its efforts with the developer/contractor. Another interviewee stated: "It can be advantageous to have the developer in control of the right way acquisition to some extent, so that they can tailor it to their specific designs and make sure that parcels that are on the critical path are acquired first." Another suggested a dual approach where the public agency develops a plan for ROW acquisition with the developer based on both the characteristics of the properties needed and the developer's scope of work and schedule. In short, the interviewees' input suggests that responsibility for ROW acquisition is subject to each project's context.

Operations Risks

Revenue Risk. For toll concessions, revenue risk remains a concern. This is certainly not surprising given the financial distress that some P3s have faced. One interviewee observed that the crux of

⁵This circumstance is somewhat perplexing given the existing framework for handling differing site conditions in more conventional projects. Common practice is to provide a geotechnical baseline report in the contract documents that indicates the expected conditions and to have a Differing Site Conditions clause that affords relief if actual conditions vary from those indicated in the documents or those ordinarily encountered. The rationale for the deviation from this industry norm in P3s is unclear.

these arrangements is balancing the maximum scale that a DBJV can bear with the minimum scale necessary for a commercially viable tolled facility. Finding this balance requires substantial due diligence and could indicate that a revenue risk P3 is unfeasible.

Operations and Maintenance (O&M). Only a few interviewees mentioned this risk. Interestingly, a common insight from those who did was that owners do not understand O&M processes or costs nearly as well as design and construction. Consequently, owners may be disadvantaged when evaluating O&M matters in procurement or monitoring them during execution.

Latent Defects. For projects with existing facilities or structures that a developer will operate and manage, latent defects risk remains troubling. Several interviewees characterized this risk as another with the potential for liabilities to be uncapped since quantifying exposure ex ante is difficult. Sharing schemes were suggested as a remedy.

Handback. Several interviewees discussed handback. Most agreed that the typical handback process defined in P3s appears reasonable, but this is an untested area in the United States. A common perspective was how pragmatic handing over assets with specified remaining service lives will prove; a few noted that this may set the stage for disputes between the parties. One interviewee commented though that a public agency is better served to enforce established performance measures (i.e. KPIs) throughout the concession period than to rely on the handback process. Another noted that by that point in the concession the parties should be truly partners rather than adversaries, so they should be able to resolve any issues.

RISK SHARING METHODS

Interviewees provided various perspectives about risk sharing methods. Foremost among the insights was the simple notion that the intent to share a risk will prompt the counterparties to *communicate* about a risk. Such communication can be very beneficial particularly if the parties discuss a risk's likelihood, its impact and what levels of exposure are acceptable. Doing so promotes a deliberate approach to risk allocation and likely reduces reliance on relief event mechanisms.

Allowances and Deductibles

Allowances and deductible schemes were frequently mentioned as effective sharing approaches. These approaches are similar since the counterparties apportion the responsibility and impact of risks between them by establishing threshold amounts. In an allowance a threshold amount for a risk or a set of risks is determined and one party bears the responsibility and impact (typically cost) of the risk(s) up to the threshold. Beyond the allowance threshold, the counterparty assumes

responsibility and impact. One interviewee described an example where grout injection was needed to stabilize subsurface soils, but the total amount of grout was not known. An allowance scheme was established where the contractor covered the cost of grout injection up to an agreed expected amount; beyond that, the owner paid for additional injection. In a deductible scheme, “tranches” are established. For example, if a deductible scheme has three tranches, then typically the developer/contractor is responsible for the first tranche, the parties share responsibility for second tranche, and the owner bears responsibility for third tranche (i.e. any amount beyond the second tranche’s threshold).

While these risk sharing approaches are well-established in P3s, some interviewees expressed concerns about how threshold amounts are established and whether they are effective. One interviewee commented that these amounts tend to follow precedents from prior projects without much regard for the current circumstances. Another interviewee noted that they can introduce an element of gaming in the procurement process since proposers can examine the threshold amounts and speculate about the likelihood of risks occurring; an optimistic view would drive pricing down since the proposer is gambling that any additional costs will be below the total threshold amounts and vice versa with a pessimistic view. Alternatively, many interviewees emphasized that if the threshold amounts are openly discussed by the counterparties, then this introduces transparency about the risks for both parties. Moreover, both the public agency and the private entities would likely need to seek approval from governing boards or higher-level executives of the total potential financial exposure from allowances and/or deductibles. This increases awareness of the implications of risks at multiple levels for the involved parties.

Indexing and Escalation

Interviewees also discussed risks associated with commodities and materials pricing. In light of recent supply chain issues and increasing inflation, this was not unexpected. Many P3 contracts include indexing or escalation provisions for fuel and petroleum-based products. Several expected that extension of these provisions to other materials such as steel would likely be a subject of discussion in the future. In addition, some suggested that such provisions should be considered for interest rates and insurance coverage; in particular, insurance premiums have become increasingly volatile.

