

Bridge Bundling Guidebook

*An Efficient and Effective Method for Maintaining
and Improving Bridge Assets*



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FOREWORD

As States continue to see an increase in the number of bridges needing attention, bundling two or more bridge projects into a single contract can offer potential savings in resources and time, directly benefiting expedient improvements to aging infrastructure nationwide.

Several State and local public agencies already employ this concept; however, because bridge bundling practices and methods are not yet standardized, the Federal Highway Administration (FHWA) sought to identify tools and techniques to assist agencies in implementing bridge bundling successfully for all funding sources.

This *Bridge Bundling Guidebook* was developed by the FHWA Bridge Bundling Implementation Team and is based on interviews, case studies, and lessons learned from practicing agencies. It offers information, tools, and methods that can help State and local agencies save procurement time, leverage design expertise, achieve cost savings, and build momentum for maintaining critical infrastructure assets.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAA	American Automobile Association
AASHTO	American Association of State Highway and Transportation Officials
ABC	accelerated bridge construction
AC	advance construction
ADA	Americans with Disabilities Act
APD	alternative project delivery
ACM	alternative contracting method
AEC	architecture, engineering, and construction
ARTBA	American Road & Transportation Builders Association
ASCE	American Society of Civil Engineers
ATC	alternative technical concept
BBIT	Bridge Bundling Implementation Team
BSIR	bridge safety inspection report
CE	categorical exclusion
CEI	construction engineering inspection
CFR	Code of Federal Regulations
CM	construction manager
CM/GC	construction manager/general contractor
CMR	construction-manager-at-risk
D-B	design-build
D-B-B	design-bid-build
DBE	Disadvantaged Business Enterprise
DBF	design-build-finance
DBFM	design-build-finance-maintain
DBFOM	design-build-finance-operate-maintain
DBO	design-build-operate
DBOM	design-build-operate-maintain
DelDOT	Delaware Department of Transportation
DOT	Department of Transportation
EA	environmental assessment
EDC	Every Day Counts

EIS	environmental impact statement
FA	Federal aid
FAST Act	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
FLAP	Federal Lands Access Program
FONSI	Finding of No Significant Impact
FY	fiscal year
GARVEE	Grant Anticipation Revenue Vehicle
GDOT	Georgia Department of Transportation
GEC	general engineering consultant
GMP	guaranteed maximum price
GPA	General Purpose Authority
GRS-IBS	geosynthetic reinforced soil-integrated bridge system
HSIP	Highway Safety Improvement Program
HTF	Highway Trust Fund
ICE	independent cost estimator
IDIQ	indefinite delivery/indefinite quantity
INDOT	Indiana Department of Transportation
IQED	Implementing Quality Environmental Documentation
IRS	Internal Revenue Service
LCP	life cycle planning
LOI	letters of interest
LPA	local public agency
MAP-21	Moving Ahead for Progress in the 21 st Century Act
MBE	minority business enterprise
MoDOT	Missouri Department of Transportation
NACE	National Association of County Engineers
NACo	National Association of Counties
NBI	National Bridge Inventory
NCGPA	Northampton County General Purpose Authority
NCHRP	National Cooperative Highway Research Program
NDOT	Nebraska Department of Transportation
NEPA	National Environmental Policy Act

NHI	National Highway Institute
NHPP	National Highway Performance Program
NHS	National Highway System
NYSDOT	New York State Department of Transportation
NYSTA	New York State Thruway Authority
ODOT	Ohio Department of Transportation
OJT	on-the-job training
O&M	operations and maintenance
OTIA	Oregon Transportation Investment Act
PABs	private activity bonds
P3	public-private partnership
PCAC	partial conversion of advance construction
PDB	progressive design-build
PDSM	Project Delivery Selection Matrix
PE	preliminary engineering
PennDOT	Pennsylvania Department of Transportation
PS&E	plans, specifications, and estimate
QA	quality assurance
QBS	qualifications-based selection
QC	quality control
RACI	responsible, accountable, consulted, and informed (matrix)
RFP	request for proposals
ROW	right-of-way
RRIF	Railroad Rehabilitation & Improvement Financing
SCDOT	South Carolina Department of Transportation
SIB	State Infrastructure Bank
SPV	special purpose vehicle
STBG	Surface Transportation Block Grant Program
TIA	Transportation Innovation Act
TIFIA	Transportation Infrastructure Finance and Innovation Act
TWG	Technical Work Group
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code

USCG	U.S Coast Guard
USDOT	U.S. Department of Transportation
VE	value engineering
VECP	value engineering change proposal
WBE	women's business enterprise

Executive Summary

A bridge bundling program targets a defined set (or bundle) of bridges that are planned for preservation/preventive maintenance, rehabilitation, or replacement in a timely and efficient manner through a series of bridge bundling contracts with the support of various funding options and/or partnerships and may include a program completion time frame.

Bridge bundling, a practice currently used by some State departments of transportation (DOTs) and local public agencies (LPAs), has demonstrated to be an efficient and effective method for maintaining and improving both Federal-aid and non-Federal-aid bridge assets. This practice includes joint State and local efforts that have resulted in cost savings and expedited project delivery. Bridge bundling has proved to be a valuable tool in all three of the major approaches to managing bridges: preservation/preventive maintenance, rehabilitation, and replacement (see Figure 1).

The National Bridge Inventory “Bridge Condition by Owner” data for 2017¹ indicated that, of the nation’s 615,002 highway bridges, 46.8 percent were in good condition, 45.4 percent were in fair condition, and 7.7 percent were in poor condition. While bridges in poor condition often get the most attention, the Federal Highway Administration (FHWA) *Bridge Preservation Guide*² notes, “Effective bridge preservation actions are intended to delay the need for costly rehabilitation or replacement while bridges are still in good or fair condition and before the onset of serious deterioration.” Bridge bundling is an ideal method for delivering projects for bridges in all conditions.

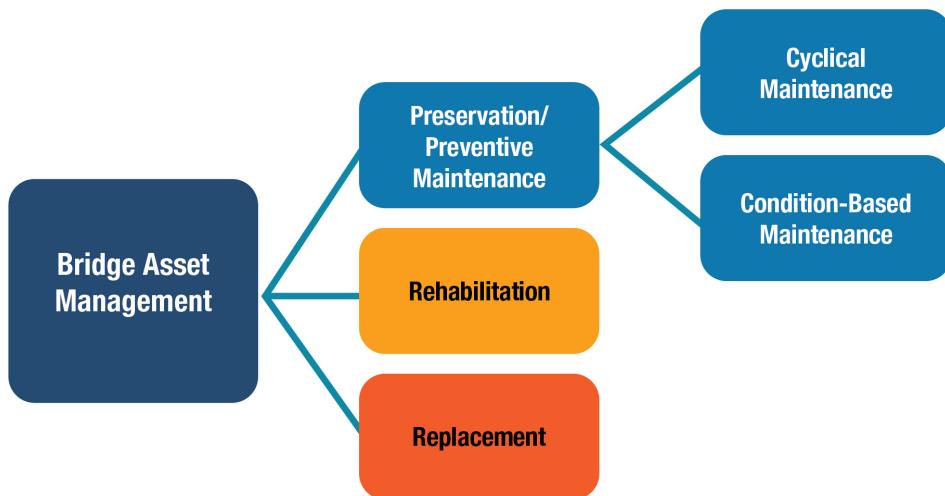


Figure 1. Bridge action categories.

Source: FHWA

¹ Federal Highway Administration, [Highway Bridge Condition by Highway System 2017](#).

² Federal Highway Administration, [Bridge Preservation Guide, Spring 2018](#)

Just as major rehabilitations and replacements for bridges in poor condition can be bundled into a single contract, preservation and preventive maintenance actions for bridges in good or fair condition may be bundled likewise. In fact, many agencies have been bundling bridge maintenance contracts for years.

FHWA has recognized bridge bundling as an innovative program to increase bridge improvement capacity. As such, it is assisting agencies in implementing bridge bundling by targeting four focus areas:

- Improve awareness that bridge bundling is a fast and efficient method to reduce the number of bridges in poor condition across the nation, increasing reliability and service for the traveling public while saving agencies time and money.
- Increase knowledge that bridge bundling works for preventive maintenance, preservation, rehabilitation, and replacement.
- Improve awareness of available funding and revenue sources, innovative financing tools, and the ability to package these tools to cover the costs of bridge bundling projects.
- Improve awareness of the best available project delivery method for implementing bridge bundling, maximizing time and cost savings.

To accomplish this, FHWA is serving as a bridge bundling information clearinghouse for DOTs, LPAs, and other bridge owners interested in bridge bundling by sharing case studies and other information, providing technical assistance, and developing training materials.

This guidebook, a how-to manual on bridge bundling, is part of this effort. It provides comprehensive information to assist DOTs, LPAs, and other bridge owners in effectively using bridge bundling as a viable project and program option to ensure measurable time and potential cost savings.

The guidebook provides reasons why bridges could be bundled and information on how to create a bridge bundle contract; different project and program delivery methods; funding and financing strategies; Federal civil rights requirements, such as Title VI of the Civil Rights Act of 1964 (Title VI) and the Disadvantaged Business Enterprise program; on-the-job training goals; environmental, right-of-way (ROW), and utility considerations; the importance of risk management; agency roles; and quality assurance. It also offers advice on making the case for bridge bundling with different stakeholder groups. Figure 2 outlines the 10 steps necessary to implement and deliver a bridge bundle project, recognizing that the steps may be more iterative than sequential.

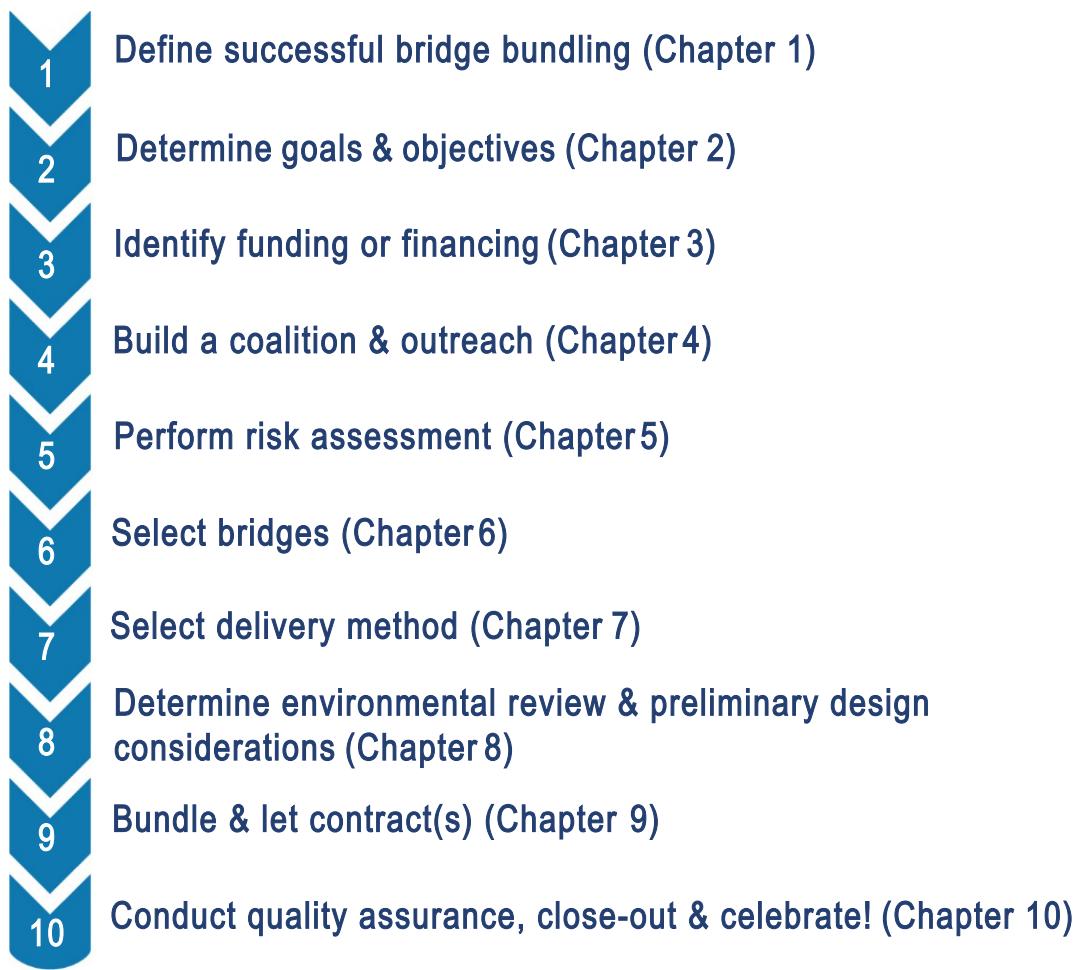


Figure 2. Ten major steps to implementing a successful bridge bundling project.

Source: FHWA

Throughout this guidebook, the following symbols are used to draw the reader's attention to links to legislation, guidance, noteworthy practices, and additional resources.



Federal legislation



NOTEWORTHY
PRACTICES

Noteworthy practices from agencies, including case studies



OTHER
RESOURCES

Other resources from agencies or professional organizations



GUIDANCE

Federal guidance



VIDEO

Video clip from State or local agency representative offering his or her perspective

Chapter 1. An Introduction to Bridge Bundling: Defining Success



Define successful bridge bundling

Determine goals & objectives

Identify funding or financing

Build a coalition & outreach

Perform risk assessment

Select bridges

Select delivery method

Determine environmental review & preliminary design considerations

Bundle & let contract(s)

Conduct quality assurance, close-out & celebrate!

Objective:

- To be able to define a successful bridge bundling project or program

Tools:

- Definition
- Case studies
- List of lessons learned

Outcome:

- Improved understanding of the range of successful bridge bundling projects and programs

1.1 What is Bridge Bundling?

“Bridge bundling” describes the use of a single contract award for preservation, preventive maintenance, rehabilitation, or replacement of multiple bridges. Such a contract could use any of several features. For instance, its scope could include both design and construction, or it could be tiered to allow a combination of work types. Its geographic coverage could extend over a county, a highway district, or an entire State. LPAs can combine efforts into one contract. Period of performance could end with the completion of construction, or it could extend through years of regular and preventive maintenance (FHWA, 2017a). In addition, bridge bundling, in certain circumstances, can be eligible for low-interest rate Federal loans³ or attract private capital.

³ The [Transportation Infrastructure Finance and Innovation Act \(TIFIA\) 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. Eligible projects also include related transportation improvement projects grouped together in order to reach the minimum cost threshold for eligibility, so long as the individual components are eligible and the related projects are secured by a common pledge.

For the purpose of this guidebook, a bridge bundling program is described as follows:

A bridge bundling program is a program that targets a defined set (or bundle) of bridges that are planned for preservation/preventive maintenance, rehabilitation, or replacement in a timely and efficient manner through a series of bridge bundling contracts with the support of various funding options and/or partnerships and may include a program completion time frame.

1.2 Bridge Bundling Successes

Many agencies have used bridge bundling contracts successfully, as shown in the case studies in Appendix C, which includes details on the following examples of successful State and local bridge bundling efforts:

- The Delaware Department of Transportation (DelDOT) uses a series of bridge bundling contracts to address preventive maintenance issues on bridges in good and fair condition. Work is prioritized by the Bridge Management Section and the contracts are administered by the DelDOT Maintenance Districts. Actions include deck sealing, bridge painting, deck patching, and joint repair.
- The New York State DOT has bundled bridges for preventive maintenance, rehabilitation, and replacement. For several years, New York has bundled specific bridges in close proximity for preventive maintenance actions such as painting, washing, and joint replacement. The New York Works program rehabilitated 116 bridges by replacing their decks. The Critical Bridges Over Water program was a fast-paced program to replace 106 scour-critical bridges.
- The Nebraska DOT (NDOT) County Bridge Match Program dedicates up to \$40 million total in State funds through June 2023 to promote innovative repair and replacement of structurally deficient bridges on county road systems. NDOT specified bridge bundling as an example of an innovative technique shown to generate cost efficiencies and project delivery time savings among peer agencies. The majority of applications have proposed bundled approaches.



[Interview with Mark Traynowicz, Nebraska DOT](#)

“...get a better economy of scale and get a better bridge project.”

- The Pennsylvania DOT (PennDOT) Rapid Bridge Replacement Project, which will replace 558 bridges statewide, is using a single design-build-finance-maintain (DBFM) public-private partnership (P3) availability-payment concession (FHWA, 2017a). In addition, PennDOT has a bridge bundling program, begun in 2012, which bundles similar locally owned bridges into smaller contracts in order to gain efficiency and reduce the financial burden on LPAs.
- The Ohio Bridge Partnership Program replaced or rehabilitated 220 county bridges over 3 years. It was funded through \$120 million in Grant Anticipation Revenue Vehicle (GARVEE) bonds and toll credits (FHWA, 2017a). The Ohio DOT placed the bridges into one large bundle for financing, but broke them into smaller bundles for design and construction.

- The Missouri DOT (MoDOT) \$685 million Safe & Sound Bridge Improvement Program either replaced or rehabilitated 802 State bridges over 3.5 years, including 554 bridges via a single design-build (D-B) contract. The other 248 bridges were designed and constructed using small bridge bundles and the design-bid-build (D-B-B) delivery method. MoDOT sold revenue bonds to finance the project (FHWA, 2017a).
- The Oregon Transportation Investment Act (OTIA) State Bridge Delivery Program provided \$1.3 billion over 10 years to either repair or replace more than 270 bridges using 87 project bundles. The projects were grouped into logical bundles along each highway corridor. Oregon DOT issued Build America Bonds to finance the program (FHWA, 2017a).
- The Georgia DOT (GDOT) D-B Bridge Bundling Program in 2016 accelerated the replacement of 25 local bridges valued at almost \$40 million. GDOT awarded five D-B contracts that bundled four to six bridges each geographically, allowing each contractor to streamline delivery by combining design and construction for the bridges in its area (FHWA, 2017a).
- The Indiana DOT (INDOT) practice of grouping (or bundling) projects into multiple-project contracts has usually resulted in lower unit costs. A recent study of 1,997 bridge projects in 715 INDOT bridge contracts over 9 years confirmed and documented the benefits of bundling (Qiao, Fricker, & Labi, 2018).

Bridge bundling has proved to be a very effective way to extend the life of fair- and good-condition bridges and to reduce the number of bridges in poor condition, particularly when coupled with other innovative alternative contracting methods (ACMs) or a finance strategy. Bridge bundling can be used for all types of projects, including preservation and preventive maintenance, rehabilitations, and replacements. Bridge owners, whether at the State, local, or facility level, which often struggle with the financial burden of repairing or replacing bridges, can take advantage of the efficiencies gained in bridge bundling.

The bridge bundling programs in Nebraska, New York, Pennsylvania, Ohio, and Georgia are State programs aimed at helping LPAs. Some local agencies, including Pennsylvania's Northampton County, Florida's Osceola County, and Washington's Thurston County, have also launched bridge bundling initiatives. Northampton County bundled 33 of its 115 bridges into a single procurement with no Federal or State financial assistance. The former Thurston County Director of Public Works reported that up to a 30 percent cost savings per bridge was achieved by bundling (Thurston County, 2017). Given these project and program successes, FHWA seeks to promote the use of bridge bundling to other agencies.



[Interview with Stan Rugis, County of Northampton, Pennsylvania](#)

“We looked not only at the quality of the bridge, the deficiency, but we also looked at the economic impact...”

1.3 Lessons Learned

The State and local bridge bundling case studies detailed in Appendix C demonstrate that bridge bundling works for similar types of bridges, for similar work types, and for all project delivery methods for the following purposes:

- Achieving performance targets.
- Completing preservation/preventive maintenance actions.
- Rehabilitating bridges.
- Replacing bridges.
- Achieving economies of scale.
- Reducing cost.
- Accelerating project schedules.
- Deploying innovation.

The case studies also demonstrate that the maximum efficiency benefits occur when bridge bundling is used in the following settings:

- Locations with no, or minimal, ROW takings.
- Locations with minimal environmental constraints.
- Locations where hydraulic analysis is completed in advance.
- Locations with sufficient advance geotechnical information.

When thoughtfully used, bridge bundling can be a valuable tool for any bridge owner, regardless of size, for any bridge action.



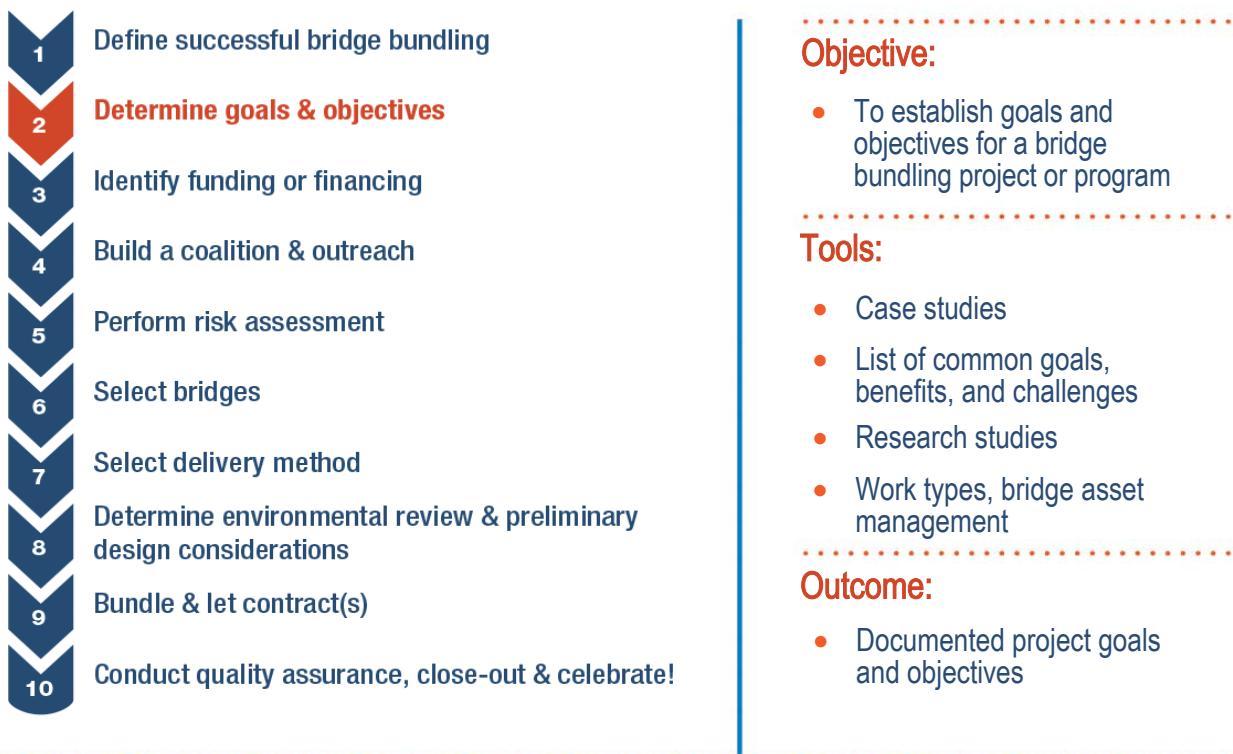
[Interview with Edward Minchin, University of Florida](#)

"It just shows great potential, and I don't really see a downside..."

1.4 Summary

Bridge bundling is a proven, effective way to both extend the life of fair- and good-condition bridges and to reduce the number of bridges in poor condition, particularly when coupled with ACMs or a finance strategy. It can be used for all types of projects, including preservation and preventive maintenance, rehabilitations, and replacements. Several available case studies demonstrate that maximum efficiencies occur when bridge bundling is used at locations with minimal or no ROW acquisitions or environmental constraints and at locations where hydraulic analysis is completed in advance.

Chapter 2. Why Bundle Bridges? Goals and Objectives



2.1 Goals and Objectives

Public agencies create bundled bridge projects because of the benefits that can be realized through the process. For some agencies, bundling bridges may be beneficial because of a need to address preservation/preventive maintenance of bridges in good and fair condition or to reduce bridges in poor condition quickly. For other agencies, it may be due to insufficient staff, a sudden increase in funding, or an obligation deadline, or it may be to address a critical corridor or leverage other funding and financing strategies. For nearly all agencies, increased efficiency is the primary reason for bundling bridges—increased efficiency in planning, project management, design, procurement, and construction.

A DOT, LPA, or other bridge owner can use bridge bundling to achieve one or more goals; some of the common goals, not listed in any particular order, are as follows:

- Achieve national goals and performance management measures (23 United States Code [U.S.C.] 150).
- Address transportation asset management plan objectives (23 U.S.C. 119).
- Save time—accelerate work that would not advance as rapidly with traditional methods.
- Save design costs.
- Save construction costs.

- Take advantage of economies of scale—improve production.
- Maximize use of available funding.
- Take advantage of financing.
- Deploy innovation.
- Expedite project delivery—achieve public improvements sooner.
- Utilize ACMs.
- Coordinate construction staging—reduce public disruption.
- Start construction of multiple bridges simultaneously.
- Maintain and improve bridge condition.
- Improve surrounding land value and economic benefits.
- Partner with other agencies to achieve efficiencies.
- Create jobs in the construction industry.
- Increase pool of bridge contractors in a geographic area.
- Create opportunities for small and disadvantaged businesses.
- Create on-the-job training opportunities.

As an agency determines its desired goals, specific objectives should be identified to define specific strategies or implementation steps to attain those goals. Objectives are more specific and outline the “who, what, when, where, and how” of reaching the goals.

2.2 Federal Legislation

Agencies should understand the funding and financing tools available for bridge bundling. Although the use of Federal funds to bundle projects has been allowed for many years, the Fixing America’s Surface Transportation Act (FAST Act) encourages States to save costs and time by bundling two or more similar bridge projects into a single contract award. Section 1111 of the FAST Act, Bundling of Bridges, adds a provision—23 U.S.C. Section 144(j)—that encourages using Federal funding on bridge bundle contracts. The statute requires each bridge project included in a bundle to meet the following criteria:

- Be eligible under either the National Highway Performance Program (NHPP), 23 U.S.C. 119, or the Surface Transportation Block Grant Program (STBG), 23 U.S.C. 133.
- Be included as a bundled project in the applicable Transportation Improvement Program or Statewide Transportation Improvement Program.
- Be awarded to a single contractor or consultant pursuant to a contract for either engineering and design or construction.
- Have the same funding category/subcategory and the same Federal share.

Such bundled bridge projects are exempt from the payback provisions of 23 U.S.C. 102(b), which require a State to repay all Federal-aid reimbursements for preliminary engineering (PE)

costs on a project that has not advanced to ROW acquisition or construction within 10 years after Federal-aid funds were first made available (FHWA, 2017a).

The FAST Act includes other provisions supportive of bridge bundling:

- Section 1106 revised 23 U.S.C. 119(i) to allow NHPP funds to pay for improvements to bridges that are not on the National Highway System (NHS) if the bridge is on a Federal-aid highway. This added flexibility to the NHPP expands the program to be used on non-NHS Federal-aid highway bridge projects (FHWA, 2017a).
- Section 1109 revised 23 U.S.C. 133 to make more Federal aid available to local areas through the revised STBG Program, gradually increasing the percentage of sub-allocated funds from 51 percent in fiscal year (FY) 2016 to 55 percent in FY 2020. The previous law sub-allocated 50 percent. The law also maintains the off-system bridge set-aside from the Moving Ahead for Progress in the 21st Century Act (MAP-21), allowing States to use STBG funds for bridges that are not on the Federal-aid highway system (FHWA, 2017a).

These legislative measures are aimed at encouraging agencies to bundle bridges to save time and reduce cost. Where appropriate, bundling bridges can rapidly reduce the number of structures that are in need of work, in addition to maintaining these critical assets in a state of good repair.



[Interview with Mark Traynowicz, Nebraska DOT](#)

"I think the biggest thing to say about bridge bundling is, it's simple."

Chapter 3 provides more detail on funding and financial options.

2.3 Benefits

The benefits of bundling bridges will depend on the agency's goals. These benefits could include one or more of the following:

2.3.1 Achieve National Performance Goals

Bridge bundling can be a strategy to help achieve national performance goals (23 U.S.C. 150(b)). The FHWA defines transportation performance management as a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals. Through the Federal rulemaking process, FHWA established national performance measures that support the national goals. State DOTs, in coordination with metropolitan planning organizations, establish performance targets that will make progress toward achieving the national performance goals. For bridges, the performance measures are the percentage of NHS bridges by deck area classified as in good condition and classified as in poor condition (23 CFR Part 490.407(c)).



The [FHWA Transportation Performance Management](#) website features a guidebook, self-assessment, frequently asked questions, and links to pertinent legislation, regulations, and relevant reports and publications.

2.3.2 Address Asset Management Plan Objectives

Bridge bundling can be an important strategy in an agency’s overall asset management practices. State DOTs may establish additional measures and targets beyond national performance goals that reflect other asset management objectives.

Asset management, as defined in 23 U.S.C. 101(a)(2), is a “strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based on quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the life cycle of the assets at a minimum practicable cost.”

The NHPP (23 U.S.C. 119) required States to develop a risk-based transportation asset management plan for the NHS to improve or preserve the condition of assets and the performance of the system. Federal-aid investments in bridge construction should support progress toward achieving performance targets documented in the State’s asset management plan. Bridge bundling can help achieve the minimum condition requirements (e.g., no more than 10 percent of NHS bridges by deck area classified as poor for three consecutive years).

The FHWA *Bridge Preservation Guide* notes “MAP-21 brought transformative changes to the Federal-Aid Highway Program with its performance management and asset management requirements. Asset management plans are an important highway infrastructure management tool to improve and preserve the condition of assets and system performance.”

Because of the importance of considering the whole life of an asset in developing cost-effective investment strategies, asset management establishes a life cycle planning (LCP) approach to managing transportation assets. LCP should be considered an approach to managing transportation assets over their whole life, covering the time each asset goes into service after construction to the time it is retired or disposed of. The 23 CFR Part 515 defines LCP as “a process to estimate the cost of managing an asset class, or asset sub-group, over its whole life with consideration for minimizing cost while preserving or improving the condition.”

An LCP strategy is a collection of treatments that represent the entire life of an asset class or sub-group. For example, one LCP strategy might include a set of treatment rules that reflect a “worst-first” philosophy that includes rehabilitation and reconstruction treatments once an asset has deteriorated. Since the worst-first strategy is not cost-effective, it is typically used only for comparison purposes to illustrate the amount of deterioration that can occur if no preservation treatments are used. A more cost-effective LCP strategy might reflect a “preservation” philosophy that is designed to include low-cost treatments to keep good roads in good condition longer, with rehabilitation and reconstruction options for more deteriorated assets.

Agencies may define different LCP strategies to represent different levels of preservation aggressiveness. For instance, an agency may have three bridge deck strategies: one that includes the application of rigid overlays, with the first overlay installed at the onset of deck deterioration; another that includes the application of thin overlays; and a third that includes patching only until partial deck reconstruction is required.

The intent in developing multiple LCP strategies is to compare whether one results in better long-term conditions than another with the same level of funding. The results of an LCP process can be used to better understand the impact of various treatment strategies on asset performance. Using available tools, such as pavement and bridge management systems, an agency can examine a range of LCP scenarios for key assets covering the period from initial construction through maintenance, preservation, repair, rehabilitation, and reconstruction.



The [FHWA Asset Management](#) website features an asset management financial report series, videos, events, and a questions and answers page.



The [FHWA Bridge Management](#) website includes links to pertinent legislation, regulations, and relevant reports and publications.

2.3.3 Maintain Bridges in Good Condition

Bridge bundling can be a cost-effective method to maintain bridges in good condition through bundling of preservation and preventive maintenance activities.

2.3.4 Maintain or Improve Bridges in Fair Condition

Bridge bundling can be a cost-effective method to maintain bridges in fair condition through bundling of preservation and preventive maintenance activities or rehabilitation actions.

2.3.5 Reduce Bridges in Poor Condition

The ability to complete multiple bridges in one bundled contract can assist public agencies in reducing the backlog of poor bridges needing attention. If alternative funding sources and contracting methods are used, the bundled bridge contracts can be completed simultaneously with the agencies' ongoing bridge programs, addressing them sooner than they would have been otherwise. The result is bridges in poor condition are replaced or rehabilitated and improved to fair or good condition, removing them from the system backlog.

2.3.6 Save Costs



Bundling similar bridges can produce cost savings due to economies of scale. Repeatable details and similar designs among bundled bridges can save both design and construction time. Bundling multiple bridges can lower the unit cost for materials used, resulting in a lower cost per bridge. Maximizing the number of bidders can also lower the cost. A recent study has documented these relationships using 9 years of data from thousands of bridge projects carried out by INDOT (Qiao, Fricker, & Labi, 2018). The INDOT research report summary is available in Appendix L-1.



A 2012 PennDOT pilot program to replace county-owned bridges reported design savings between 25 and 50 percent. This program delivered focused projects, selecting only bridges with nearly identical details in an effort to repair and replace multiple bridges with one design. The pilot also reported construction savings between 5 and 15 percent. PennDOT usually requires a local match of 5 percent for bridge replacements, but participating counties had the local match requirement waived due to the program's documented savings. In Oregon, the DOT documented a 16 percent savings on a \$163 million project that bundled and replaced two bridges over the Willamette River on Interstate 5 using the construction manager/general contractor (CM/GC) method.

Opportunities for design savings:

- Consolidating the PE phase among structures, which allows for preparing one contract instead of multiple contracts.
- Determining the final structure type quickly—efficiency is gained through repeatable details instead of a custom design for each location.
- Completing PE information (borings, pavement cores, subsurface utility exploration, surveys, etc.) with a single contract for all bridges in the contract package.
- Reducing the number of plan sheets in the plans, specifications, and estimate (PS&E) package.
- Grouping meetings with permit review agencies and utilities.

Opportunities for construction savings, particularly if the locations have geographic proximity:

- Purchasing larger quantities of materials, providing leverage for a lower price.
- Using similar beam fabrications and structural details, leading to worker efficiency during construction.
- Reducing contractor mobilization costs.
- Using labor and equipment efficiently by synchronizing staging locations.
- Starting construction sooner, thus realizing measurable time savings that equate to cost savings.

2.3.7 Coordinate National Environmental Policy Act Approval

When using Federal aid, even though a separate National Environmental Policy Act (NEPA) approval for each location is still required, efficiencies can be gained by coordinating multiple locations with environmental oversight agencies in one NEPA document and permit application. Also, States may have programmatic approaches available that can accelerate the permitting process. Responsibilities for obtaining permits generally remain with the transportation agency, but on some bridge bundling contracts, it has been delegated to the design-builder with approval from FHWA: 23 CFR 636.109(b)(6)-(8) (see Chapter 8 for more information on environmental reviews).

2.3.8 Expedite Project Delivery

Bundling bridges into conventional D-B-B contracts can expedite project delivery because only one PS&E process is required instead of a separate one for each location. Administration and oversight of a single contract, as compared to many if the projects were let individually, reduces the oversight resources required of the sponsor agency. Using ACMs in conjunction with bridge bundling can advance the project completion even further. In case studies involving bundling and methods such as D-B or CM/GC, overall project times were reduced.

2.3.9 Start Construction Earlier

Efficiencies in design, procurement, and construction lead to earlier construction starts for bridges bundled into a single contract. Compared to going through a separate process for each bridge location, consolidation into one package can shorten the overall duration of project development and allow for an earlier start and earlier completion. It is important to note that bridge bundling does not eliminate the need to acquire ROW, obtain the necessary permits, and coordinate with utilities. Proper management of these activities, however, allows bridges with fewer complications to be designed and under construction first, while bridges in more complex locations go to construction later.

2.3.10 Coordinate Construction Staging

If bridge locations are in close proximity, a single contractor can maximize its labor force and equipment through planning and construction staging between projects. In addition, in areas where detours and traffic impacts overlap between structures, a single contractor constructing multiple bridges can coordinate construction activities to limit the effects on the traveling public. For example, on the I-5 Willamette River Bridge project, Oregon DOT specified which bridges could not be closed or have reduced capacity at the same time so that mobility was not severely affected.

2.3.11 Reduce Burden on Agency Staff

Public agencies across the country can have more work than their staff can complete. Bridge bundling can help reduce this workload through the following:

- Reducing management oversight with fewer contracts to manage.
- Preparing procurement for one contract in place of multiple contracts.
- Standardizing designs or design details for multiple bridges.
- Coordinating with one contractor instead of many during construction.
- Reducing the number of project managers needed. (Depending on size, bundled contracts can be handled by fewer, or maybe just one, project manager.)
- Outsourcing project or program management.
- Using alternative project delivery methods that allow transfer of traditional agency duties to a third party (e.g., the design-builder).

2.3.12 Use Project Delivery and Procurement Innovation

Bundling bridges, depending on the agencies' governing laws, may allow for use of innovative project delivery methods such as CM/GC, D-B, and P3 (i.e., design-build-finance-operate-maintain [DBFOM]) and procurement methods such as best value and qualifications-based selection (QBS) (see Chapter 7 for additional discussion).

2.3.13 Apply Technical/Engineering Innovation

Bundling bridges may allow for technical and engineering innovation not feasible on individual bridges. Project delivery methods such as CM/GC and D-B involve contractors earlier in the process than D-B-B, allowing for construction means and methods innovations specific to the project, reduced risks, and schedule acceleration. In addition, incorporating the alternative technical concepts (ATC) process in the procurement phase (most common with D-B, but also used in D-B-B procurements) enables contractors to submit innovation, cost savings, and schedule reductions through solutions that are equal to or better than the contract requirements (see Chapter 7 and Appendix H for more information).

2.3.14 Capitalize on Funding and Finance Innovation

Funding to repair bridges that are in need of attention, especially bridges that are in poor condition, is a concern for all public agencies. Bridge owners often cannot identify the funding sources needed to address bridges in poor condition, therefore the bridges tend to be neglected. Bridge bundling, coupled with an innovative finance mechanism (bonds, loans, or P3), can allow agencies to move needed projects forward and pay for them over the expected life of the structure.

2.3.15 Benefit from Local Partnering—Shared Services

LPAs or other bridge owners may combine their individual bridge projects or programs into a joint bridge bundling contract to achieve benefits otherwise not possible as an individual organization. Local agencies may also consider partnering with their State DOT to achieve the benefits of bridge bundling. Partnering with a State DOT has the added benefit of familiarity with the Federal requirements for projects involving Federal-aid.

2.3.16 Increased Construction Workforce Opportunities

An area's bridge construction workforce may not be sufficient to construct the bridges in a bundling project—providing an opportunity to expand the construction workforce. This is particularly true for multi-year projects and long-term bundling programs.

2.3.17 Increased Opportunities for Small and Disadvantaged Businesses

Factors such as project size, time, location, type of work, relevant market, available Disadvantaged Business Enterprises (DBEs), capacity of DBEs, etc. are considered when setting contract goals. The nature of bundling results in larger project size, larger geographic areas, and additional subcontracting opportunities—providing increased opportunities for small and disadvantaged businesses.

2.4 Considerations

Although the benefits of bundling bridges are numerous, depending on an agency's goals, there may be other issues to consider. These may include the following:

2.4.1 Worst First

Should an agency focus on the “worst” bridges first (those in poor condition) at the expense of performing preservation and preventive maintenance on bridges in good and fair condition? If bridges in good and fair condition are ignored through deferred investments in them, this may ultimately result in higher cost. A least-cost and more sustainable approach over the long term will include preserving and maintaining good and fair bridges so that they do not move into poor condition.

2.4.2 Limited Competition

In general, as contract size increases, the number of eligible contractors to bid is reduced. If bundled bridge contracts become too large, then cost savings gained through efficiency in design and construction can be lost due to the lack of competition. Each agency needs to determine the correct size of a bundled bridge contract to balance these factors. Some suggestions on contract size are included in Chapter 6.

2.4.3 Bond Capacity

The ability of bidders to obtain performance and payment bonds should be considered. Large bridge bundling projects that take more than several years to complete, and particularly those with maintenance periods, will limit the pool of bidders because of concerns over future bonding capacity.

2.4.4 Finance Cost

Financing costs should be weighed when determining the optimal bundle size to obtain the best prices. The cost savings that may be enjoyed by the economies of scale may be quickly eclipsed if the financing costs are too high.

2.4.5 Mutual Dependence

If bridges are bundled into a conventional D-B-B contract, an engineering problem or environmental issue at one location can prevent the entire package from being advertised. In the PS&E package, all components, such as permits, utility relocations, and ROW clearance, need to be completed prior to advertisement. Therefore, a complication in ROW acquisition at one location, for example, can delay the advertisement of the entire bundled bridge contract. Other project delivery methods, such as D-B and CM/GC, can be used to overcome this limitation.

2.4.6 State Contracting and Procurement Restrictions

Certain innovative contracting methods, such as CM/GC, may not be expressly permitted by State law. It is incumbent on the agency to identify whether there are any restrictions.

2.4.7 Funding—Annual Program Impact

Bridge bundling contracts funded through anything other than current revenue streams will have to be paid for over a period of years, with financing costs added. The duty to make payments on a yearly basis from funding sources could limit the annual volume of work that an agency can perform until the bridge bundling project is paid for completely.

2.4.8 Local Industry Capacity

In the case of large bundles, local industry may have difficulties keeping up with the size and pace of a fast-moving bridge bundle. This includes the capacity of fabricators to produce precast elements, the capacity of review agencies to process permits, and the capacity of utility companies to relocate their facilities. The agency needs to reach out to the local industry to gauge their capacity before moving forward on a large bridge bundle project. The agency may also opt to fund additional positions at review agencies if turnaround times are on the critical path. Further discussion on this topic is included in Chapter 4.

2.4.9 Agency Capacity

The capacity of the agency to properly manage a bundled project may not be sufficient, or the agency may not be staffed to handle such large projects. This can be overcome by smaller bridge bundle contracts or outsourcing project or program management. The agency's funding and financing capacity should be considered and addressed. Capacity to garner public and political support may be a factor as well.

2.4.10 Federal Fund Use

If Federal funds are utilized, then Federal requirements associated with those funds must be met. The agency must be aware of stipulations that come with the use of Federal money and plan appropriately. More information on the responsibilities of using Federal funding can be found in Chapter 3, section 3.5.



[FHWA Contract Administration Core Curriculum Manual 2014](#)

Table 1. Summary of bridge bundling benefits and considerations.

SUMMARY OF BRIDGE BUNDLING BENEFITS	SUMMARY OF BRIDGE BUNDLING CONSIDERATIONS
<ul style="list-style-type: none">• Achieve national performance goals.• Address asset management plan objectives.• Maintain or improve bridge condition.	<ul style="list-style-type: none">• Worst first.• Limited competition.• Bond capacity.

SUMMARY OF BRIDGE BUNDLING BENEFITS	SUMMARY OF BRIDGE BUNDLING CONSIDERATIONS
<ul style="list-style-type: none"> • Save costs (economies of scale). • Coordinate NEPA approval. • Expedite project delivery. • Start construction earlier. • Coordinate construction staging. • Reduce burden on agency staff. • Use project delivery and procurement innovation. • Apply technical/engineering innovation. • Capitalize on funding and finance innovation. • Benefit from local partnering–shared services. • Increase construction workforce opportunities. • Increase opportunities for small and disadvantaged businesses. 	<ul style="list-style-type: none"> • Finance costs. • Mutual dependence. • State procurement restrictions. • Funding–annual program impact. • Local industry capacity. • Agency capacity. • Federal fund use.

2.5 Planning

Public agencies bundle bridges for a variety of reasons specific to their agency characteristics, geographic area, goals, funding and financing availability, and the condition of their bridges. Bridge bundling projects can be small (less than 10 bridges) to large in scale (500-plus bridges). Agencies may find it beneficial to address their needs through a bridge bundle contract with another agency.

Before deciding to perform a large-scale bundling project, the appropriateness and timing should be evaluated considering long-term funding and financing and long-term bridge condition predictions. If there is a large backlog of needs (good, fair, and poor bridges needing preservation/preventive maintenance, rehabilitation, or replacement), bridge bundling will not solve all problems or address the issues that lead to the backlog. In some cases bundling can help an agency catch up; however, this may be short lived if later bridge needs are left unattended or insufficiently funded.

An agency should not enter into a cycle of investing in bridges, then deferring investments and not maintaining bridges, then investing again when bridge needs become too excessive to ignore. A continual and balanced program of preventive maintenance, rehabilitation, and replacement is the most economically cost-effective and sustainable. For this reason, continual delivery of smaller-scale bridge bundling projects under a bundling program is often most beneficial.

In summary, the best time to bundle bridges is very agency dependent. An agency may have a large need to maintain bridges in good condition, maintain or improve bridges in fair condition, eliminate bridges that are in poor condition, meet an aggressive schedule, and/or supplement a lack of staff to perform the work in-house. For others, the decision to bundle bridges may arise from additional funding or a political initiative, or from opportunities to take advantage of innovative financing or to combine efforts with another agency.

2.5.1 Addressing Needs

2.5.1.1 Maintain Good Bridges. Good bridge asset management practice involves maximizing the service life of each bridge asset that is meeting its transportation need. Performing cyclical maintenance and condition-based maintenance through bundling of preservation activities is a cost-effective method used by many State DOTs. Bundling bridge projects to focus on a bridge element or component will address the need to maintain bridges in good condition.

2.5.1.2 Maintain or Improve Fair Bridges. As with maintaining bridges in good condition, the same applies to bridges in fair condition. Extending the service life of these bridges is less costly, in the long-term, than deferring these activities to the point of major rehabilitation or replacement.

Table 2, Table 3, and Table 4 provide examples of cyclical and condition-based maintenance activities that can be considered for bundling contracts.



The New York State DOT (NYSDOT) Project Development Manual identifies the Federal-aid eligible, element-specific work types the agency often uses in bundled bridge contracts (shown in Table 2).

Table 2. NYSDOT element-specific, Federal-aid eligible bridge work.Source: NYSDOT ⁴

CATEGORY	ELEMENT-SPECIFIC CYCLICAL BRIDGE WORK	ELEMENT-SPECIFIC BRIDGE WORK ¹
Description	Programmed, routine bridge work that is time dependent and does not address immediate bridge deficiencies.	Programmed bridge work that does not involve the evaluation of different alternatives but addresses specific (not necessarily all) bridge deficiencies.
List of Eligible Work	<ul style="list-style-type: none"> • Bridge Washing • Bridge Painting • Crack Sealing • Deck Sealing • Substructure Concrete Sealing • Asphalt Overlay Replacement • Bearing Lubrication 	<ul style="list-style-type: none"> • Bearing Replacements/Repairs • Bridge Railing Upgrades • Monolithic Deck Overlays/Asphalt Overlay Placement ² • Vulnerability Reduction Measures: Seismic, Collision, Hydraulic, Overload, Steel Detail, and Concrete Detail Vulnerabilities ³ • Substructure Repairs • Primary/Secondary Member Repair • Localized Deck/Approach Slab Repairs • Joint Replacements/Repairs • Repair or Replace Curbs, Sidewalks, and Fasciae ² • Navigational Lights

NOTES:

1. If work noted in this column is part of an alternative, or represents an alternative in a multi-alternative project, the project cannot be processed as an element-specific project.
2. Both monolithic deck overlay work and repairing or replacing curbs, sidewalks, and fasciae require consideration of eliminating "safety walks" and nonstandard bridge railing.
3. Vulnerability reduction measures are those actions necessary to upgrade features with vulnerability ratings of 1 or 2 to a level (3 or higher) that will allow consideration for NYSDOT's Capital Program. Hydraulic vulnerability reduction is meant to include maintenance repair or replacement of scour protection before its condition degrades to a vulnerability rating of 1 or 2.

⁴ [NYSDOT Project Development Manual](#), Appendix 7 “Scoping & Design Approval Documents,” Exhibit 7-5, page 7-10.

Table 3. Examples of cyclical maintenance activities.

Source: FHWA Bridge Preservation Guide, Spring 2018

CYCCLICAL MAINTENANCE ACTIVITY	BRIDGE COMPONENT
Clean/Wash Bridge	Deck and/or Super/Substructure
Clean and Flush Drains	Deck
Clean Joints	Deck
Deck/Parapet/Rail Sealing and Crack Sealing	Deck
Seal Concrete	Super/Substructure

Table 4. Examples of condition-based maintenance activities.

Source: FHWA Bridge Preservation Guide, Spring 2018

EXAMPLES OF CONDITION-BASED MAINTENANCE ACTIVITY	BRIDGE COMPONENT
Drains, Repair/Replace	Deck
Joint Seal Replacement	Deck
Joint Repair/Replace/Elimination	Deck
Electrochemical Extraction/Cathodic Protection	Deck
Concrete Deck Repair in Conjunction with Overlays, Cathodic Protection Systems or Electrochemical Extraction Treatment	Deck
Deck Overlays (thin polymer epoxy, asphalt with waterproof membrane, rigid overlays)	Deck
Repair/Replace Approach Slabs	Approach
Seal/Patch/Repair Superstructure Concrete	Superstructure
Protective Coat Concrete/Steel Elements	Superstructure
Spot/Zone/Full Painting Steel Elements	Superstructure
Steel Member Repair	Superstructure
Fatigue Crack Mitigation (pin-and-hanger replacement, retrofit fracture-critical members)	Superstructure

EXAMPLES OF CONDITION-BASED MAINTENANCE ACTIVITY	BRIDGE COMPONENT
Bearing Restoration (cleaning, lubrication, resetting, replacement)	Superstructure
Movable Bridge Machinery Cleaning/Lubrication/Repair	Superstructure
Patch/Repair Substructure Concrete	Substructure/Culvert
Protective Coat/Concrete/Steel Substructure	Substructure/Culvert
Electrochemical Extraction/Cathodic Protection	Substructure/Culvert
Spot/Zone/Full Painting Steel Substructure	Substructure
Pile Preservation (jackets/wraps/cathodic protection)	Substructure
Channel Cleaning / Debris Removal	Channel
Scour Countermeasure (installation/repair)	Channel

2.5.1.3 Reduce Poor Bridges: The 2017 National Bridge Inventory Highway Bridge Condition data indicates 47,619 bridges rated in poor condition, equating to more than 21 million square meters (226 million square feet) of deck area. Finding a way to repair, rehabilitate, or replace bridges in poor condition is an issue across the country and is not exclusive to any particular area. Most of these poor condition bridges (42,777) are not on the NHS, and many are the responsibility of LPAs, among which a backlog of bridges in poor condition is a common problem. Extensive rehabilitation or replacement is required to eliminate bridges in poor condition.

2.5.1.4 Expedite Delivery/Start of Construction: Despite the backlog of bridges needing attention for preservation/preventive maintenance and repair, many public agencies simply do not have the capability to do the much-needed work. This results in deferred maintenance or bridges that either have load restrictions or are closed completely. The lack of preservation on bridges results in decreased service life and decreasing condition ratings. Bridges with closures and restrictions negatively affect the community and the local economy. When bridges on critical routes reach a poor condition, it can be necessary to choose a procurement method that can expedite the delivery of these projects. Expedited delivery and construction can also be desirable when it is important to show results quickly.



[Interview with Gregg Hostetler, Infrastructure Engineers, LLC](#)

“...it offers a lot of really strategic advantages for certain sets of bridges.”

2.5.1.5 Supplement Staff and/or Expertise: Staffing shortages are a reality for nearly all public agencies. Bundling bridges can allow agencies to deliver projects with less burden on their staff by, for example:

- Joining with another agency (State or local).
- Coupling bridge bundling with an ACM.
- Managing a single contract instead of many.
- Using performance-based specifications, which may reduce oversight needed.

It is important to note that putting together a bridge bundle contract, particularly one with an alternative contracting delivery method, and managing it still requires a significant amount of effort. The FHWA provides technical support and resources for agencies interested in pursuing ACMs. Another option available if the agency staff does not have the expertise or the personnel depth to create and manage a bridge bundle contract is outsourcing.

2.5.2 Taking Advantage of Opportunities

2.5.2.1 Funding Awareness: Public agencies may not necessarily know of all the existing sources of funding available for bridge-related projects. Numerous funding sources at the Federal, State, and/or local level are often used to pay for transportation infrastructure. As funding programs and enabling legislation changes frequently, agencies should endeavor to learn about all the funding sources available to them; for example, LPAs can reach out to their State DOT for information, and State DOTs can reach out to their FHWA Division Office.

2.5.2.2 Financing Avenues: The largest obstacle most public agencies face in trying to address bridges that need attention is a lack of funding to do the work. Accordingly, public agencies, particularly cities and counties, need to be creative when trying to solve this common problem.

DOTs can accomplish bridge bundling projects by issuing bonds (GARVEE or revenue bonds) or obtaining a loan from the State Infrastructure Bank. Another financing solution is to partner with private industry through a P3 to perform the work. By doing this, the public agency can advance much-needed projects and pay for them over time or as future revenues become available. In addition to availability payments (committing future funds to pay the concessionaire), this solution can be particularly useful if the improvements will lead to future development and revenues (e.g., tolls and value capture).

An additional option is for LPAs to take advantage of State agency-led initiatives. As the condition of bridges under the jurisdiction of LPAs continues to decline, more State agencies may become involved. These collaborations have already been successful in States such as Pennsylvania, Ohio, Georgia, and Nebraska and may be pursued in more. For additional information on funding and financing strategies, see Chapter 3.

2.5.2.3 Political Initiative: When an elected official creates an initiative on infrastructure, quick results are usually desired. Bundling bridges and using ACMs enable bridge projects to be completed in less time so that results are quickly realized. Ohio and Nebraska provide two examples:



NOTEWORTHY
PRACTICES

Ohio Bridge Partnership Program: Ohio Governor John Kasich announced in October 2013 that the State would invest \$120 million to repair or replace more than 200 locally owned bridges over the next 3 years. Future Federal funds were leveraged with GARVEE bonds and coupled with toll credits to provide the matching funds for the 80/20 split, eliminating the need for a local match. Ohio DOT managed the program and selected the bridges based on predetermined criteria. All of the contracts were bridge-bundled D-B contracts. Ohio DOT actually completed 210 bridges with the original \$120 million due to cost savings.⁵ Ohio's legislature voted to extend the program through FY 2019.



NOTEWORTHY
PRACTICES

Nebraska Transportation Innovation Act: Signed in April 2016, the act provides tools to deliver road projects faster “through innovative methods that are proven in other States and right-sized for Nebraska.”⁶ It dedicated \$40 million through June 2023 to the County Bridge Match Program to promote innovation and accelerate the repair and replacement of deficient bridges on county road systems. In addition to providing new funding, the act enables the use of D-B and CM/GC project delivery (Nebraska Department of Transportation, 2017).



VIDEO

[Interview with Keith Molenaar, University of Colorado](#)

“I would tell States not to be fearful of trying bridge bundling.”

2.6 Summary

An important first step toward taking advantage of bridge bundling’s benefits is establishing the goals and objectives of the project or program. Without clearly defined goals and objectives, subsequent steps will be difficult or impossible. As the project or program progresses, there may be a need to reevaluate or refine the goals and objectives—this iterative process is common. This step in the process should result in a documented list of goals and objectives to share with the bridge bundling team and stakeholders.

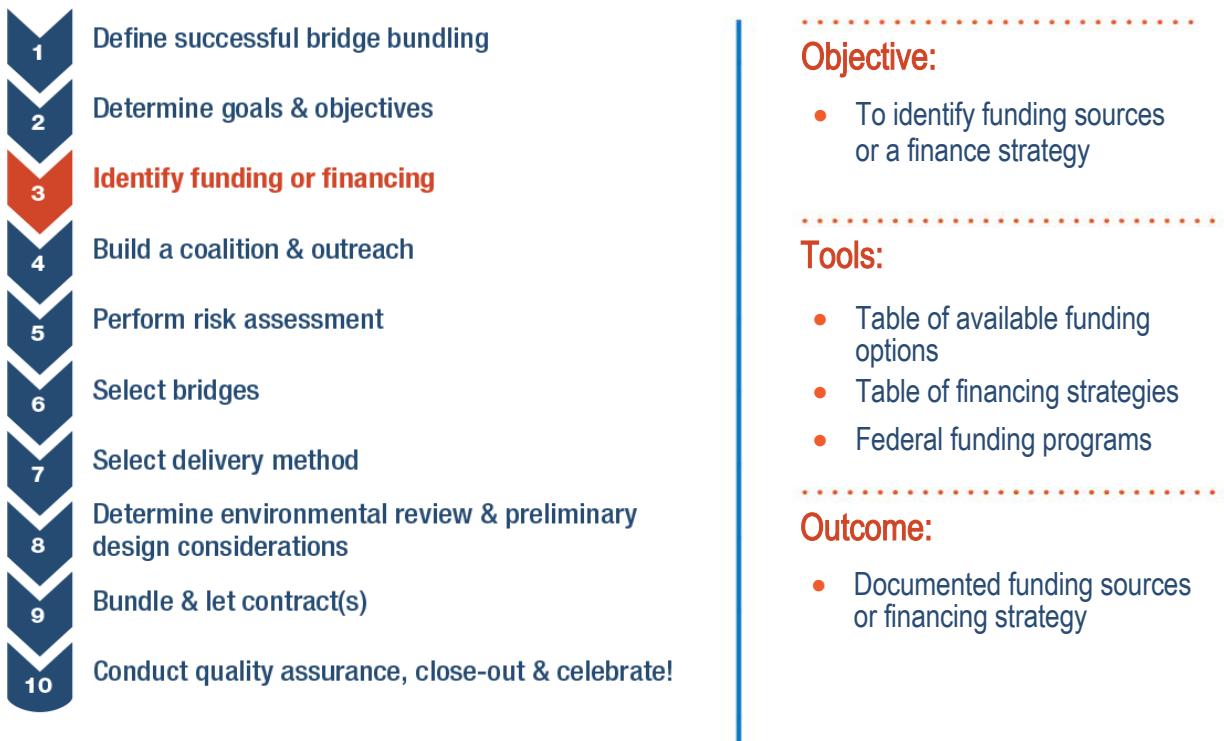
Both the benefits and challenges of bridge bundling will depend on an agency’s goals. Benefits may include improving asset management, saving costs, expediting project delivery, coordinating construction staging, and/or reducing the workload of agency staff. Challenges that may need to be addressed include finance costs, State contracting and procurement restrictions, meeting Federal requirements if Federal funds are used, and the capacity of local industry to keep up with the size and pace of large bundles.

⁵ Barna, J. Ohio Bridge Partnership Program. FHWA Bridge Bundling Workshop. Enola, PA, July 19, 2016.

⁶ Nebraska DOT County Bridge Match Program [informational flyer](#).

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Chapter 3. Funding or Financing Strategies



Objective:

- To identify funding sources or a finance strategy

Tools:

- Table of available funding options
- Table of financing strategies
- Federal funding programs

Outcome:

- Documented funding sources or financing strategy

3.1 Funding Approaches

Identifying the project funding⁷ or method of financing will not only determine the project scope and limits, but will also drive the delivery method, environmental process, and approval process.

Bridge bundling projects that use existing funding are encouraged. Bridge bundling projects that rely on future funds need to be carefully evaluated. To answer whether it is appropriate to temporarily commit resources at a high level to address bridge needs, analyses should be conducted to determine the long-term benefits. Bridge management software programs that perform network-level life-cycle cost and condition analyses are used to determine the long-term conditions and accompanying annual funding requirements that result from alternative funding strategies.

Alternative funding strategies are defined by varying levels of investment (short- and long-term) and distribution of the investment between work categories (preservation/preventive maintenance, rehabilitation, and replacement). Differences in network conditions over a long-term time horizon exceeding 25 years can be used to evaluate the funding strategies. Such analyses are needed if future funds will be used or if financing is being pursued. This analysis

⁷ Certain types of funds may have restrictions on their use. (For example, 23 U.S.C. 144 (j)(5))

can help determine if funding a large-scale project is beneficial, the appropriate funded or financed size of the project, and the timing to perform the project.

There is an important distinction between *funding* and *financing*, therefore these terms are not used interchangeably in this guide. Funding refers to Federal, State, and/or local money used to pay for transportation infrastructure. Financing refers to how agencies meet the up-front costs of addressing infrastructure needs when pay-as-you-go funding may not be immediately available. Many States and LPAs issue tax exempt debt (which carries a lower interest rate) to finance infrastructure and repay the debt over time from various revenue sources. Funding, in the form of a dedicated revenue source, must be present to support financing regardless of which finance technique is used. Table 5 provides examples of funding and financing options. This is not an inclusive list.

Table 5. Example funding and financing strategies.

FUNDING STRATEGIES	FINANCING STRATEGIES
<ul style="list-style-type: none"> • State and Local Funds • Federal-aid Highway Program: <ul style="list-style-type: none"> ◦ National Highway Performance Program ◦ Surface Transportation Block Grant Program ◦ National Highway Freight Program • Highway Infrastructure Program <p>Potential New Revenue Sources</p> <ul style="list-style-type: none"> • Value Capture^a <p>Federal-aid Cash Management Tools</p> <ul style="list-style-type: none"> • Advance Construction • Partial Conversion of Advance Construction • Tapered Match • Soft Match (toll credits, credit for bridges not on Federal-aid highways) <p>Revenue Streams</p> <ul style="list-style-type: none"> • Federal Motor Fuel Taxes • State Motor Fuel Taxes • Alternative Fuel Taxes • Fees—Tolling and Pricing • Traditional Funding Strategies 	<ul style="list-style-type: none"> • General Obligation Bonds • Revenue Bonds • GARVEE Bonds • State Infrastructure Banks • Federal Credit Assistance—TIFIA • Private Activity Bonds Program • Section 129 Loans • Public-Private Partnerships (DBF, DBOM, DBFOM) • Railroad Rehabilitation and Improvement Financing Program

DBF = design-build-finance, DBOM = design-build-operate-maintain, DBFOM = design-build-finance-operate-maintain

^a[Value capture](#) refers to a set of strategies for capturing the land value created from transportation improvements in the form of revenue to fund other transportation improvements or investments.



More information on [GARVEE Bonds](#) is available on the FHWA Office of Innovative Program Delivery's Center for Innovative Finance Support website.

3.2 Funding Challenges

Paying for transportation systems is a complex, intergovernmental process, with Federal funding provided to States for highway, intermodal, and public transit programs. Funding for highways and bridges is primarily provided under the Federal-Aid Highway Program, which has a special type of budget authority (referred to as “contract authority”) authorized from the Highway Account of the Highway Trust Fund (HTF) that authorizes the Federal Government to commit to projects with the contract authority that is authorized to be distributed annually to the States. The commitments are honored on a “progress basis” as costs are incurred, and the Federal share of costs is billed to the Federal Government.

Highway and bridge funding is also sometimes provided through General Fund appropriations, such as the Highway Infrastructure Program in FYs 2018 and 2019. Distributions are made to States under the provisions of Federal surface transportation legislation for contract authority and annual appropriations bills for General Fund appropriations. States then distribute the funding within their borders consistent with Federal law, including allocations to local governments for road projects and other transportation uses. States may also direct a portion of State revenues to local governments, usually based on a combination of factors including each jurisdiction’s population, road miles, land area, number of registered vehicles, or other criteria.

With this type of funding system, local agencies responsible for transportation infrastructure often rely on their State to ensure they have adequate avenues for transportation funding. Moreover, the State controls local funding opportunities in that legislation must be enacted at the State level to allow local entities to assess their own taxes and fees. In addition to general revenues, local agencies may rely on a range of taxes and fees for transportation projects, including real estate taxes, personal property taxes, local option sales taxes, local gas taxes, motor vehicle license and registration fees, development impact fees, and assessments in special districts for transportation purposes.

State legislatures may provide some relief to local governments by appropriating funds for specific purposes, including local matches for federally funded projects, if the State transportation budget can be adequately funded. With aging infrastructure, cost inflation, constrained resources, changing demographics, and growing demand, States and local governments may face challenges in meeting their transportation infrastructure needs. That is why it is important to evaluate the effectiveness of existing revenue sources, take full advantage of the most current Federal programs, explore the potential of new revenue sources, and find ways to maximize the spending power of the revenue collected.

Recent Federal surface transportation legislation has provided additional flexibility for bridge projects as described in Section 3.4.

3.3 Existing Revenue Generators

One existing revenue source that receives a lot of attention is the fuel tax, simply because of its importance to transportation funding on all levels. The HTF is primarily supported by Federal excise taxes on gasoline and diesel fuel, and State fuel taxes are the largest source of State revenues for highways and bridges. However, over the past decade, fuel tax revenues have fallen due to changing driving habits, more fuel-efficient vehicles, and the use of alternative fuels. Furthermore, the Federal fuel tax and many State fuel taxes have remained at fixed cents-per-gallon rates for many years. This combination of circumstances has created significant revenue shortfalls on all fronts.

3.4 Federal Formula Funding Programs

There are two major Federal-aid highway formula funding programs that can be applied to bridges: the National Highway Performance Program and the Surface Transportation Block Grant Program.

3.4.1 National Highway Performance Program

The NHPP (23 U.S.C. 119) is the largest of the Federal-aid highway formula programs (56 percent of the apportioned program), with annual authorizations averaging over \$23 billion. The program provides funding for improvement of the condition and performance of the NHS.

Section 1106 of the FAST Act provided additional flexibility under the NHPP, extending eligibility to bridges that are on Federal-aid highways, by adding language allowing States to use NHPP funds to pay for reconstruction, resurfacing, restoration, rehabilitation, or preservation of bridges not on the NHS, as long as the bridge is on a Federal-aid highway.

A limitation on the use of NHPP funds for bridges on a Federal-aid highway but not on the NHS is present in 23 U.S.C. 119(i)(2), which states, “Limitation. – A State required to make obligations under subsection (f) shall ensure such requirements are satisfied in order to use the flexibility under paragraph (1).”

Additionally, States may use NHPP funds to pay for the subsidy and administrative costs associated with Federal credit assistance under TIFIA on all NHPP-eligible projects, not just bridges.



Scope of eligibility for NHPP funds can be found in the [National Highway Performance Program](#) summary in FHWA's *A Guide to Federal-aid Programs and Projects* and in more detail in the March 9, 2016, FHWA informational memorandum on [NHPP Implementation Guidance as Revised by the FAST Act](#).

3.4.2 Surface Transportation Block Grant Program

The STBG (23 U.S.C. 133), formerly known as the Surface Transportation Program, is the second largest of the Federal-aid highway programs (28 percent of the apportioned program), with annual authorizations averaging over \$11.6 billion, and offers the broadest eligibility

criteria. Funds can be used on any Federal-aid highway, on bridge projects on any public road, on transit capital projects, on routes for non-motorized transportation, and on bridge and tunnel inspection and inspector training. STBG funds in an amount not less than 15 percent of the State's highway bridge program apportionment for FY 2009 are set aside for off-system bridges (23 U.S.C. 133(f)).

In addition to renaming the program, Section 1109 of the FAST Act increased the percentage of STBG funds that are sub-allocated to local areas each fiscal year by 1 percentage point, from 51 percent in FY 2016 to 55 percent in FY 2020. STBG-eligible activities include the subsidy and administrative costs under TIFIA as noted in 23 U.S.C. 133(b)(13), “Upon request of a State and subject to the approval of the Secretary, if Transportation Infrastructure Finance and Innovation Act (TIFIA) credit assistance is approved for an STBG-eligible project, then the State may use STBG funds to pay the subsidy and administrative costs associated with providing Federal credit assistance for the projects” and in 23 U.S.C. 133(b)(14) “The creation and operation by a State of an office to assist in the design, implementation, and oversight of public-private partnerships eligible to receive funding under this title and chapter 53 of title 49, and the payment of a stipend to unsuccessful private bidders to offset their proposal development costs, if necessary to encourage robust competition in public-private partnership procurements.”

Allowing the bridges on Federal-aid highways to be eligible for NHPP funds, in addition to STBG funds, provides States multiple Federal funding sources and the option to use more of their STBG funds for bridges that are not on Federal-aid highways.



The [FHWA Information Memorandum on STBG Implementation Guidance as revised by the FAST Act](#).



[Surface Transportation Block Grant Program](#) summary from FHWA's *A Guide to Federal-aid Programs and Projects*.

Table 6. Federal funding programs (\$ millions).

Source: FHWA

PROGRAM	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	TOTAL
National Highway Performance Program	22,332	22,830	23,264	23,742	24,236	116,404
Surface Transportation Block Grant Program	11,163	11,425	11,669	11,877	12,137	58,271
Highway Safety Improvement Program (HSIP)	2,101	2,275	2,318	2,360	2,407	11,461
Railway-Highway Crossings (HSIP set-aside)	350	230	235	240	245	1,300
National Highway Freight Program	1,140	1,091	1,190	1,339	1,487	6,247
Congestion Mitigation & Air Quality Improvement Program	2,309	2,357	2,403	2,449	2,499	12,017
Metropolitan Transportation Planning	329	336	343	350	359	1,717
Total	39,724	40,544	41,421	42,355	43,370	207,417

NOTE: Amounts given are in millions of dollars. Surface Transportation Block Grant amounts include the transportation alternatives annual set-aside of \$835 million in FY 2016 and FY 2017 and \$850 million in FY 2018, FY 2019, and FY 2020. Totals may not add due to rounding. National Highway Freight Program figures represent net amounts after a portion is applied to the Metropolitan Planning Program under Section 1104(b)(6) of the FAST Act, 23 U.S.C. 104 and 130. Total apportioned programs figure represents gross authorizations. State-by-State apportionments are available on the FHWA [website](#).

3.5 Federal-aid Complexities

Using Federal aid to fund transportation projects invokes Federal requirements that apply to federally funded projects, which may add complexity to the project delivery process, especially if a local agency is unfamiliar with these requirements. These Federal provisions often impose additional requirements on a project, depending on a State's rules and regulations governing projects funded with State funds.



FHWA's [Federal-aid Essentials](#) video library is a resource designed to help local agencies understand Federal-aid requirements.

For Federal-aid projects with an estimated total cost of \$500 million or more ("major project" threshold), the processes and Federal requirements involved in project delivery become more complex, rendering it more challenging, but ever more important, for the process to be well managed. These projects require specific cost estimating actions, a financial plan, and a project management plan.



FHWA's [Major Projects](#) website contains detailed information and guidelines on the tools and programs (cost estimating, financial plans, project management plans) mandated by Congress and the FHWA for the delivery of large transportation projects. Also available are resources ranging from studies on contingency fund management to white papers highlighting lessons learned in delivered projects.

3.6 Federal-aid Management Tools

3.6.1 Tools for State DOTs

Federal law provides the following options for States to begin projects using non-Federal funds while remaining eligible to be reimbursed with Federal-aid at a later date.

3.6.1.1 Advance Construction (23 U.S.C. 115; 23 CFR 630 subpart G)

Through FHWA, States can pursue an advance construction (AC) designation, which essentially reserves the right for the State to seek full or partial reimbursement of the Federal share of project costs (typically 80 percent) at some later date when the required obligational authority associated with the obligation of Federal-aid contract authority funding is available (see Figure 3). This, in turn, allows a greater number of projects to be advanced concurrently. States can use AC to facilitate construction of large projects while maintaining obligational authority for smaller ones.

Ultimately, AC allows a State to maintain flexibility in its transportation funding program, and there is no obligation or guarantee on either side. The State may choose not to convert the project or, alternatively, if Federal funds are not available, the State will not be able to convert the project to a Federal-aid project.

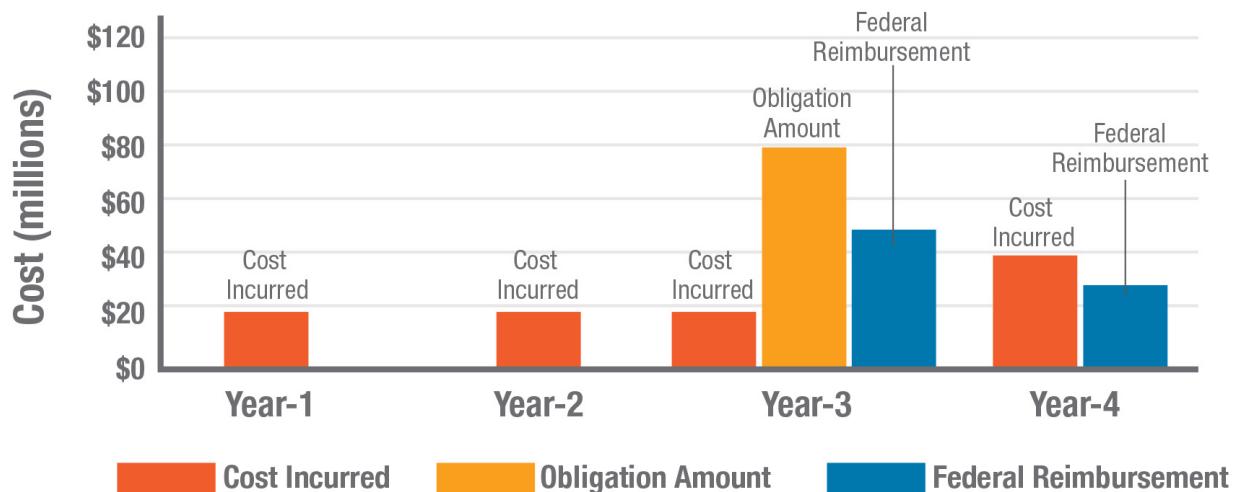


Figure 3. Advance construction Federal reimbursement.

Source: FHWA

Benefits of AC

- State may advance a project while preserving its eligibility to receive Federal-aid reimbursements in the future.
- State can conserve obligation authority, improve cash flow, and maintain flexibility in its transportation funding program.

Considerations for AC

- AC project must follow Federal procedures and meet Federal requirements. Certain types of funds may have restrictions on their use. (For example, 23 U.S.C. 144 (j)(5))
- AC projects must be included in the Statewide Transportation Improvement Program—both in year of authorization and year of conversion(s). (23 CFR part 450)

3.6.1.2 Partial Conversion of Advance Construction (23 U.S.C. 115; 23 CFR 630 subpart G)

Partial conversion of advance construction (PCAC) is a modified approach that allows the State to receive staged reimbursement for the Federal share of project costs to meet cash flow requirements. PCAC is used in conjunction with GARVEE bonds when Federal funds are obligated for debt-service payments over a period of time.

3.6.2 Tools for Local Agencies

The following options can help LPAs address the fiscal challenges often presented in meeting the obligation for the typical 20 percent local match on Federal-aid projects.

3.6.2.1 Tapered Match

Tapered match (23 U.S.C. 121; 23 U.S.C. 133) allows a project's Federal share to vary from payment to payment to reach the project's maximum authorized share. Under this scenario,

States can spend the Federal share at the start of a project and apply the matching funds as the project nears completion (see Figure 4).

With tapering, a State can advance a project before fully securing bond and capital market financing or overcome near-term gaps in State matching funds. Tapered match may also be useful when the project sponsor lacks the funds needed to match a Federal-aid project at the start, but will accumulate the match over the life of the project. For example, this technique may facilitate a project when a new local tax has recently been enacted. Using tapered match would allow time for the new tax revenues to accumulate.

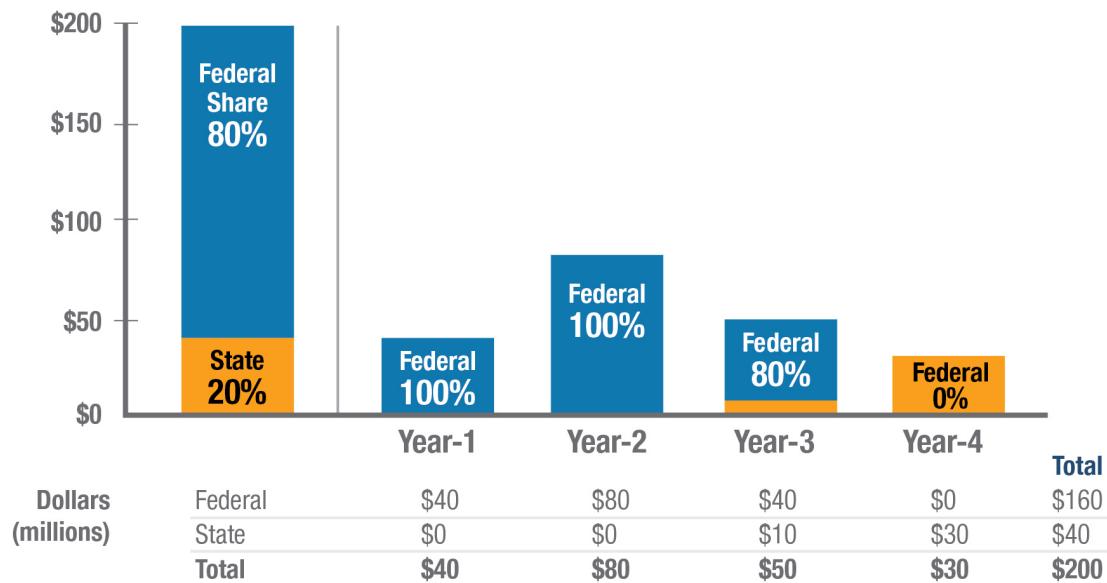


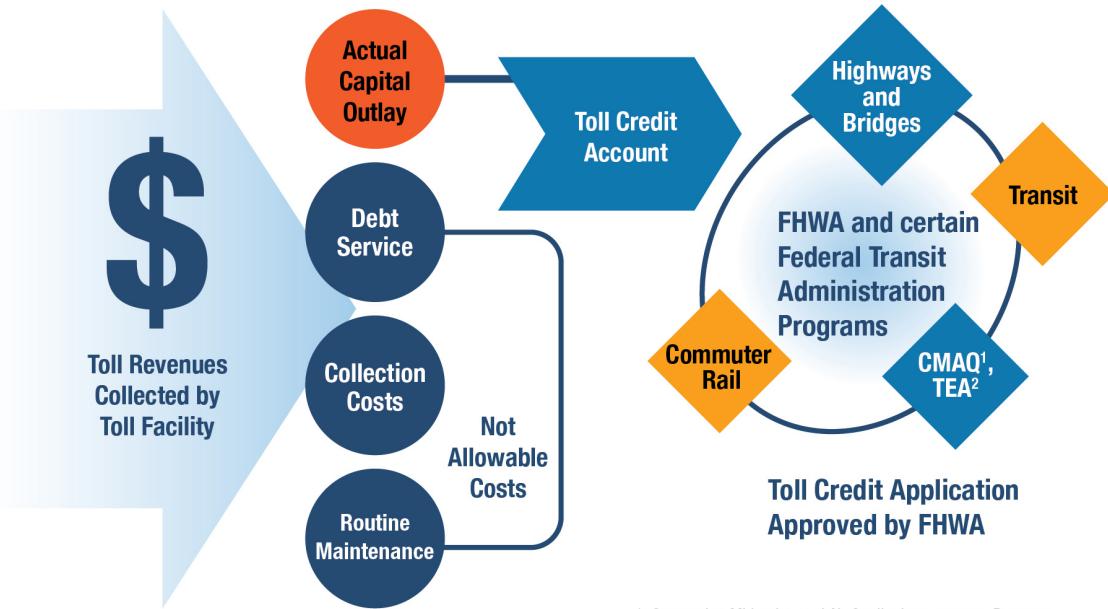
Figure 4. Tapered match example.

Source: FHWA

3.6.2.2 Soft Match

Federal law also permits the non-Federal share of a project's cost to be met through a "soft match." Two sources of soft match are toll credits (23 U.S.C. 120(j)) and the Program for Bridges Not on Federal-Aid Highways (23 U.S.C. 144(m)). By using a soft match on a Federal-aid project, the Federal share can effectively be increased to 100 percent.

3.6.2.2.1 Credits from Tolls: Toll credits are earned when a State, a toll authority, or a private entity funds a capital transportation improvement with toll revenues earned on existing toll facilities (see Figure 5).



1. Congestion Mitigation and Air Quality Improvement Program

2. Transportation Enhancement Activities

Figure 5. Toll credits structure.

Source: FHWA

3.6.2.2 Credit for Bridges Not on Federal-aid Highways (23 U.S.C. 133(f)(3)): If construction of an off-system bridge replacement or rehabilitation project is fully funded by State and/or local sources but is eligible for Federal funds under 23 U.S.C. 133, up to 80 percent of the construction cost may be used as credit toward the non-Federal share of other projects that are eligible for Federal funds. Credits may be earned if the “source” bridge project is:

- Non-controversial.
- Certified by the State to have been carried out in accordance with all standards applicable to such projects under 23 U.S.C. 133.
- Determined by FHWA upon completion to be no longer a deficient bridge.

The source bridge project is not required to satisfy typical Federal-aid requirements, such as NEPA review and the Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act).

3.7 Potential New Revenue Sources—Value Capture

Public investments in transportation infrastructure can substantially increase the value of adjacent land. Infrastructure improvement enhances access, and access creates value for underutilized assets. Value creation is followed by value realization through subsequent private sector investment and induced economic activity. Capturing the value of this benefit of infrastructure improvement is gaining interest as a finance mechanism for infrastructure investments.

The cycles of value capture are shown in Figure 6. State and local governments should evaluate value capture techniques, including land value tax, tax increment financing, special assessments, transportation utility fees, development impact fees, and joint development.

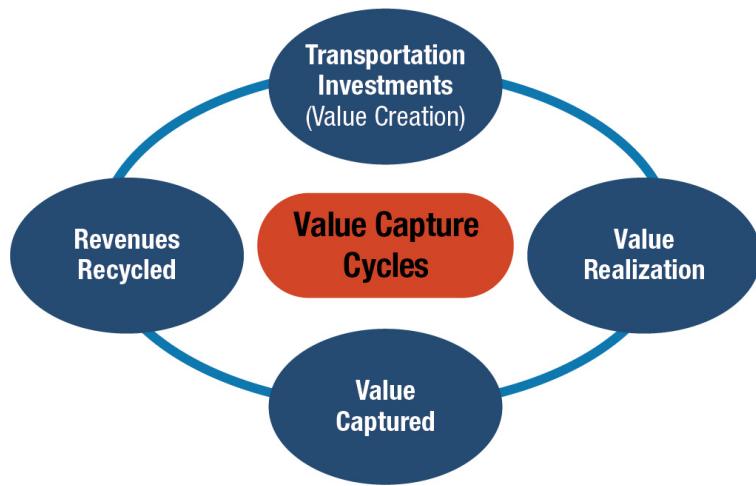


Figure 6. Value capture cycles.

Source: FHWA

Different Types of Value Capture:

This approach is mostly found in State and local laws, rather than Federal law (ROW use agreements and joint development being exceptions that are addressed in Federal highway and transit law).⁸

- **Air rights agreements** establish development rights above (or below) a transportation facility in exchange for a financial contribution or future additional property and/or income taxes.
- **Developer contributions** are voluntary payments made to local governments by private businesses and developers to support the cost of implementing surface transportation improvements. Also known as proffers, developer contributions involve a private firm or individual benefiting from the project giving money, land, or other services to the project sponsor to help expedite project implementation.
- **Development impact fees/traffic mitigation fees** are one-time charges levied on new development to help recover the cost of infrastructure projects and services. The cost of infrastructure services adjacent to the new development is transferred to those most likely to benefit from the infrastructure.

⁸ There are specific requirements for non-highway use of a Federal-aid highway ROW and specific valuation requirements (fair market value) if it is property purchased with Federal-aid funds.

- **Joint development** refers to the development of a transportation facility and adjacent private real estate development, in which a private sector partner either provides the facility or makes a financial contribution to offset its costs.
- **Land value tax** is a payment for the benefits received from the surface transportation system and municipal investment in other infrastructure. Land value taxation is also levied on the unimproved value of land, without regard to vertical improvements.
- **Negotiated exactions** are similar to development impact fees, as they are one-time charges levied on new development. These fees are primarily applied to new developments to help recover growth-related public service costs but can be levied for off-site or on-site services.
- **Special assessment districts** levy incremental property taxes on land and buildings deriving direct benefits as a result of a surface transportation improvement. Special assessments—also known as benefit assessments or special taxes—are one of the most prominent forms of value capture in the United States.
- **Sales tax districts** are a type of special assessment district that requires those benefiting from the project to pay a limited sales tax instead of a property tax.
- **Tax increment financing** leverages the future increment in property value within a development (or redevelopment) project to finance development-related costs, including infrastructure improvements.
- **Transportation reinvestment zones** are an innovative tool that allows local governments to raise funds to help pay for transportation improvements using all or part of the incremental growth in property and sales taxes from a designated area around the project.
- **Transportation utility fees** treat transportation networks like a utility, similar to other local services such as water and wastewater treatment that are financed primarily from user charges.

Benefits of Value Capture:

- Shifts the funding focus from the narrower “user pays” to a broader “beneficiary pays” approach.
- Applies costs of infrastructure improvements to beneficiaries equitably.
- Increases economic activity in proximity to the development.
- Encounters limited public opposition; politically well-accepted.
- Generates stable revenue sources (tax incremental financing).
- Provides gap funding sources for highway improvements. Facilitates access to ongoing revenue sources as new property tax revenue to the city or county.
- Leverages funding from multiple Federal sources.
- Provides source or repayment for TIFIA, State Infrastructure Bank (SIB), or Section 129 loans.

Potential Limitations of Value Capture:

- Measurements of the direct change in land values so there are minimal variations.
- Susceptibility of revenue streams to changes in real estate markets.
- Lack of long-term sustainability (development impact fees).
- Possibility of administrative and compliance burdens.



More information on [value capture](#) is available on the FHWA Office of Innovative Program Delivery's Center for Innovative Finance Support website and the [EDC-5 value capture](#) website.



University of Minnesota Center for Transportation Studies: [Value Capture for Transportation Finance](#)



Refer to the Osceola County (Florida) Roadway and Bridge Bundling Program case study in Appendix C for details on the county's use of value capture via impact fees.

3.8 Innovative Finance Strategies

An innovative financing strategy can help advance a bridge bundling project. Tapping into the fiscal advantages of certain partners, such as a local government's superior bond ratings and guarantees, is an effective method to spread the risks. Financing mechanisms allow States and local governments to borrow against or otherwise leverage State and Federal revenues. However, many States have enacted laws that place restrictions on or even prohibit certain transportation finance mechanisms. The following are some of the more commonly deployed mechanisms used to support agency transportation infrastructure goals.