RECOMMENDATIONS FOR IMPROVING THE MARKET

Interviewees were asked to share their top recommendations for improving the P3 market to conclude the interview. These recommendations were grouped into common themes; thematic areas are presented below in order of frequency of mention.

Communication and Dialogue about Risks

By far, the top recommendation was the need to improve communication and dialogue about risks in P3s. Summaries of interviewee comments follow:

- ▶ Parties need to identify issues and communicate during procurement and contract formation to expose risks and potential issues as early as possible;
- ▶ One-on-one communication and discussion between parties on how to address a risk is the best way to shape provisions for each risk;
- ▶ Owners should listen to industry and bidders to truly understand what's being said. One-on-one meetings need to have detailed discussions about the risk register and price or worth or cost of each and every risk;
- ▶ Identify most likely or most significant risks and transparently allocate them beforehand so parties anticipate that these may materialize and how they will be handled;
- ▶ Communicate with the owner and expand the discussion to cover as much information as possible. Have market discussions before procurement starts. Conduct these in one-on-one sessions with all key stakeholders present rather than open forums; such meetings enable richer and more candid discussions;
- ▶ Better communication is needed among the parties. The parties should come to the table approaching discussions about risk as the pursuit of optimal risk allocation versus negotiations about risk transfer;
- ▶ Be more honest about which party is best able to manage each and every risk; if neither, then it should likely be the owner's risk;
- ▶ Have honest discussions about any contingencies and their implications;
- ▶ Owners must budget for contingencies that may fall back to them due to improper risk transfer. Owners should also expect relief events for "known unknowns" and fairly compensate developers/contractors if warranted;
- ▶ Issue draft RFPs or draft contracts/terms prior to procurement start; ideally, issue these prior to or concurrently with release of the RFQ.

Progressive or Collaborative Development

Interviewees also suggested that more progressive or collaborative development in P3s could change the dynamics in the market. Yet, some indicated that this is not a universal remedy.

Summaries of interviewee comments follow.

- ▶ The public agency should truly evaluate whether it is appropriate to have a competitive versus negotiated process; is there the potential for more value through dialogue and collaboration in advancing a project?
- ▶ Progressive approaches can make sense for particular projects where there is a need to front-load programming and design, but this creates some risk for both parties so the process will need “offramps” for both parties if the collaboration is not working;
- ▶ P3s need improved collaboration and cooperation between counterparties;
- ▶ The progressive model is being promoted as a remedy for the market; under certain conditions this might make sense, but does the progressive model solve the root causes of a project’s principal risks? Do more reasonable communication and diligence in a “conventional” procurement resolve these issues?
- ▶ A progressive approach promotes better negotiations and, depending on a project’s context, it can allow better alignment between parties with respect to objectives and risks. The tradeoff is no competitive pressure on pricing. Competitive procurement allows owners to assess whether contingencies and risk transfer are appropriate through one-on-one meetings among competing teams.

Improve Dispute Resolution

Dispute resolution was also mentioned by interviewees, particularly the importance of expediting this process.

- ▶ Find mechanisms to resolve disputes faster and more equitably, so problems are not lingering and resulting in major claims;
- ▶ Expedited dispute resolution can help contractors to minimize money lost with respect to delay impacts. Options to continue to fund construction work as disputes are being addressed or resolved need greater consideration. For instance, the parties could enter into an interim binding agreement for a claim/dispute where the owner continues to fund the work while reserving the right to recoup funds later if justified.

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- ▶ Parties should consider an “incremental” dispute resolution process. For instance, if the parties can agree on 80% of a claim, then they should compensate and/or extend based on what is agreed. The balance can remain under consideration and/or protest.

Project Preparation

Some interviewees offered suggestions about project preparation, which are summarized below.

- ▶ What is the minimum essential scope for a P3? What can the owner do to set a project up for success through its due diligence? Owners need to consider these questions carefully;
- ▶ An owner should advance and provide enough information about utilities and other third party risks so that it proves beneficial to all parties involved;
- ▶ Getting third party agreements in advance rather than during procurement is more efficient than negotiating the same agreements during the procurement process. This can reduce the uncertainty around third party obligations or at least inform the parties about where issues remain.

CONCLUSION

The enacted Infrastructure Investment and Jobs Act (IIJA) requires procuring agencies to evaluate key terms, major compensation events and risk allocation during planning and development of a P3 project. Hence, the purpose of this report was to characterize the state of practice in P3s for risk allocation by examining how risks are provisioned and allocated in existing P3 contracts and by collecting input about current practices from a representative sample of practitioners. The findings are intended to inform decision-making by public agencies as they plan, procure and implement P3 projects.