Agencies typically pay for large highway projects in three ways:

- Grants provided by Federal, State, and local sources.
- Pay-as-you-go financing (government financing of capital outlays from current revenues or grants rather than by borrowing), having the funds immediately available when needed to pay for the transportation project, corresponding to the cash-flow needs of the project, especially if the project can be built in segments.
- Tax-exempt municipal bonds, secured by State or local sales taxes, gas taxes, and sometimes toll revenues. In some instances, financing can be secured by the future Federal-aid funding.
- If these methods are not sufficient, innovative financing may need to be considered.

Bridge bundled projects, including smaller scale bundles, can gain access to capital markets, attract private investment, and save transaction costs when financed through the Federal credit programs administered through the U.S. Department of Transportation (USDOT) Build America Bureau, the Federal Credit Assistance TIFIA loan program, the Railroad Rehabilitation and Improvement Financing (RRIF) program, the Private Activity Bonds (PABs) program, Section 129 loans, and SIBs.

Although each program currently has its own lending criteria, both TIFIA and RRIF have attractive loan terms that include low rates of interest—often below the market rate—and generous and flexible repayment terms allowing for long periods of interest capitalization, significant back loading of repayments, or longer terms. The FAST Act included substantive and procedural changes to both TIFIA and RRIF and expanded eligibility for the benefit of local and rural projects.

Public and private stakeholders will need to perform within the constraints and opportunities defined by prevailing public and private financial markets. In many cases, specific projects are financed with combinations of public, private, or quasi-public debt.

3.8.1 Bond Issuances

Bond issuances, which result in States borrowing money from investors (bondholders) with a promise of future repayment of principal and interest, are among the most common finance mechanisms used by States to finance road and bridge projects. Although bond financing imposes interest and other debt-related costs, bringing a project to construction more quickly than otherwise possible can sometimes offset these costs. Delaying projects can impose costs that derive from a variety of sources: inflation, lost driver time, freight delays, wasted fuel, and forgone or deferred economic development.

The following are typical bonds used for transportation finance purposes:

- General obligation bonds, which are backed by the full faith and credit of the State.
- Revenue bonds, which are guaranteed by specific State revenue streams, such as tolls.

An innovative financing strategy, GARVEE bonds (23 U.S.C. 122) borrow against anticipated future Federal aid. GARVEEs enable a State to accelerate construction timelines and spread the cost of a transportation facility over its useful life instead of just the construction period. There are two primary types of GARVEEs: direct and indirect (Federal reimbursement).

Direct GARVEEs are secured by specific Federal-aid apportionment categories, and proceeds are used to pay for a specific project (or projects) (See Figure 7). A direct GARVEE requires FHWA Division Office approval of the project authorization and debt-service schedule (23 U.S.C. 122).⁹

⁹ This is not a specific requirement under 23 U.S.C 122, and a regulation has not been issued; however, it is viewed as a requirement stemming from sound internal control provisions under 2 CFR 200.303.

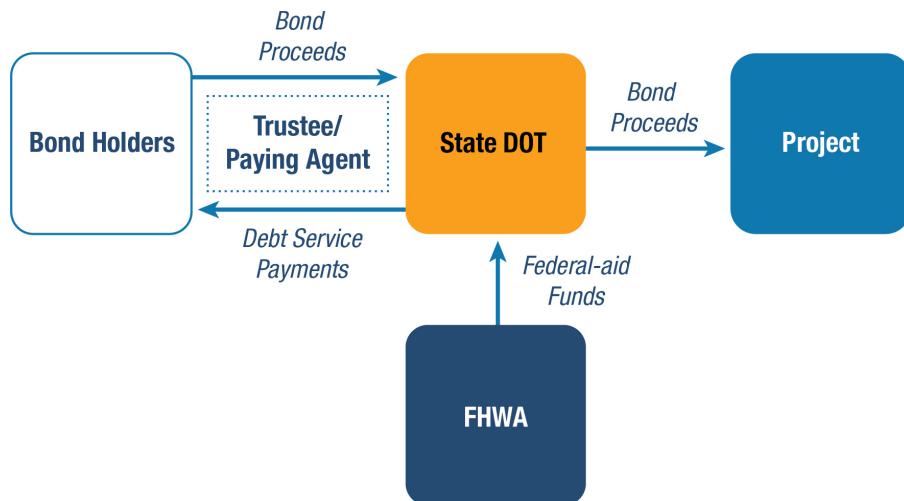


Figure 7. Direct GARVEE process.

Source: FHWA

Indirect (Federal reimbursement) GARVEEs are secured by anticipated Federal-aid reimbursements on projects that are eligible for Federal funding. The State issues bonds to pay for projects, and at the same time, the State also authorizes Federal funds to pay for those projects. As it is constructed, the State pays for the project with bond proceeds but also bills Federal funds for the eligible incurred costs (not debt service). The State can then take the Federal reimbursements to use for any purpose. The GARVEE Federal reimbursement process is shown in Figure 8.

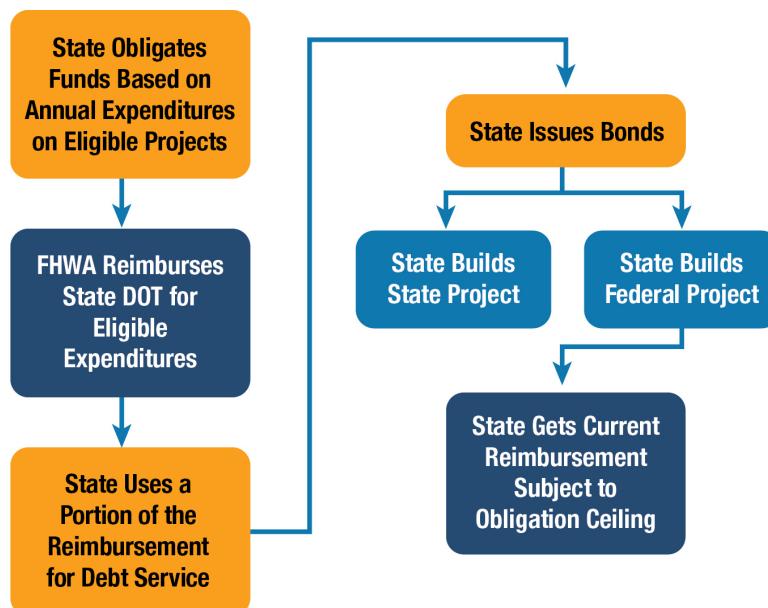


Figure 8. GARVEE Federal reimbursement.

Source: FHWA

Benefits of GARVEEs

- Interest costs and other bond-related costs may be eligible for Federal reimbursement.
- Project costs can be spread over a longer time period.
- Construction may be accelerated, thereby:
 - Reducing project costs due to economies of scale and, in some cases, avoided inflation.
 - Avoiding additional costs associated with the continued deterioration of the facility.
 - Advancing the project's economic, safety, congestion mitigation, and environmental benefits to the public.

Potential Limitations of GARVEEs

- The Federal-aid program is not assured to be reauthorized over the life of the bonds (no Federal guarantee of payment).
- GARVEEs require the State to dedicate future Federal-aid funds to pay debt service; accordingly, future programmatic flexibility can be restricted.
- Political options in the future may also be limited on occasion.



Refer to the Missouri DOT, Ohio DOT, and South Carolina DOT case studies in Appendix C for details on their use of GARVEE bonds.

3.8.2 State Infrastructure Banks

A SIB (23 U.S.C. 610) is a revolving infrastructure investment fund that can offer loans or other credit assistance to public (and private) sponsors of transportation projects. SIBs are established and administered by States (see Figure 9). SIBs may be capitalized with regular Federal-aid highway apportionments and State funds and can offer a range of flexible financial assistance, including loans and various forms of credit enhancements. SIB loans can reduce the cost of projects by providing better rates and repayment terms than would be available elsewhere. Local governments can take advantage of a SIB by structuring repayment to flow from property tax revenues, tolls, fees, or special district taxes. While the initial capital for these banks can come from Federal and/or State sources, a SIB account that is capitalized solely with State funds can help accelerate project delivery by allowing financed projects to follow State regulations in some areas versus certain Federal regulations.

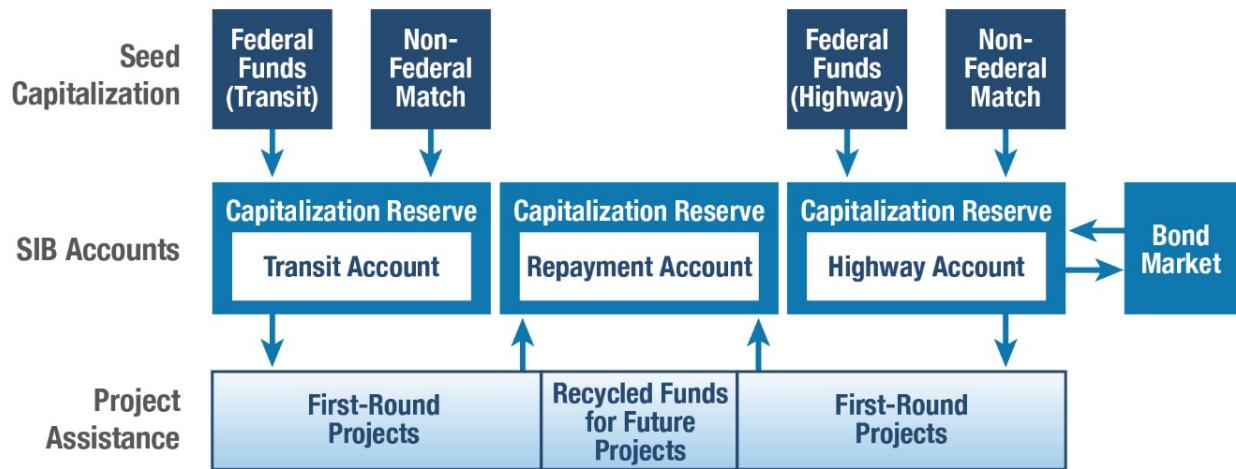


Figure 9. Basic SIB structure.

Source: FHWA

Benefits of SIBs

- Complement traditional funding techniques and serve as a useful tool to meet project-financing demands, stretching both Federal and State dollars.
- Offer flexible project financing, such as low-interest loans and credit assistance that can be tailored to the individual projects.
- Accelerate completion of projects.
- Provide incentive for increased State or local investment.
- Enhance opportunities for private investment by lowering the financial risk and creating a stronger market condition.
- Create a permanent additional revenue/financing source based on SIB interest income and other program income earned (revolving fund concept).
- Provide opportunities to local governments to advance their high-priority projects (through local funds or by borrowing against their State's allocations of Federal aid).
- Provide opportunities to private-sector borrowers to advance desired projects (as long as they are willing to provide a revenue source).
- Support or leverage other borrowing (e.g., issuing its own debt or guaranteeing other entities' debt).

Legal Requirements of SIBs

- SIB projects are required to go through a Federal review process and meet Federal requirements (e.g., Title 23 U.S.C. or 49 U.S.C., NEPA, the Uniform Act, Davis-Bacon Act, DBE, Buy America, Title VI, Section 504 of the Rehabilitation Act of 1973 (Section 504), and, regardless of funding source, the Americans with Disabilities Act [ADA]).
- Resources need to be allocated to manage ongoing SIB lending and repayment functions.

- The State's monitoring responsibility for the duration of SIB activity is longer than a typical grant-assistance timeframe.
- The possibility exists for default and/or failure to make timely debt-service payments.
- SIBs may cause a reduction in Federal-aid funds available for other transportation program purposes (to the extent Federal aid is used to capitalize a SIB).
- The task of underwriting a large number of small loans, loan guarantees, lines of credit, and so forth may require intensive management and/or increased administrative costs.
- The possibility of default may be higher with some local governments and new borrowers.

For example, the Nebraska Transportation Innovation Act (TIA), enacted in April 2016, provided NDOT with new revenue, programs, and tools to increase mobility, freight, economic growth, and safety in Nebraska. The purpose of the TIA is to accelerate highway capital improvement, promote innovative solutions for deficient county bridges, and help finance transportation improvements that connect new and growing businesses. The TIA legislation resulted in a total allocation of \$450 million for targeted infrastructure investment and created the Transportation Infrastructure Bank (TIB), which received a one-time transfer of \$50 million from the Cash Reserve Fund in 2016. The TIB receives annual revenue from fuel taxes generated by Legislative Bill 610 (passed in 2015). The fuel tax revenue is projected to generate \$400 million for infrastructure investment prior to the 2033 sunset of the TIB.



NOTEWORTHY
PRACTICES

[Nebraska Transportation Infrastructure Bank](#)



NOTEWORTHY
PRACTICES

[Pennsylvania Infrastructure Bank](#)

3.8.3 Federal Credit Assistance

TIFIA, the Transportation Infrastructure Finance and Innovation Act program, 23 U.S.C. 601 et seq., provides direct loans (up to 49 percent of project cost), loan guarantees, and standby lines of credit (up to 33 percent of project cost) to finance surface transportation projects. Like SIBs, TIFIA credit assistance provides improved access to capital markets, flexible repayment terms, and potentially more favorable interest rates than can be found in private capital markets. TIFIA can also help advance qualified projects that otherwise might be delayed or deferred because of size, complexity, or uncertainty over the timing of revenues.

Through the FAST Act (FAST Act Section 2001; 23 U.S.C. 601-609), a TIFIA direct loan can now be used to capitalize a rural projects account in a SIB (see Figure 10). The SIB must use the funds in its rural projects account to make loans for surface transportation infrastructure projects located outside of an urbanized area with a population greater than 150,000, as determined by the U.S. Census Bureau. The principal amount of a TIFIA direct loan to capitalize a rural projects

fund within a SIB must be between \$10 million and \$100 million. Loans made by SIBs from a rural projects fund must comply with certain specific requirements, including the following:

- The SIB loan cannot exceed 80 percent of the cost of carrying out the project.
- The SIB loan must bear interest at or below the interest rate on the TIFIA loan (half of the U.S. Treasury rate) that was used to capitalize the rural projects fund.
- The SIB loan repayment must commence no later than 5 years after completion of the project.
- The SIB loan term cannot exceed 30 years after the date of the first payment on the loan.

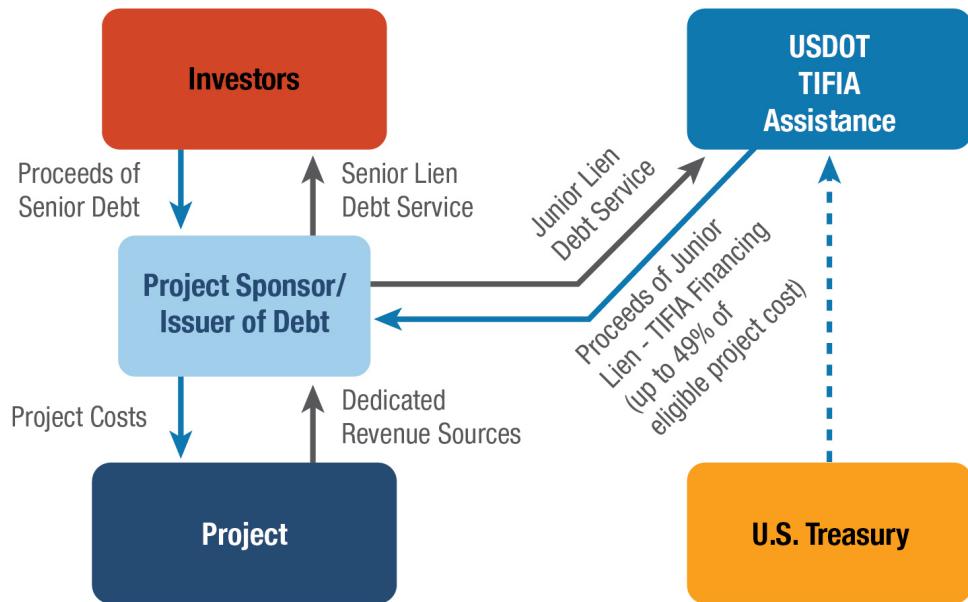


Figure 10. TIFIA process.

Source: FHWA

Benefits of TIFIA

- Long-term, fixed-cost, permanent, up-front financing.
- Borrower/revenue source may be minimum investment grade.
- Non-recourse financing—project cash flow supported.
- Loan funds can be drawn as needed.
- Senior or subordinate lien.
- Flexible amortization.
- Low interest rates—equivalent to U.S. Treasury rates.
- Extended repayment—up to 35 years.
- No pre-payment penalty.

Legal Requirements of TIFIA

- Minimum anticipated project costs are at least \$10 million for transit-oriented development and local and rural projects, \$15 million for intelligent transportation system projects, and \$50 million for all other eligible surface transportation projects.
- Loan amount is limited to 33 percent of the project costs.
- Dedicated revenue source must be pledged to secure debt-service payments for both the TIFIA and senior debt financing.
- TIFIA projects are required to go through a Federal review process and meet Federal requirements (e.g., Title 23 U.S.C. or 49 U.S.C., NEPA, the Uniform Act, Davis-Bacon Act, DBE, Buy America, Title VI, Section 504, and, regardless of funding source, the ADA).
- The senior debt and TIFIA loan must receive investment-grade ratings from at least two nationally recognized credit rating agencies (or only one rating if less than \$75 million).



USDOT Build America Bureau information on [TIFIA eligibility](#) requirements.

3.8.4 Private Activity Bonds

Private activity bonds (PABs) are debt instruments authorized by the Secretary of Transportation and issued by a conduit issuer on behalf of a private entity for highway and freight transfer projects, allowing a private project sponsor to benefit from the lower financing costs of tax-exempt municipal bonds (see Figure 11). The law, Section 11143 of Title XI of SAFETEA-LU, limits the total amount of such bonds to \$15 billion and directs the Secretary of Transportation to allocate this amount among qualified facilities.

Providing private developers and operators with access to tax-exempt interest rates lowers the cost of capital significantly, enhancing investment prospects. Increasing the involvement of private investors in highway and freight projects generates new sources of money, ideas, and efficiency.

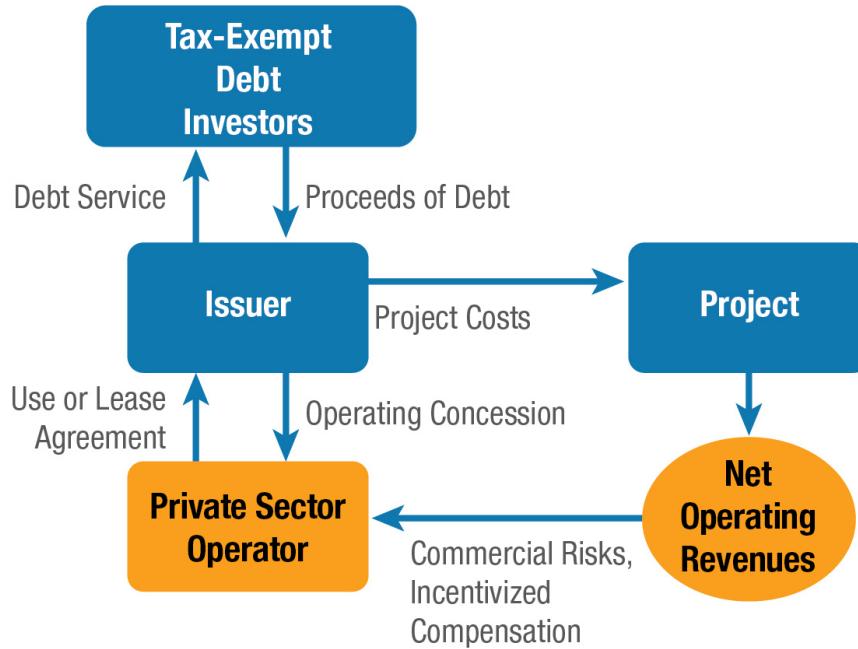


Figure 11. Private activity bonds flowchart.

Source: University of Southern California, National Center for Innovations in Public Finance

PABs Benefits

- Offer most competitive funding cost.
- Maximize funding available for the project.
- Allow a layer of equity to be combined with the efficiency of tax-exempt debt.
- Are exempt from statewide caps that apply to other categories of PABs.
- Allow compliance with Federal requirements on only the project segment that receives PABs funding.

PABs Potential Limitations

- Law limits total allocation of PABs to \$15 billion nationwide.
- State and local projects must be eligible to receive Title 23 or Title 49 assistance to qualify.
- State or local governments seeking the DOT allocation must have separate legal authority to issue bonds
- Projects are subject to Davis-Bacon Act, Buy America, and other Federal-aid procurement requirements.
- PABs must adhere to U.S. Internal Revenue Service (IRS) requirements concerning investment yields, permitted use, etc.



More information on PABs is available on the FHWA Office of Innovative Program Delivery's [Center for Innovative Finance Support](#) and USDOT [Build America](#) Bureau websites.

3.8.5 Section 129 Loans

Pursuant to Section 1012 of the Intermodal Surface Transportation Efficiency Act of 1991, certain State loans to transportation projects became eligible for reimbursement from Federal-Aid Highway Program funds. States can essentially recycle Federal-Aid Highway Program funds by lending them out, obtaining repayments from dedicated revenue sources, and then reusing the repaid funds on other highway projects.

Section 129(a)(7) of Title 23 allows Federal participation in a State loan to support projects with dedicated revenue streams, including tolls, excise taxes, sales taxes, real property taxes, motor vehicle taxes, incremental property taxes, or other beneficiary fees. Further, Section 129 loans can be used to fund the up-front developmental costs of the project, subject to repayment from the permanent project financing.

Similar to SIBs, Section 129 loans allow States to leverage additional transportation resources and recycle assistance to other eligible projects. States have the flexibility to negotiate interest rates and other terms of Section 129 loans. When a loan is repaid (see flow of funds in Figure 12), the State is required to use the funds for a Title 23-eligible project or credit enhancement activities, such as the purchase of insurance or a capital reserve to improve credit market access or lower interest rate costs for a Title 23-eligible project. One important distinction between SIB and Section 129 loans is that projects that receive assistance from repaid Section 129 loans are not required to meet the same number of Federal requirements as those using SIB loans.



Figure 12. Section 129 loans flow of funds.

Source: FHWA

Section 129 Loans Benefits

Similar to SIBs, Section 129 Loans:

- Complement traditional funding techniques and serve as a useful tool to meet project-financing demands, stretching both Federal and State dollars.
- Provide flexible project financing, such as low-interest loans and credit assistance that can be tailored to the individual projects.
- Accelerate completion of projects.

- Offer incentive for increased State or local investment.
- Enhance opportunities for private investment by lowering financial risk and creating a stronger market condition.
- Create a permanent additional revenue/financing source based on Section 129 interest income and other program income earned (revolving fund concept).
- Provide opportunities to local governments to advance their high-priority projects (through local funds or by borrowing against their dedicated funding sources).
- Provide opportunities to private sector borrowers to advance desired projects (as long as they are willing to provide a revenue source).
- Support or leverage other borrowing (e.g., issuing its own debt or guaranteeing other entities' debt).

Repaid loan funds may be obligated for a Title 23-eligible purpose. These projects, however, are not subject to Federal requirements, as the repayment source is a non-Federal resource.

Potential Limitations of Section 129 Loans

- The project must have a dedicated revenue source pledged to secure debt-service payments.
- The first round of funds loaned must meet Federal requirements, including: Title 23 U.S.C. or 49 U.S.C., NEPA, the Uniform Act, Buy America, Title VI, Section 504, and, regardless of funding source, the ADA.
- Resources need to be allocated to manage ongoing Section 129 loan lending and repayment functions.
- The State-monitoring responsibility for the duration of Section 129 loan activity is longer than a typical grant-assistance timeframe.
- It brings possibility of default and/or failure to make timely debt-service payments.
- The possibility of default may be higher with some local governments and new borrowers.



More information on [Section 129 loans](#) is available on the FHWA Office of Innovative Program Delivery's Center for Innovative Finance Support website.

3.9 Tolling and Pricing Revenue

Tolling and pricing involves charging fees for the use of a roadway facility (includes bridges). The revenue generated may be used to pay for highway operations and maintenance and, in many cases, as the primary source of repayment for long-term debt used to finance the toll facility itself.

Tolling involves the imposition of per-use fees on motorists to use a highway. Historically, these fees have been fixed, distance-based tolls that vary by vehicle type, but not by time of day. Their primary purpose has been to generate revenue.

Pricing involves the imposition of fees or tolls that vary based on the level of demand for travel on a highway facility. The fees may vary according to a fixed schedule or in real time based on actual travel conditions. Also known as congestion pricing, value pricing, variable pricing, peak-period pricing, or market-based pricing, this strategy manages demand by imposing a fee that varies by time of day, direction of travel, type of vehicle, number of occupants, or other factors. While pricing generates revenue, this strategy also seeks to manage congestion, environmental impacts, and other external costs.

Title 23 U.S.C. (Highways) includes a general prohibition on the imposition of tolls on Federal-aid highways. However, Title 23 and other statutes have also carved out certain exceptions to this policy. Two mainstream Federal tolling programs and two pilot programs offer States opportunities to use tolling to generate revenue to support highway construction activities and implement priced managed lanes on Federal-aid highways.



More information on [tolling and pricing](#) is available on the FHWA Office of Innovative Program Delivery's Center for Innovative Finance Support website.

3.10 Public-Private Partnership

Public-private partnerships (P3s) combine elements of the design-build (D-B) project delivery method and financing. P3s are contractual agreements between a public agency and a private entity that allow for greater private participation in project delivery. In transportation projects, this participation typically involves the private sector taking on additional project risks such as design, construction, finance, long-term operation, and traffic revenue.

The specific combination of transferred risk depends on both the specifics of a project and the public policy objectives of the State DOT. One of the very unique potential benefits of a P3 is the ability to utilize more flexible financial structures that use private equity. For a large project that costs more than a State or locality can provide with conventional financing, a private partner can help bridge the gap.

For example, for the Port of Miami Tunnel project, the private partner delivered a tunnel in an urban area, bearing the risk of construction delays and providing up-front financing. Under the concession agreement, the Florida DOT paid a total of \$100 million in milestone payments during the construction period between 2010 and 2013 and a \$350 million final acceptance payment upon construction completion. This is followed by 30 years of availability payments during the operating period. Deductions will be made from the availability payment if the operation of the facility does not meet prescribed performance standards.



NOTEWORTHY
PRACTICES

FHWA Center for Innovative Finance Support Project Profile: [Port of Miami Tunnel](#)



OTHER
RESOURCES

Learn more about the financial structuring of P3s from the FHWA Center for Innovative Finance Support [P3 Toolkit](#) and get more information on P3 technical assistance opportunities from the USDOT [Build America Bureau](#).

3.10.1 P3 Small-Scale Project Bundling

P3 can be a useful financing tool for small-scale projects. In fact, P3 bundling is becoming an attractive option for agencies to bring private capital and the benefits of the P3 financing model to smaller assets. When bundled into a single, larger procurement, a beneficial P3 structure can be implemented to address a group of similar assets across multiple sites, an assortment of different assets at a single site, or different assets across multiple sites.

- The Pennsylvania Rapid Bridge Replacement Project bundled 558 small bridge projects into a single P3 design-build-finance-maintain (DBFM) availability-payment concession to take advantage of the economies of scale that the private sector could offer.
- The Northampton County (Pennsylvania) Bridge Renewal Program bundled 33 structurally deficient bridges into a single P3 DBFM availability-payment concession arrangement.



OTHER
RESOURCES

More information on [P3s](#) is available on the FHWA Center for Innovative Finance Support website.



NOTEWORTHY
PRACTICES

Refer to the case studies in Appendix C for details on PennDOT's and Northampton County's use of P3 as a financing tool for small-scale projects.

3.10.2 P3 Financial Structure

The P3 method serves to insulate the public sector from the financial risks of a project through the use of project-specific financing. It is commonly thought that P3 are limited to toll facilities, however this delivery method has been used for projects where the financing is secured by future tax revenues, availability and/or milestone payments, future Federal appropriations, shadow tolls, and governmental lease payments. P3 concession arrangements provides States with increased financial security by allowing the private sector to utilize more flexible financial structures and vehicles. This arrangement typically uses financing that is non-recourse to the States where the

project is located. There is an exception where the State pledges a specific revenue to support the project, in which case the State's exposure is limited to the extent of the pledged revenue.

Figure 13 depicts a common financing structure for P3 concession projects. Although a single company may bid on and develop a project, generally several companies form a consortium to develop the project. In order to make a clear separation between the members of the consortium and the project itself, a special purpose vehicle (SPV) or project company known as the concessionaire is generally created after the public agency has awarded the project to the consortium. The members of the consortium then become the shareholders of the SPV, and their liability is limited to the amount of shared capital they have invested in the new company.

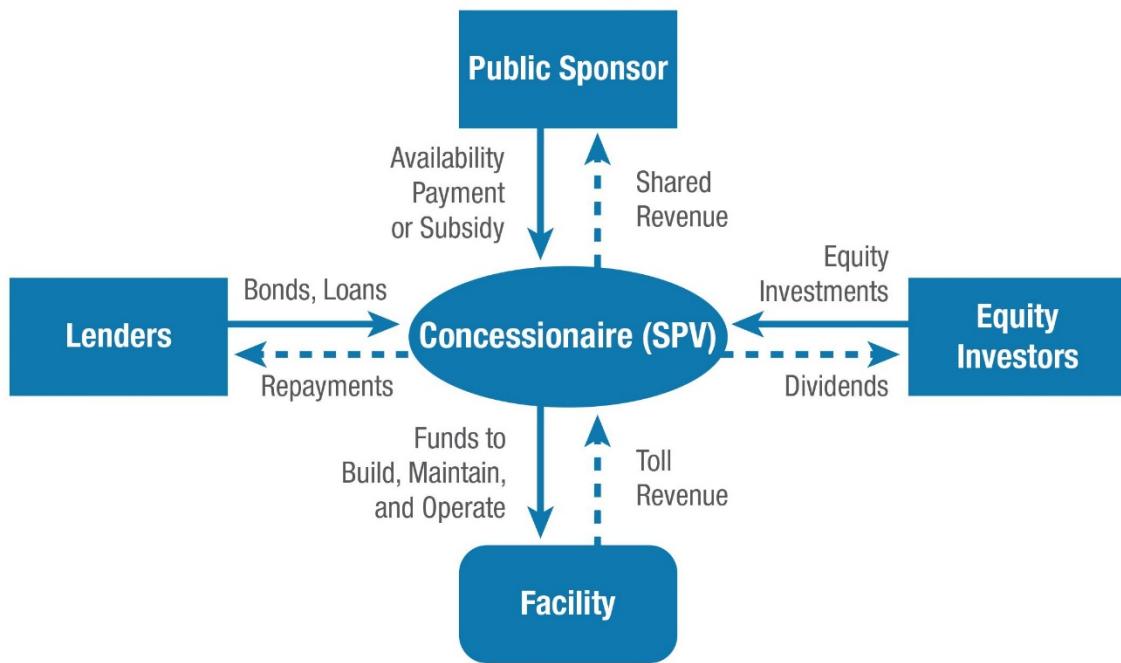


Figure 13. P3 financing structure.

Source: FHWA Center for Innovative Finance Support

By using project financing, the concessionaire raises funds from investors and lenders based on the project's future revenue stream or "cash flows." The project's net cash flows (after deducting operating costs and tax payments) must be sufficient to service and repay debt and provide a return to equity. Public agencies may provide direct funding or financing support, guarantees, or other risk-mitigation measures.

In New Zealand, where P3s are more common than in the United States, the New Zealand Social Infrastructure Fund Limited notes:

“PPP projects typically generate relatively stable and predictable cash flows over the term of a Concession. Because of the nature of these cash flows, Private Entities can support relatively high levels of debt. While debt levels are expected to be high initially (particularly, during the project construction phase) debt typically declines over the term of a Concession as it is repaid from operating cash flows.

A Private Entity will typically fund the initial project costs, including construction costs, through a mixture of long-term non-recourse senior debt, subordinated debt and equity. Ideally, where possible, senior debt and/or an equity bridging facility is drawn first and equity and subordinated debt are drawn towards the end of the construction phase (usually two-to-three years) to minimize calls on equity capital until the asset is operational.

Once a Social Infrastructure Asset becomes operational, a Private Entity will receive revenues from the Public Sector Client for the remainder of the length of the Concession, provided agreed service levels are met. The revenues are typically inflation-linked and can be either ‘availability’ or ‘demand’ based depending on the nature of the project:

‘Availability’- based projects entitle a Private Entity to receive regular payments from a Public Sector Client to the extent that the project asset is available for use in accordance with contractually agreed service levels.

‘Demand’- based projects entitle a Private Entity to receive payments related to the usage of the project asset.”

©2009 New Zealand Social Infrastructure Fund Limited



More from “[What are Public-Private Partnerships?](#)” is available on the New Zealand Social Infrastructure Fund Limited website.

With the P3 design-build-finance-operate-maintain (DBFOM) approach, the responsibilities for designing, building, financing, operating and maintaining are transferred to private sector partners. There is a great deal of variety in DBFOM arrangements in the United States, especially in the degree to which financial responsibilities are actually transferred to the private sector. One commonality that cuts across all DBFOM projects is they are either partly or wholly financed by debt-leveraging revenue streams dedicated to the project. Future revenues are leveraged to issue bonds or other debt that provide funds for capital and project development costs. Figure 14, from the USDOT [Guidebook on Financing of Highway Public-Private Partnership Projects](#) (December 2016), demonstrates the financing structure with operations and maintenance (O&M).

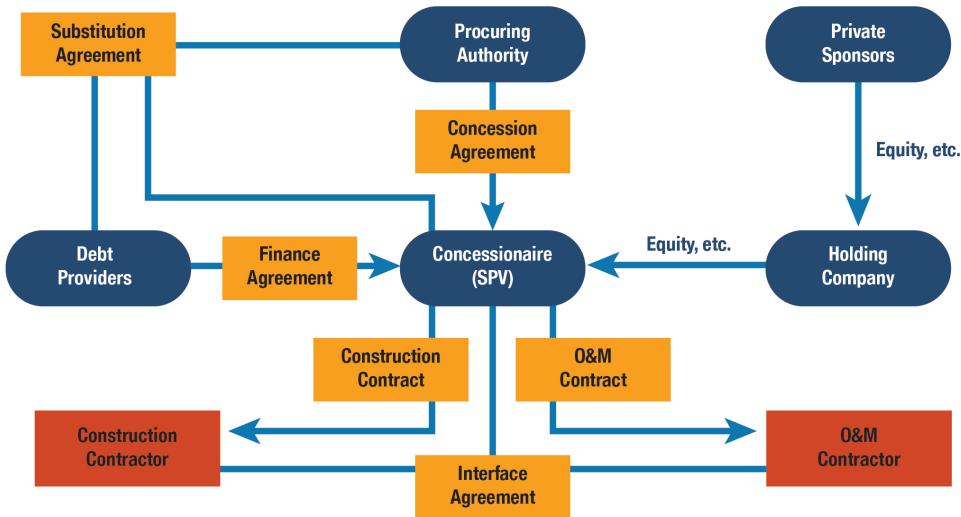


Figure 14. P3 financing structure with O&M.

Source: USDOT

3.11 Summary

States and local governments are challenged to address their aging infrastructure with limited resources. Evaluating the effectiveness of existing revenue sources, taking advantage of the most current Federal programs, and exploring the potential of new revenue sources can lead to an increase in available funding. However, finding ways to maximize the spending power of the revenue collected is equally important. Given the various transportation funding and financing considerations outlined in this chapter, it is clear that there is not a one-size-fits-all approach. To develop the best funding and financing strategy for bridge bundling within a particular State, it is essential for agencies to understand the application of each tool and to work collaboratively to pair the right project with the right tools.



For more details on [P3s](#), FHWA's Center for Innovative Finance Support has extensive information, case studies, tools, and other resources available online.



[USDOT P3 Library](#)

FHWA P3 Resources:

- [Fact sheets](#).
- [Project profiles](#).
- Interactive maps of [new build facilities](#) and [existing facilities](#).

Chapter 4. Coalition Building and Outreach



4.1 Stakeholder Support

Early in the process, the public agency should engage stakeholders to gain support for a bridge bundle project or program. This may include outreach to internal organizations, elected officials, industry, other stakeholders, and the public, as described in the following examples:

- Internal Organizations.** It is likely necessary to identify key individuals and the parts of an organization that will play a role in implementing the project or program. Key individuals, such as subject matter experts, should be selected to be members of an implementation team. This team will be responsible for guiding the effort and will be held accountable for its success. Other individuals who will need to be kept informed of the effort (such as agency executives) should also be identified.
- Elected Officials.** Public project bidding laws differ by State and county. It is important to know the local laws that govern the methods by which a public project may be delivered. Elected officials may need to be educated, or provided an overview, on bridge bundling projects and programs.
- Industry.** Before planning a bridge bundle, the agency should reach out to local industry and trade associations to gauge their interest and estimate the contract size that will optimize participation. This can be done through informal conversations; meetings with contractor, fabricator, and engineering associations; and participation in industry

workshops. The outreach should aim to provide information, obtain feedback, and gain support for the bridge bundle project or program.

Note: Certain States have laws, such as Pennsylvania's Adverse Interest Act, which place restrictions on entities that serve as a State advisor or consultant such that these entities cannot subsequently participate in the ultimate project once it is advertised. In this case, meetings with individual companies should be avoided.

- **Public.** One of the drawbacks of doing a successful bridge bundle contract is that the agency must be willing to release control of some aspects of the project. The more flexibility given to the contractor, the more efficient its staff will have the chance to be. While this will lead to lower prices and faster completion times, it can be difficult to coordinate road closures with the public in the fashion to which they are accustomed. It is important to conduct a public outreach program to educate affected communities on the benefits of bridge bundling to gain support for the program.

Making the case for a bridge bundling project or program may involve many diverse groups that are either needed to support or will be affected by the project. These may include internal agency staff, the construction and engineering industry, and other stakeholders such as approval agencies, the public, governing bodies, and financial institutions if private funds are being used.

4.2 Communication Plan and Outreach Topics

Successful outreach translates to open and frequent communication. The agency benefits if all relevant parties are engaged and understand the different perspectives and issues in order to make as strong a case as possible. By understanding the existing support and concerns, the agency can focus its efforts on those that will be most productive to achieving the goals of the project (or modifying them if necessary).

A communication plan (see Table 7) can be developed that describes the specific organizations needed for support of an agency's bridge bundling project and those affected by it, as well as the recommended content, type, methods, and frequency of communication. This tool will enable the project team to quickly see and understand the groups involved, who is responsible for communication, and how communication should be conducted.

Table 7. Example communication plan.

ORGANIZATION OR INDIVIDUAL	CONTENT	FREQUENCY	MEDIUM	SOURCE	RESPONSIBILITY
Commissioner	Progress Report	Weekly	E-mail	Management Team	Project Manager
Construction Industry Association	Project Overview	Monthly	In-person (agency meeting)	Project Manager	Project Manager
Legislature	Benefits, Risks	Once	In-person (committee meeting)	Project Management Plan, Risk Management Plan	Commissioner
Procurement Team	Risk Allocation	Bi-weekly	Risk Report on File Sharing Site	Risk Management Plan	Risk Manager

Tables 8 through 13 further describe these organizations and potential communication topics and discussion items.

Table 8. Example communication topics: internal.

CATEGORY	ORGANIZATION / GROUP	COMMUNICATION TOPICS / DISCUSSION ITEMS
Agencies: DOTs, LPAs, or any other bridge asset agency (e.g., tribal nations, toll authorities, cities)	Executive	<ul style="list-style-type: none"> • Need for bundling • Goals and objectives • Pros and cons • Risks
	Bridge Office	<ul style="list-style-type: none"> • Goals and objectives • Supporting data • Selection criteria (bridge types, locations) • Schedule • Risks • Procurement and delivery methods
	Procurement Office	<ul style="list-style-type: none"> • Goals and objectives • Procurement and delivery methods • DBE, civil rights requirements • Risks
	Environmental Office	<ul style="list-style-type: none"> • Goals and objectives • Bridge types and locations • Schedule • Risks • Procurement and delivery methods
	Materials Office	<ul style="list-style-type: none"> • Goals and objectives • Bridge types and locations • Schedule • Risks • Procurement and delivery methods
	Design Office	<ul style="list-style-type: none"> • Goals and objectives • Bridge types and locations • Schedule • ADA compliance • Risks • Procurement and delivery methods

CATEGORY	ORGANIZATION / GROUP	COMMUNICATION TOPICS / DISCUSSION ITEMS
	ROW Office	<ul style="list-style-type: none"> • Goals and objectives • Bridge types and locations • Schedule • Risks • Procurement and delivery methods
	Construction Office	<ul style="list-style-type: none"> • Goals and objectives • Bridge types and locations • Schedule • Risks • Procurement and delivery methods
	Local Project Administration Office	<ul style="list-style-type: none"> • Goals and objectives • Bridge types and locations • Schedule • Risks • Procurement and delivery methods

Table 9. Example communication topics: industry (construction and engineering).

CATEGORY	ORGANIZATION / GROUP	COMMUNICATION TOPICS / DISCUSSION ITEMS
Construction Industry	Contractor Associations and Labor Unions	<ul style="list-style-type: none"> • Goals and objectives • Existing support • Concerns/issues • Capacity • Delivery method preferred
	Bridge Contractors	<ul style="list-style-type: none"> • Goals and objectives • Capacity/workload • Delivery method preferred • Performance bond limits
	Material Suppliers	<ul style="list-style-type: none"> • Goals and objectives • Capacity • Production rates
	Pre-cast Fabricators	<ul style="list-style-type: none"> • Goals and objectives • Capacity • Production rates
Design Industry	Engineering Associations	<ul style="list-style-type: none"> • Goals and objectives • Capacity/workload • Delivery method preferred
	Bridge Designers	<ul style="list-style-type: none"> • Goals and objectives • Capacity/workload • Delivery method preferred
Quality Assurance	Consultant Firms	<ul style="list-style-type: none"> • Goals and objectives • Capacity/workload • Delivery method preferred
	Laboratories	<ul style="list-style-type: none"> • Goals and objectives • Capacity/workload

Table 10. Example communication topics: control agencies.

CATEGORY	ORGANIZATION / GROUP	COMMUNICATION TOPICS / DISCUSSION ITEMS
Agencies	FHWA	<ul style="list-style-type: none"> • Goals and objectives • Federal funds • Other funds • Bridge types and locations • Schedule • DBE, civil rights requirements • ADA • Risks • Procurement and delivery methods
	State Environment / Permitting Agency	<ul style="list-style-type: none"> • Goals and objectives • Project overview • Bridge types and locations • Schedule • Risks • Procurement and delivery methods
	State Office of Comptroller	<ul style="list-style-type: none"> • Goals and objectives • Project overview • Schedule • Risks • Procurement and delivery methods
	State Office of Attorney General	<ul style="list-style-type: none"> • Goals and objectives • Project overview • Schedule • Risks • Procurement and delivery methods

Table 11. Example communication topics: constituents.

CATEGORY	ORGANIZATION / GROUP	COMMUNICATION TOPICS / DISCUSSION ITEMS
External Stakeholders /Constituents	General Public	<ul style="list-style-type: none"> • Project overview • Schedule • Procurement and delivery methods
	Residents (in vicinity of each bridge)	<ul style="list-style-type: none"> • Project overview • Schedule for each bridge
	Bridge Users	<ul style="list-style-type: none"> • Project overview • Schedule for each bridge
	Trucking Associations	<ul style="list-style-type: none"> • Mobility • Detours • Schedule for each bridge
	Emergency Response	<ul style="list-style-type: none"> • Project overview • Schedule for each bridge
	Law Enforcement	<ul style="list-style-type: none"> • State Police • Highway Patrol • County/Parish Sheriff • Local municipality
	Schools	<ul style="list-style-type: none"> • Project overview • Schedule for each bridge
	Businesses	<ul style="list-style-type: none"> • Project overview • Schedule for each bridge
	Hospitals	<ul style="list-style-type: none"> • Project overview • Schedule for each bridge

Table 12. Example communication topics: elected officials.

CATEGORY	ORGANIZATION / GROUP	COMMUNICATION TOPICS / DISCUSSION ITEMS
State Elected Officials	Governor	<ul style="list-style-type: none"> • Project/program overview
	Legislature	<ul style="list-style-type: none"> • Project/program overview
Local Elected Officials	Local Government (for each bridge)	<ul style="list-style-type: none"> • Project/program overview
Federal Elected Officials	State Senators	<ul style="list-style-type: none"> • Project/program overview
	State Representatives	<ul style="list-style-type: none"> • Project/program overview

Table 13. Example communication topics: financial markets.

CATEGORY	ORGANIZATION / GROUP	COMMUNICATION TOPICS / DISCUSSION ITEMS
Financial Markets	P3 Concessionaires	<ul style="list-style-type: none"> • Project overview • Schedule • Risks • Procurement and delivery methods
	Banks	<ul style="list-style-type: none"> • Project overview • Schedule • Risks • Procurement and delivery methods
	Rating Agencies	<ul style="list-style-type: none"> • Project overview • Schedule • Risks • Procurement and delivery methods

4.3 Summary

Public agencies should engage stakeholders early in the process to gain support for a bridge bundle project or program. This may include outreach to internal organizations, elected officials, industry, other stakeholders, and the public. A documented communication plan that describes the specific organizations needed for project support and those affected by it, as well as the recommended content, type, methods, and frequency of communication, should be prepared during this step in the bridge bundling process.

Chapter 5. Risk Assessment



5.1 Risk Management

Risks are threats and opportunities to achieving project goals. Identifying and assessing these risks will greatly improve the chances for a successful project.



[Interview with Keith Molenaar, University of Colorado](#)

“Risk management is an important part of bridge bundling.”

Formal risk assessment or risk analysis may be the most underutilized or misunderstood project management process. When one considers the programming, the environmental process, the bridge selection process, the project delivery method selection, and the procurement method selection decisions that need to be made for a successful bridge bundling project, it is apparent that *these are all risk allocation decisions*. Risks should be placed on the party that is in the best position to control that risk; shifting risks to a party not best equipped to address that risk will result in higher cost, delays, decreased quality, or disputes.

Agencies can benefit tremendously from a *formal risk management process* as they develop and deliver their bridge bundle project or program. It is highly recommended that a formal risk

management process be implemented throughout the project or program life. Risk assessments do not only identify threats to achieving project goals, but also opportunities for achieving them.

Because each bridge bundling project or program is unique, each will benefit from a structured approach to identifying top threats and opportunities (i.e., risks) — and acting on them. Risk assessments should be conducted throughout the project or program life, building off the previous results. Agencies find it serves as an excellent communication tool with the project team and stakeholders. Risk assessments identify, in a structured manner, the areas for agencies to focus their limited resources on that will result in the largest project benefit.



For an outline of the risk management process, see Appendix F. Risk Management Process Overview.

5.2 Bridge Bundling Threats and Opportunities

Table 14 provides examples of bridge bundling threats and opportunities and potential responses to these risks.

Table 14. Examples of risks and responses for bridge bundling.

POTENTIAL BRIDGE BUNDLING RISKS (THREATS AND OPPORTUNITIES)	
THREAT (T) OR OPPORTUNITY (O)	POTENTIAL RESPONSE
Unclear goals and objectives (T)	<ul style="list-style-type: none">• Get stakeholder input.• Document.
Project delivery method not clear (T)	<ul style="list-style-type: none">• Utilize project delivery selection tool (risk-based).
Accelerated delivery/schedule constraints (T)	<ul style="list-style-type: none">• Use CM/GC delivery method• Use D-B delivery method.• Use ATC process.• Use incentives/disincentive clauses.• Use A+B bidding (D-B-B).• Use schedule as a selection criterion (best value procurement).

POTENTIAL BRIDGE BUNDLING RISKS (THREATS AND OPPORTUNITIES)	
THREAT (T) OR OPPORTUNITY (O)	POTENTIAL RESPONSE
Utility/Third-Party conflicts (T)	<ul style="list-style-type: none"> • Owner assumes risks. • Clearly assign responsibility in procurement/contract documents. • Utilize the “3 Cs”: coordination, cooperation, and communication. • Relocate utilities in advance of procurement. • Avoid locations with unknown utility information.
Geotechnical conditions (T)	<ul style="list-style-type: none"> • Owner assumes risks. • Conduct geotechnical investigations in advance. • Conduct geotechnical investigations during procurement (to save time). • Assign risk to design-builder. • Provide all available data and previous studies as part of procurement. • Employ the GeoTech Tool Box (SHRP2 R02)¹ • Avoid locations with unknown geotechnical information.
Innovation desired (O)	<ul style="list-style-type: none"> • Incorporate ATC process. • Use D-B project delivery method. • Use CM/GC project delivery method. • Use best-value procurement (establish evaluation criteria). • Consider FHWA Every Day Counts initiatives. • Consider SHRP2 products. • See Appendix K: Other Bridge-Related Innovation.
Fixed budget (T)	<ul style="list-style-type: none"> • Use D-B project delivery method. • Use CM/GC project delivery method. • Using maximum price, request proposal responder to identify amount of work they can do within this budget.

POTENTIAL BRIDGE BUNDLING RISKS (THREATS AND OPPORTUNITIES)	
THREAT (T) OR OPPORTUNITY (O)	POTENTIAL RESPONSE
Insufficient funds (T)	<ul style="list-style-type: none"> • Owner assumes risks. • Consider P3 financing. • Issue revenue bonds or GARVEE bonds. • Obtain Federal Credit Assistance (SIBs or TIFIA). • Modify/reduce scope. • Use guaranteed maximum price. • Ask for innovation.
Hydraulic/Floodplain issues (T)	<ul style="list-style-type: none"> • Assign responsibility to design-builder. • Address in environmental/preliminary design study phase. • Follow FHWA hydrology and hydraulics design standards (23 CFR 650.115 and 650.117). • Avoid locations within a floodplain. • Owner assumes risks.
Communication (T)	<ul style="list-style-type: none"> • Develop a communication plan.
Railroads (T)	<ul style="list-style-type: none"> • Owner assumes risks. • Early coordination (SHRP2 R16). • Avoid.
Local government coordination (T and O)	<ul style="list-style-type: none"> • Develop a communication plan. • Secure local funding.
Permits/Authorizations (T)	<ul style="list-style-type: none"> • Educate. • Consider programmatic agreements. • Early coordination. • Bundle coordination. • Avoid.
Elected officials buy-in (O)	<ul style="list-style-type: none"> • Educate. • Demonstrate need. • Develop a communication plan. • Secure funding.

POTENTIAL BRIDGE BUNDLING RISKS (THREATS AND OPPORTUNITIES)	
THREAT (T) OR OPPORTUNITY (O)	POTENTIAL RESPONSE
Agency personnel and expertise capacity (T)	<ul style="list-style-type: none"> • Training. • Develop a communication plan. • Outsource.
DBE (T/O)	<ul style="list-style-type: none"> • Educate. • Outreach activities. • Appropriate project or location-specific goals.
ADA (T/O)	<ul style="list-style-type: none"> • Educate. • Outreach activities. • Design considerations or requirements.

NOTE:

1. Transportation Research Board second Strategic Highway Research Program GeoTechTools



[Interview with Travis Konda, HNTB Corporation](#)

“...make sure that contract allows the contractor to select what bridge he works on when, so as to alleviate some of the risk of tying them into a particular sequence.”



[Interview with Stan Rugis, County of Northampton, Pennsylvania](#)

“Risk management is fundamental to our model.”

5.3 Summary

Involving stakeholders in a formal process to identify project or program risks will greatly enhance the identification of threats and opportunities to an agency's goals and objectives. This step in the bridge bundling process should result in a risk management plan and initial project or program risk register. Good project management practice means risk analysis is not a one-time activity, but a continuous effort throughout the life of the project or program. Therefore, the initial risk register should be updated regularly and serve as an excellent communication tool as the project or program progresses and is refined.

Chapter 6. Bridge Selection



- 1 Define successful bridge bundling
- 2 Determine goals & objectives
- 3 Identify funding or financing
- 4 Build a coalition & outreach
- 5 Perform risk assessment
- Select bridges**
- 7 Select delivery method
- 8 Determine environmental review & preliminary design considerations
- 9 Bundle & let contract(s)
- 10 Conduct quality assurance, close-out & celebrate!

Objective:

- To identify bridge selection criteria and candidate bridges

Tools:

- Bridge selection matrix
- Table of contract sizes
- Table of contract durations

Outcome:

- List of candidate bridges for bundling

6.1 Determining Optimal Bundle Size

Once a public agency has decided to bundle bridges and established desired goals, it will then decide the size of the bridge bundle project. There is no one-size-fits-all approach to bridge bundling. The size of a bridge bundle can vary widely depending on goals, funding or financing available, agency capacity, timeframe, and availability of contractors to construct the bridge bundle project. Bridge bundling contracts prepared by agencies have ranged from 2 to 558 bridges, as shown on the following page in Table 15.



Interview with Travis Konda, HNTB Corporation

“In terms of how many bridges we can put inside one package, I think that really depends on the scale of the entities involved.”



Interview with Edward Minchin, University of Florida

“...the more bidders you have, the better price you get.”

Table 15. Number of bridges per contract bundle.

AGENCY	FUNDING SOURCE	D-B-B	IDIQ ¹	CM/GC	D-B	P3
Delaware DOT	Federal – State	2-20	22	-	28	-
Erie County, NY	Federal – Local	3-25	-	-	-	-
Georgia DOT	State	-	-	-	5-7	-
Missouri DOT	Federal reimbursement bonds	2-10	-	-	554	-
Nebraska DOT	SIB – Local	2-7	-	-	-	-
New York State DOT	Federal – State	2-19	6-200	-	6-16	-
Northampton County, PA	Private – Local	-	-	-	-	33
Ohio DOT	GARVEE bonds	2-3	-	-	2-6	-
Oregon DOT	State	-	-	3	-	-
Osceola County, FL ²	Local	-	-	13	-	-
Pennsylvania DOT	State, Private – Federal	7-18	-	-	-	558
South Carolina DOT	Federal – State	3-5	-	-	3-13	-
RANGE	-	2-25	6-200	3-13	2-554	33-558

NOTE:

1. Indefinite Delivery/Indefinite Quantity
2. For the program, not individual projects.

6.1.1 Public Agency Characteristics

The size of the public agency and the way it is set up to do business will have a big impact on determining the optimal size of the bridge bundling program.

First and foremost, the agency's annual budget and existing funding sources should be considered. This will determine the amount of funding available to either pay directly for the bridge bundle or the need for a financing alternative. When choosing a financing alternative, the public agency should carefully consider whether it can afford the payments without jeopardizing

its credit rating or ability to continue operations and maintain other assets. Some agencies receive new funding specifically for a bridge bundling program.

Second, the staff resources available to deliver and manage the bridge bundle, as well as their expertise in doing so, should be considered. Although many agencies report efficiencies in administering bridge bundle projects, bridge bundles typically require fast agency response to maximize the efficiency of the contractor. Slow review times and answers to contractor questions can cost the contractor time and money—and lead to contract claims. If the agency's staff do not have the capability to respond quickly, they may want to consider outsourcing some program management, especially as bundles get larger. The agency needs to assess staff capabilities in determining the optimum bridge bundle size.

Another consideration in determining bundle size is the size and condition of the bridge inventory that the agency is responsible for maintaining. Bridge bundling coupled with financing is particularly useful if an agency has a large percentage of its bridge inventory in need of attention to lower the percentage of bridges in poor condition. Bundle sizes can be proportioned to meet a desired condition level within a certain time frame.

6.1.2 Industry Capacity

The capacity of industry in the area is an integral part of determining the correct size of the bridge bundle. This includes the ability of the local contractors to bid the work, the capacity of the fabricators to produce bridge elements, the capacity of consulting engineers to complete design, and the ability of third parties involved to keep up with the pace of the project. Bundles that are too large can decrease competition and lead to increased prices. Additionally, the capacity of review agencies to process large numbers of permits and the ability of utility companies to relocate utilities can be bottlenecks for a bridge bundle. If the agency is expecting rapid turnaround times and an increase in permit applications and utility relocations, a meeting with the relevant third parties prior to advertisement is an important consideration.

6.2 Timing Bridge Bundle Projects

Establishing the appropriate time frame can be one of the most critical elements of a bridge bundle project. Often, aggressive schedules are sought for bundles because agencies are bundling to address an urgent need. These aggressive schedules can be driven by the condition of the bridges, effects on the traveling public, or an elected official's initiative. While it is good to take advantage of the efficiencies of bridge bundling to speed up project delivery (see Appendix K for acceleration methods), overly aggressive schedules can unnecessarily drive up costs. Contractors do not have unlimited resources, and overtime pay should be considered when assessing project cost. Traffic management and the capacity/capability of materials suppliers to meet the projected schedule also need to be considered. If possible, choose reasonable time frames that will allow the expected types of contractors to complete the work without unnecessary accelerations.

In addition, the agency needs to acknowledge that while bridge bundling lends itself to faster delivery, third-party coordination and review can slow down a project. If the contractor is expected to coordinate with utilities, acquire ROW, apply for permits, or coordinate with railroads, appropriate time frames, similar to what is budgeted for other bridge projects, should be included in the contract schedule. A significant advantage of bridge bundling is that projects with issues that take longer to coordinate can be delayed while simpler projects are constructed

first. If this approach is taken when determining timing, it is important that the agency explicitly states the expectation that coordination for the more complex projects begin early.

Table 16. Bridge bundling contract durations (years).

AGENCY	D-B-B	IDIQ	CM/GC	D-B	P3
Delaware DOT	-	3, 5	-	-	-
Erie County, NY	2	-	-	-	-
Georgia DOT	-	-	-	3	-
Missouri DOT	3	-	-	5	-
Nebraska DOT	1-2	-	-	-	-
New York State DOT	1, 2	1, 2, 3	-	2	-
Northampton County, PA	-	-	-	-	12+10
Ohio DOT	-	-	-	3	-
Oregon DOT	-	-	7	-	-
Osceola County, FL ¹	-	-	7	-	-
Pennsylvania DOT	2	-	-	-	25
South Carolina DOT	-	-	-	varies	-
RANGE	1-3	1-5	7	2-5	10-25

NOTE:

1. For the program, not individual projects.

6.3 Identifying Bridge Selection / Screening Criteria

The bridge selection process for a bridge bundle is one of the most vital components to ensuring success and achieving agency goals. Time and effort spent up front to select the proper bridges for the contract will pay dividends in the end.

In general, it is best to bundle bridges in a manner that least complicates the contract. It is important to take advantage of measures to simplify the design and procurement process and

increase efficiency in design and construction. Following are several key considerations in this regard for an agency.



[Interview with Travis Konda, HNTB Corporation](#)

“...gain that efficiency by using the same components and basically putting together the same bridge, just multiple times.”

6.3.1 Geographic Location and Proximity

Choosing bridges within geographic proximity will help lower mobilization costs. Additionally, the contractor can phase construction to maximize labor force efficiency and limit impacts to traffic. In some cases, multiple locations may be able to be completed under a single detour or may be phased together to take advantage of lane closures.

Geographic proximity also has advantages from an agency’s perspective. Depending on how the public agency is structured, it is advantageous to have the reviews performed by the same staff. This is especially applicable in larger State agencies that are decentralized by districts. Often, each district is unique and has different preferences. This can complicate the design and review process, leading to delays and additional costs.

6.3.2 Road Type, Geometry, Traffic, and Work Zone Control

Bridges on local rural roads with less traffic may be easier to bundle because they usually do not require significant traffic analysis and coordination. If possible, these should be constructed in a single phase under a detour (i.e., full closure) to simplify the design and to provide the contractor unobstructed use of the work site. If a detour is permitted, the length of the closure should be limited by the bid documents. Overlapping detours should be avoided.

Bridges on roadways that require little or no alignment changes are preferred for bridge bundling contracts. Limiting alignment corrections will limit the length of roadway that needs to be reconstructed. It will also likely have fewer impacts on utilities, ROW, and environmental resources.¹⁰

Bundling bridges on high-volume roads, such as interstates, can also be done successfully if the work types are similar and it is possible to take advantage of maintenance of traffic phasing.

6.3.3 Bridge Size

Bridge rehabilitations or replacements that are ideal for bundling are typically smaller, single-span structures. The most commonly used criteria for size are bridges between 20 and 100 feet long, with some bridges as long as 150 feet. It is also ideal to have repeatable details among bundled bridges, for example, bridges with no skew and similar span and rise are ideal candidates for bundling. Nearby culverts (note: a culvert greater than 20 feet long is considered a bridge-length culvert) requiring work can be considered for inclusion in the bridge bundle

¹⁰ Bonini, M. Pennsylvania Public-Private Transportation Partnerships (P3). FHWA Bridge Bundling Workshop. Enola, PA, July 19, 2016.

contract as well. Projects involving only bundled culverts have also been successful. Longer-span bridges can typically be included in preventive maintenance or preservation bundling contracts.

6.3.4 Similar Bridge or Work Types

In addition to being bundled by size, bridges may also be bundled by work type. By grouping like types of work, economies of scale and repeatable details are realized, resulting in lower fabrication and construction costs. Following are some examples of bridge bundles by work type that have been used successfully:

- Bridge replacements with similar spans and superstructure construction details.
- Culvert replacements.
- Bridge deck replacements/rehabilitation.
- Bridge painting.
- Bridge preservation/preventive maintenance (e.g., concrete patching, joint replacement, deck sealing).
- Low-water crossings (bridges that only accommodate low flow; under high-flow conditions, water runs over the roadway precluding vehicular traffic).

When bundling bridges, it may be better to extend the span of slightly shorter bridges in order to match the size of other bridges in the bundle. Increased cost from a longer span can be recovered through efficiencies gained by not having to develop a site-specific design and through increased production in construction.

6.3.5 Environmental Permitting

Locations expected to have complex permitting needs with widely variable approval times should be avoided (see Chapter 8 for additional discussion).

6.3.6 Hydrology and Hydraulics

When design services are being requested, it is preferable to complete the hydrology and hydraulics designs prior to bundling bridge projects and include the relevant information in the bid package. If the structure openings are properly sized prior to letting the contract, it simplifies the design and construction of the bridges (see Chapter 8 for additional discussion). The designer must ensure these efforts comply with local and, where applicable, FHWA floodplain and hydrology and hydraulics design standards and report requirements (including scour evaluations).

6.3.7 Geotechnical Conditions

When design services are requested, it is important to provide adequate geotechnical information in the contract to eliminate uncertainties. To the extent possible, subsurface explorations should be provided in the contract (see Chapter 8 for additional discussion).

6.3.8 Utilities and Other Third Parties

Bridges with limited or no utility involvement should be chosen for bridge bundles to assist in streamlining the delivery and construction process (see Chapter 8 for additional discussion).

6.3.9 Right-of-Way

It is preferable that bridges included in a bundle have no new ROW needs; however, simple ROW takes can be accommodated (see Chapter 8 for additional discussion).

6.3.10 Railroads

Unless all railroad coordination is completed prior to letting of the bridge bundle, including bridges with railroad involvement in a bundled project should be carefully considered or avoided (see Chapter 8 for additional discussion).

Table 17. Summary of bridge selection screening considerations and best practices.

CRITERIA	DISCUSSION
Geographic Location and Proximity	Bridges in same geographic area and proximity can reduce mobilization costs and inspection costs.
Road Type, Geometry, Traffic, and Work Zone Control	Similar road types and similar traffic volumes can result in construction efficiencies through similar work zone control setup.
Bridge Size	Bundling bridges of similar size results in fewer complications.
Similar Bridge Types	Bundling similar bridge types results in fewer complications and less need for different designs and construction means and methods.
Similar Work Types	Bundle by similar work types: <ul style="list-style-type: none">• Preservation activities• Rehabilitation activities• Replacements
Environmental Permitting	Location-specific studies may be necessary but may allow for a streamlined process if bundled.

CRITERIA	DISCUSSION
Hydrology and Hydraulics	Advance analysis results in better contracts and less risk to contractor, resulting in lower cost.
Geotechnical Conditions	More advance work and more data reduce contractor risk, resulting in lower cost.
Utilities/Third Parties	Minimizing bundling bridges with utilities (or securing utility agreements in advance) will reduce construction risks.
Right-of-Way	Often a key consideration. Locations where the work can be completed within the existing ROW will reduce risks.
Railroads	Risk typically remains with the agency. If risk is transferred by contract, it may result in additional cost or time delays.

6.4 Summary

Agencies can identify candidate bridges for bundling by employing selection criteria that meet specific project or program goals while considering an agency's risk analysis. These criteria include industry capacity, project timeframe, environmental permitting, utilities and ROW, bridge size, and geographic location and proximity. Tools described in this chapter to assist in identifying candidates for bundling include a bridge selection matrix, ranges of contract sizes and contract durations, and a table of potential screening criteria.

Chapter 7. Project Delivery and Procurement Method Selection



Objective:

- To identify the most appropriate project delivery and procurement method

Tools:

- Comparison tables of project delivery & procurement methods
- Project Delivery Selection Tool

Outcome:

- Selected project delivery & procurement method

7.1 Project Delivery Methods

While the traditional D-B-B project delivery method remains prevalent among DOTs and LPAs, many agencies have been selectively adopting alternative project delivery (APD) methods, also commonly referred to as alternative contracting methods (ACMs). ACMs increase collaboration among the agency, designer, and constructor (NCHRP 787, 2016b).

Figure 15 represents the basic organizational relationships in D-B-B, Indefinite Delivery/Indefinite Quantity (IDIQ), CM/GC, D-B, and P3s (DBFOM). Table 18, at the end of this chapter, summarizes the typical project goals, project characteristics, and procurement methods for each delivery method for bridge bundled projects.

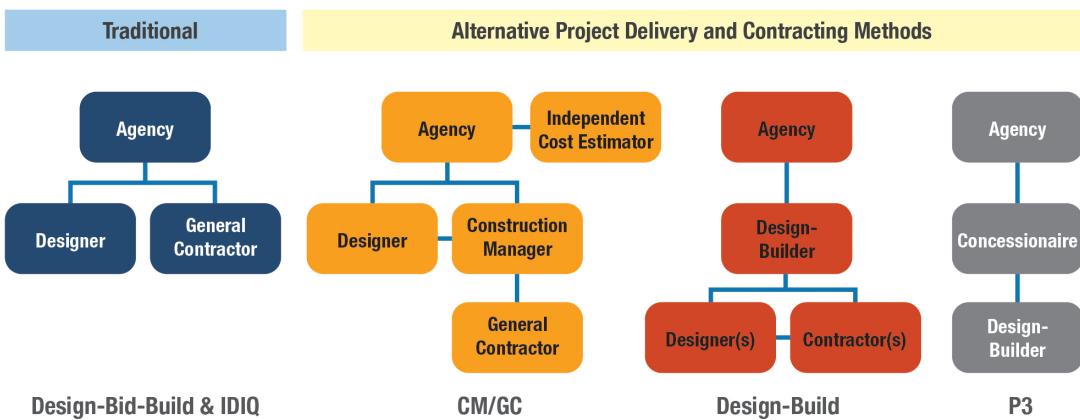


Figure 15. Project delivery methods and organizational relationships.

Source: FHWA

For bridge bundling contracts, agencies have typically used either D-B-B or D-B delivery methods. If desired, the D-B ACM can be combined with additional responsibilities, such as finance, operate, and maintain for a specified time period. Additionally, IDIQ project delivery has been used effectively for years for bundling bridge preservation and preventive maintenance projects. Under the IDIQ method, contractors bid on unit work items with the location to be determined under future work orders. An estimate of the total work over the life of the contract is provided in each contract.

Another ACM that is proving useful for agencies in delivering bridge bundle projects is CM/GC. This ACM is gaining approval from owners, and the benefits are documented in an FHWA TechBrief, “Alternative Contracting Method Performance in U.S. Highway Construction” (FHWA-HRT-17-100), which shows CM/GC is outperforming both D-B-B and D-B in cost and schedule savings (see Figure 16). CM/GC is not only a good tool for bridge replacement bundles, but can be very effective for bundling bridge rehabilitation projects, where the complete scope of the work is often undefined.



[Interview with Ed Minchin, University of Florida](#)

“...in those States that don't have the legislation to be able to do alternative contract methods, you could still do bridge bundling because it works well with design-bid-build also.”



Appendix L-2 is a Transportation Research Board 2018 Annual Meeting presentation on research data regarding the performance of D-B-B, CM/GC, and D-B.

Average Duration under Various Contract Methods for Projects between \$10 Million and \$50 Million

Contract Method	Mean Cost \$	Mean Project Duration (Days)	Mean Agency Design Duration (Days)	Mean Construction Duration (Days) ¹
D-B-B (n=34)	\$21,188,585	2,130	1,139	818
CM/GC (n=10)	\$23,912,981	662	281	349
D-B/BV (n=10)	\$18,604,503	1,420	638	639



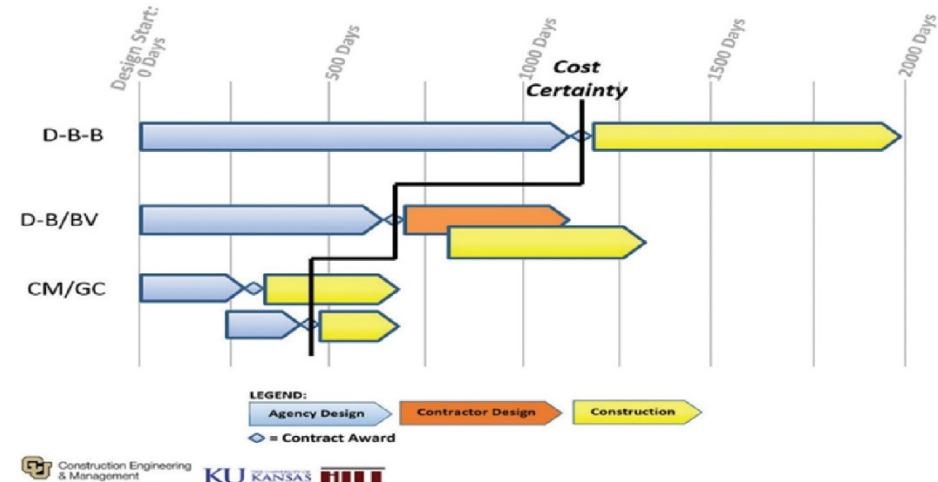
The CM/GC contracting method increases the speed of project delivery over other methods such as D-B-B and design-build/best value (D-B/BV). This graph compares the durations of projects with similar initial costs (as shown in the column for mean cost) and does not indicate the final price of the projects. The subscripts for each contract method indicate the number of projects used to gather the data.

1. Construction duration for design-bid/best-value projects includes design-builder design and construction (D-B contract duration).

Figure 16. Average contract durations.

Source: FHWA TechBrief HRT-17-100

Timing of Award under Various Contract Methods for Projects between \$10 Million and \$50 Million



ACMs like design-build/best value (D-B/BV) and CM/GC enable transportation planners to determine the cost certainty faster than the traditional D-B-B method. Cost certainty is the point at which the contractor provides a firm price for the project to the agency. For CM/GC, cost certainty is known after the cost for the last construction package has been agreed on. The figure shows two packages for illustrative purposes.

Note: IDIQ timing is similar to D-B-B; and, P3 is similar to D-B

Figure 17. Timing of award for ACMs.

Source: FHWA TechBrief HRT-17-100

7.2 Risk-Based Project Delivery Method Selection

The different project delivery methods at their basic level are nothing more than different ways to allocate risk among the different parties. Conducting a risk assessment (see Chapter 5) is critical to determining the most appropriate project delivery method. Figure 18 is a graphical representation of how risks are allocated between the agency and contractor for each delivery method.

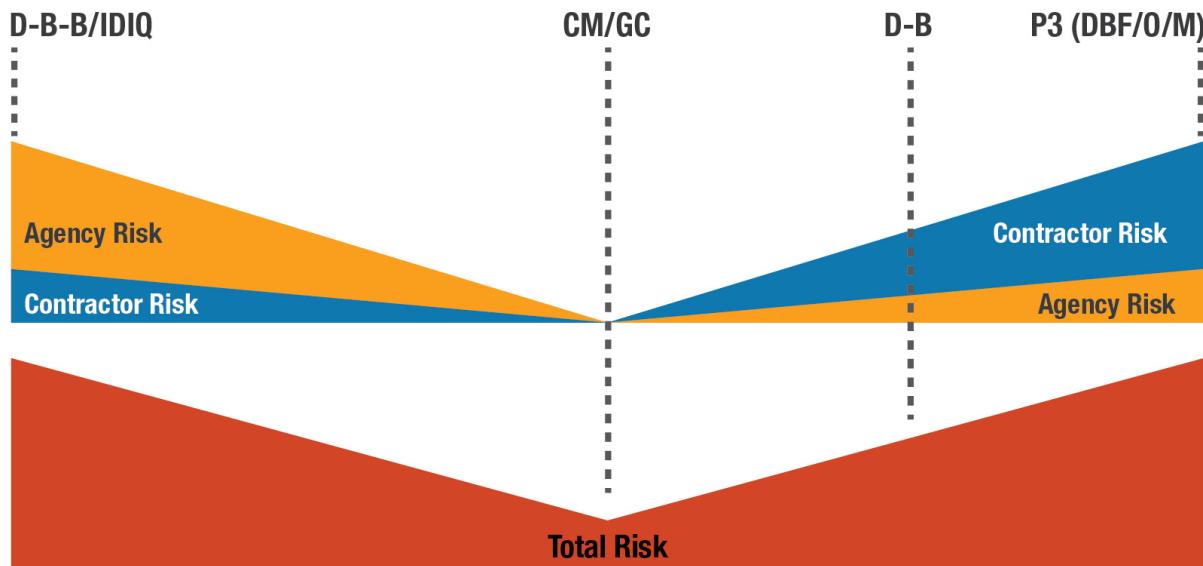


Figure 18. Risk allocation by project delivery method.

Source: FHWA

Several tools are available to assist an agency in selecting a delivery method. The FHWA and Colorado DOT's Next-Generation Transportation Construction Management Pooled Fund Study sponsored the University of Colorado in developing the Project Delivery Selection Matrix (PDSM). The PDSM provides a formal risk-based approach for selecting project delivery methods for highway projects. The process uses a series of evaluation worksheets and forms to guide agency staff and project team members through a project delivery selection workshop. The result is a brief Project Delivery Selection Report that matches the unique goals and characteristics of each individual project (FHWA, 2017c).

The primary objectives of the PDSM are as follows:

- Present a structured approach to assist agencies in making project delivery decisions.
- Assist agencies in determining if there is a dominant or optimal choice of a delivery method.
- Provide documentation of the selection decision.

The primary evaluation factors include:

- Schedule.
- Complexity and innovation.
- Level of design.
- Cost.
- Experience/availability of agency staff.
- Level of oversight and control.
- Competition and contractor experience.



The University of Colorado's website provides a downloadable version of the [Project Delivery Selection Matrix](#).

OTHER
RESOURCES

A description of various contracting methods and how they may be used in conjunction with bridge bundling follows.

7.3 Design-Bid-Build

7.3.1 D-B-B Definition

D-B-B is a project delivery contracting method whereby the contracting agency either performs the design work in-house or procures an engineering design firm to prepare the design, drawings, and specifications under a design services contract, and then separately contracts for at-risk construction by engaging a contractor through competitive bidding. Under this arrangement, the contracting agency warrants to the contractor that the design, drawings, and specifications are complete and free from error (contracting agency takes the risk) (FHWA, 2006). This method has historically been used by most public agencies to deliver projects. It is typically paired with a low-bid procurement to ensure transparency and a fair process for awarding public construction projects.

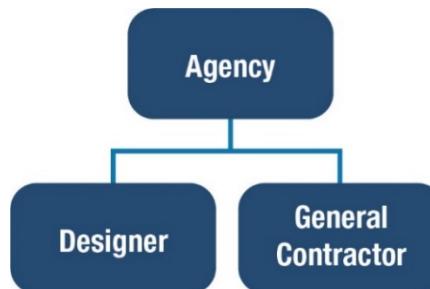


Figure 19. D-B-B organizational relationships.

Source: FHWA

7.3.2 Agency Responsibility

In a D-B-B project delivery method, the agency is responsible for delivering a PS&E package that is complete and free from error. This means that all components of the design are the responsibility of the agency. In addition to the PS&E package, other responsibilities of the agency may include the following, depending on the scope of work:

- Acquiring ROW.
- Locating utilities accurately and performing any necessary utility coordination.
- Completing hydrology, hydraulics, and scour analyses and acquiring flood permits.
- Providing accurate and complete information from a subsurface investigation.
- Coordinating with railroads.
- Acquiring all environmental permits.
- Following the NEPA process.

In general, the agency assumes the risk when using the D-B-B delivery. The agency bears the responsibility for any increased cost or delays due to errors or omissions in the bid documents.

7.3.3 Contractor Responsibility

In the D-B-B project delivery method, the construction contract requires the contractor to bear the responsibility for meeting the requirements of the bid documents within its bid price. This includes ensuring that construction methods and materials and the final product are in accordance with plans and specifications. It also includes meeting the schedule as required in the contract documents.

7.3.4 Quality Assurance

Design quality assurance (QA) and design quality control (QC) are solely the responsibility of the agency. Whether the project is designed by in-house staff or outsourced to a consultant, designs are typically managed and reviewed by in-house staff to ensure conformance with agency standards.

During construction, the contractor is responsible for meeting the requirements of the contract (QC). The agency provides construction inspection and acceptance to ensure that practices are in conformance with the plans and specifications.

7.3.5 Project Flexibility

A project delivered using D-B-B methods typically has little room for flexibility and innovation. The agency has developed a complete set of plans and specifications with the expectation that the project will be constructed in accordance with them. The contractor bids the project knowing that compliance with the requirements of the PS&E package is necessary.

Some agencies have methods incorporated into their D-B-B process that provide more flexibility to the contractor to propose changes to the contract. This can be done through the acceptance of value engineering change proposals (VECPs) or ATCs.

VECPs are commonly used on D-B-B projects. A VECP is a post-award contract change submitted by the contractor under a VECP clause that improves the project's performance, value, or quality. It may also lower the cost and/or shorten the delivery time. Cost savings associated with VECPs are typically split between the agency and the contractor.

Although ATCs are not commonly used with the D-B-B project delivery method, some States, including Missouri, have incorporated them into the contracting process. An ATC can be defined as a suggested change submitted by a proposing team (or contractor) to the public agency's supplied design, project scope, or construction criteria. In order to be considered, the ATC should provide a solution that is equal to or better than the requirements in the PS&E package or request for proposal (RFP) (Unkefer, 2014).

In order for ATCs to be used with a D-B-B delivery method, the advertisement process should include time to allow contractors' ideas to be evaluated and, if accepted, developed into the final design. The responsibility for developing the ATC final design can be with the agency or contractor. Once completed, the final design is then bid by the contractor that submitted it.

Since ATCs are completed before bid, the agency receives all of the cost savings associated with the ATC. The contractor gains a bidding advantage over competitors by bidding its own innovation. Although ATCs encourage innovation, the evaluation and incorporation of ATCs into the final design can be a lengthy process that inhibits the speedy delivery many agencies seek from a bridge bundling project. The use of ATCs on federally funded D-B-B projects requires approval under the [FHWA Special Experimental Project No. 14](#) program.

Other techniques can be applied to D-B-B projects to reduce time, such as cost + time bidding (also known as A+B bidding) and use of incentive/disincentive contract clauses.

7.3.6 D-B-B Advantages

- Agencies and contractors are familiar with the process.
- Agency maintains maximum control by specifying the final product exactly.
- All issues are worked out before advertisement.
- It is permitted by the laws of every State.
- It typically results in the fastest construction schedule, and therefore the least disruption to the public, if designed properly and if the agency meets its obligations with respect to NEPA, ROW, utilities, and permits.

7.3.7 D-B-B Disadvantages

- Agency assumes all risk for the PS&E package.
- It is not always the fastest project delivery due to separation between design and construction.
- It may not provide the best value to the agency for all project circumstances or types.
- The inherent division between design and construction may result in antagonistic relationships between project parties (NCHRP 787, 2016b).

- It does not encourage innovation and creativity by the contractor.
- It does not include contractor input into the design.

7.3.8 D-B-B Project Best Options

Over the decades, D-B-B has provided taxpayers with a large portfolio of functional, safe, and efficient transportation facilities at the lowest price that responsible, competitive bidders can offer. D-B-B as a project delivery method has been used by agencies for all types of projects. It is a particularly good fit where there is a clear solution for the proposed project and where there is little room for innovation.

In addition to non-complex bridge replacement bundles, D-B-B has been used effectively to bundle maintenance activities and preventive maintenance activities such as deck sealing and bridge painting. It is also a good method of delivery for projects with significant third-party involvement (i.e., ROW acquisition, utility coordination, railroad involvement, and permitting).

Using the D-B-B method to bundle bridges takes advantage of many of the efficiencies that can be gained by bridge bundling. Additional efficiencies can be achieved by packaging similar bridges together so that one design can be used for multiple bridges. This will save in both the cost of design and construction.

7.3.9 D-B-B Bridge Bundle Project Examples



PennDOT Pilot Projects for Local Bridges: This program targeted locally owned bridges. The goal was to bundle similar (or same, if possible) bridge designs for multiple locations within a given district. This allowed one design to be used for multiple locations with only minor alterations.

Using one design for all of the bridges on the contract led to additional savings gained by the following:

- Consolidating the PE phase from many bridges into one.
- Determining the final structure type quickly.
- Reducing the complexity of the PS&E package.
- Grouping environmental and utility field meetings.

Documented savings in design (25 to 50 percent) and construction (5 to 15 percent) allowed for the normal LPA contribution of 5 percent to be waived for bridges in the program.¹¹ The procurement method used for these projects was low bid.

¹¹ Bruner, J. Local Bridge Bundling. FHWA Bridge Bundling Workshop. Enola, PA, July 19, 2016.



MoDOT Safe & Sound Bridge Improvement Program: A D-B-B approach was used for 248 of the 802 bridges replaced or rehabilitated in the Missouri Safe & Sound Program. MoDOT grouped bridges of similar type, size, or location and let them in batches to accelerate the construction program. The first 100 were considered “quick start” bridges and had minimal ROW involvement. These projects included new superstructures or decking only. The remaining 148 included both rehabilitations and replacements (Missouri DOT, 2013). The designs were straightforward with no complications. Efficiencies were gained through grouping similar projects in close proximity into one contract. The procurement method used for these projects was low bid.

7.4 Indefinite Delivery/Indefinite Quantity

7.4.1 Definition

IDIQ is a form of project delivery whereby the contracting agency prepares a contract that provides for an indefinite quantity of supplies or services during a period of time. These contracts are also often referred to as “on call” or “open end” contracts. Under this arrangement, the contracting agency provides a description and an estimate of the project items and services that will be required. When used for bridge bundling, this method has historically been used for bridge maintenance work. It is typically paired with a low-bid procurement of the estimated item quantities. IDIQs are also known as job ordering contracting, emergency standby contracts, and term agreements.

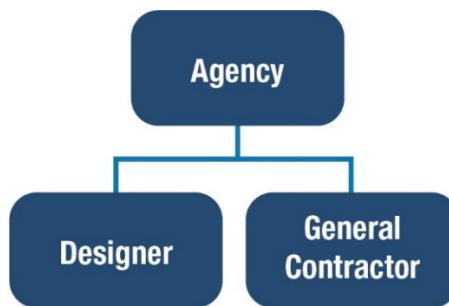


Figure 20. IDIQ organizational relationships.

Source: FHWA

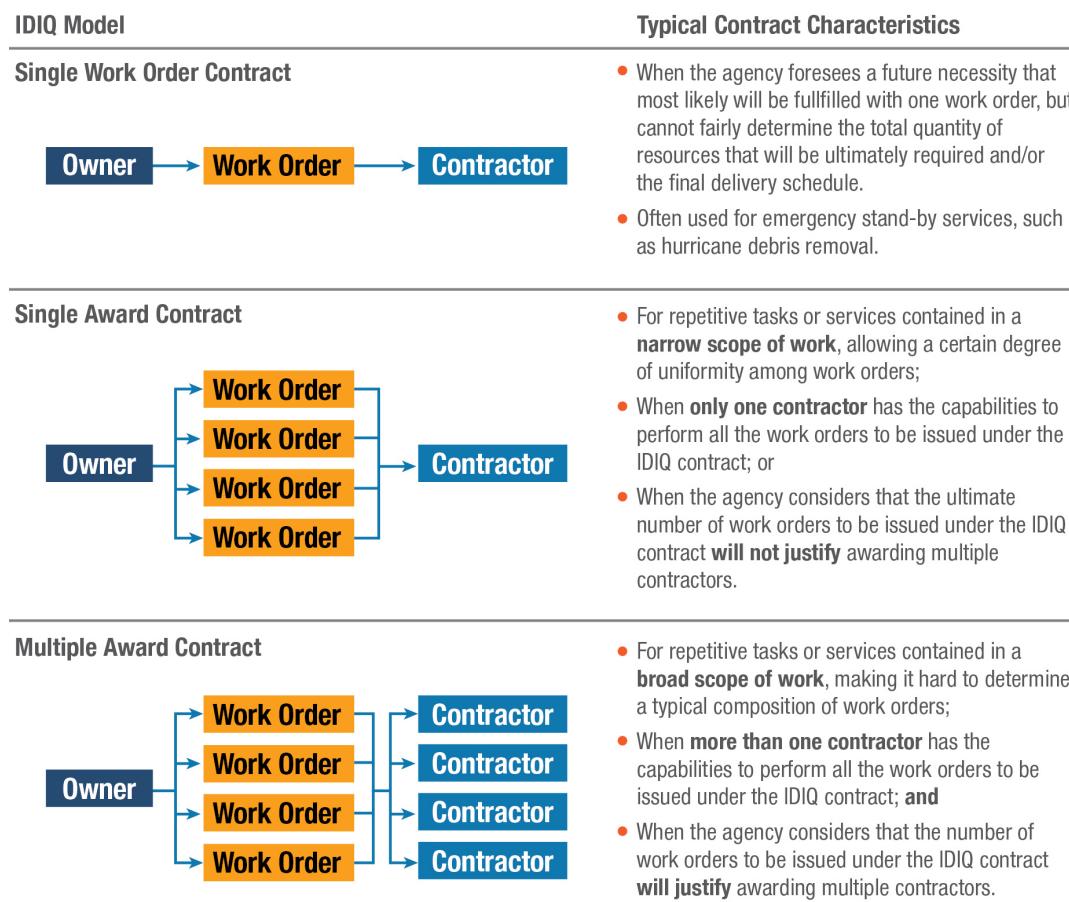
7.4.2 Agency Responsibility

In an IDIQ project delivery, the agency is responsible for preparing a PS&E package that describes the anticipated work and estimates quantities based on historical data. Although some locations and work may be predetermined, most of the locations and work are determined after award on an as-needed basis. The agency may involve the contractor in the development of design details. The agency is typically responsible for the same items as in a D-B-B project delivery.