An assessment of 26 P3 transportation project contracts determined how 30 general, construction and operation risks were allocated. Not surprisingly, risks related to construction (*design, performance*), finance (*financing, refinancing*), operation (*availability and service, operation expenses, maintenance*), project company ownership (transfer) and handback (*handback*) were predominantly transferred to the private sector. The public sector predominantly retained only two risks (*changes by public authority and interest rates pre-financial close*). These results confirm the risk transfer tenet of P3s. Nearly a third of the risks were treated by event mechanisms (relief, compensation or delay events), and these mechanisms were often associated with *socio-political opposition, change in law, site geology/conditions, network modifications and latent defects* risks. Risk sharing was also employed, and the most frequent sharing methods included: (a) external reference (typically to a pricing index), (b) negotiation, and (c) deductible schemes. The prevalence of event mechanisms has important implications. Foremost, the parties do not know ex-ante who will bear a risk and to what extent. Additionally, the procedural nature of the event mechanism provisions will require the parties to expend considerable effort ex-post to assess and resolve associated risks.

Interviews with 14 experienced practitioners enriched the findings from the contract analysis. By far, risks related to geology/site conditions and third-parties such as utilities were identified as the most problematic risks in P3s. The prevailing concern was the potential for such risks to be uncapped. Without provisions to mitigate this possibility, developers and DBJV members will include significant contingencies in their proposals or, more significantly, withdraw from a procurement. Risk sharing methods such as allowances or deductibles as well as timely decision-making and dispute resolution were suggested as mitigation strategies. Interviewees also raised a number of general issues such as the fixed price, date certain structure of P3s and project preparation. When asked for top recommendations to improve the market, the vast majority of interviewees recommended more open and transparent communication about risks among involved parties with such communication starting prior to procurement through industry forums or one-on-one meetings.

The findings in this report shed light on current practices and issues with risk allocation in transportation P3s. Public agencies and private participants can use the information about risk allocation as well as the general issues raised to enhance decision-making about assessment and planning of P3 projects.

REFERENCES

- Barutha, P. Karaca, I. Pinto-Nunez, M., and Gransberg, D.D. (2019) "Project Risk Perception on Public Private Partnership Projects," Proceedings of the Transportation Research Board Annual Meeting, Paper #19-04767, January, Washington, DC.
- Beidleman, C. R., Fletcher, D., and Veshosky, D. (1990). "On allocating risk: The essence of project finance." *Sloan Management Review*, 31(3), 47–55.
- Bing, L., Akintoye, A., Edwards, P. J., and Hardcastle, C. (2005). "The allocation of risk in PPP/PFI construction projects in the U.K." *International Journal of Project Management*, 23(1), 25–35.
- Chou, J., and Pramudawardhani, D. (2015). "Cross-country comparisons of key drivers, critical success factors and risk allocation for public-private partnership projects." *International Journal of Project Management*, 33(5), 1136–1150.
- Chung, D., Hensher, D. A., and Rose, J. M. (2010). "Toward the betterment of risk allocation: Investigating risk perceptions of Australian stakeholder groups to public-private-partnership tollroad projects." *Research in Transportation Economics*, 30(1), 43–58.
- Dudkin, G., and Vålilä, T. (2006). "Transaction costs in public-private partnerships: A first look at the evidence." *Competition and Regulation in Network Industries*, 1(2), 307–330.
- Eno Center for Transportation. (2015). *Partnership Financing: Improving Transportation Infrastructure through Public Private Partnerships*, Washington, DC.
- Federal Highway Administration. (2012). *Risk assessment for public-private partnerships: A Primer*, Report FHWA-OIPD-13-004, Washington, DC.
- Hardcastle, C. and Boothroyd, K. (2003). "Risks overview in public-private partnership," in eds. Akintoye, A., Beck, M., and Hardcastle, C. (2003). *Public Private Partnerships, Managing Risk and Opportunities*. Blackwell Science, Ltd. Malden, MA.
- Li, B., Akintoye, A., Edwards, P. J., and Hardcastle, C. (2005). "Critical success factors for PPP/PFI projects in the U.K. construction industry." *Construction Management and Economics*, 23(5), 459–471.
- Nguyen, D., Garvin, M. J. and Gonzalez, E. E. (2018), "Risk allocation in U.S. public-private partnership highway project contracts," *Journal of Construction Engineering and Management*, 144(5), 04018017.
- Quiggin, J. (2005). "Public-private partnerships: options for improved risk allocation," *Australian*

Economic Review, 38(4), 445-50.

Rubin, D. K. and Powers, M. B. (2019). "After bottom-line hits, more firms exit fixed-price work," Engineering News-Record, August 7.

Parsons, J. and Rubin, D. K. (2020). "Court Ruling Clears P3 Team to Leave Disputed \$2B Md. Purple Line Rail Project," Engineering News-Record, September 11.



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