In general, the contractor rates are agreed upon at award, the task orders are bid for time, tasks are typically competed between two or more IDIQ contractors, a maximum dollar cap is established up front, and subcontractors are pre-approved (as shown in Figure 21).

7.4.3 Contractor Responsibility

In IDIQ project delivery, the contractor bears the responsibility for meeting the requirements of the bid documents. This includes ensuring construction methods and materials and the final product are in accordance with plans and specifications. The contractor bears more risk in IDIQ contracts than with traditional D-B-B contracts because the bid is based on estimated quantities and unknown locations. The contractor may be given the opportunity to have input into the design details and work schedule. For items not included in the contract, the contractor negotiates the price for these additional items.



Adapted from *Fundamentals of Indefinite Delivery/Indefinite Quantity Contracting: A Primer for Public Transportation Agencies* by Jorge A. Rueda-Benavides and Douglas D. Gransberg. (Transportation Research Board 93rd Annual Meeting Compendium of Papers)

Original image: ©2015 National Academy of Sciences

Figure 21. IDIQ contracting models structure.
(NCHRP 473, 2015)

7.4.4 Quality Assurance

During design, the QA is solely the responsibility of the agency. Whether developed with in-house staff or outsourced to a consultant, designs are typically managed and reviewed by in-house staff to ensure conformance with agency standards. The agency may opt to include the contractor in the review of design details if they differ from those included in the original contract documents.

During construction, the contractor is responsible for meeting the requirements of the contract (QC). The agency provides construction inspection and acceptance to ensure that practices are in conformance with the plans and specifications.

7.4.5 Project Flexibility

Given that the exact locations and work are not entirely known for IDIQ contracts, this project delivery method should have quite a bit of flexibility. Allowing the contractor to have input into the approach to each location before work starts is beneficial for both parties.

7.4.6 IDIQ Advantages

- Quick contract delivery, as there are not a lot of details to be developed.
- Quick response to urgent issues as agency has an on-call contractor already under contract.
- Good tool for maintenance, as not a lot of details are needed and many bridges can be addressed.
- Valuable contractor input for agency on proper repair method, materials, and schedule.

7.4.7 IDIQ Disadvantages

- Usually higher cost, as the risk for the contractor in bidding unknown locations and work is higher.
- Accurately predicting the work that will be needed can be difficult for an agency.
- Typically, work that involves coordination with third parties can delay response times.
- Not considered a good mechanism for most bridge replacement or major rehabilitation projects, as it typically comes at a premium cost.

7.4.8 IDIQ Project Best Options

IDIQ is a good project delivery method for simple work that does not involve third parties. It is particularly useful for preventive maintenance items, such as concrete patching and joint replacement. A good mechanism for an IDIQ contract is to include some known locations and repair details in the contract with additional items and quantities for additional work and locations to be determined later. Another viable option is to combine IDIQs with the CM/GC delivery method. This is advantageous for emergency and bridge rehabilitation and repair bundles.

7.4.9 IDIQ Bridge Bundling Project Examples



DelDOT Culvert Replacement Open-End Contract (2015–2017): This project was for the replacement of large, corrugated metal pipe culverts. DelDOT has hundreds in poor condition that are targeted for replacement. In this IDIQ contract, five known locations were included in the package with complete designs that were shovel ready. Additional quantities were included for locations to be determined in the future. In all, 15 additional locations were added successfully. The contractor that won the bid was involved in the design of the additional locations, helping to determine utility relocations, stream diversion plans, and schedule. The IDIQ methodology helped speed delivery with this bridge bundle, as DelDOT did not need to go through the procurement process for each additional location.¹² The procurement method used for this project was low bid.

7.5 Construction Manager/General Contractor

7.5.1 Definition

The CM/GC project delivery method is an integrated team approach to the planning, design, and construction of the project. The successful offeror providing CM/GC delivery applies its professional construction management capabilities during the planning and design of a project (i.e., preconstruction phase). In addition to aiding in the preconstruction process, the selected construction manager (CM) typically prepares and submits a guaranteed maximum price (GMP) for a work package or the whole project, depending on the project format and agency needs.

During the construction phase, the CM provides traditional construction services, functioning as the prime contractor responsible for completing the work on schedule within the GMP. The CM/GC is directly supported throughout both phases, i.e., the preconstruction and construction phase, by its pre-selected subcontractors. These subcontractors are best identified, by company name and specialty, within the CM's original proposal to the agency.

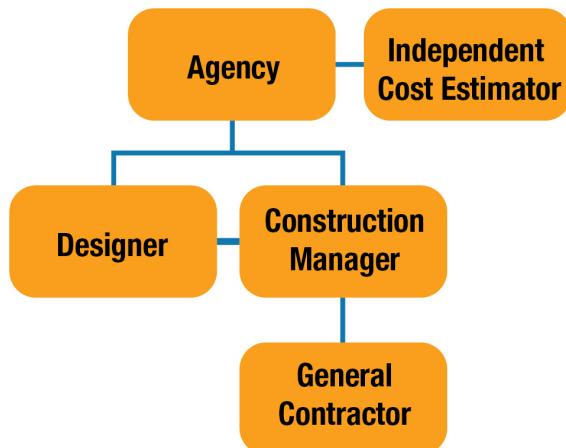


Figure 22. CM/GC organizational relationships.

Source: FHWA

¹² Hastings, J. Delaware Bridge Bundling. FHWA Bridge Bundling Workshop. Enola, PA, July 19, 2016.

Initially, the CM begins the project by providing assistance during the preconstruction phases concerning constructability, pricing, scheduling, staging and phasing, means and methods, efficiencies, material procurement, risk identification/mitigation, early work packages, stakeholder issues and concerns, etc. Under separate contracts, the owner selects a designer to prepare the designs and may retain an independent cost estimator (ICE) to prepare an independent cost estimate to provide checks and balances for the CM-provided construction costs, production rates, material supplier/subcontractor costs, and phasing/schedule.

The ICE is typically hired by the agency to ensure the price negotiation process is fair and reasonable. Since the CM is not selected based on lowest price, the ICE provides the agency with assurance that it received the best overall project value.

The CM is not authorized to proceed into construction unless the agency agrees that the price and schedule provided, as part of a guarantee to complete the project or a portion of the project, (and independently evaluated by the ICE and team) are fair, reasonable, and defensible. If early work packages with mini-GMPs for a portion of the work are used, CM/GC has the power to ensure that construction is underway early in the process, in some cases as early as 2 weeks after a notice to proceed. Early work packages may be broken into such items as construction of retention ponds, partial clearing and grubbing, and ordering of long lead items (such as structural steel and drainage structures). In effect, these early work packages become a valuable tool for constructing shovel-ready portions of a project. Early work packages also hand the team an initial short-term win, which creates momentum.

With CM/GC, an agency custom-builds its entire team, including its subcontractors, to properly fit the specific needs and objectives of each project. A unique partnership is formed with the agency, CM, subcontractors, ICE, and the design and inspection professionals (project team). This CM/GC partnership focuses on innovating, cost savings, meeting the project and stakeholder objectives of shortening project duration, providing significant risk identification and mitigation, increasing use of innovative design and construction techniques, finding and resolving constructability issues in advance of construction, and identifying and addressing stakeholder needs and concerns

7.5.2 Agency Responsibility

In the CM/GC project delivery method, the agency is responsible for selecting the designer (if not in-house), the CM, and the ICE. The team is still responsible for the normal activities associated with completing a PS&E package, such as the following:

- ROW plans, negotiations, and acquisitions.
- Accurate location of utilities and any necessary utility coordination.
- Hydrology, hydraulics, and scour analyses and reports and flood permit acquisition.
- Subsurface investigation and geotechnical design.
- Railroad coordination.
- Environmental permit acquisition.
- NEPA process.

The difference with CM/GC, however, is that both the agency, designer, and the CM share the risks for the success of the design and construction. Risks are allocated to the party that can best respond to that risk. Since the CM is part of the design process, the design can be tailored to the CM's preferred means and methods for construction.

7.5.3 CM Responsibility

In addition to constructing the project, the CM is responsible for participating in the design process, called the preconstruction phase, and shares the risk in the completeness and constructability of the design plans.

The CM responsibilities during the design process include providing input on the following:

- Selection of structure type and materials.
- Methods of construction.
- Schedule.
- Impacts to utilities and railroads.
- Potential environmental mitigation.
- ROW required to construct the project.
- Maintenance of traffic.

Typical CM/GC contractual requirements include:

- Construction limits and environmental impact determinations.
- Design meeting assistance.
- Independent cost estimate comparison meetings.
- Constructability reviews.
- Design reviews.
- Market surveys for design decisions.
- Project quantity estimates.
- Design option pricing.
- Project risks identification and risk response strategies.
- Staging needs.
- Cost model.
- Overall project schedule from design through construction.
- Material cost forecasting.
- Value analysis during design.
- Contracting and construction responsibility.

- Innovation development, schedule acceleration, and cost savings.
- Public information assistance.

7.5.4 Quality Assurance

During design, QA is a joint responsibility of the agency, designer, and CM. The design is reviewed to ensure conformance with agency standards. The agency will include the CM in review of design details as they relate to the CM's design input and construction means and methods.

During construction, the contractor is responsible for meeting the requirements of the contract (QC). The agency provides construction inspection and acceptance to ensure that practices are in conformance with the plans and specifications.

7.5.5 Project Flexibility

The CM/GC project delivery method typically provides for a very high degree of flexibility and innovation within the team, while the agency maintains control over the final product. By bringing the CM in during design, the agency provides the opportunity to have input into the project that utilizes the CM's skills and equipment best. The CM is selected based on responses to an RFP in which the goals of the project are described, but the details have not yet been completed (e.g., qualification based criteria, understanding of CM/GC, past history, experience, possible innovations). Since the agency, the CM, and the designer develop the design as a team, they can advance a project that is best for all parties. They all discuss the risk, and all parties have a stake in ensuring the design and construction are successful. Research shows that the earlier a CM is brought into the design, the greater the innovations realized by the project.

7.5.6 CM/GC Advantages

- The CM can offer new innovations, best practices, reduced costs, and an accelerated schedule during the design phase (FHWA, 2017d).
- The agency can employ new innovations, assist in the design process, and make informed decisions regarding cost and schedule (FHWA, 2017d).
- The CM, agency, and designer team are encouraged to look at all options, including using innovative techniques or approaches that reduce time and cost (FHWA, 2017d).
- CM/GC provides flexibility to allocate and reallocate risks throughout the project duration.
- The designer, typically as part of contractual requirements, is required to meet regularly with the CM to develop solutions.
- The agency can understand and reduce risk by exploring mitigation options with feedback provided by the CM (FHWA, 2017d).
- The CM reviews designs and provides feedback, improving design quality and eliminating errors and omissions related change orders and overruns (FHWA, 2017d).

- The CM and the ICE provide cost estimates for all designs and alternatives within the design phase, improving cost control and allowing the agency to make informed decisions around project costs (FHWA, 2017d).
- The CM can begin planning the overall project schedule during the design phase, optimizing construction schedules and minimizing traffic impacts (FHWA, 2017d).
- CM/GC allows speed, brevity, and control.
- It incentivizes innovation to a greater extent than any other delivery system.
- The intensity of the design effort is in the planning—not plans production.
- CM/GC offers the greatest ability to fast-track early components of construction.
- It offers the fastest way for a construction project to progress from conception to completion.
- It facilitates identification of and responses to risks.
- It enables aggressive delivery.
- It allows early and accurate cost certainty.
- CM/GC provides the ability to handpick an “A” team.
- It improves constructability.
- CM/GC facilitates streamlined plans.
- It can improve quality.
- It offers early work packages.
- CM/GC allows for flexibility in changing project scope.
- It provides cost control.
- The value engineering process is built-in, continuous.

7.5.7 CM/GC Disadvantages

- There is a false perception that CM/GC is more expensive than D-B-B and D-B (requires clear contract language for designer and CM on schedule).
- Some public agencies and CMs are not familiar with the process.
- Some CMs are used to getting work through low bid, so there may be pushback from the contracting community.
- A change in State legislation may be required to allow public agencies to use CM/GC.
- There is a perception that since the contractor is not selected solely on price, selections may be biased.

7.5.8 CM/GC Project Best Options

CM/GC can be a useful tool for all types of bridge bundle projects. This ACM can be particularly useful when the owner needs contractor feedback during the design phase. This can include projects with complex components that require innovation or out-of-the-box thinking. Complex project issues can range from a highly technical project to a politically charged project. It can also include projects with significant public involvement or ROW or utility issues that affect the overall schedule as well as bridge maintenance and rehabilitation. These are the types of projects owners may typically avoid when doing bridge bundles, but by gaining contractor insight during design, the projects can be bundled efficiently while sharing risk between both parties.

7.5.9 CM/GC Bridge Bundling Examples



Osceola County, Florida: Osceola County issued six RFPs for a total of 11 major roadway projects, including 13 bundled bridges, which were in various stages of planning, permitting, and design. Using QBS, county staff chose six CMs. They then divided the 11 projects among them, ensuring the best fit based on the strengths of each. The six CMs were actively involved in the completion of all permits, designs, and construction for the 11 projects and 13 bridges, which were completed ahead of schedule and under budget. See the Osceola County case study in Appendix C for more information.



[Interview with Gregg Hostetler, Infrastructure Engineers, LLC](#)

“...bundled all the projects and put them out via CM/GC, which resulted in some pretty stellar results...”



I-5 Willamette River Bridge Project (Oregon): The use of CM/GC contracting resulted in the I-5 Willamette River Bridge project (two bridges) being opened for public use about 13 months earlier than would have been anticipated under the D-B-B contracting method. Input from the CM/GC and the local community, stakeholders, and public agencies helped Oregon DOT to control costs, schedule, and design; manage risks; and resolve and adjust outcomes as the project proceeded. The partnership and constant collaboration among the parties significantly contributed to the success of the project.

The final cost of the project was \$162,917,204. When compared to the estimated cost of \$194 million for delivery of the project using D-B-B, Oregon DOT realized an estimated cost savings of \$31,082,796, or about 16 percent. This does not take into account the cost efficiencies and savings resulting from construction acceleration using CM/GC compared to the traditional D-B-B delivery method. In addition, the project had significant achievements and successes in innovations and environmental stewardship, receiving 21 industry recognition awards.

The successes of the I-5 Willamette River Bridge project demonstrated that the CM/GC method, when compared to the traditional D-B-B method, could save Oregon DOT time and money for certain construction projects.

7.6 Design-Build

7.6.1 Definition

According to the Design-Build Institute of America (Design-Build Institute of America, 1994), the D-B form of project delivery is a system of contracting whereby one entity performs both engineering and construction under a single contract. Under this arrangement, the design-builder warrants to the contracting agency that it will produce design documents that are complete and free from error (design-builder takes the risk). Portions of the overall design or construction work can be performed by the design-builder or subcontracted to other companies that may or may not be part of the D-B team. For public agencies, D-B contracting selection is typically a competitive process based on some combination of price, duration, and proposer qualifications (FHWA, 2006). This process is often referred to as best value. Low-bid procurement has also been utilized.

Progressive design-build (PDB) is a variation of D-B that has been used recently in a few locations. PDB facilitates involvement of the D-B team during the earliest stages of the agency's project development, ensuring they are part of the project team developing design solutions (Design-Build Institute of America, 1994). PDB uses a qualifications-based or best-value selection, followed by a process whereby the agency then progresses toward a design and contract price with the team (thus the term "progressive").

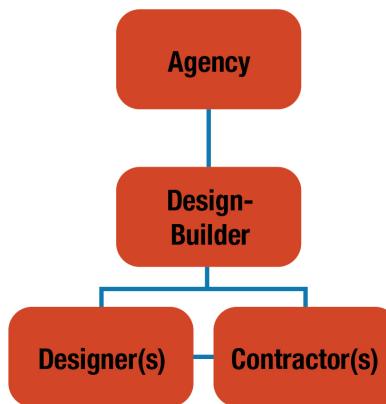


Figure 23. D-B organizational relationships.

Source: FHWA

7.6.2 Agency Responsibility

In D-B project delivery, the agency is responsible for delivering an RFP that clearly defines the expected deliverables. Individual agencies achieve this differently. For some, this involves preparing 30 percent plans with specifications (or sufficient design to get environmental determination and permits), and the D-B team simply finishes the design. For others, it may simply be a list of bridge locations with specified design requirements that each structure must meet. *The key to the success of a D-B project is a clearly written RFP—being prescriptive where necessary, flexible in other areas.* To successfully deliver a bundled D-B bridge project, the agency should dedicate the necessary resources in the RFP development process. The final

product will only be as good as the RFP. Other responsibilities are either performed by the agency or designated to the D-B team. They include the following:

- ROW plan development and negotiations. (In some cases, acquisitions could be by the design-builder.)
- Accurate location of utilities and any necessary utility coordination.
- Hydrology, hydraulics, and scour analyses and reports and acquisition of flood permits.
- Subsurface investigation and geotechnical design.
- Railroad coordination.
- Environmental permit acquisition.
- NEPA process, if applicable.

In general, the agency assumes less risk when using D-B delivery. However, the agency bears the responsibility for any increased cost due to deviations from the RFP or changed field conditions.

7.6.3 Contractor Responsibility

In the D-B project delivery contracting method, the contractor bears much more of the responsibility than with D-B-B. The contractor is responsible for providing designs and constructing projects that meet the requirements of the RFP. The contractor will likely also have responsibilities for third-party coordination, as listed previously under agency responsibility. In general, the contractor assumes more of the risk when using the D-B delivery—and prices the project accordingly.

7.6.4 Quality Assurance

The D-B team is primarily responsible for providing QA and QC of the design to ensure accuracy for construction. Errors in the plans that cause construction problems are the responsibility of the D-B team. The agency, or an agent of the agency, will review the plans to ensure conformance with the RFP.

During construction, the contractor is responsible for meeting the requirements of the contract. The D-B team often hires a third party to ensure that practices are in conformance with the plans and specifications. Regardless of whether the D-B team uses a third party or their own forces for QC, for Federal-aid projects the agency must perform independent verification of material quality (23 CFR part 637). The agency's independent verification may be performed directly by agency forces or by an independent consultant hired by the agency. The D-B team's QC results may be used as part of the agency's acceptance decision provided that the material quality has been validated by the agency's verification testing.

Since agencies may place additional responsibilities on the D-B team, such as to finance, operate, and maintain the projects for a specified period of time, this may help ensure the D-B team provides a durable and quality product over the specified time but does not come without additional costs. This is discussed further under Section 7.7.

7.6.5 Project Flexibility

A project delivered using D-B methods typically provides for the highest degree of flexibility and innovation on behalf of the contractor. By not completing the design, the agency gives the contractor the opportunity to maximize efficiency and design the project in a way that utilizes its skills and equipment best. The contractor bids the project knowing that it must comply with the requirements of the RFP, but typically has many options for how to complete it. The fewer requirements the agency provides in the RFP, the more flexibility the contractor will have in developing the plans. Of course, that also comes with less control over the product that the agency will receive. Each agency determines how prescriptive the RFP should be for its project.

The agency may opt for additional flexibility by including an ATC process in the procurement. ATCs are often considered for D-B projects. This method gives D-B teams an opportunity to propose alternatives to requirements in the RFP. If ATCs are included, the agency should allow time between advertisement and award to evaluate the ATCs and decide whether to accept them. ATCs can allow the agency to capitalize on contractor innovation by accepting them before receiving bids. See Appendix I for more information on the ATC process.

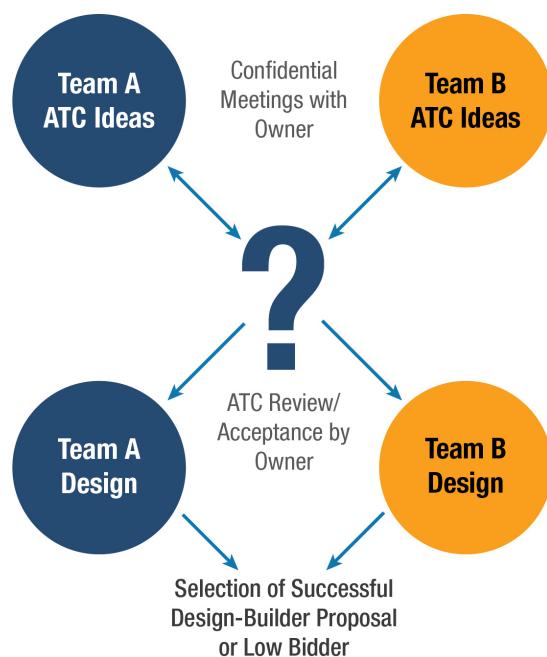


Figure 24. ATC review process.
Source: FHWA

7.6.6 D-B Advantages

- Encourages innovation.
- Maximizes contractor efficiencies.
- Speeds project delivery.
- May reduce agency risk.

7.6.7 D-B Disadvantages

- Agency has reduced control.
- Contractor assumes most of the risk, so the cost may be higher.
- Cost savings due to risk not actualized go back to the contractor versus the agency.
- Some public agencies and contractors are not familiar with the process.
- The perception that since the contractor is not selected solely on price, selections may be biased.
- Many design professionals do not like D-B because it makes them accountable to the contractor instead of the agency (NCHRP 787, 2016b).
- D-B is a more sophisticated approach to project delivery, therefore it requires more planning (NCHRP 787, 2016b).
- Pressure on designers *relating to price* is predominant in D-B lump sum contracts.
- State legislation may be required to allow agencies to use D-B.

7.6.8 D-B Project Best Options

The D-B project delivery method is appropriate for many projects. It is particularly useful when the agency is faced with choosing between multiple ways to design a project. D-B with best-value procurement allows the contractor with the best solution to be awarded the project.

For bridge bundles, D-B can also be very useful in completing simple, straightforward projects quickly. When desiring speed in delivery, some agencies opt to include only the simplest bridge repair or replacement projects in the D-B bridge bundle contract. Choosing this route gives the D-B bridge bundle project the best chance of success without encountering delays. It also allows the agency to produce and advertise the contract quickly by minimizing the amount of advanced coordination and planning that needs to be completed.

It is best to select projects that have limited third-party involvement (i.e., ROW acquisition, utility coordination, railroad involvement, and permitting). If there is significant coordination with a third party involved in the contract, there should be ample time to perform it.

Using the D-B method to bundle bridges takes advantage of all the efficiencies that can be gained by bridge bundling. The D-B team can decide which details will be the most cost efficient and easiest to construct. This will save in both the cost of design and construction.

7.6.9 D-B Bridge Bundling Examples



Georgia Bridge Bundles for Local Bridges: GDOT's Design-Build Bridge Bundle program is aimed at addressing replacement of local bridges in poor condition. The agency awarded 25 bridges in 5 bundles in 2016 and another 13 bridges in 2 bundles in 2017. The procurement method used was low bid.

GDOT is very prescriptive in its RFP by including 50-percent plans in the bid package. The contractor is responsible for completing the designs and constructing the bridges. In lieu of a 4-month ATC process, GDOT provides contractors a draft RFP for comment prior to

advertisement. Contractors then get a chance for questions and one-on-one meetings with GDOT. GDOT considers the program successful as it has sped up project delivery without increasing cost. Also, small bundles have kept the local contracting community engaged in the process.



NOTEWORTHY
PRACTICES

MoDOT Safe & Sound Program: A D-B approach was used to replace 554 bridges out of the 802 that were replaced or rehabilitated in 3.5 years in the Missouri Safe & Sound Program. The D-B bridges were distributed evenly across the State. The designs were straightforward with no complications. The RFP was very open and allowed maximum flexibility to the D-B team. The goal was to minimize public inconvenience and replace bridges fast. The procurement method used for this project was best value. MoDOT considers the project to be successful, but the D-B bridges cost more and were generally less durable designs than the D-B-B bridges as the RFP allowed for less than typical standards (Missouri DOT, 2013).

7.7 Public-Private Partnership

7.7.1 Definition

A public-private partnership (P3) is a contractual agreement between a public agency and a private entity that allows for greater private participation in the delivery of a transportation project. Typically, this participation involves the private sector taking on additional project risks, such as design, construction, finance, operation, and/or maintenance of a transportation asset for a defined period. States, and more recently local governments, have begun exploring P3s for their potential to expedite transportation improvements with limited transportation funding reserves. In fact, 35 of 50 States are using, or have authorized the use of, P3 for transportation projects to some extent.



Source: [Report on Highway Public-Private Partnership Concessions in the United States \(December 2016\)](#)

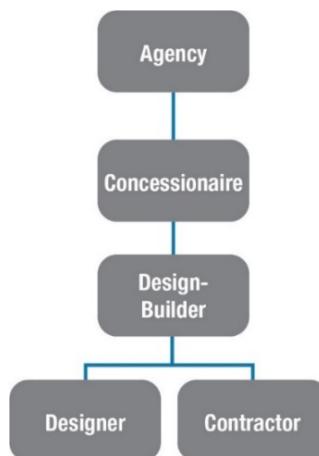


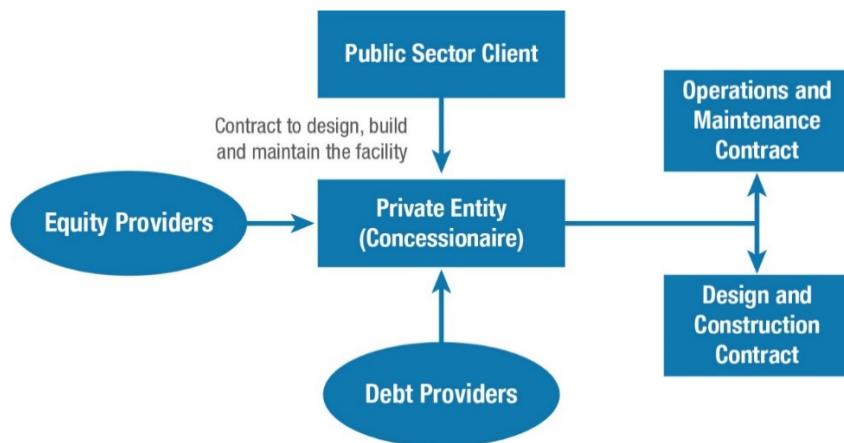
Figure 25. P3 organizational relationships.

Source: FHWA

It is important to note that P3s are not a revenue source. Although P3s may increase financing capacity and reduce costs, a source of revenue for the project must still be identified. P3s are also not truly a procurement method, though they may be confused as such due to their own unique procurement approaches. Procurement methods for P3s are often controlled by the laws that authorize the use of P3s. Although some States allow unsolicited P3 proposals, a competitive process is typically preferable. If proposals are solicited from multiple entities, selections can be based on:

- Lowest net present value availability payment.
- Best overall value.
- Lowest public subsidy through bond proceeds or budgetary authority.
- Largest upfront lease payment to project sponsor.

A qualifications component could also be added to the selection criteria, similar to best value.



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Figure 26. P3 contractual relationships.

7.7.2 Agency Responsibility

The agency has the same responsibilities as with a D-B project. Additionally, the agency's legal counsel should ensure that all necessary State legislation is in place to allow the P3. Also, the agency should be diligent in preparing and reviewing the contractual language and terms of the agreement.

7.7.3 Contractor Responsibility

The P3 team will have the same responsibilities as outlined for a D-B project. Additionally, the P3 team will be responsible for other items outlined in the RFP, which could include financing, operating, and/or maintaining the bridges for a predetermined period of time.

7.7.4 Quality Assurance

QA is similar to that for a D-B project. Additional QA is provided when the P3 team is contracted to maintain the bridges for a period of time.

7.7.5 Project Flexibility

There are many different forms of P3s. Some guidance includes D-B as a form of P3, which is technically correct. For the purposes of this guidebook, D-B is considered the typical project delivery method used for bridge bundling P3s. (Some States have implemented P3s using the CM/GC delivery method as well.) The three primary types of D-B P3s to be considered for bridge bundling include:

- **design-build-finance (DBF)** – One contract is awarded for the design, construction, and full or partial financing of the project. Under DBF, the constructor agrees to provide all or some of the construction financing. The design-builder is repaid with milestone and/or completion payments made by the project sponsor. In addition to all the potential benefits of D-B, DBF allows project sponsors to accelerate the construction of projects that they would otherwise have to wait to procure until they had amassed the required funding.
- **design-build-operate-maintain (DBOM)** – An integrated partnership that combines the design and construction responsibilities of D-B with operations and maintenance. DBOM provides project sponsors with all the potential benefits of the D-B project delivery method. In addition, by bundling the operation of projects with their design and construction, these procurements incentivize the private partner to apply cost-saving, life-cycle costing principles to align the design of the project with long-term maintenance needs.
- **design-build-finance-operate-maintain (DBFOM)** – Also known as “concessions,” DBFOM provides project sponsors with the cost and acceleration benefits of D-B, the added life-cycle benefits of DBOM, and the access to new sources of financing associated with DBF.

7.7.6 P3 Advantages

- Can expedite project delivery.
- Increases protection against some risks.
- Brings construction and operational efficiencies.
- Increases investment in transportation assets.
- Increases opportunities for “new” money (e.g., new toll facilities).
- Brings together multiple financing sources required for large-scale projects.
- Enhances cost control.
- Adds certainty regarding cost and schedule.
- Brings potential private-sector expertise.

- Introduces life-cycle perspective—better quality up front and improved maintenance.
- Improves customer focus.
- Leverages each partner’s strengths.
- Conserves public sector debt capacity.

7.7.7 P3 Disadvantages

- The P3 procurement process involves difficult financial, legal, and technical issues. DOTs and LPAs need to acquire the technical and institutional capacity to develop and oversee P3s in various phases, including planning, project feasibility evaluation, and contract negotiations.
- There are extensive up-front administrative costs. However, as P3 becomes more popular and current P3 projects advance, the process is expected to become more cost effective through templating and more refined based on lessons learned.
- The P3 project will likely be paid for over time (e.g., through availability payments), and that will not only result in paying financing costs, but may also impact the agency’s ongoing and long-term program by reducing the amount of future funds available.

7.7.8 P3 Project Best Options

P3s for new-build facilities can involve construction of a new surface transportation asset or modernization, upgrade, or expansion of an existing facility. These P3s are structured as DBFOM concessions that bundle together and transfer to a private sector partner responsibilities for design, construction, finance, and long-term operations and maintenance over the concession period.

P3 concessions may be used to lease existing publicly financed tolled facilities to private sector investor operators for a specified period of time, during which they have the right to collect tolls on the facility. In exchange, the private partner operates and maintains the facility and in some cases make improvements to it. The private partner typically also pays an up-front concession fee for the right to operate the road and retain toll revenues.

P3 decisions are typically based on a value for money analysis (financial impact of choosing P3 delivery method over other approaches) or a benefit-cost analysis (a broader analysis that includes societal costs).



FHWA Office of Innovative Program Delivery Center for Innovative Finance
Support: [P3 Defined](#)



FHWA Office of Innovative Program Delivery Center for Innovative Finance
Support Fact Sheet: [Benefit-Cost Analysis for Public-Private Partnership Project Delivery](#)

7.7.9 P3 Project Examples



PennDOT's Rapid Bridge Replacement Project: Through the Rapid Bridge Replacement project, 558 poor condition bridges around the State will be replaced while minimizing impacts to the traveling public. The project is unique because it is the first of its kind in the nation to bundle the replacement of hundreds of bridges in a P3 agreement. No other P3 project in the country has embarked on a multi-asset, multi-location undertaking of this magnitude. PennDOT used the DBFM model of the P3 arrangement.



Northampton County P3 Bridge Project: In 2016, Northampton County in eastern Pennsylvania became the State's first LPA to utilize P3. Though Pennsylvania law does not allow local governments to enter into a P3 agreement, it does allow municipal authorities to do so. To comply with this, Northampton County gave temporary ownership of the 33 bridges to its General Purpose Authority (GPA), which entered into a P3 agreement with a contractor to design and rehabilitate or reconstruct all 33 bridges within 4 years, maintain the bridges for 10 years after construction, and finance the project over the 14-year agreement period.

Northampton County and the GPA used PennDOT's Rapid Bridge Replacement Project as a guide to develop the procurement process and contract. However, since no Federal or State funding was to be used, the terms were modified to follow the county's policies and procedures, which are less stringent than those of PennDOT (leading to additional cost savings). The GPA also hired a consultant to assist with administration of the contract. In an effort to recoup some of the up-front costs, the Northampton County GPA has marketed itself to other counties around the State to set up and administer P3 projects on their behalf.

7.8 Procurement Methods

The primary procurement methods for bridge bundle contracts are low bid, qualifications-based selection (QBS), and best value. The type of work that is included in the bridge bundle and the delivery method selected will factor into the procurement method. Other methods, or modifications of these three, may be used at the agency's discretion. A description of each procurement method, in order of increasing risk transfer to the private sector, and how it may be used in conjunction with bridge bundling follows.

7.8.1 Low Bid

Low bid is the traditional procurement method used for public projects. It is a competitive, closed bid system wherein selection is based solely on price. Prospective contractors submit bids based on a bid package advertised by the agency. To be successful, the low bidder must be fully responsive to the design and specifications of the project (Molenaar, Harper, & Yugar-Arias, 2014).

Agencies may require prequalification as a part of their bidding process to ensure that only contractors capable of performing the work are bidding on the advertised package.

Advantages

- Agencies and contractors are familiar with the process.
- It ensures the work goes to the lowest responsible, responsive bidder.

Disadvantages

- The low bid process does not allow the agency to get the cost benefit of contractor innovation and creativity.
- The lowest bid gets the contract, which is not always from the most qualified contractor.
- For D-B, the contractor experiences added risks that will be priced in their bid.
- For D-B-B, project change orders tend to be higher, resulting in higher final project costs than low bid (FHWA, 2017c).

Projects Where Low Bid May Be the Best Option

Low bid is the most common procurement procedure for public agencies. It can be used for all types of projects and ensures transparency in contract award. It is a particularly good fit for bundling simple types of bridge projects. However, when projects are large and/or include high-risk items, low-bid procurement may not be the best option.

Low bid procurement is usually paired with the D-B-B project delivery method. It can also be used successfully with D-B projects, provided the nature of the work is straightforward and the bundles do not get too large.

7.8.2 Best Value

A best-value procurement method is a combination of low bid and QBS. In a best-value approach, both price and other key factors are used to make the selection. The weighting given to the factors is at the discretion of the agency. Factors typically considered aside from price are qualifications, schedule, quality, and experience. Prospective contractors submit their sealed bid in addition to a statement of qualifications and ideas for the work based on a description in an RFP written by the agency. The selection can be a one-step or two-step process with interviews (Molenaar, Harper, & Yugar-Arias, 2014).

For large and complex projects, a significant investment is made by proposers to prepare their statement of qualifications and proposals. Provided they meet minimum criteria with their submittal, it is customary to compensate unsuccessful proposers with a stipend for a portion of their investment (typically an amount specified in the Request for Qualifications and the RFP).

Advantages

- It allows the agency to consider both qualifications and price in the selection process.
- It provides the agency the benefit of contractor innovation and creativity.

Disadvantages

- Contractors, especially smaller, local companies, are not accustomed to submitting best-value proposals.

- There is a perception that since the contractor is not selected solely on price, selections may be biased.
- It may not be allowed by State procurement laws.

Projects Where Best Value May Be the Best Option

Best value is ideally suited for the D-B project delivery method. With this method, key factors in addition to price are considered in the award of the contract. The agency has the opportunity to capitalize on innovations proposed by the contractor in the bidding process.

7.8.3 Qualifications-Based Selection

QBS is the traditional procurement method used for selecting professional services by public agencies, but it can also be used for selecting a contractor for bridge bundles. It is a competitive system where selection is based on the qualifications, experience, and past performance of the contractor. Prospective contractors submit their statement of qualifications and ideas for the work based on a description in an RFP written by the agency. The selection can be a one-step or two-step process with interviews (Molenaar, Harper, & Yugar-Arias, 2014). Price is negotiated after the entity to perform the work is selected.

Advantages

- It allows the agency to choose the most qualified contractor for the work.
- It provides the agency with the benefit of innovation and creativity by the contractor.
- The contractor is more likely to be compensated for taking on a higher level of risk.

Disadvantages

- Contractors, especially smaller, local companies, are not accustomed to submitting QBS proposals.
- There is a perception that since the contractor is not selected solely on price, selections may be biased.
- It may not be allowed by State procurement laws.

Projects Where QBS May Be the Best Option

QBS is ideally suited for the CM/GC project delivery method and complex D-B projects. With this method, the most qualified contractor is chosen for the project. The contractor is involved in the design process and the price is negotiated typically with the assistance of an ICE. CM/GC projects using QBS have optimized construction schedules and significantly reduced construction change orders, making this process a viable option for agencies (FHWA, 2017d).

7.9 Summary

Agencies typically use either D-B-B or D-B delivery methods for bridge bundling. Another ACM that is proving useful for agencies in delivering bridge bundle projects is CM/GC. Understanding the different project delivery and procurement methods that are available and the

benefits and disadvantages of each will help agencies to select the most appropriate methods to meet goals and objectives.

Many factors are relevant in making this determination, for example, the funding or financing strategy and risk analysis will provide critical input into the decision. Tools available to assist agencies in selecting a delivery method include the Project Delivery Selection Matrix developed by the University of Colorado.

Table 18. Summary of project delivery methods and procurement methods for bridge bundle contracts.

CATEGORIES	D-B-B	IDIQ	CM/GC	D-B	P3
Program Goals	<ul style="list-style-type: none"> • Agency retains design risks • Traditional delivery • Maintain control of final product 	<ul style="list-style-type: none"> • Quick response for unknown needs • Improve asset management 	<ul style="list-style-type: none"> • Risk allocation to party best to handle • Contractor innovation • Bundle bridges with complex components 	<ul style="list-style-type: none"> • Transfer risks to contractor • Increase capacity of bridge program • Contractor Innovation 	<ul style="list-style-type: none"> • Transfer risk to concessionaire • Operations, long-term maintenance • Contractor Innovation
Project Characteristics	<ul style="list-style-type: none"> • Similar bridge types • Simple designs • Third-party issues resolved before advertisement. 	<ul style="list-style-type: none"> • Preservations • Preventative maintenance • Culvert replacements • Predictable but not yet determined work. 	<ul style="list-style-type: none"> • Bridges that owners might avoid in a bridge bundle due to complexities. • Significant third-party involvement • “Out of the box” thinking required 	<ul style="list-style-type: none"> • Simple bridges for time savings • Complex bridges for innovation • Limited third-party involvement (ROW, Environmental, Utilities, Railroads, etc.). 	<ul style="list-style-type: none"> • Simple bridges for time savings • Complex bridges for innovation • Limited third-party involvement (ROW, Utilities, Environmental, Railroads, etc.). • Bridge maintenance • Variety of work types.
Procurement Methods	<ul style="list-style-type: none"> • Low Bid • Best Value 	<ul style="list-style-type: none"> • Low Bid 	<ul style="list-style-type: none"> • QBS • GMP 	<ul style="list-style-type: none"> • Best Value • QBS • Low Bid 	<ul style="list-style-type: none"> • Best Value • QBS

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Chapter 8. Environmental Review and Preliminary Design



- 1 Define successful bridge bundling
- 2 Determine goals & objectives
- 3 Identify funding or financing
- 4 Build a coalition & outreach
- 5 Perform risk assessment
- 6 Select bridges
- 7 Select delivery method
- 8 **Determine environmental review & preliminary design considerations**
- 9 Bundle & let contract(s)
- 10 Conduct quality assurance, close-out & celebrate!

Objective:

- To identify environmental clearance & permitting issues and preliminary design issues

Tools:

- Lists of potential issues
- Case studies
- Noteworthy practices

Outcome:

- Identification of environmental & preliminary design issues to address

When selecting bridges for a bridge bundling package, it is important to consider the potential environmental, ROW, and utility impacts at each site. Most agencies that have initiated a bridge bundling program started by packaging bridges with minimal impacts. At some point, however, more challenging sites will prevail on the list of bridges requiring attention. This chapter outlines the environmental, ROW, and utility considerations for deciding which bridges to bundle.



[Interview with Mark Traynowicz, Nebraska DOT](#)

“...try to limit any other environmental concerns you might have so one bridge doesn't hold up the rest of the bridges.”



NOTEWORTHY PRACTICES

Both the South Carolina DOT (SCDOT) and NYSDOT bundled environmental documentation and approvals. SCDOT employed a NEPA box for analysis. NYSDOT has element-specific approval documents. See case studies in Appendix C.

8.1 Environmental Review and Clearance

As noted in Chapter 3, allocating Federal aid to a project triggers the National Environmental Policy Act (NEPA) and associated Federal regulations (42 U.S.C. 4321-4347, 40 CFR Part 1500, and 23 CFR Parts 771 and 777). If the project is entirely locally or State funded but requires a permit or approval from a Federal agency, such as the U.S. Coast Guard (USCG) or the U.S. Army Corps of Engineers (USACE), compliance with NEPA and associated regulations applicable to the lead Federal permitting agency will be required. Additionally, some States have environmental laws that apply even if the project is 100 percent State funded and no Federal agency involvement is prescribed.

It is important to note that a project must comply with NEPA if any amount of Federal funding is to be used for any phase (PE, final design, ROW, utilities, or construction). If Federal funds are used for a highway project, FHWA serves as the lead agency under NEPA and is responsible for coordinating with the many Federal agencies responsible for the various Federal environmental requirements. For projects that are non-Federal aid but involve other Federal permits or approvals, another Federal agency (e.g., USACE or USCG) would serve as the lead for Federal actions. NEPA also applies whenever the FHWA must take an action to authorize the project (e.g., Interstate access modification), even if no Federal funds are used.

If NEPA applies, the Federal agency¹³ must evaluate the project's potential impacts on the natural, economic, and social environments, including, but not limited to, the following:

- Threatened and/or endangered species (and their habitats).
- Migratory birds.
- USACE Section 408 authorizations.
- Cultural resources (archeological or historic).
- Public parklands.
- Floodplains and wetlands.
- Noise levels, water quality, and air quality.
- Human health and safety.
- Social and economic impacts on communities.

The State DOT normally prepares these evaluations for FHWA independent evaluation and decision-making, but there are some situations in which the State DOT carries out all NEPA work (i.e., pursuant to an assignment under 23 U.S.C. 326 or 327, or a programmatic categorical exclusion agreement under 23 CFR 771.117(g)).

¹³ The responsibility belongs to the Federal agency unless the project is under Title 23 and is in a NEPA assignment State or within the scope of an FHWA-State DOT programmatic categorical exclusion agreement under 23 CFR 771.117(g).

NEPA also requires identification of measures to avoid, minimize, or mitigate the impacts. The level of documentation required depends largely on the context and intensity of the impacts. There are three primary levels of documentation depending on the class of action:

- Categorical Exclusion (CE): project will not have a significant environmental impact and usually involves activities on the “C” or “D” list if federally funded. See 23 CFR 771.117.
- Environmental Assessment (EA): project requires study to determine the significance of environmental impacts. If none, the project is awarded a Finding of No Significant Impact (FONSI). If significant impact(s) is determined, an environmental impact statement is required. See 23 CFR 771.119 and 771.121.
- Environmental Impact Statement (EIS): project is likely to cause significant environmental impact(s). The project decision will be stated in a Record of Decision (ROD). See 23 CFR 771.123, 771.125, and 771.127.

Section 4(f). Additional documentation may be necessary for Federal highway projects that require the use of land from publicly owned parks, recreation areas, wildlife and waterfowl refuges, and public or private historic sites, commonly referred to as Section 4(f) (requirements originated in Section 4(f) of the U.S. Department of Transportation Act of 1966). Section 4(f) requirements (see 23 U.S.C. 138, 49 U.S.C. 303, and 23 CFR Part 774) stipulate that FHWA and other USDOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless the following conditions apply:

There is no feasible and prudent avoidance alternative to the use of land; and the action includes all possible planning to minimize harm to the property resulting from such use;

OR

The Administration determines that the use of the property will have a de minimis impact.

Section 106. Related to, but independent from, Section 4(f) is Section 106 of the National Historic Preservation Act of 1966. The purpose of Section 106 is for Federal agencies to consider the effects of their undertakings on historic sites that are on or eligible for the National Register of Historic Places. If impacts result, agencies should seek ways to avoid, minimize, or resolve those effects that are considered adverse. Consultation between the parties in the Section 106 process (including the State Historic Preservation Officer and/or the Tribal Historic Preservation Officer if on tribal lands and the Advisory Council on Historic Preservation) supports the tasks of the identification of historic properties, the consideration of effects, and the resolution of adverse effects to impacted properties. (23 CFR Part 800)



More information and guidance is available in FHWA's [Environmental Review Toolkit](#).



See Appendix 7 in the NYSDOT's [Project Development Manual](#) for NEPA documentation formats and sample approval documents.

In general, for fastest delivery, only bridge projects that meet the criteria for a CE should be considered for bridge bundling. Projects requiring an EA may also be candidates for bridge bundling if a FONSI is anticipated, although the agency should take into account that more time will be necessary for the environmental review process. Projects requiring an EIS are generally not well suited for bridge bundling. Projects that have already achieved environmental clearance are also candidates for bundling.

Additional considerations should include the type of permit required from a resource agency and the ability to mitigate using standard or programmatic approaches for impacts to those resources. For example, bridge projects that require a USACE nationwide permit or other programmatic permit for impacts to Section 10 of the Rivers and Harbors Act of 1899 or Section 404 of the Clean Water Act may be mitigated easily using existing mitigation banks, in-lieu-fee programs, or other third-party arrangements if available in the watershed. These permits are designed for actions that have predictable outcomes and incorporate a vetted, time-lined (typically 45 to 60 days) review process. Projects that require a USACE individual permit or permittee-responsible mitigation are not the best candidates for bridge bundling unless a permit has already been issued and there is an approved mitigation plan.



For more information on the Federal permitting process, see "[Recommended Best Practices for Environmental Review and Authorizations for Infrastructure Projects](#)," a report required by Title 41 of the FAST Act.

Note that for States approved for NEPA Assignment under 23 U.S.C. 327, the State DOT acts as the lead Federal agency for federally funded projects. In these cases, the FHWA Division Office is not responsible for NEPA and cannot assist on a project level. All NEPA requirements, considerations, and liabilities are held by the State DOT. This should not limit the use of bridge bundling, and the coordination of all NEPA reviews is the responsibility of the DOT. It is important to note that the Bridge Permit Exception (23 U.S.C. 144(c)) is retained by the FHWA Division Office and is not assignable to the State DOT. The exception applies to USCG bridge permitting for federally funded projects, and the FHWA Division Office (in coordination with the local USCG bridge office) determines if an exception (permit not required) applies to a bridge. Bridge projects over waterways that are not federally funded should be coordinated with the appropriate USCG district office.



2014 [FHWA-USCG memorandum of agreement](#) to coordinate and improve bridge planning and permitting.



For more information on bridge permitting with the USCG, see the FHWA “[Back to the Basics: Bridge Permitting](#)” Successes in Stewardship newsletter.

8.2 Environmental Permitting

Opportunities for streamlining the permitting process should be evaluated. Locations expected to have complex permitting needs with widely variable approval times should be avoided. Depending on the contract type, the responsibility for obtaining environmental permits can remain with the agency or be delegated to the contractor under a design-build contracting instrument. If Federal funds are used for the bundled design-build contract, approval from FHWA may be required before delegating responsibilities for obtaining permits (23 CFR 636.109(b)(6)-(8)).

FHWA’s [*2015 Red Book: Synchronizing Environmental Reviews for Transportation and Other Infrastructure Projects*](#) provides a suite of tools for Federal agencies to support effective and efficient interagency coordination, including joint agency meetings, communication technology, abbreviated permit reviews, and a means for concurrent reviews. By increasing the use of review synchronization, more effective and efficient environmental reviews are anticipated that could result in projects with reduced impacts to the environment as well as savings of time and money.

The *Red Book* key messages are:

- Communicate early with other agencies.
- Have open communication with other agencies.
- Be flexible within the constructs of existing laws and regulations.

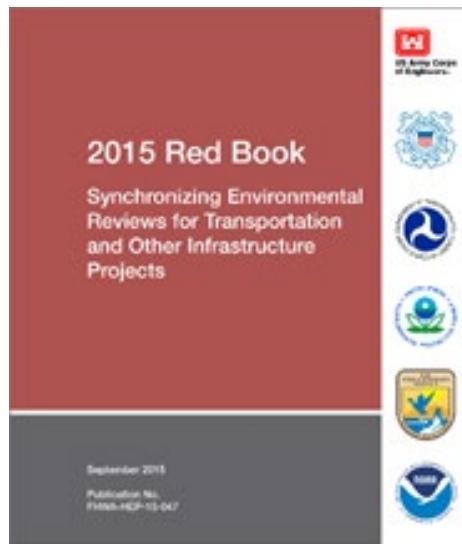


Figure 27. The FHWA *Red Book*

Source: FHWA

8.2.1 Waterway and National Pollutant Discharge Elimination System Permitting

Waterway and National Pollutant Discharge Elimination System permitting are generally handled by each State's environmental protection agency and related partners. As when any outside or third-party agency is involved with a project, this presents a potential for delays. These delays can often be attributed to limited resources within the agency, as well as differing interpretations, opinions, policies, or priorities. It is therefore important to coordinate with these agencies in advance of advertising a bridge bundle. This will allow them to plan accordingly, specifically for resource allocation.

It is also vital to conduct a pre-application meeting to familiarize the reviewers with the project and its nuances as well as to obtain concurrence on the planned permitting approach. If it will be the responsibility of the contractor or contracting team to obtain these permits, then a meeting between the regulating agency and the selected contractor/team should be held soon after selection to familiarize all parties with the required process.

Some State DOTs fund dedicated reviewer positions at their State environmental agency. These third-party liaisons help address the limited resources at the environmental agency and allow the State DOT to prioritize reviews.

Triggers for more complex permitting procedures are generally tied to wetland impacts and earth disturbance over established limits, water surface elevation increases, point discharge outlets into waterways, threatened and/or endangered species presence, and road or waterway realignment. Careful consideration should be given prior to bundling projects that are anticipated to have these issues.

8.3 Preliminary Design

The effort dedicated to preliminary design will depend on several factors—which project delivery method was chosen, what effort is necessary to secure environmental determination and permits, which risks the agency has responsibility for, and other factors specific to the agency. The following sections describe some of the more common preliminary engineering topics critical to successful project delivery.

8.3.1 Right-of-Way

Acquiring ROW, whether it be permanent or temporary, for a bridge project presents another consideration in developing the project schedule. Projects displacing people or businesses can be time-consuming. Given these delay implications, bundled bridge projects should consider locations where no or minimal new ROW is necessary.

For Federal-aid projects, ROW must be acquired, relocations completed, and ROW cleared in accordance with the Uniform Act (49 CFR part 24). Depending on the contract type, the responsibility for carrying out ROW acquisition can remain with the public agency or be supported by the contractor. Generally, ROW is acquired and relocations are completed for the entire project before physical construction begins. There are exceptions as described in 23 CFR 635.309, and the agency should consider whether any of those exceptions may apply to the project. There are special provisions for D-B projects in 23 CFR 710.309. Pursuant to those provisions, the agency may choose not to allow construction to commence until all property is

acquired and relocations have been completed; or, may permit physical construction to start on an individual property or group of properties once the ROW requirements are met for those properties if applicable requirements are met.



Different States handle ROW acquisitions in different ways, and 23 CFR 710.309(d) includes provisions applicable where the agency decides to delegate ROW responsibilities to a D-B contractor. In the large D-B contract used for the MoDOT Safe & Sound Bridge Improvement Program, the agency had the D-B team prepare all ROW acquisition plans, but the actual acquisition was performed by the State DOT. A ROW reserve fund was created for the purchase of the ROW. To encourage the D-B team to work within the existing ROW where possible, any money left over in the ROW reserve fund at the completion of the project was split between the State and the contractor. (A non-Federal-aid ROW reserve fund was created.)

PennDOT took a different approach to its Rapid Bridge Replacement bridge bundle program. While understanding that some locations would require time to complete the ROW process, agency staff designated a number of fast-start bridges with clear ROW certifications that could be constructed without delay.

In South Carolina, however, the DOT assigns the responsibility of ROW acquisition for bridge bundle contracts on the D-B team. Any necessary ROW is actually purchased by the D-B team on behalf of SC DOT. The cost of the ROW acquisition is included in the bid price that is submitted in the proposal.

Agencies should be aware of the delays that ROW acquisitions can cause, and if the delays cannot be avoided, make sure to plan properly to deal with them.

8.3.2 Utilities – Third Parties

Utility coordination can be very lengthy and unpredictable. It often causes project delays and is frequently cited as a high-risk area for construction activities. Complications with unexpected utility relocations can lead to additional issues with ROW and environmental permitting.

Bridges with limited or no utility involvement should be chosen for bridge bundles to assist in streamlining the delivery and construction process. Depending on the contract type, the responsibility for utility coordination can remain with the agency or be delegated to the contractor. If there is uncertainty involving utility conflicts, particularly on a bridge that has an early delivery date in the bundle, the agency should retain responsibility for the utility coordination and even advance relocation, if needed.

Early communication and coordination is critical on most projects, and it can work well for D-B-B project delivery. For other project delivery methods, the responsibility for coordination and agreements should be clearly specified.



NYSDOT, for example, on D-B projects provides a preliminary utility agreement in the RFP of the bridge bundle project. The agency then meets with the affected utility companies and the short-listed firms, allowing each firm to have a one-on-one meeting with the utilities prior to submitting its bid. Some States have begun paying for all or a portion of the utility relocation cost when the utility is within the existing public ROW. These cost-sharing programs encourage utility companies to expedite their efforts and/or allow agencies to incorporate the relocation work into the project construction

contract. For example, GDOT has a policy (public interest determination) whereby all utility relocation costs for most P3 or D-B projects are paid for by GDOT (or the project sponsor) if the utility agrees to allow the D-B contractor or the P3 developer to perform the relocations.

Even with the success that some of these bridge bundle programs have had, by far the most common strategy for dealing with utilities in bridge bundle projects is avoidance. Avoiding locations with significant utility impacts reduces risk by limiting third party involvement and gives the project the best chance for success.

8.3.3 Hydrology and Hydraulics

States handle the responsibility of performing hydrology, hydraulics, and scour analyses differently, depending on the type of contract delivery and the nature of the watersheds. For D-B-B, where all bridge details are included in the contract, the hydrology, hydraulics, and scour analyses are performed prior to bidding in order to design the bridge. D-B bridge bundle contracts can be completed prior to bidding or by the D-B contractor.

For most contracts, it is better if the hydrology, hydraulics, and scour analyses designs and reports are completed prior to bundling bridge projects with the relevant information included in the bid package. It simplifies the design and construction of bundled bridges if the structure openings are properly sized prior to letting the contract. This will eliminate miscommunications and a possible point of contention regarding the expected hydraulic capacity/size of and predicted scour at the proposed bridge.

If performing the hydrologic, hydraulic, and scour analyses and creating the associated reports is the responsibility of the design-builder, the RFP should outline the assumptions the D-B team should make for bidding purposes and outline a method for dealing with locations that do not meet that assumption. In MoDOT's large bridge bundle, the D-B team was instructed to assume the same size opening as in the existing structure for bidding, and MoDOT paid for structures that required larger openings. Due to the work involved with the hydrology, hydraulic, and scour analyses, it is not reasonable to expect the D-B team to complete them prior to the bid.

Locations that will require advanced hydraulic or scour analyses due to an existing flooding situation, complex stream configuration, dynamic stream characteristics, or other issues should be avoided if the analysis cannot be completed prior to contract letting.

8.3.4 Geotechnical Conditions

Geotechnical considerations are a potential cause of unexpected costs, delays, and contract claims. Bridge locations in areas where soil/rock profiles are consistent are preferred. Areas that are known to have complex foundation designs and frequent problems during construction should be avoided.

When design services are requested, primarily for reconstruction, it is important to provide adequate geotechnical information in the contract to eliminate uncertainties. To the extent possible, subsurface explorations should be provided in the contract. Also, the agency should be explicit in the RFP about the types of foundation that are acceptable. The contractor likely will provide the least expensive foundation that meets the requirements of the contract.

Even with the inclusion of subsurface information, there is still an opportunity for unexpected conditions once construction begins. The contract should provide for a process to resolve changed condition issues, if encountered.

8.3.5 Railroads

Due to the complexities of collaborating with railroads, the agency typically assumes this responsibility. The risk to the schedule involved with railroad coordination is high for a contractor to assume. Potential costs for that risk will likely be passed back to the agency in the bid. Unless all railroad coordination is completed prior to letting of the bridge bundle, bundled projects including bridges with railroad involvement should be carefully thought through.



For more information on facilitating coordination with railroads in advancing Federal-aid projects, see the FHWA “[Railroad Coordination on Federal-Aid Highway Projects.](#)”



More information and guidance is available in FHWA’s [Every Day Counts initiative “Improving DOT and Railroad Coordination”](#) and the Strategic Highway Research Program project [“Railroad-DOT Mitigation Strategies \(R16\).”](#)

8.4 Summary

It is important to consider the potential environmental, ROW, and utility impacts at each site when selecting bridges to bundle. FHWA’s 2015 Red Book suggests communicating early and openly with other agencies and looking for flexibilities within the constructs of existing laws and regulations.

Early communication and coordination can assist in ROW, utility, and railroad coordination; however, avoiding locations with significant impacts reduces risks. For most contracts, it is better if the hydrology and hydraulics designs and subsurface investigations are completed prior to letting of the bridge bundle. Incorporating remaining risks into an updated risk register is recommended.

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Chapter 9. Contract Bundling and Letting



Agencies, while recognizing the unique attributes of bridge bundling, should think through how the bridge bundle project will be managed and how quality will be assured (see Chapter 10). The project size may be larger than traditional bridge projects, there may be multiple locations, distances between construction sites may be lengthy, innovative or new methods may be used, the number of stakeholders and communities involved may be larger, there may be accelerated completion schedules, and there may be much political interest in the project. The management structure should be aligned with the unique features of the bridge bundling project; selection of key staff and defined responsibilities will be critical to successfully meeting project goals and objectives.

9.1 Roles and Responsibilities

How an agency organizes and defines responsibilities to deliver a bridge bundling project will depend on many factors unique to the project and agency. The following questions can help guide agencies in deciding on roles and responsibilities (see also the bridge bundling implementation checklist in Appendix B).

- Has an executive sponsor or lead been designated?
- Are the project goals clearly stated? Refine as necessary.
- Are the scope, schedule, and cost known?

- Will the project be managed centrally (in headquarters) or in districts/regions?
- Will the project be led by a newly created group or in an existing program area?
- Are staff members experienced and available to lead the project?
- Are funds available for outsourcing any work that cannot be managed by existing staff?
- Is there sufficient lead time to bring outsourced services on board?
- Are the project manager's roles and responsibilities clearly defined and documented?
- Is the party with approval authority for decisions documented?
- How will quality be managed? How will risk be managed? How will stakeholders be managed? How will procurement be managed? Who will be managing these knowledge areas?
- Are external resources needed for managing quality, communications, risk, stakeholders, and procurement?
- Will the agency's current management systems handle projects with multiple locations and multiple pay centers, or do new systems need to be developed?
- What dispute process will be used, and who will manage it?

9.2 Project Delivery Methods

Following are some factors to consider by project delivery method when selecting key staff to manage and oversee QA.

D-B-B project PS&E are prepared as with any individual bridge project, the difference being whether similar bridges and or different types of bridges are included, resulting in more site-specific details or common/standard details.

IDIQ QA is similar to D-B-B projects.

CM/GC provides for a collaborative risk allocation process as the design is progressed and construction packages are released. Design QA and construction QA are similar to D-B-B projects.

D-B projects are only as good as the RFP, so agencies should be prescriptive where necessary and otherwise leave the design-builder flexibility (within the project's constraints), such as in design criteria to be met. Procurement document preparation (letters of interest, requests for qualifications, RFP, evaluation teams) often requires more experienced, senior staff during the multi-month process. The post-award phase requires quick turnaround times on design reviews and construction packages.

ATCs are used to increase innovation, cost savings, schedule savings, and long-term maintenance savings. The process should be managed and be confidential.

P3 agency's QA role will vary depending on how the P3 is constructed. Operate and maintain P3s typically have performance measures associated with them. In projects with a finance component, QA typically becomes the responsibility of the financier, with the agency providing oversight to ensure contract requirements are met. When the concession period is over, there are

typically contractual handback provisions and specifications, which include monitoring and inspection procedures, to be met before the asset is returned to the agency (financial incentives, such as a handback reserve account, surety bonds, and extended letters of credit can minimize the risk of an asset being returned in an unacceptable condition).

9.3 Project Management Plan

Creating a Project Management Plan to document decisions and provide a framework for the team delivering the project is highly recommended. Including a tool such as a responsibility assignment matrix, also known as a Responsible, Accountable, Consulted, and Informed (RACI) Matrix, may be valuable. Going through the process to develop a plan will force the agency to think through all aspects, provide a valuable communication tool, and allow for adjustments as the project progresses and more information becomes available.

Table 19. RACI Matrix.

SAMPLE BRIDGE BUNDLING PROJECT RACI MATRIX							
CATEGORIES	EXECUTIVE SPONSOR	PROJECT MANAGER	RISK MANAGER	BRIDGE ASSET ENGINEER	PROGRAM PLANNING DIRECTOR	DESIGN ENGINEER	CONSTRUCTION ENGINEER
Establish Goals & Objectives	Responsible	Accountable	Consulted	Informed	-	-	-
Funding	Accountable	Accountable	-	Informed	Responsible	-	-
Project Management Plan	Informed	Responsible	Consulted	Consulted	Consulted	Consulted	Consulted
Risk Management Plan	Informed	Accountable	Responsible	Consulted	Consulted	Consulted	Consulted
Communication Management Plan	Informed	Responsible	Consulted	-	-	-	-
Bridge Selection Criteria	-	Accountable	Informed	Responsible	-	Informed	Informed
Procurement Management	-	Accountable	Consulted	-	-	-	-
Stakeholder Engagement	Informed	Accountable	Consulted	-	Consulted	-	Consulted

9.4 Civil Rights and Disadvantaged Business Enterprise Considerations

All bridge bundling Federal-aid projects must conform to the same Federal requirements as other Federal-aid projects. Applicable Federal civil rights requirements include, among others: the ADA, Title VI, the DBE program, On-the-Job Training, Equal Employment Opportunity (EEO), and Contractor Compliance. State DOTs cannot delegate their responsibility to ensure the regulatory requirements of these programs are met.



The FHWA Office of Civil Rights [website](#) provides information on the authorities, guidance, and technical assistance for each of its programs.

Recipients of FHWA funding are required to implement the Federal DBE program. The State DOTs administer the DBE program at the State level (regulations can be found in 49 CFR Part 26). For bridge bundling projects, there are no differences in how this program is applied compared to other types of projects. It is important to contact the State DOT Civil Rights Office early in the process for guidance.



For projects utilizing alternative delivery and procurement methods, State DOTs and other stakeholders should consult FHWA's DBE Program handbook on [*Administration and Oversight on Projects with Alternative Contracting and Procurement Methods*](#).

9.5 Design and Construction Considerations

For bridge bundling projects, design and construction considerations are magnified because they will affect numerous bridges (either positively or negatively). It is important to thoroughly consider design and construction decisions in the context of delivery method, oversight, and final product (e.g., quality, long-term maintenance, and serviceability). A structured risk management process, as described in Chapter 5 and Appendix F, will greatly assist agencies in understanding the threats and opportunities related to design and construction.

Key considerations include the following:

- The agency should have appropriate staffing, resources, and guidance for design and construction oversight to meet a scale that may exceed its conventional project needs. For D-B projects, the number and frequency of design and construction submittals and requirements for timely response will affect the agency, agency consultant, permit agencies, etc. Similarly, the number of simultaneous construction operations and on-site construction inspection approvals can require more than conventional oversight resources.
- If the contractor is responsible for design, the agency will need to provide sufficient information on subsurface conditions, environmental allowances and restrictions, utility

relocation responsibilities, ROW, etc. to minimize unknowns so the contractor can provide a cost-competitive bid or proposal. The more investigation the agency conducts at the beginning, the less risk is on the contractor, which will reduce cost and dispute potential.

- The agency should provide contract design criteria and construction specifications and guidance so the contractor can design and/or construct bridges that satisfy agency expectations and provide cost-competitive bids or proposals that account for those expectations.
- Bridge quality and performance will largely be affected by criteria that can be subjective and is not always clearly specified. Examples include selection of bridge geometrics that accommodate traffic demands and waterway hydraulics, geology, and geomorphology; inclusion of bridge types, features, and details that are durable and low maintenance; and inclusion of parapet and rail that are appropriate for the location.
- Specifications and special provisions should not be overlooked. Being familiar with and using approved specifications, particularly specifications approved for Federal-aid when Federal-aid funding is used, will avoid reimbursement issues. This does not preclude the use of special provisions, as long as it is recognized that there is a pre-approval process that must be followed and appropriate time is allocated for the approval (23 CFR part 630). Another consideration is adopting another owner's approved specifications into the contract.

These design and construction aspects have some subjectivity and are not always clearly specified in standard design and construction specifications. Some, but not all, agencies have written policies, guidelines, and specifications that address these points so that consistency is achieved within their jurisdiction. These agencies may be better equipped to deliver a project with a larger number of bridges. Agencies that do not will need to address these issues within the contract specifications or rely on an organization that does have established specifications, guidelines, and policies (or adopt them).

For example, Nebraska DOT included the following statement in contracts for its highly successful County Bridge Match Program: “*All bridge projects shall be designed in accordance with the ‘State of Nebraska, Department of Roads (NDOR) Policy for Design, Load-Rating and Inspection of Public Road Bridges’ dated May 24, 2010; which includes the Nebraska Minimum Design Standards.*” (State Bridge Engineer Mark Traynowicz)

9.6 Summary

When developing the contracts for letting a bridge bundling project, the management structure should be aligned with the project’s unique features. Selection of key staff and defined responsibilities will be critical to successfully meeting project goals and objectives. A responsibility matrix can aid in this effort, along with reviewing civil rights considerations and sample contract documents.

For bridge bundling projects, design and construction considerations are magnified because they will affect numerous bridges. Creating a Project Management Plan to document decisions and provide a framework for the team delivering the project is highly recommended.

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Chapter 10. Quality Assurance, Close-out, and Celebration



Objective:

- To understand the issues to consider & options available for quality assurance

Tools:

- List of items to consider
- Comparison tables of quality assurance options

Outcome:

- Quality assurance plan

10.1 Quality Assurance: Control and Acceptance

The American Association of State Highway and Transportation Officials (AASHTO) defines quality assurance (QA) as “*(1) All those planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service; or (2) making sure the quality of a product is what it should be.*” (AASHTO, 2006)

Similarly, 23 CFR 637.203 defines QA as “*All those planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.*” FHWA notes that QA is a broad umbrella term covering the shared responsibilities of both the contractor and the agency for achieving a project’s contracted level of quality. Under the umbrella, the basic categories of responsibilities are quality control (QC) activities performed by the contractor and acceptance activities performed by the agency (FHWA, 2016).



[Interview with Keith Molenaar, University of Colorado](#)

“...we’re still going to be using the same processes and the same quality checks and quality assurance at the end of the project.”



Figure 28. QA responsibilities: shared by the contractor and the agency.

Source: FHWA

Based on the requirements in 23 CFR Part 637, a construction QA program consists of the following core elements: (FHWA, 2012)

- Contractor QC.
- Agency acceptance.
- Independent assurance.
- Dispute resolution.
- Personnel qualification.
- Laboratory accreditation/qualification.

For federally funded projects, one of the fundamental concepts in QA specifications is the separation of the functions of QC and acceptance. In QA specifications, the contractor is responsible for the QC and the agency is responsible for obtaining and conducting verification tests and making the acceptance decision. Although QA is a combination of QC and acceptance, the separation of these two functions is important (FHWA, 2004).



FHWA offers National Highway Institute (NHI) Courses [134064](#) (1.5-day) and [134064A](#) (3-day) called “Transportation Construction Quality Assurance,” which provide training on the fundamentals of effective transportation construction QA.



[Interview with Mark Traynowicz, Nebraska DOT](#)

“The quality assurance for us for the construction side of it is much easier, I think, when we go to a bundled project...”

How QA activities are handled will primarily be driven by the project delivery method used. The options are no different from other types of non-bridge bundle projects. Unique considerations related to bundled bridge projects include the following:

- Active construction may be taking place in numerous physical locations.
- Geographic distance between bridge locations may be great.
- Multiple locations resulting in multiple work zone control operations may affect corridors, requiring additional coordination and communication.
- For D-B projects, design speed may be accelerated, requiring quick review turnaround times by the agency.
- For D-B projects, co-located offices are common, requiring agency staff to be present.
- For CM/GC projects, frequent meetings with the designer and contractor may be necessary, requiring additional coordination and organization.
- Design detail and construction method standardization across a large number of bridges may improve QA reviews.
- Precast elements are often used, requiring on-site QA activities at fabricator facilities if precast is not self-performed by the general contractor.
- Precast element use on a large scale introduces other QA touch-points, such as long-term storage means and methods, shipping methods, and lifting and installing techniques—all of which can introduce quality issues.
- Large-quantity and frequent roadway permits (overweight and oversize) may need to be secured.
- Local concrete plants' capacity may be exceeded, necessitating on-site batch plants or use of non-local plants with extra hauling distances.
- Materials testing frequency and amounts may exceed lab capabilities.
- Agency staff levels may not be adequate to administer the contract or perform QA.
- Agency staff may not be familiar with alternative project delivery methods, requiring training in advance of work start.
- Contract restrictions may limit activities to night or weekend periods, requiring non-traditional hours for staff.

The above considerations should be discussed as part of the project's risk assessment to identify threats and opportunities to achieve project goals and objectives.

The organization models for QA will depend on the project delivery method used. For D-B-B projects, with the previous list of considerations in mind, the options include agency staff or an agency representative (consultant services). CM/GC project delivery would employ the traditional design and construction QA methods (same as used in D-B-B). For D-B projects, there are three models that can be used: QA by agency staff, QA by agency representative (consultant), or QA by an independent firm as part of the D-B team with agency verification.

While D-B offers the design-builder more control over design, materials, and construction methods than D-B-B, the agency still has an important role in assuring quality. As agencies develop D-B procurement documents, it is important that roles and responsibilities for design-builder QC and agency acceptance be clearly defined. The responsibility for acceptance by the agency (or its designated agent) is applicable regardless of the project delivery method used (FHWA, 2017c).

Table 20 summarizes the above options and relates them to the contractor QC function.

Table 20. Bridge bundling quality assurance staffing options.

BRIDGE BUNDLING QUALITY ASSURANCE OPTIONS		
PROJECT DELIVERY METHOD	AGENCY OVERSIGHT & ACCEPTANCE OPTIONS	QUALITY CONTROL OPTIONS
D-B-B & IDIQ	<ul style="list-style-type: none"> • By agency in-house staff. • By agency representative (outsourced to consultant). 	<ul style="list-style-type: none"> • Contractor QC staff are independent of construction staff.
CM/GC	<ul style="list-style-type: none"> • By agency in-house staff. • By agency representative (outsourced to consultant). 	<ul style="list-style-type: none"> • Same as D-B-B.
D-B & P3	<ul style="list-style-type: none"> • By agency in-house staff. • By agency representative (outsourced to consultant). 	<ul style="list-style-type: none"> • D-B QC staff are independent of construction staff. • Design-builder employs an independent testing firm. • Agency responsible for verification testing.

10.2 Close-out and Celebrate!

Closing-out a project and celebrating accomplishments are important parts of good project management. Documenting lessons learned, updating agency processes and procedures, and updating contract documents language will also benefit future efforts.

The following is a list of close-out items, not inclusive, to consider:

Marketing

- Advertise successes with website updates, press releases, reports to elected officials, etc.
- Share briefings on successes with industry organizations.

Bridge Asset Management

- Were project goals and objectives met?
- How were performance measures improved?

Risk Management

- Update risk register (for future reference, document responses to risks).
- Document which risks were closed-out.
- Document which risk responses were effective.
- Document which risk did not occur.
- Document what risks were missed (not identified).
- Document the opportunities exploited.

Lessons Learned

- Identify any changes in processes and procedures.
- Identify any contract language for future projects.
- Document change orders or disputes – how were they resolved?
- Document scope changes and why.
- Document schedule adjustments necessary and why.

Objective:

- To celebrate the project successes and capture lessons learned

Tools:

- List of close-out & celebration items to consider
- Implementation checklist

Outcome:

- Celebration actions
- Close-out actions

Share

- Share practices with other bridge owners, FHWA division and program offices (including the Every Day Counts program), others.
- Write technical journal articles.
- Present or prepare papers for the Transportation Research Board Annual Meeting or technical committees.
- Present or prepare papers for AASHTO committees or meetings.
- Give technical presentations at other professional organization conferences (e.g., American Society of Civil Engineers, Design-Build Institute of America, Accelerated Bridge Construction).

Plan

- Using the lessons learned and successes of the past bridge bundle, begin planning for the next one.

10.3 Summary

QA activities will primarily be driven by the project delivery method used. Unique considerations related to bridge bundle projects should be discussed as part of the project's risk assessment to identify threats and opportunities to achieve project goals and objectives. A documented QA plan should result from this step in the process.

When closing-out a project, celebrating accomplishments and acknowledging those individuals or organizations that played a key role will help establish a strong foundation for future efforts. Documenting lessons learned, updating agency processes and procedures, and updating contract documents language will also benefit future endeavors.

Chapter 11. Summary

This guidebook was created by FHWA through contract DTFH61-13-D-00023. This contract included the convening of a Technical Work Group (TWG) with members representing State Bridge Engineers, LPA officials, academia, legal, and consultants. In addition, the contract resulted in in-person interviews with agency staff who have had success in delivering bundled bridge projects at the State and local level. The States visited were Georgia, Missouri, Nebraska, New York, Ohio, Oregon, Pennsylvania, and South Carolina. The input and guidance from the TWG and State visits were invaluable in creating this guidebook.

This guidebook was prepared as a how-to manual for DOTs, LPAs, and other bridge owners to better understand the aspects of creating a bundled bridge project, to assist in making the case for bridge bundling, and to provide the tools and background for doing so.

Bridge bundling programs target a defined set (or bundle) of bridges that are planned for preservation/preventive maintenance, rehabilitation, or replacement in a timely and efficient manner through a series of contracts with the support of various funding options and/or partnerships and may include a program completion time frame. The likely benefits of bridge bundling include better risk allocation, cost savings (economies of scale), expedited procurement (faster construction start), earlier completion (standardized elements), technical innovation, reduced number of poor bridges, increased service life of bridges, coordinated construction staging, reduced burden on agency staff, and funding and financing innovation.

Every bridge bundling project starts with describing the project goals and objectives (which can be an iterative process and modified as more information becomes available). With the goals identified, a guiding coalition can be established and a project manager selected. Moving forward, the process is dependent on understanding the opportunities and threats to achieving the goals and objectives.

An initial risk assessment should be conducted, resulting in a risk register that should be updated through the life of the project. Preparing a communication plan outlining stakeholder (internal and external) engagement is beneficial. Identifying the necessary or available funds (existing budgets, new Federal or State sources, or seeking private equity through a P3 arrangement) is obviously critical to placing a limit on the scope of work. Technical issues need to be addressed, including bridge selection criteria, bridge standards to be met, ROW needs, environmental approval process, and third-party coordination.

Based on an updated risk analysis, a project delivery method (e.g., D-B-B, IDIQ, CM/GC, D-B, or P3) needs to be selected. The procurement methodology needs to be determined (low bid, best value, or QBS). Consideration should be given to incorporating the ATC process in the procurement. How QA will be conducted and civil rights requirements will be met will need to be incorporated into the contract documents. As the post-award activities commence and progress, an updated risk assessment can help an agency determine where its resources can best be used. Finally, closing-out the project and capturing lessons learned for future projects is a good practice.

Although bridge bundling projects share many similarities to other types of projects, there are unique considerations an agency should be aware of, including political and stakeholder interest and support, scale of project, design details applied across a large number of bridges, multiple

simultaneous construction locations, agency turnaround times (on D-B projects), agency capacity to manage, and QA challenges.

The bottom line: bridge bundling can meet the needs of bridge owners through economies of scale and faster delivery capabilities. This guidebook was developed to provide understanding of the following four considerations:

- Bridge bundling is a fast and efficient method owners can use to address bridges in need of attention, effectively reducing the number of bridges in poor condition across the nation and potentially increasing service life and transportation safety for the traveling public while saving agencies time and money.
- Bridge bundling works for preventive maintenance, preservation, rehabilitation, and replacement.
- Funding and revenue sources and innovative financing tools are available that can be packaged to finance and pay for bridge bundling projects.
- Several project delivery methods are available for implementing bridge bundling, maximizing time and cost savings.

Figure 29 provides an overview of the 10-step bridge bundling process. Although shown sequentially, depending on the circumstances, several of the steps may be progressed concurrently. In addition, the development of a communication plan and risk management plan are shown as a discrete step, but in practice, communication and risk analysis are typically a continuous or frequently practiced activity throughout the life cycle of the project or program.

The appendices include readily useable tools to assist in delivery of bridge bundle projects. These include implementation checklists, case studies, selection criteria, funding and financing options, a detailed process flow chart, sample contract documents, and other innovation considerations.

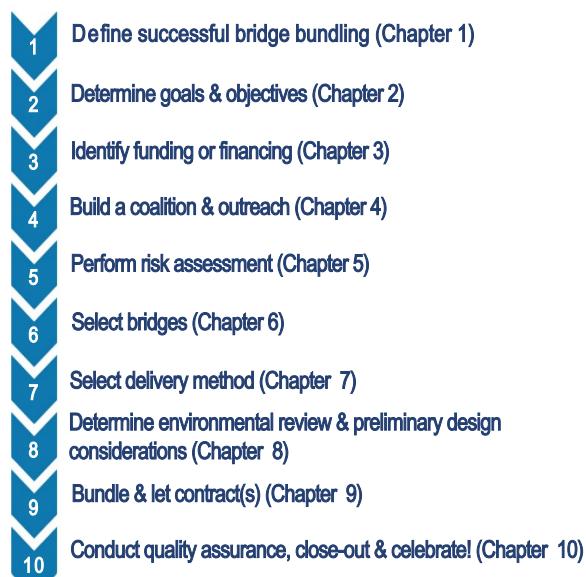


Figure 29. Bridge bundling process summary.

Source: FHWA

Glossary

Alliancing – A commercial/legal framework between an owner-participant and one or more private-sector parties as service provider or non-owner participants for delivering one or more capital works projects.

Alternative Contracting Methods (ACMs) – Contracting methods—including design-build, construction manager/general contractor, and alternative technical concepts—to accelerate project delivery, encourage the deployment of innovation, and minimize unforeseen delays and cost overruns.

Alternative Delivery Method (ADM) – A wide array of methods used by public agencies to deliver transportation project improvements. These methods include construction manager/general contractor, design-build, design-build-operate-maintain, design-build-finance, design-build-finance-operate-maintain, fee services, long-term lease concessions, and operations and maintenance. Also known as alternative project delivery.

Alternative Project Delivery (APD) – A wide array of methods used by public agencies to deliver transportation project improvements. These methods include construction manager/general contractor, design-build, design-build-operate-maintain, design-build-finance, design-build-finance-operate-maintain, fee services, long-term lease concessions, and operations and maintenance (FHWA, 2017c). Also known as alternative delivery method.

Agency – A State highway agency, local public agency, or any other bridge asset agency (e.g., tribal nations, toll authorities, and the Office of Federal Lands Highway).

Americans with Disabilities Act (ADA) – The Americans with Disabilities Act of 1990 (42 U.S.C. 12101) is a civil rights law that prohibits discrimination based on disability. It affords similar protections against discrimination to Americans with disabilities as the Civil Rights Act of 1964.

Bundle – A group of things packaged together (in the context of this guidebook – a group of two or more bridges packaged in a project, program, or contract).

Bridge Bundling – A defined set (or bundle) of bridges that are planned for preservation/preventive maintenance, rehabilitation, or replacement in a timely and efficient manner through a series of bridge bundling contracts with the support of various funding options and/or partnerships that may include a program completion time frame.

Contract – A mutually binding legal relationship obligating the seller to furnish supplies or services and the buyer to pay for them (Glossary of Award Types, 2017).

Contracting – Purchasing, renting, leasing, or otherwise obtaining supplies or services from non-Federal sources. Contracting includes a description of supplies and services required, selection and solicitation of sources, preparation and award of contracts, and all phases of contract administration (Glossary of Award Types, 2017).

Contractor Compliance Program – The Contractor Compliance Program ensures that Federal contractors and subcontractors performing work on Federal and federally assisted highway contracts comply with nondiscrimination and affirmative action requirements. FHWA and State Transportation Agencies are responsible for assuring that Federal contractors and subcontractors do not discriminate in their employment and contracting practices based on race, color, religion, sex, national origin, age or disability. An overview and authorities are available on the FHWA [website](#).

Construction Manager/General Contractor (CM/GC) – The agency procures professional services on a qualifications or best-value basis from a construction manager during the design phase to offer suggestions on innovations, cost and schedule savings, and constructability issues. Upon completion of the design or individual design packages, the contractor and agency negotiate a price for the construction contract (often verified by an independent cost estimator), and then the construction manager acts as a general contractor to complete construction. The contract can employ a guaranteed maximum price administered on a cost-reimbursable basis, unit price, or lump-sum contract (FHWA, 2017c).

Culvert – A structure designed hydraulically to take advantage of submergence to increase water carrying capacity. Culverts, as distinguished from bridges, are usually covered with embankment and are composed of structural material around the entire perimeter; although some are supported on spread footing with a streambed serving as the bottom of the culvert. If the opening measured along the center of the roadway is more than 20 feet, then it is considered a bridge (National Bridge Inspection Standards - Definitions, 2009).

Design-Build (D-B) – A project delivery method that combines two, usually separate services into a single contract. With D-B procurements, agencies execute a single, fixed-fee contract (lump sum) for both architectural/engineering services and construction. The D-B entity—also known as a constructor—may be a single firm, a consortium, a joint venture or other organization assembled for a particular project. D-B has been implemented using various procurement approaches, including qualified low bid and best value (FHWA, 2017c).

Design-Bid-Build (D-B-B) – The traditional delivery method where the agency contracts separately for design and construction services, the bid is based on complete (100 percent) plans and specifications, and design and construction occur sequentially. D-B-B is typically a unit-priced contract, but it can also include lump-sum items (FHWA, 2017c).

Design-Build-Finance (DBF) – A project delivery method where procurement is a single contract awarded for the design, construction, and full or partial financing of a facility. Responsibility for the long-term maintenance and operation of the facility remains with the project sponsor, but could be included in a separate agreement. This approach takes advantage of the efficiencies of the design-build approach and also allows the project

sponsor to defer financing either completely or partially during the construction period (FHWA, 2017b).

Design-Build-Finance-Operate (DBFO) – Concessions whereby a single private consortium develops, builds, finances, and operates the road for a set number of years. See Design-Build-Finance-Operate-Maintain (DBFOM).

Design-Build-Finance-Operate-Maintain (DBFOM) – A concessions approach where the responsibilities for designing, building, financing, operating, and maintaining are bundled together and transferred to private sector partners.

There is a great deal of variety in DBFOM arrangements in the United States, especially in the degree to which financial responsibilities are actually transferred to the private sector. One commonality that cuts across all DBFOM projects is that they are either partly or wholly financed by debt-leveraging revenue streams dedicated to the project. Direct user fees (tolls) are the most common revenue source. Availability payments have also been used in this capacity. Future revenues are leveraged to issue bonds or other debt that provide funds for capital and project development costs. Often, they are also supplemented by public sector grants in the form of money or contributions in kind, such as right-of-way. Private partners are usually required to make equity investments as well (FHWA, 2017b).

Special Purpose IRS Rule 63-20 DBFOM –

Public sector agencies in the United States may finance capital projects by issuing tax-exempt debt, often making it more cost-effective for public project sponsors to issue debt than their private sector partners. Using this type of debt keeps interest costs low and generates attractive opportunities for both private and corporate investors. One method of reducing the borrowing costs to the private partner is to issue debt through a nonprofit public-benefit corporation pursuant to IRS Rule 63-20 and Revenue Proclamation 82-26. The nonprofit corporation is able to issue tax-exempt debt on behalf of private project developers (FHWA, 2017b).

Design-Build-Operate (DBO) – In a DBO project, a single contract is awarded for the design, construction, and operation of a capital improvement. Title to the facility remains with the public sector unless the project is a design-build-operate-transfer or design-build-own-operate project. On a public project, the operations phase is normally handled by the public sector or awarded to the private sector under a separate operations and maintenance agreement. Combining all three phases into a DBO approach maintains the continuity of private sector involvement and can facilitate private-sector financing of public projects supported by user fees generated during the operations phase (FHWA, 2017b). See Design-Build-Finance-Operate-Maintain.

Design-Build-Operate-Maintain (DBOM) – An integrated procurement model that combines the design and construction responsibilities of design-build procurements with operations and maintenance. These project components are procured from the private sector in a single contract with financing independently secured by the public sector project sponsor. This

project delivery approach is also known by a number of different names, including turnkey procurement and build-operate-transfer (FHWA, 2017b).

Disadvantaged Business Enterprise (DBE) Program – DBE is a legislatively mandated USDOT program that applies to Federal-aid highway dollars expended on federally assisted contracts issued by USDOT recipients such as State DOTs. The U.S. Congress established the DBE program in 1982 to ensure nondiscrimination in the award and administration of DOT-assisted contracts, help remove barriers to the participation of DBEs in DOT-assisted contracts, and assist the development of firms that can compete successfully in the marketplace outside of the DBE program. Implementation of the DBE program is guided by USDOT regulations found at 49 CFR part 26.

Equal Employment Opportunity (EEO) Counseling Program – It FHWA policy to provide equal opportunity in Federal employment and to prohibit discrimination in employment based on race, color, religion, sex, national origin, age, disability, genetic information, or sexual orientation. Retaliation against any person(s) for opposing any of the practices made unlawful by the EEO laws is prohibited. An overview and authorities are available on the FHWA [website](#).

Federal-aid – The Federal-Aid Highway Program supports State highway systems by providing financial assistance for the construction, maintenance, and operation of the nation's 3.9-million-mile highway network, including the Interstate Highway System, primary highways, and secondary local roads. The Federal Highway Administration is charged with implementing the Federal-Aid Highway Program in cooperation with the States and local government.

Federal Highway Administration (FHWA) – An agency within the U.S. Department of Transportation that supports State and local governments in the design, construction, and maintenance of the nation's highway system (Federal-Aid Highway Program) and various federally and tribal-owned lands (Federal Lands Highway Program).

Grant Anticipation Revenue Vehicle (GARVEE) – A bond, note, certificate, mortgage, lease, or other debt financing instruments, the proceeds of which are used to fund a project eligible for assistance under Title 23, Code of Federal Regulations, Section 122. GARVEEs can be issued by a State, a political subdivision of a State, or a public authority. Reimbursable debt-related costs include interest payments, retirement of principal, and any other cost incidental to the sale of an eligible debt instrument.

Indefinite Delivery/Indefinite Quantity (IDIQ) – A type of contract that provides for an indefinite quantity of supplies or services during a fixed period of time.

Incentive and Disincentive (I/D) Provisions – Time-related contract language that provides for a monetary payment or penalty for contract or activity completion within certain time constraints. At the most basic level, I/D provisions can be categorized into two groups: A+B (cost + time) and I/D. The primary distinction between these two types is that the

contractor determines the contract duration for an A+B contract, while the agency specifies the contract time for an I/D contract (NCHRP 652, 2016a).

Independent Cost Estimator (ICE) – Refers to the process in which a third party is hired to conduct a detailed estimate of the cost of a proposed construction project. An ICE can provide a more objective view of the cost and is used mainly for the purpose of transparency.

Innovation – A new idea, method, or device (in this guidebook, those related to bridge bundling).

Job Ordering Contracting (JOC) – A non-determinate location/non-determinate quantity-type contract. The heart of a JOC contract is a construction task catalog (CTC) consisting of hundreds of pre-priced work activities. The prices in the CTC are based on the estimated labor, equipment, and material costs to perform the work. All costs are based on local pricing (local prevailing wage rates, equipment costs, and local materials costs). Contractors bid a single adjustment factor that includes their overhead and profit and their risk assessment as to the prices in the CTC. The bidder submitting the lowest adjustment factor is declared the winner.

Local Public Agency (LPA) – An LPA is any public agency that receives Federal Highway Administration Federal transportation funds. These funds are passed through the State highway agency to the qualifying agency for improving infrastructure or providing transportation services.

National Bridge Inspection Standards (NBIS) – The United States Secretary of Transportation established the National Bridge Inspection Standards to locate and evaluate existing bridge deficiencies to ensure the safety of the traveling public.

On-the-Job Training (OJT) – A Federal Highway Administration program that requires State highway agencies to establish apprenticeships and training programs targeted to move women, minorities, and disadvantaged individuals into journey-level positions to ensure a competent workforce is available to meet highway construction hiring needs and to address the historical under-representation of members of these groups in highway construction skilled crafts. The OJT Supportive Services (OJT/SS) Program was established in Title 23, Code of Federal Regulations, Part 230 to supplement the OJT program and support State highway agency training programs by providing services to highway construction contractors and assistance to highway construction apprentices and trainees. The primary objectives of OJT/SS are to increase the overall effectiveness of the State highway agencies' approved training programs and to seek other ways to increase the training opportunities for women, minorities, and disadvantaged individuals.

Public Investment – The money that a government spends on public services or assets, whether through central or local governments or through publicly owned industries or corporations.

Public-Private Partnership (P3) – A contractual agreement between a public agency and a private entity that allows for greater private participation in the delivery of a transportation

project (FHWA, 2017c). P3s include any contractual arrangement in which the private sector takes on more risk. P3 goals may vary from raising funds from lease of an existing facility (brownfield) to constructing a brand-new facility (greenfield). P3s do not necessarily involve toll facilities. P3s traditionally include variations of design-build with one or more operate, maintain, and/or finance components (e.g., design-build-operate, design-build-finance-operate, design-build-finance-operate-maintain (DBFOM), availability-payment concession, and DBFOM concession) and could include other delivery methods such as construction manager/general contractor and alliancing.

Procurement Method – The means used to select a vendor (contractor, designer, or other service). These include low bid, best value, and qualifications-based selection. Other less common methods include adjusted low bid, sole source, and emergency selection.

Project Delivery Method (PDM) – The comprehensive process used by an agency to deliver a project, which includes planning, programming, design, construction, and consideration of required operations and maintenance. These methods include design-bid-build, indefinite delivery/indefinite quantity, design-build (D-B), and public-private partnerships (P3s). P3s include D-B with operate, maintain, and/or financing components, e.g., design-build-operate, design-build-finance-operate, design-build-operate-maintain, and design-build-finance-operate-maintain.

Progressive Design-Build (PDB) – A variation of design-build that facilitates involvement of the design-build team during the earliest stages of the agency’s project development, ensuring they are part of the project team developing design solutions (Design-Build Institute of America, 1994).

Quality Assurance (QA) – (1) All those planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service; or (2) ensuring the quality of a product is what it should be.

QA addresses the overall process of obtaining the quality of a service, product, or facility in the most efficient, economical, and satisfactory manner possible. Within this broad context, QA includes the elements of quality control, independent assurance, acceptance, dispute resolution, etc. The use of the term QA/QC or QC/QA is discouraged; the term QA should be used. QA involves continued evaluation of the activities of planning, design, development of plans and specifications, advertising and awarding of contracts, construction and maintenance, and the interactions of these activities (TRB Circular E-C173, 2013).

Quality Control (QC) – Also called “process control.” The system used by a contractor to monitor, assess, and adjust production or placement processes to ensure the final product will meet the specified level of quality. QC includes sampling, testing, inspection, and corrective action (where required) to maintain continuous control of a production or placement process (TRB Circular E-C173, 2013).

Title VI of the Civil Rights Act of 1964 – Title VI prohibits discrimination based on race, color, and national origin. Specifically, 42 USC 2000d states that “No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.” The use of the word “person” is important as the protections afforded under Title VI apply to anyone, regardless of whether the individual is lawfully present in the United States or a citizen of a State within the United States. An overview and authorities are available on the FHWA [website](#).

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Appendix A. Bridge Bundling Process Flowchart

The following process flowchart outlines the steps necessary to create a bridge bundling contract. Several of these may be completed in parallel, and the process may be iterative.

Table 21. Bridge bundling process steps, objectives, tools, and outcomes.

PROCESS STEPS	OBJECTIVE	TOOLS	OUTCOME
Step 1. Define successful bridge bundling (Chapter 1)	To be able to define a successful bridge bundling project or program.	<ul style="list-style-type: none">• Definition• Case studies• List of lessons learned	Improved understanding of the range of successful bridge bundling projects and programs
Step 2. Determine goals & objectives (Chapter 2)	To establish goals and objectives for a bridge bundling project or program.	<ul style="list-style-type: none">• Case studies, research studies• List of goals, benefits, challenges• Work types, asset management.	Documented project goals and objectives
Step 3. Identify funding or financing (Chapter 3)	To identify funding sources or a finance strategy.	<ul style="list-style-type: none">• Table of available funding options• Table of financing strategies• Federal funding programs	Documented funding sources or financing strategy
Step 4. Build a coalition & outreach (Chapter 4)	To identify the project implementation team and internal and external outreach plans.	<ul style="list-style-type: none">• Example communication plan• Tables of communication topics	Communication plan

Continuous communication >
v
v Continuously assessing risks ^

PROCESS STEPS	OBJECTIVE	TOOLS	OUTCOME
Step 5. Perform risk assessment (Chapter 5)	To formally identify initial project risks (threats and opportunities).	<ul style="list-style-type: none"> Risk process overview List of potential threats and opportunities List of potential risk responses 	Risk management plan Project risk register
Step 6. Select bridges (Chapter 6)	To formally identify bridge selection criteria and candidate bridges.	<ul style="list-style-type: none"> Bridge selection matrix Table of contract sizes Table of contract durations Table of screening criteria 	List of candidate bridges for bundling
Step 7. Select delivery method (Chapter 7)	To identify the most appropriate project delivery and procurement method.	<ul style="list-style-type: none"> Comparison tables of project delivery and procurement methods Project Delivery Selection Tool 	Selected project delivery and procurement method
Step 8. Determine environmental review & preliminary design considerations (Chapter 8)	To identify environmental clearance and permitting issues; and preliminary design issues.	<ul style="list-style-type: none"> List of potential issues Case studies Noteworthy practices 	Identification of environmental and preliminary design issues to address
Step 9. Bundle & let contract(s) (Chapter 9)	To identify roles and responsibilities for contract creation and management.	<ul style="list-style-type: none"> Responsibility matrix Civil rights and Disadvantaged Business Enterprise table Sample contract documents 	Project management plan

PROCESS STEPS	OBJECTIVE	TOOLS	OUTCOME
Step 10. Conduct quality assurance, close-out & celebrate! (Chapter 10)	To understand the issues to consider and options available for quality assurance.	<ul style="list-style-type: none"> • List of items to consider. • Comparison tables of quality assurance options 	Quality assurance plans
	To celebrate the project successes and capture lessons learned.	<ul style="list-style-type: none"> • List of close-out and celebration items to consider • Implementation checklist 	Celebration actions Close-out actions

Appendix B. Bridge Bundling Implementation Checklist

The following checklist is intended to guide the bridge bundling project agency through the steps and decisions necessary to create a bridge bundling project and as a mechanism to record project decisions. It can also serve as a valuable communication tool for all project stakeholders.

Table 22. Bridge bundling checklist.

BRIDGE BUNDLING CHECKLIST			
Project Name:			
Date:			
Brief Project Description/Scope of Work:			
<input checked="" type="checkbox"/>	ACTIVITY	DETAILED CONSIDERATIONS	COMMENTS:
<input type="checkbox"/>	Bridge asset management: size & timing of bridge bundling review	<ul style="list-style-type: none">• Alternative investment strategies• Long-term network lifecycle cost & condition analysis• Long-term financial analysis• Ability to fund future preservation, rehabilitation & replacement needs• Effect of investment on future finances & bridge conditions	-
<input type="checkbox"/>	Project manager identified	<ul style="list-style-type: none">• Role and responsibilities documented• Formal announcement made	-
<input type="checkbox"/>	Goals and objectives documented (clear and understandable)	<ul style="list-style-type: none">• Legislated goals• Performance goals• Agency-directed goals• Innovation goals• Time/schedule goals• Condition improvement goals• Economic goals• Resiliency goals• Other goals	-

BRIDGE BUNDLING CHECKLIST

<input type="checkbox"/>	Funding available/budget	<ul style="list-style-type: none"> • Existing funds • New State/local sources • Federal credit assistance • Private equity (public-private partnership) • Soft match credits (tolls and non-Federal-aid bridges) • Discretionary bridge program • Finance plan for projects with an estimated total cost of \$100 million or more (per Federal Highway Administration major projects requirements) (23 U.S.C. 106 (h)(i)) 	-
<input type="checkbox"/>	Guiding coalition designated	<ul style="list-style-type: none"> • Executive lead • Management team 	-
<input type="checkbox"/>	Communication plan developed	<ul style="list-style-type: none"> • Internal • Industry (construction and engineering) • Other stakeholders • Affected constituents • Elected officials • Financial markets (for a public-private partnership) 	-
<input type="checkbox"/>	Stakeholder support	<ul style="list-style-type: none"> • Internal • External 	-
<input type="checkbox"/>	Initial risk assessment (threats and opportunities)	<ul style="list-style-type: none"> • Risk management plan developed • Risks identified • Risks evaluated • Risk responses formulated • Risk register created 	-

BRIDGE BUNDLING CHECKLIST

<input type="checkbox"/>	Bridge selection criteria established	<ul style="list-style-type: none"> • State-owned • Local-owned • Other-owned • Condition and work needs • Work type • Environmental restrictions • Engineering restrictions • Geographic limits 	-
<input type="checkbox"/>	Project delivery method selected	<ul style="list-style-type: none"> • Design-bid-build • Indefinite delivery/indefinite quantity • Construction manager/general contractor • Design-build • Public-private partnership/design-build-finance-operate-maintain 	-
<input type="checkbox"/>	Procurement method selected	<ul style="list-style-type: none"> • Low bid • Best value • Qualifications-based selection 	-
<input type="checkbox"/>	Bridge standards to be met established	<ul style="list-style-type: none"> • Federal standards • State standards • Design considerations • Construction considerations 	-
<input type="checkbox"/>	Environmental clearance process	<ul style="list-style-type: none"> • Federal (including National Environmental Policy Act) • State • Local 	-
<input type="checkbox"/>	Right-of-way determined	<ul style="list-style-type: none"> • Within existing • Additional acquisitions needed 	-

BRIDGE BUNDLING CHECKLIST

<input type="checkbox"/>	Civil rights requirements determined	<ul style="list-style-type: none"> • Federal (Disadvantaged Business Enterprise Program) • State (minority/women's business enterprise program) • Local 	-
<input type="checkbox"/>	Third-party issues identified, coordination plan	<ul style="list-style-type: none"> • Utilities • Railroads 	-
<input type="checkbox"/>	Risk assessment/risk transfer decisions (to be reflected in contract documents)	<ul style="list-style-type: none"> • Risk register updated • Risk responses identify responsible party • Contract provisions address risks transferred to others 	-
<input type="checkbox"/>	Quality assurance process selected	<ul style="list-style-type: none"> • By agency staff • By agency representative • By local agency • By public-private partnership concessionaire 	-
<input type="checkbox"/>	Project estimate within budget	<ul style="list-style-type: none"> • Yes: continue • No: re-evaluate scope 	-
<input type="checkbox"/>	Contract/procurement documents prepared	<ul style="list-style-type: none"> • Transferred risks clearly articulated • Quality assurance roles clearly defined 	-
<input type="checkbox"/>	Post-award management team established	<ul style="list-style-type: none"> • Project manager identified (same or new) • Delivery team members identified and roles defined 	-

BRIDGE BUNDLING CHECKLIST

<input type="checkbox"/>	Risk assessment (threats and opportunities)	<ul style="list-style-type: none"> • Risk management plan developed (build from original plan) • Risks identified • Risks evaluated • Risk responses formulated • Risk register updated • Risk monitored and controlled 	
<input type="checkbox"/>	Project close-out	<ul style="list-style-type: none"> • Asset management performance measures updated • Process and procedures updated • Contract language changes made • Risk register updated • Plans recorded • Lessons learned recorded 	
<input type="checkbox"/>	Celebrate and recognize	<ul style="list-style-type: none"> • Internal recognition provided • External recognition provided • Successes marketed/advertised • Technical papers and presentations developed • Lessons learned and best practices shared with others 	

Appendix C. Case Studies

The case studies listed in Table 23 document 17 bridge bundling efforts. The case studies cover the following aspects of bridge bundling projects and programs:

Scope of work:

- Preservation/preventive maintenance
- Rehabilitation
- Replacement/new

Ownership:

- State
- Local
- Combined (State and local)

Source of funding and financing:

- Federal
- State
- Local
- Private sector

Delivery:

- Design-bid-build
- Indefinite delivery/indefinite quantity
- Construction manager/general contractor
- Design-build
- Public-private partnerships (design-build-finance)

Procurement:

- Low bid
- Best value
- Qualifications-based selection

Table 23. Bridge bundling case studies.

LEAD AGENCY	BRIDGE PROJECT TYPE	CONTRACTING METHODS		CONTRACT SIZE		FUNDING SOURCE	NOTES
		DELIVERY	PROCUREMENT	# BRIDGES	COST		
Delaware DOT	Preservation/ Preventive Maintenance	D-B-B	Low Bid	2–20	\$1.5M–\$4.5M	Federal and State Funds	Bridge bundles to address preventive maintenance.
Delaware DOT	Replacement	D-B-B	Low Bid	3–5	\$1M	Federal and State Funds	Bridge bundle program to address large culvert replacements.
	Replacement	IDIQ	Low Bid	22	\$5.5M		
	Replacement	D-B	Best Value	28	\$11M		
Erie County, NY	Preservation/ Preventive Maintenance	D-B-B	Low Bid	3–25	\$1M–\$1.5M per year	Federal and State Funds	Bundled by work type: steel repair, deck repair, cleaning, deck sealing.
FHWA Central Federal Lands Highway Division	Replacement	D-B-B	Best Value	11	\$49M	Federal-aid: Emergency Relief Program	Included 10 miles of roadway. Extensive stakeholder communication.
Georgia DOT	Replacement	D-B	Low Bid	5–7	\$8M–\$13M	100% State Funded	Targeted local bridges; RFP with 50% plans.

LEAD AGENCY	BRIDGE PROJECT TYPE	CONTRACTING METHODS		CONTRACT SIZE		FUNDING SOURCE	NOTES
		DELIVERY	PROCUREMENT	# BRIDGES	COST		
Missouri DOT	Replacement	D-B	Best Value	554	\$487M	Federal Reimbursement Bonds	Part of Safe & Sound Bridge Improvement Program. D-B contract very non-prescriptive.
	Rehabilitation Replacement	D-B-B	Low Bid	2–10	<\$5M		
Nebraska DOT	Replacement	Determined by lead county	State Infrastructure Bank provides matching funds to counties up to \$150K.	State program assists with replacement of local bridges. Encourages bridge bundling and cooperation between counties.			
New York State DOT	Preservation/ Preventive Maintenance	D-B-B	Low Bid	6–200	\$2M–\$6M	Federal and State Funds	Bridge bundles to address preventive maintenance in Region 1.
New York State DOT	Rehabilitation	D-B	Best Value	6–16	\$24M–\$31M	Federal and State Funds	NY Works program. Replaced 110 bridge decks. D-B-B contracts with limited plan details.
	Rehabilitation	D-B-B	Low Bid	2–19	\$5M–\$29M		
Northampton County, PA	Rehabilitation Replacement	P3 (DBFM)	Best Value	33	\$38.5M	P3 with payments for 14 years.	P3 put together by a county; 100% county funded.
Ohio DOT	Replacement	D-B	Low Bid	2–3	\$1M–\$2M	Financed with GARVEE bonds paid back over 12 years.	Targeted local bridges. Program financed in \$110M bundle and split into smaller contracts.

LEAD AGENCY	BRIDGE PROJECT TYPE	CONTRACTING METHODS		CONTRACT SIZE		FUNDING SOURCE	NOTES
		DELIVERY	PROCUREMENT	# BRIDGES	COST		
Oregon DOT	Replacement	CM/GC	QBS	3	\$163M	State funded	Bundled by location.
Oregon DOT	Replacement	D-B-B D-B CM/GC	Low bid Best value QBS	85 10 1	\$1.3B	Federal and State funds	Bridges were bundled by location and corridor and by project type (complex or simple).
Osceola County, FL	New	CM/GC	QBS	13	\$350M	Local	A program of 11 roadway projects with 13 bridges.
Pennsylvania DOT	Rehabilitation Replacement	D-B-B	Low Bid	7-8	\$3M-\$13M	100% State Funded	Targeted local bridges. One design—multiple bridges.
Pennsylvania DOT	Replacement	P3 (DBFM)	Best Value	558	\$899M	P3 with payments for 25 years.	Largest P3 bridge bundle project.
South Carolina DOT	Replacement	D-B	Adjusted Low Bid	3-13	\$8M-\$53M	Federal-State Funds	Mature D-B program. Learned from past bridge bundles.

CM/GC = construction manager/general contractor, D-B = design-build, D-B-B = design-bid-build, DBFM = design-build-finance-maintain, DOT = department of transportation, GARVEE = Grant Anticipation Revenue Vehicle, IDIQ = indefinite delivery/indefinite quantity, P3 = public-private partnership, QBS = qualifications-based selection, RFP = request for proposal

DelDOT Culvert Replacement Bridge Bundling Program

Agency Name:	Delaware Department of Transportation (DelDOT)
Project Location:	Statewide
Project Delivery Method:	Design-bid-build (D-B-B), indefinite delivery indefinite quantity (IDIQ), design-build (D-B)
Procurement Method:	Low bid, best value
Total Project Cost:	D-B-B small bundles (D-B-B/low bid) – \$1 million per contract Open-end contract (IDIQ/low bid) – \$5.5 million over 3 years D-B contract (D-B/best value) – \$11 million over 3 years Funding has ranged from \$1 to \$3 million per year, total.
Funding Source:	Small D-B-B bundles – 100 percent State funded, Federal and State funded (80/20) Open-end contract – 100 percent State funded D-B contract – Federal and State funded (80/20)
Construction Schedule:	Different durations: each location is assigned a construction schedule based on the work required to complete the job.
Project Description:	In the early 2000s, DelDOT discovered a serious problem with deterioration of large pipe culverts. Due to a decision made in the 1980s to remove them from the bridge inventory, hundreds of large culverts in poor condition had escaped inspection for decades. DelDOT assessed the problem and began a bundling program to replace the culverts quickly. The first attempt to speed up project delivery and get cost savings through economy of scale was to create small bundles of culvert replacements. Plans were prepared and projects were awarded based on low bid. This worked, but improvements to the process were still needed. Some of the small bundles were delayed because of issues in a single location (right-of-way [ROW], utilities, etc.). Also, DelDOT was looking for ways to reduce the time needed for developing plans and procuring a contract. This led to the second contracting method, which was development of an IDIQ contract. In this contract, DelDOT developed detailed plans for five locations that were shovel ready. Additional quantities were included for locations to be determined at a later date. In all, 17 additional locations were added successfully. The

contractor that won the bid was involved in the design of the additional locations, helping to determine utility relocations, stream diversion plans, ROW needs, and schedule. The IDIQ methodology helped accelerate delivery with this bridge bundle, as DelDOT did not need to go through the procurement process for each additional location. The procurement method used for this project was low bid.

In an effort to move even quicker, DelDOT created a D-B contract that bundled the replacement of 28 culverts under one contract. The successful D-B team was responsible for all aspects of the project, including plan preparation, utility coordination, permit acquisition, and ROW negotiations. The procurement method used for this project was best value, considering both price and qualifications of the team.

In total, DelDOT has spent between \$1 and \$3 million per year for more than 10 years on culvert replacement bridge bundles. Even with the simple nature of the work, the contracting methods that gave the contractor input during design were beneficial for the department. Costs per location were comparable across all three contracting methods.



Figure 30. Delaware pipe culvert bundle projects.

Source: DelDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal for the culvert bundling contracts is to reduce the number of culverts in poor condition as quickly as possible.
Bridge Selection Criteria	Pipe culverts with over 20 square feet of opening that are in poor condition that can be replaced in kind with pipes.
Delivery and Procurement Method	Small D-B-B bundles: D-B-B, low bid Open-end contract: IDIQ, low bid D-B contract: D-B, best value
Funding Sources/Financing Strategy	Small D-B-B bundles – 100 percent State funded, Federal and State funded (80/20) Open-end contract – 100 percent State funded D-B contract – Federal and State funded (80/20)
Environmental, Right-of-Way, and Utility Considerations	Small D-B-B bundles: Completed by DelDOT before advertisement. Open-end contract: For added locations, completed by DelDOT after procurement with input from the contractor. D-B contract: Third-party coordination is the responsibility of the contractor.
Program Risks	Small D-B-B bundles: Typical D-B-B contract—risk is on the owner. Open-end contract: IDIQ contracts have inherently higher risk in providing a bid price because locations and exact work type are unknown. Providing known locations and work types lowered the risk. D-B contract: Risk is primarily on the contractor. Culvert replacements are primarily low risk.
Owner Management/Quality Assurance	Small D-B-B bundles: Typical D-B-B contract. Open-end contract: Contractor involved in design review. Inspection performed by DelDOT. D-B contract: Quality assurance, quality control, and construction inspection are the responsibility of the D-B team.
Stakeholder Communication	Communication is the same as for any other project. For the D-B contract, the D-B team is responsible for communication with the affected community.

DelDOT Preventive Maintenance Bridge Bundling Program

Agency Name:	Delaware Department of Transportation (DelDOT)
Project Location:	Statewide
Project Delivery Method:	Indefinite delivery indefinite quantity (IDIQ), design-bid-build (D-B-B)
Procurement Method:	Low bid
Total Project Cost:	North District bridge maintenance contract (IDIQ/low bid) – \$3 million over 3 years Canal District bridge maintenance contract (IDIQ/low bid) – \$3 million over 3 years Central District bridge maintenance contract (IDIQ/low bid) – \$1.5 million over 3 years South District bridge maintenance contract (IDIQ/low bid) – \$1.5 million over 3 years Interstate deck patching contract (IDIQ/low bid) – \$4.5 million over 3 years Deck sealing contract (D-B-B/low bid) – \$2 million over 5 years Bridge painting contract (D-B-B/low bid) – \$3 million per year
	Current funding is around \$8 million per year, total.
Funding Source:	Bridge maintenance contracts – 100 percent State funded Interstate deck patching contract – 100 percent State funded Deck sealing contract – Federal and State funded (80/20) Bridge painting contract – Federal and State funded (80/20)
Construction Schedule:	The maintenance contracts are 3-year, open-end contracts. The deck sealing and bridge painting contracts are assigned times based on the work.
Project Description:	DelDOT uses a series of bridge bundling contracts to address preventive maintenance issues. Work to be included in these contracts is prioritized by the agency's Bridge Management Section, and the contracts are administered by the DelDOT Maintenance Districts.

A combination of Federal and State funds is used to pay for the work. DelDOT and the Federal Highway Administration (FHWA) agreed to a memorandum of understanding on the types of preventive maintenance activities that Federal funds can be used to address. On the open-end bridge maintenance contracts, DelDOT uses 100-percent State funds in order to be able to react quicker without the need for National Environmental Policy Act (NEPA) clearance. Even though the NEPA process is simple for maintenance work, the time needed to obtain clearance can be critical when there is an urgent need for a repair.

The deck sealing and bridge painting contracts are true preventive maintenance contracts. DelDOT takes a programmatic approach to prioritizing work in a timely manner. The goal is to keep decks sealed and steel beams painted to prevent deterioration. The deck-sealing contract focuses on decks with black steel reinforcement that are in good condition. The program is aimed at sealing these decks every 5 years. The locations and quantities are determined in design. Plans are put together in a proposal format and awarded based on low bid.

The bridge maintenance and deck patching contracts are intended to address preventive maintenance for bridges identified as needing work on an annual basis as part of the prioritization process, but also serve as a means to address emergency-related issues. The exact locations and work types are not known, but DelDOT advertises the contracts based on historical work. Plans are put together in proposal format with assumed items and quantities and awarded based on low bid. Items of work needed over the term of the contract (usually 3 years) that are not in the contract are negotiated.

Even though much of the work performed is repair work, DelDOT considers these contracts to be preventive maintenance. Most of these bridges are still in fair or good condition and would otherwise not receive work until they deteriorated significantly. Putting together a contract for one bridge would not be efficient and would have such low quantity that it would not be worthwhile. Bundling allows the repairs to be made in a timely manner.

The focus of these contracts is to keep the decks and joints in good condition to prevent deterioration of the bearings and substructure. Because contractors do not know the exact location and type of work, the prices for the IDIQ maintenance contracts tend to be higher to account for the risk. The tradeoff is that DelDOT can get

repairs completed quicker and have a method to address emergency bridge-related issues while also performing preventive maintenance for its bridge inventory.

To maximize the return on investment, DelDOT staff tries to focus the work on the items that have a direct effect on the condition ratings of the bridge (for example, not repairing small spalls on the substructure). Contractors have the opportunity to assist in developing design details and have input on the timing of work to minimize disruptions to traffic.

In total, DelDOT spends around \$8 million per year on preventive bridge maintenance activities, which is approximately 15 percent of the agency's bridge-preservation budget.

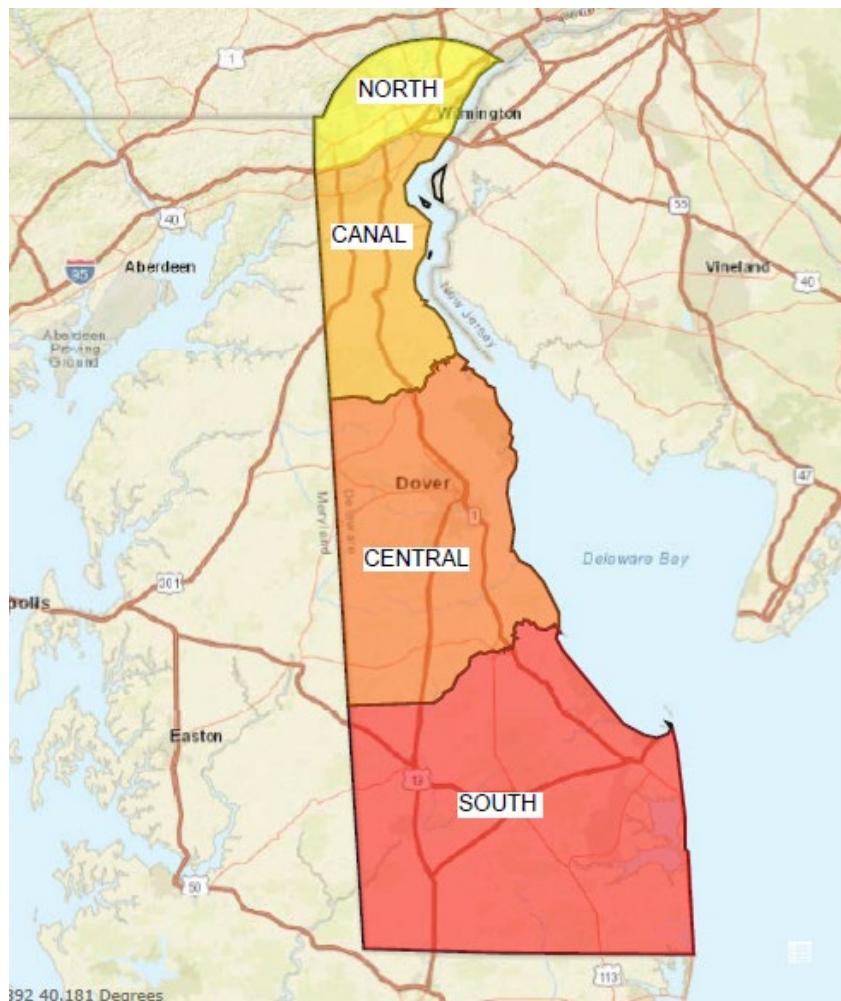


Figure 31. Delaware DOT Maintenance Districts.

Source: DelDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal for the preventive maintenance contracts is to save time and money by bundling similar work (deck sealing and bridge painting). The goal for the open-end contracts is to minimize response time and to address small maintenance items early via bundling.
Bridge Selection Criteria	<ul style="list-style-type: none"> • Deck sealing – decks with black bar and in good condition. • Bridge painting – paint condition index less than 75. • Open-end contracts – deck spalls and delamination, leaking joints, deteriorated back walls, bearings (items identified during inspections), spot painting, concrete sealing, scour repair.
Delivery and Procurement Method	<ul style="list-style-type: none"> • Deck sealing – D-B-B, low bid • Bridge painting – D-B-B, low bid • Open-end maintenance contracts – IDIQ, low bid
Funding Sources/Financing Strategy	<ul style="list-style-type: none"> • Contracts with known locations – federally funded • Contracts with unknown locations – 100 percent State funded
Environmental, Right-of-Way, and Utility Considerations	Bridge maintenance work—no third-party involvement
Program Risks	IDIQ contracts have inherently higher risk in providing a bid price because locations and exact work type are unknown. Contracts with known locations are low risk.
Owner Management/Quality Assurance	Contracts are put together by the Bridge Management Section, but are managed by the Maintenance Districts. Construction inspection is performed by DelDOT. Construction details for IDIQ contracts are put together by the Bridge Management Section with input from the contractor.
Stakeholder Communication	Communication is limited to notifications for road and lane closures as needed to do the work.

Erie County (New York) Preventive Maintenance Bridge Bundling Program

Agency Name:	Erie County
Project Location:	Erie County, NY
Project Delivery Method:	Design-bid-build (D-B-B)
Procurement Method:	Low bid
Total Project Cost:	\$1 million every other year (steel repairs) \$1 million every other year (deck repairs) \$250,000 every other year (bridge washing) \$200,000 per year (deck sealing)
	Current funding is \$1 to \$1.5 million per year, total.
Funding Source:	All contracts are 80 percent federally funded. The 20 percent match is provided by Erie County. Sometimes the New York State Department of Transportation (NYSDOT) covers 15 percent of the matching funds.
Construction Schedule:	The maintenance contracts are assigned times based on the work.
Project Description:	Erie County uses a series of bridge bundling contracts to address preventive maintenance issues. The bridges are bundled primarily by work type. Location is also a consideration. There are four types of bundled maintenance contracts: steel repair contracts, deck repair contracts, bridge washing contracts, and deck sealing contracts.
	The contracts are assembled by the County Bridge Engineer. Erie County relies on Federal funds to pay for 80 percent of the cost to complete the work. The agency submits a bridge preventive maintenance work plan to NYSDOT for consideration. NYSDOT makes the determination on funding. NYSDOT places an emphasis on preventive maintenance contracts and, dependent on funding, sometimes covers 15 percent of the local match.
	The steel repair contracts address repair-type work such as repairs to webs, repairs to flanges, repairs to bearings, continuity of simple spans for joint elimination, armored joint replacements, and bridge painting. These contracts include detailed plans by location. There is typically one contract every other year at a value of around \$1 million. On average, the steel repair contract includes three to

four bridges, depending on the type of work. Erie County paints bridges on a 12-year cycle.

The deck repair contracts address repair-type work such as patching of spalls and delaminated concrete decks and adding an asphalt overlay with waterproofing membrane, joint repair and replacement, and replacement of membranes and asphalt overlays. These contracts include detailed plans by location. There is typically one contract every other year at a value of around \$1 million. The deck repair and steel repair contracts alternate years. On average, the deck repair contract includes three to four bridges, depending on the type of work. Only critical work is performed, not complete deck replacements.

The bridge washing and deck sealing contracts are true preventive maintenance contracts. The bridge washing contract is usually around \$250,000, and it is done every other year. All non-culvert bridges with spans over 20 feet are washed (around 240). Deck sealing contracts are let every year at an approximate value of \$200,000. Erie County has around 150 bridges over 20 feet in length with bare concrete decks. These decks are sealed on a 6-year cycle, so about 25 bridges are sealed every year. The locations and quantities for both the bridge washing and deck sealing contracts are determined in design. Plans are put together in a proposal format and awarded based on low bid.

In total, Erie County spends \$1 to \$1.5 million per year on preventive bridge maintenance activities, which is 40 percent of the agency's bridge budget, on average. NYSDOT encourages counties to spend Federal dollars on preventive maintenance to preserve existing assets.

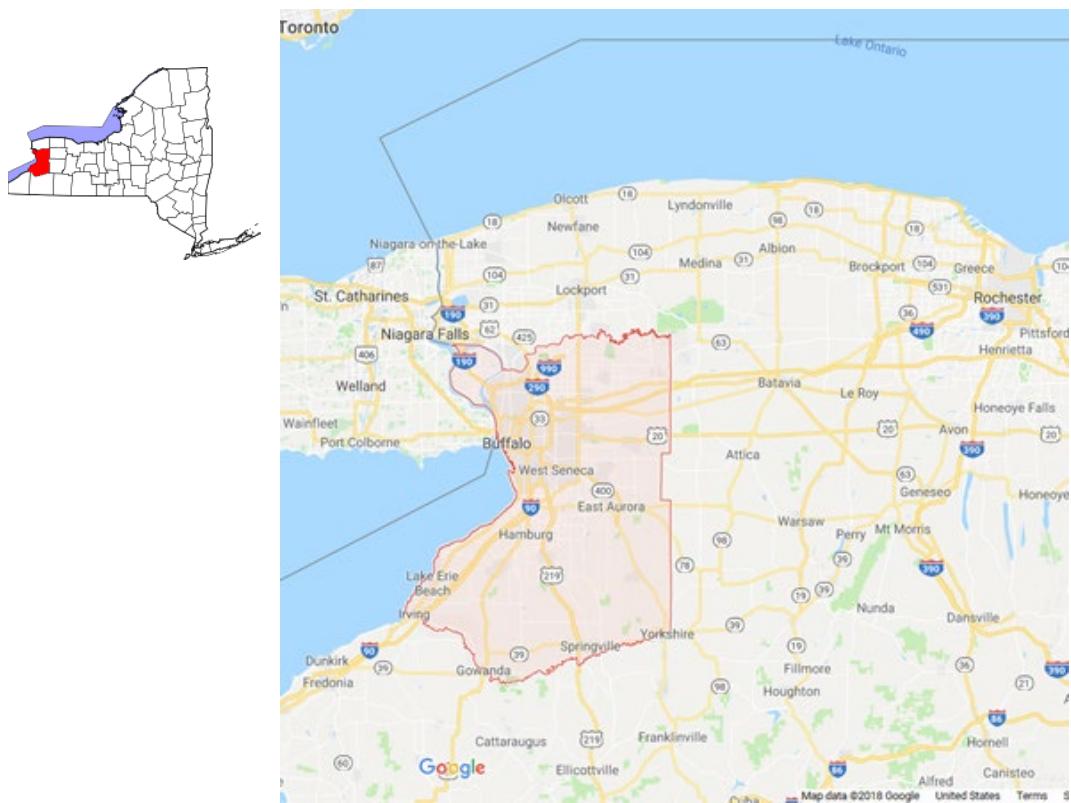


Figure 32. Map of Erie County, New York.

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal for the preventive maintenance contracts is to extend the service life of bridges by addressing small maintenance items early through bundling. Bundling by location and similar work type also saves money through economy of scale.
Bridge Selection Criteria	Bridges are selected for work by the Erie County Bridge Engineer. Work is generated from inspections and communication with bridge maintenance personnel.
Delivery and Procurement Method	D-B-B, low bid
Funding Sources/Financing Strategy	All contracts are 80 percent federally funded. The 20 percent match is provided by Erie County. Sometimes NYSDOT covers 15 percent of the matching funds.
Environmental, Right-of-Way, and Utility Considerations	Bridge maintenance work—no third-party involvement.
Program Risks	The maintenance work is generally low risk.
Owner Management/Quality Assurance	Contracts are put together by the Erie County Bridge Engineer and the county's engineering consultant, submitted to NYSDOT for consideration and approval. Construction inspection is performed by Erie County or its consultant for the project.
Stakeholder Communication	Communication is limited to notifications for road, bridge, and lane closures as needed to do the work.

GDOT Design-Build Bridge Replacement Program

Agency Name:	Georgia Department of Transportation (GDOT)
Project Location:	Statewide
Project Delivery Method:	Design-build (D-B)
Procurement Method:	Low bid
Total Project Cost:	2016 – \$39.6 million (25 bridge replacements in five bundles) 2017 – \$25 million (13 bridge replacements in two bundles) Future funding is \$30 million per year.
Funding Source:	100% State funded No local match
Construction Schedule:	GDOT provides 1,095 days per bridge bundle, with a road closure time duration assigned for each bridge.
Project Description:	<p>With the passing of Georgia House Bill 170, the Transportation Funding Act of 2015 was expected to raise nearly \$1 billion per year in transportation-dedicated funding. With that, the GDOT bridge program increased from \$100 million per year to approximately \$250 million per year. In an effort to ramp up replacement and repair of county-owned bridges, GDOT began a bridge bundling program aimed at efficiency and speed using the D-B project delivery method coupled with low-bid procurement.</p> <p>GDOT meets with the counties for endorsements and concurrence when choosing bridges for the program. The D-B request for proposals (RFP) is very prescriptive and includes 50-percent design plans in the package. In an effort to save time during the procurement process, GDOT does not include an opportunity for alternative technical concepts. Instead, the bundle projects include an industry forum that offers a chance for participating teams to conduct one-on-one meetings with GDOT to propose innovative ideas.</p>
Program Website:	GDOT Design-Build GDOT Design-Build SharePoint Site See also: GDOT Fiscal Year 2018 Design-Build Bridge Replacements Industry Forum presentation (January 29, 2018)

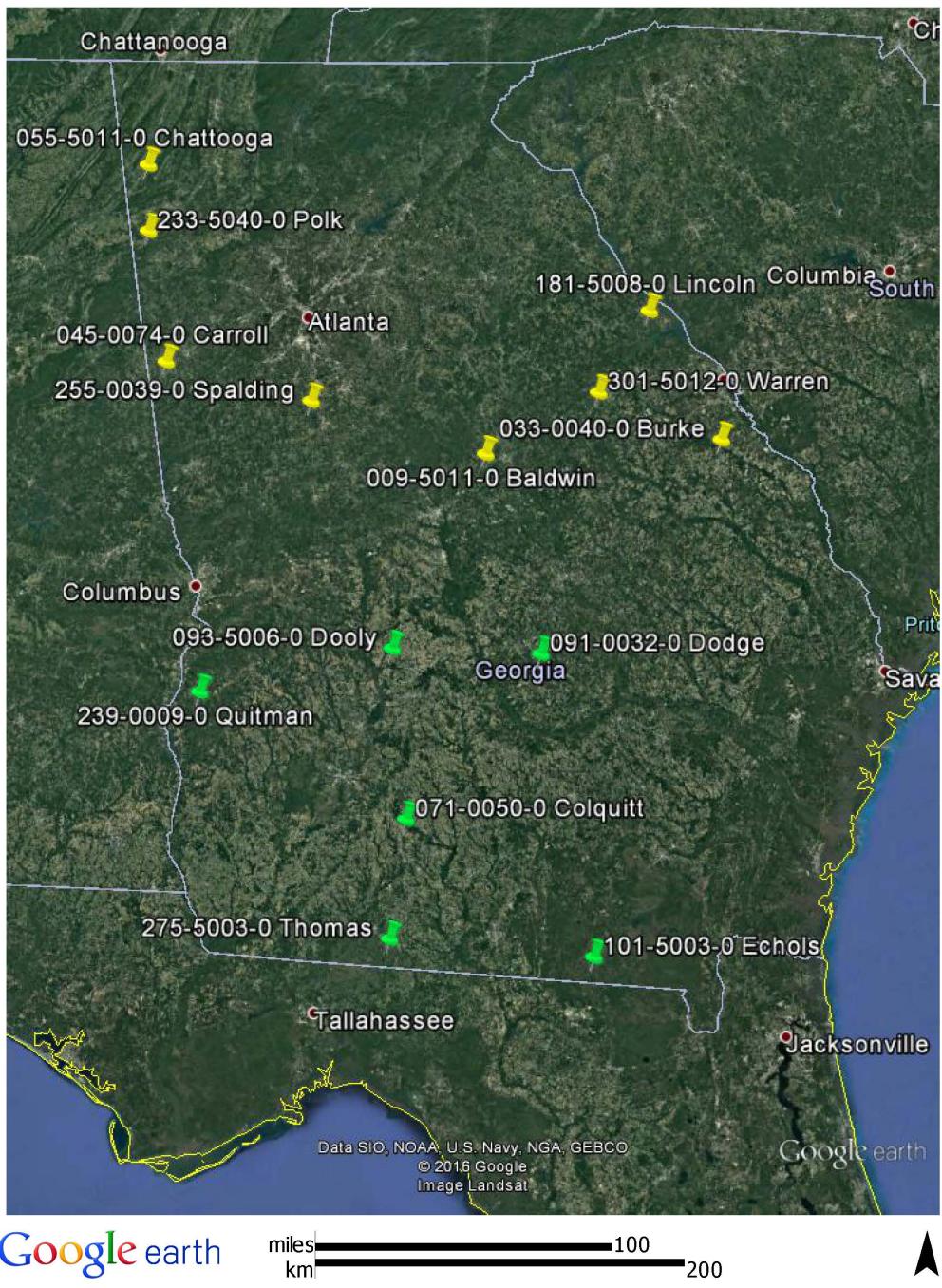


Figure 33. Map showing Georgia D-B bridge bundle project sites.
Source: GDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal of the program is to deliver projects quickly and efficiently in order to rapidly reduce the number of locally owned bridges in poor condition.
Bridge Selection Criteria	<p>The screening process is vital to project success. Bridges that could hold up the contract are eliminated from consideration.</p> <ul style="list-style-type: none"> • County owned. • Poor Condition. • Limited or no right-of-way (ROW) needs. • Small bridges across small creeks (typically). • Available detour routes (preferred). • Low traffic volume. • No railroad involvement. • No Federal Emergency Management Agency floodplains. • Close proximity for grouping.
Delivery and Procurement Method	D-B, low bid (Contractors should be prequalified.)
Funding Sources/Financing Strategy	<p>100% State funded</p> <p>No local match</p>
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> • The general engineering consultant (GEC) putting together the D-B bundles completes the hydrology and hydraulics analysis. The GEC also considers the environmental impacts, endangered species, and windows for construction and includes that information in the RFP. • The D-B team prepares all environmental permits. GDOT submits them. • Because the projects are State funded, the U.S. Army Corps of Engineers (USACE) becomes the lead agency for the National Environmental Policy Act (NEPA) process for locations requiring a USACE permit. • If ROW is needed, the D-B team prepares the plans and obtains the appraisals. GDOT makes the acquisitions. • Utility coordination is the responsibility of the D-B team. It is typically not an issue because GDOT has the authority to pay for utility relocations in the contract. • Because they are State funded, projects can be advertised without final environmental approvals. Approvals are usually received between award and start of construction. This helps speed up procurement.

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Risks	<p>Many traditional risks that accompany a D-B project are minimized because the GDOT RFP is very prescriptive. The following are the biggest threats in the D-B bridge bundles:</p> <ul style="list-style-type: none"> • Regulatory agency review times. • Local contractor support. • Engineer of Record's length of engagement in construction.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • A GEC represents GDOT for scope, RFP development, and review. • The GDOT Bridge Section reviews the GEC and does final plan reviews. • Construction inspection is completed by a third party and is paid for by GDOT.
Stakeholder Communication	<ul style="list-style-type: none"> • Worked with Governor's office to set program goals. • Met with industry to gain program support. • Work with counties to select bridges. • Conduct industry forum for bidders with opportunities for one-on-one meetings for each bundle.

Larimer County Road 43 (Colorado) Emergency Project Bridge Bundling

Agency Name:	Federal Highway Administration (FHWA) Central Federal Lands Highway Division (CFLHD)
Project Location:	Larimer County, CO
Project Delivery Method:	Design-bid-build (D-B-B)
Procurement Method:	Best value, single award task order contract (SATOC)
Total Project Cost:	\$49 million for design and construction to repair or replace 10 miles of roadway and 12 bridges
Funding Source:	FHWA Emergency Relief Program. Determined to be 100 percent eligible through the Federal Lands Access Program (FLAP).
Construction Schedule:	October 2014 through July 2016 (22 months)
Project Description:	<p>During the week of September 9, 2013, heavy rains resulted in catastrophic flooding along Colorado's Front Range, heavily damaging Larimer County Road 43, which provides access to the Roosevelt National Forest and Rocky Mountain National Park.</p> <p>The design and construction approach was founded on streamlining the emergency and permanent repairs and integrating roadway design with stream restoration along the North Fork of the Big Thompson River. Throughout design and construction, the long-term resiliency of the facility was a major consideration. Where possible, the roadway was realigned to help protect it from future storms and the bridges were strategically placed to minimize impacts from future floods.</p> <p>The total project included repair or reconstruction of 10 miles of roadway and replacement of 12 bridges. The effort required 250,000 cubic yards of rock excavation, 50,000 cubic yards of roadway armor, and the replacement of 14 metal pipes and box culverts with 12 single-span bridges between 40 and 50 feet in length. All work was completed under a SATOC. Plans were developed to a point where they could be bid and the contractor was chosen based on best value. The SATOC allowed the contractor to begin work immediately on some areas, while details and third-party issues for other areas were still being worked out. There were 12 task orders in all, and work started 7 days after award.</p>

The contractor also had the flexibility to work with the CFLHD project delivery team to collaborate on the phasing of work packages and over-the-shoulder design reviews to optimize the final product. One example was the substructure for the bridges. They were originally designed as geosynthetic reinforced soil-integrated bridge system (GRS-IBS) abutments, but through a collaborative effort, were changed to a cast-in-place abutment founded on partially grouted large rock (the same rock used for the armor). This rock was readily available as it was generated on site, making it more efficient and inexpensive than the originally proposed solution.

Although this was a D-B-B contract, the use of the SATOC allowed it to function more like a construction manager/general contractor (CM/GC) contract, with a quick start and constant communication and collaboration between the designers and contractor throughout the project. The collaboration also resulted in shared risk between the contractor and CFLHD.

In order to maximize efficiencies in design and construction, the mix of culverts that previously existed were replaced with bridges with similar details. The standardized design was criteria driven, and there was flexibility in the contract to accommodate changes.

All bridges had the following characteristics:

- Single spans 40 to 50 feet long.
- Prestressed concrete box beam superstructures (designed by precaster).
- Abutment walls 7 to 10 feet high (one conservative design for all abutments based on the highest wall).
- Same foundation design.
- Skews limited and rounded to nearest 10 degrees.

The results of the bundling and innovative contracting were astounding. All roadway and bridge work was completed in 22 months, compared to an estimated 3 to 5 years to complete the work using traditional methods. The construction costs for the entire project were half of the estimated cost, with the bridges coming in 40 percent less than the budgeted amount based on previous bids. Also, by using similar design details, the estimated 6,500 hours to design the 12 structures came down to only 3,000 hours, a reduction of over 50 percent. Although the bundling of work and innovative contracting were out of necessity due to an emergency, CFLHD is looking at the benefits gained from the process in order to incorporate best practices into future projects.



Figure 34. Larimer County Road 43 during flooding.

Source: Colorado DOT

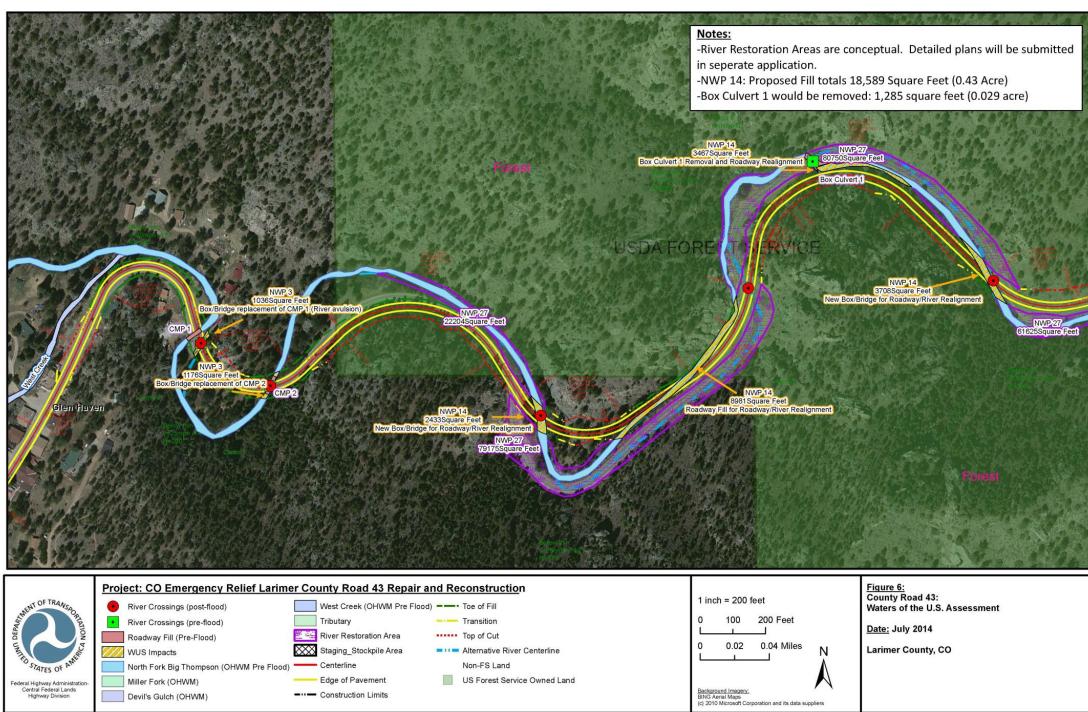


Figure 35. Larimer County Road 43 repair and construction plan.

Source: FHWA Central Federal Lands Highway Division

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	Goals included streamlining emergency and permanent repairs after 10 miles of roadway with 14 bridges were heavily damaged or destroyed by flooding as the result of intense rainfall in September 2013.
Bridge Selection Criteria	Bridges damaged or destroyed by flooding. Locations of two bridges were moved or eliminated due to realignment of the roadway.
Delivery and Procurement Method	D-B-B, best value SATOC with 12 tasks. Contractor began working on some tasks 7 days after award while details for other tasks were still being resolved.
Funding Sources/Financing Strategy	Funded through the Emergency Relief Program. Determined 100-percent eligible through FLAP.
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> • Environmental clearance led by CFLHD. Right-of-way and utility issues were the responsibility of Larimer County. • Task orders without third-party complications went first. • Over 75 private land acquisitions executed. Utilized landowner and community design reviews to foster endorsement and ownership of design. This streamlined the acquisition process. • Natural disaster programmatic environmental assessment NEPA document was utilized. There was extensive regulatory agency coordination. • Stream restoration and roadway/bridge realignments improved natural channel conditions, infrastructure sustainability, and resiliency of both the canyon and transportation facility.
Program Risks	Risk was shared, similar to a CM/GC project. Although it was D-B-B, the use of the SATOC allowed for a collaborative and integrated effort between CFLHD, the contractor, Larimer County, the regulatory agencies, and the community.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • Quality assurance was conducted the same as for other Federal Lands projects. It is routine for the contractor to provide its own quality control, and Federal Lands provides quality assurance.
Stakeholder Communication	<ul style="list-style-type: none"> • Extensive stakeholder communication was conducted throughout the project. • Larimer County set up a website shortly after the flooding event to keep stakeholders informed. • The construction contract included a public information component. The contractor had a public relations firm involved to provide day-to-day communications with all stakeholders. • The community was involved in the review of the design to foster ownership in the process.

MoDOT Safe & Sound Bridge Improvement Program

Agency Name:	Missouri Department of Transportation (MoDOT)
Project Location:	statewide (at least one in every county)
Project Delivery Method:	design-build (D-B) (554 bridges) design-bid-build (D-B-B) (248 bridges) 802 total bridges
Procurement Method:	best value, D-B; low bid, D-B-B
Total Project Cost:	\$685 million (\$487 million for D-B, \$198 million for D-B-B)
Funding Source:	Federal reimbursement bonds
Construction Schedule:	The goal was to complete construction of 802 bridges in 5 years. The D-B portion required 3 years of construction to complete. The D-B-B started 1 year earlier and finished at the same time. Average road closure was 42 days. Road closures were necessary to make the program affordable. Without closures, the program would have been reduced by 40 percent.
Project Description:	In the mid-2000s, more than 10 percent of Missouri's bridges were rated serious (Condition 3) or poor (Condition 4) under Federal Highway Administration National Bridge Inspection Standards. The timeframe to repair the approximately 1,100 bridges using MoDOT's standard capital programming approach was too long. Missouri accelerated the rehabilitation or replacement of 802 of these bridges under the Missouri Safe & Sound Bridge Improvement Program. MoDOT pursued a public-private partnership to construct and maintain the bridges for 20 years; however, that procurement was found unaffordable during the major recession in 2008. Subsequently, the program was delivered by more traditional financing and project delivery. It was completed with Grant Anticipation Revenue Vehicles (GARVEE) bond financing and a combination of D-B and D-B-B procurement. Of the 802 bridges, 554 that were known to be replacements were bundled into a single D-B project. The remaining 248 bridges, primarily major rehabilitations, were delivered by conventional D-B-B. Those bridges were bundled into bid packages of 2 to 10 bridges each. The contract for the D-B project was not prescriptive and allowed for construction schedule flexibility. The request for proposals

(RFP) was written to minimize closure duration and overall project timeline. The bridges that were constructed met the requirements in the RFP but did not follow typical MoDOT details, leading to concerns about durability and the need for more maintenance than was typical of MoDOT standard bridge types. They were constructed faster than traditional MoDOT bridges due to the design details used.

The D-B-B bridges were bundled by structure type, location, and schedule. The first 100 were considered fast-start bridges. These were mostly superstructure replacements or rehabilitation projects with minimal right-of-way (ROW) needs and coordination. The bundles were sized and scheduled to allow a spectrum of local contractors to perform the work. Most of the 802 bridges were constructed by local contractors. The D-B contractor self-performed a small percentage.

Overall, the program was very successful. MoDOT was able to replace 802 bridges in just 4 years.

Project Website: [MoDOT Safe & Sound](#)

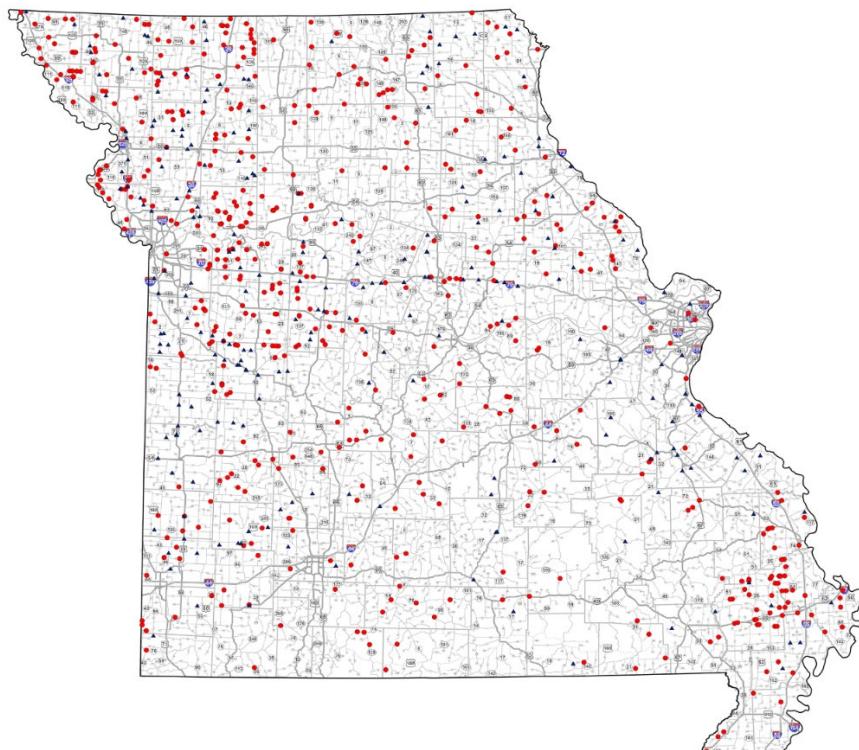


Figure 36. MoDOT Safe & Sound Bridge Improvement Plan project sites.

Source: MoDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The program's goal was to quickly reduce the percentage of bridges in poor condition on the local system.
Bridge Selection Criteria	<ul style="list-style-type: none"> • State owned. • Poor Condition. • Limited or no ROW needs. • Relatively small bridges (averaged 147 feet long and 24 feet wide). • Available detour routes (preferred). • Low-volume roads. Annual average daily traffic volume under 400 (preferred). • No railroad involvement. • No historic bridges. • Minimal environmental impacts. <p>In addition, MoDOT selected bridges based on maximizing the total number improved, rather than total deck area.</p>
Delivery and Procurement Method	D-B, best value D-B-B, low bid
Funding Sources/Financing Strategy	Federally funded with GARVEE bonds.
Environmental, Right-of-Way, and Utility Considerations	<p>D-B Contract</p> <ul style="list-style-type: none"> • All bridges were categorical exclusions. MoDOT performed the environmental coordination. • Bridges with minor anticipated ROW needs were chosen. A reserve fund was set up to purchase ROW. As an incentive to the D-B team to work within the existing ROW where possible, any money left in the reserve fund was split between the State and the contractor. • A subsurface utility engineering contract was performed by MoDOT in advance and utility information was provided in the RFP. Utility coordination was the responsibility of the D-B team. • The D-B team conducted hydrology and hydraulics analysis. For bidding purposes, it was assumed that the bridge opening would be the same as existing. • MoDOT funded a temporary position at the review agency to process the floodplain permits in a timely manner. <p>D-B-B Contracts</p> <ul style="list-style-type: none"> • MoDOT completed and advertised final plans, specifications, and estimate (PS&E) packages. • MoDOT performed all coordination. • MoDOT performed hydrology and hydraulics. • Bridges with little anticipated ROW needs were chosen.

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Risks	<p>D-B Contract</p> <ul style="list-style-type: none"> • MoDOT was responsible for proper scope in the RFP. • MoDOT assumed the risk for a bridge opening increase needed for hydraulic capacity. • The D-B team was responsible for design and construction. • The D-B team assumed the risk for geotechnical design. • Weather was a shared risk. <p>D-B-B Contracts</p> <ul style="list-style-type: none"> • Risks were similar to traditional D-B-B projects. • MoDOT was responsible for providing a complete design package. • MoDOT was responsible for all coordination with third parties.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • MoDOT created a Safe & Sound team of eight staff members who did not report to the Bridge Section. • The Safe & Sound team had the power of the Chief Engineer to make decisions. This allowed them to be responsive and avoid delays for this fast-paced project. • MoDOT performed all community relations. <p>D-B Contract</p> <ul style="list-style-type: none"> • The Safe & Sound team held daily conference calls and met weekly with the D-B team to discuss issues and head off problems. • Quality assurance and quality control was the responsibility of the D-B team. The process worked well. • MoDOT performed the material testing. <p>D-B-B Contracts</p> <ul style="list-style-type: none"> • Run like traditional D-B-B contracts.
Stakeholder Communication	<ul style="list-style-type: none"> • MoDOT held an industry meeting prior to proposing the massive bridge bundle contract to gauge interest from the contracting community. Over 200 people from four different countries attended. • The project had the necessary political buy-in to succeed. (The poor condition of rural bridges was evident statewide.) • MoDOT performed a successful public relations campaign to obtain public buy-in for short-term road closures to replace the bridges. • MoDOT met with the financial markets to determine the best way to fund the project.

NDOT County Bridge Match Program

Agency Name:	Nebraska Department of Transportation (NDOT)
Project Location:	Statewide
Project Delivery Method:	Design-bid-build (D-B-B), with legislative authority for design-build (D-B) and construction manager/general contractor (CM/GC)
Procurement Method:	Low bid
Total Project Cost:	Up to \$40 million over 10 years
Funding Source:	100 percent State funded
Construction Schedule:	Determined by lead county
Project Description:	Seventy-four percent (11,147) of Nebraska's 15,065 bridges (crossings over 20 feet in length) are on the county road system. Of these, 2,152 (19.3 percent) are rated in poor condition. In an effort to help reduce this number, NDOT created a County Bridge Match Program within a Nebraska Transportation Infrastructure Bank. The program does not offer loans or credit assistance, but is a pay-as-you-go program.

The County Bridge Match Program dedicates up to \$40 million through June 2023 to promote innovation and accelerate the reduction of county-owned bridges in poor condition. The first request for proposals (RFP) issued in November 2016 had \$4 million dedicated for the program. Participation is voluntary, and counties must apply for acceptance. The applications must note the importance of the project and are scored on a number factors, including innovation, cost and time savings, and potential future use of the innovation. NDOT will reimburse counties for 55 percent of the construction costs up to \$150,000 per bridge. The counties are responsible for delivering the projects.

Bridge bundling is one of the innovations encouraged by NDOT through the County Bridge Match Program. The program also allows and encourages counties to work together to bundle bridges in separate counties into one project. Although each county alone may not have the means to reap the benefits of a bridge bundle, by working collaboratively, counties have that ability. Most of the applications have used bundled approaches. Additionally, through Nebraska's 2016 Transportation Innovation Act, innovative project delivery methods such as D-B and CM/GC may be used to deliver the bridge bundle projects.

NDOT, through authorizing State legislation, also created a Federal funds purchase program that allows the department to enter into agreements with local entities for purchase of Federal-aid transportation funds at a discount rate, providing a way for local public agencies (LPAs) to exchange Federal funds for State funds. The State funds obtained must be expended for highway and bridge needs.

The stated benefits of NDOT's Federal funds purchase program include the following:

- Local control of LPA projects.
- Federal Highway Administration (FHWA) requirements and oversight eliminated.
- Wider variety of transportation projects funded by LPAs.
- All project phases eligible for funds.
- Minimal environmental requirements.
- No NDOT/FHWA oversight of required permits, consultant procurement, or contracts.
- Minimal State oversight of funded projects.

Program Website:

[Nebraska Transportation Innovation Act Bridge Program](#)

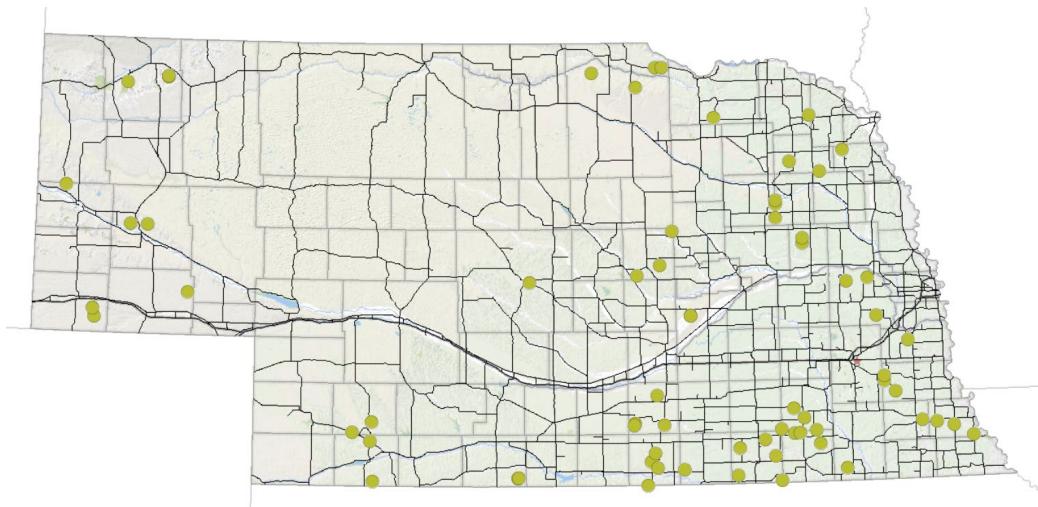


Figure 37. Map of eligible and selected NDOT County Bridge Match Program sites.

Source: NDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal is to encourage innovative project design and delivery to assist counties in reducing the number of bridges in poor condition.
Bridge Selection Criteria	<ul style="list-style-type: none"> • County owned. • Poor condition. • Greater than 20-foot span. • Not yet advertised for construction.
Delivery and Procurement Method	NDOT publishes an RFP for acceptance into the program. Bridge bundling is encouraged as an innovation. Awards are made based on scored applications. The county decides the appropriate delivery and procurement method for each project. The agency then has the ability to work with other counties and use D-B or CM/GC to deliver bridge bundle projects.
Funding Sources/Financing Strategy	100 percent State funded up to 55 percent of the project or \$150,000
Environmental, Right-of-Way, and Utility Considerations	<p>Counties are responsible for all coordination.</p> <p>Program encourages cooperation among counties for hydraulic studies by basin.</p>
Program Risks	Depends on the delivery and procurement method selected by the county.
Owner Management/Quality Assurance	Depends on the delivery and procurement method selected by the county.
Stakeholder Communication	Coordinated with the Nebraska Association of County Officials to set up the program.

New York Works Accelerated Bridge Program

Agency Name:	New York State Department of Transportation (NYSDOT)
Project Location:	Statewide
Project Delivery Method:	Design-bid-build (D-B-B) and design-build (D-B)
Procurement Method:	Low bid (D-B-B) and best value (D-B)
Total Project Cost:	\$135 million for 81 bridge deck replacements in 9 bundles (D-B-B program) \$84 million for 35 bridge deck replacements in 3 bundles (D-B program)
Funding Source:	Appropriated in annual funding process using existing State and Federal funds.
Construction Schedule:	Replaced 116 bridge decks in 2 years.
Project Description:	<p>This was a fast-paced program to replace bridge decks on 116 bridges over a period of 2 years. The goal was to get New Yorkers back to work during the slow economy in 2012 and 2013. Both D-B-B and D-B were used to deliver bridge bundles to complete the work.</p> <p>The D-B-B projects were bundled with efforts to maximize efficiency in design and construction. Designs were proposal-only packages, meaning they were typically produced on 8.5" × 11" paper and contained requirements for construction with minimum details. This allowed the contractors flexibility in construction.</p> <p>The contractor was responsible for existing survey and final deck grades. NYSDOT bridge designers stayed involved during construction to ensure contractors' details met the requirements in the plans and NYSDOT standards.</p> <p>NYSDOT also gave the contractors flexibility with the order in which they worked on the bridges. Contractors became more efficient as they learned lessons from bridges constructed early in the bundle. NYSDOT incorporated lessons learned into later bundles.</p> <p>The D-B projects were bundled by the zones in which they were located. These projects were typically more complex than the D-B-B projects. The D-B projects were awarded based on best value.</p>

One of the D-B bundles in western New York covered too large of a geographical area. This led to a high bid by a joint venture team of three contractors. The bids were rejected, and the projects were designed using D-B-B and bundled into smaller packages in closer proximity.

The New York Works bridge deck replacements are a great example of efficiencies gained in design and construction using bridge bundling.

Project News:

New York Works press releases announced the [program](#) and the [completion](#) of 112 of the accelerated bridge projects.

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal was to quickly reduce the number of bridge decks in poor condition and to keep them from becoming poor for a period of at least 10 years. Another goal of the program was to get New Yorkers back to work, leading to a very aggressive schedule.
Bridge Selection Criteria	<ul style="list-style-type: none"> • State owned. • Bridge deck in poor condition. • No right-of-way (ROW) takes. • Minimal environmental issues. • Minimal utility relocations. • Minimal bridges involving a railroad. • No historic bridges. • Minimal roadway approach work. • No aesthetic considerations. Workhorse bridges.
Delivery and Procurement Method	D-B-B, low bid D-B, best value (60 percent price/40 percent technical score)
Funding Sources/Financing Strategy	Appropriated in annual funding process with existing State and Federal funds. Spent \$219 million in just 2 years.
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> • Projects were within existing ROW. • Locations with significant utility involvement were avoided. • Contractors were responsible for utility relocations (D-B projects). • All bridges were categorical exclusions.
Program Risks	There was minimal risk associated with these deck replacements. Most risk was on the contractor. Even the D-B-B contracts had minimal details, making the contractor responsible for ensuring the new decks were at the proper grade.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • D-B-B projects put together by the Structures Design Bureau. Designers stayed involved through construction. • D-B projects run by NYSDOT D-B program. • D-B teams performed construction inspection with quality control by NYSDOT.
Stakeholder Communication	The New York Works program was so fast paced that no advance communication was done. All bridges were State owned and work was within existing ROW.

Northampton County (Pennsylvania) Public-Private Partnership

Agency Name:	Northampton County
Project Location:	Northampton County, PA
Project Delivery Method:	Design-build-finance-maintain (DBFM)
Procurement Method:	Best value
Total Project Cost:	\$38.5 million including interest and maintenance cost
Funding Source:	Public-private partnership (P3), 100 percent county funded
	Payment structure:
	<ul style="list-style-type: none">○ \$37.5 million in construction payments over a 12-year period.○ Estimated \$1 million in maintenance payments over a 10-year period starting in year 5 (following completion of construction).
Construction Schedule:	4 years
Project Description:	<p>Northampton County is located in eastern Pennsylvania, bordering New Jersey, and is the owner of 119 bridges. Like most other counties in the Commonwealth, a significant percentage of its bridge inventory was rated in poor condition or was considered functionally obsolete. Addressing each deficient or obsolete bridge using traditional contracting methods (bid and repair/replace one bridge at a time) would have taken more than 20 years to complete. In order to accelerate replacement or rehabilitation of these bridges, Northampton County used an innovative P3 approach to address 33 bridges under one contract.</p> <p>Pennsylvania's Act 88 allows public entities to use P3 delivery of transportation projects. The definition of "public entities" in Act 88 includes municipal authorities but does not include counties. To satisfy Act 88, Northampton County transferred the ownership of the 33 bridges within the project to the Northampton County General Purpose Authority (NCGPA), a municipal authority formed in 1998 under the Pennsylvania Municipal Authorities Act with broad powers, including the right to finance and coordinate transportation projects. NCGPA does not have a paid staff, which required issuance of a request for proposals (RFP) for an independent engineer to administer the bridge projects on its behalf.</p>

Northampton County entered into a service agreement with NCGPA in which NCGPA agreed to obtain the services of a private entity developer to replace, rehabilitate, repair, and warranty the 33 bridges within the project over a period of 14 years, while the county agreed to provide the funding. NCGPA then entered into a Public/Private Transportation Partnership Agreement with the developer setting forth the terms of project delivery and payment.

Through these agreements, the county makes payment to NCGPA as shown in Table 24, and NCGPA in turn pays the developer. Funding is entirely from Northampton County's budget. No Federal or State funds are required.

Northampton County demonstrated initiative in using this innovative approach to address severe infrastructure deficits. Rather than addressing these bridges over decades on a pay-as-you-go basis, or waiting for Federal or Commonwealth funding, the county took control, using private financing under a payment structure it could afford. In addition, by using a service agreement/contract for the bridge replacement rather than a typical debt obligation tax increase or toll encumbrance to fund the project, the county maintained its Moody's and Standard & Poor's ratings, guaranteeing an unencumbered revenue stream to fund other county projects.

Numerous other counties, municipalities, and public agencies are looking at the Northampton County model as a template for addressing bridge deficiencies.

Project Profile:

[Northampton County Bridge Renewal Program](#)

Table 24. Northampton County General Purpose Authority payment schedule.

Source: Northampton County

Year	Costs of Construction	Maintenance Costs	Annual Payments
2017	\$3,625,000	-	\$3,625,000
2018	\$3,875,000	-	\$3,875,000
2019	\$4,125,000	-	\$4,125,000
2020	\$3,875,000	-	\$3,875,000
2021	\$3,875,000	\$99,500	\$3,974,500
2022	\$2,586,629	\$99,500	\$2,686,129
2023	\$2,586,629	\$99,500	\$2,686,129
2024	\$2,586,629	\$99,500	\$2,686,129
2025	\$2,586,629	\$99,500	\$2,686,129
2026	\$2,586,629	\$99,500	\$2,686,129
2027	\$2,586,629	\$99,500	\$2,686,129
2028	\$2,586,629	\$99,500	\$2,686,129
2029	-	\$99,500	\$99,500
2030	-	\$99,500	\$99,500
Total	\$37,481,403	\$995,000	\$38,476,403

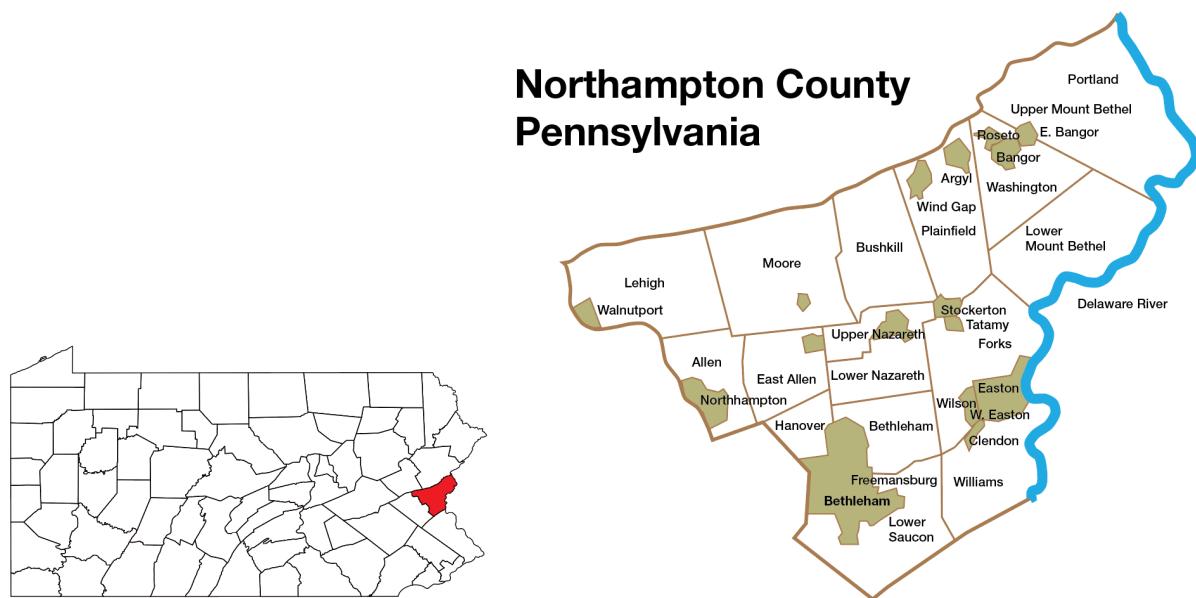


Figure 38. Map of Northampton County, PA.

Source: FHWA

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal was to quickly reduce the number of bridges in poor condition and the number of functionally obsolete bridges in the county bridge inventory.
Bridge Selection Criteria	<ul style="list-style-type: none"> • Poor condition. • County owned. • Functionally obsolete.
Delivery and Procurement Method	DBFM, best value
Funding Sources/Financing Strategy	<p>Public-private partnership</p> <p>100 percent county funded</p>
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> • No Federal funding or Federal action required; therefore, no National Environmental Policy Act clearance required. • Owner and developer partnered to resolve all environmental, utility, and right-of-way (ROW) issues. • Developer responsible for utility coordination. • Developer responsible for preparing ROW plans and acquisition. • Developer responsible for cost of temporary easements for construction. • Owner responsible for cost of permanent easements. • Owner responsible for any required utility agreements and costs.
Program Risks	<ul style="list-style-type: none"> • Since this project is DBFM, the risk is primarily on the developer. • Risk to the owner is loss of control, making it important to have a very good RFP. • Owner must ensure that payments are manageable and do not inhibit future necessary work.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • Engineering firm hired by owner to administer project, perform design reviews, and provide construction inspection of critical construction activities.
Stakeholder Communication	<ul style="list-style-type: none"> • Owner is responsible for all stakeholder communication.

NYSDOT Region 1 Preventive Maintenance Bridge Bundling Program

Agency Name:	New York State Department of Transportation (NYSDOT)
Project Location:	Region 1
Project Delivery Method:	Design-bid-build (D-B-B)
Procurement Method:	Low bid
Total Project Cost:	<p>Bridge preservation contract – \$5 to \$6 million per year Bridge painting contract – \$3 million per year Bridge washing and deck sealing contract – \$2 million every other year</p> <p>Current funding is \$9 to \$10 million per year, total.</p>
Funding Source:	<p>Bridge preservation contract – Federal and State funded (80/20) Bridge painting contract – 100 percent State funded or Federal and State (80/20) funded Bridge washing contract – 100 percent State funded or Federal and State (80/20) funded</p>
Construction Schedule:	Maintenance contracts are assigned times based on the work.
Project Description:	<p>NYSDOT's Region 1 uses a series of bridge bundling contracts to address preventive maintenance issues. The contracts are assembled by the Bridge Design Section and administered by the Construction Section. There are three types of bundled maintenance contracts: bridge preservation contracts, bridge painting contracts, and bridge washing contracts.</p> <p>The bridge preservation contracts address repair-type work such as deck overlays, joint replacements, bearings, and patching spalls. These contracts include detailed plans by location. There is typically one contract per year at a value of \$5 to \$6 million. On average, the bridge preservation contract includes six to eight bridges, depending on the type of work. An effort is made to group bridges by location and similar work types. Only critical work is performed.</p> <p>The bridge painting and bridge washing contracts are true preventive maintenance contracts. The goal is to keep steel beams painted and bridges washed in order to prevent deterioration. A bridge painting contract is completed every year, with an average value of \$3 million. Typically, three to four bridges are painted,</p>

depending on the size. The bridge washing contract is usually around \$2 million, and it is done every other year. Up to 200 bridges are washed and up to 100 bridge decks are sealed with silane under this contract. The locations and quantities are determined in design. Plans are put together in a proposal format and awarded based on low bid.

In total, NYSDOT Region 1 spends \$9 to \$10 million per year on preventive bridge maintenance activities, which is approximately 25 percent of the agency's bridge budget. NYSDOT spends such a large portion of its budget on preventive maintenance because staff consider this to be some of the most important work that the department does.

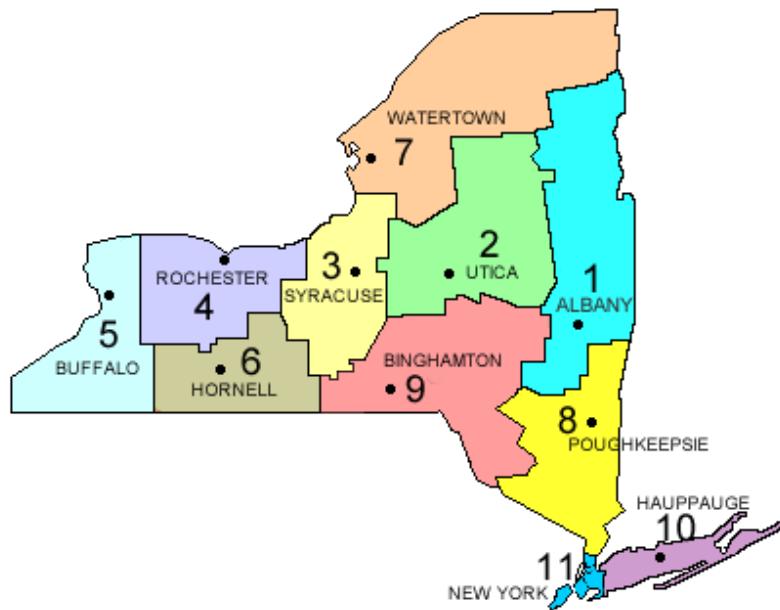


Figure 39. New York State DOT Regions.

Source: NYSDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal for the preventive maintenance contracts is to extend the service life of bridges by addressing small maintenance items early through bundling. Bundling by location and similar work type also saves money through economy of scale.
Bridge Selection Criteria	Bridges are selected for work and work is tracked on a master list, which is generated from inspections and communication with bridge maintenance personnel.
Delivery and Procurement Method	D-B-B, low bid
Funding Sources/Financing Strategy	<ul style="list-style-type: none"> • Bridge preservation contracts – Federal and State (80/20) funded • Bridge painting contracts – 100 percent State Funded or Federal and State funded (80/20) • Bridge washing contracts – 100 percent State Funded or Federal and State funded (80/20)
Environmental, Right-of-Way, and Utility Considerations	Bridge maintenance work—no third-party involvement.
Program Risks	The maintenance work is generally low risk.
Owner Management/Quality Assurance	Contracts are put together by the Bridge Design Section and administered by the Construction Section. Construction inspection is performed by NYSDOT.
Stakeholder Communication	Communication is limited to notifications for the road and lane closures needed to do the work.

Ohio Bridge Partnership Program

Agency Name:	Ohio Department of Transportation (ODOT)
Project Location:	Statewide
Project Delivery Method:	Design-build (D-B)
Procurement Method:	Low bid (Contractors have to be prequalified.)
Total Project Cost:	\$110 million in the first 3 years (\$100 million for counties, \$10 million for cities) Funding has continued at \$5 million per year through 2019.
Funding Source:	100 percent federally funded with Grant Anticipation Revenue Vehicle (GARVEE) bonds and toll credits; no local match. ODOT will pay back GARVEE bonds over 12 years.
Construction Schedule:	Thirty bridges completed in first 8 months; 200 bridges in the first 3 years. Road closure duration assigned at each location. Typically 45 to 60 days.
Project Description:	In October 2013, Ohio Governor John Kasich announced that Ohio would invest \$110 million to repair or replace more than 200 county- and city-owned bridges over the next 3 years. The program was 100 percent federally funded. ODOT used GARVEE bonds to pay for 80 percent of the program, and the 20 percent match was covered using toll credits, eliminating any local match. ODOT worked collaboratively with the Federal Highway Administration (FHWA) to sign a memorandum of agreement that allowed them to bundle the entire program for financing and then break the projects out into smaller bundles of two to three bridges per contract. The first 200 bridges were let as D-B contracts. The goal was to replace as many local bridges in poor condition as possible with the \$110 million budget and 3-year time frame. The expectation was to deliver safe, quality bridges with a no-nonsense approach to project delivery and construction. In order to maximize the efficiency of the program, most of the locations were bridge replacements completed under detours. Approach road work was minimized. Local preferences were accommodated when necessary and warranted, but in general, these were workhorse bridges with simple construction. Cost savings allowed ODOT to complete 210 bridges with the original

\$110 million, 10 more than expected. The program has continued, due to its success, at a rate of \$5 million per year. Current projects are being delivered with the design-bid-build methodology, with the local agencies providing the preliminary engineering.

Project News:

[200th Bridge Funded through Partnership Opens](#)

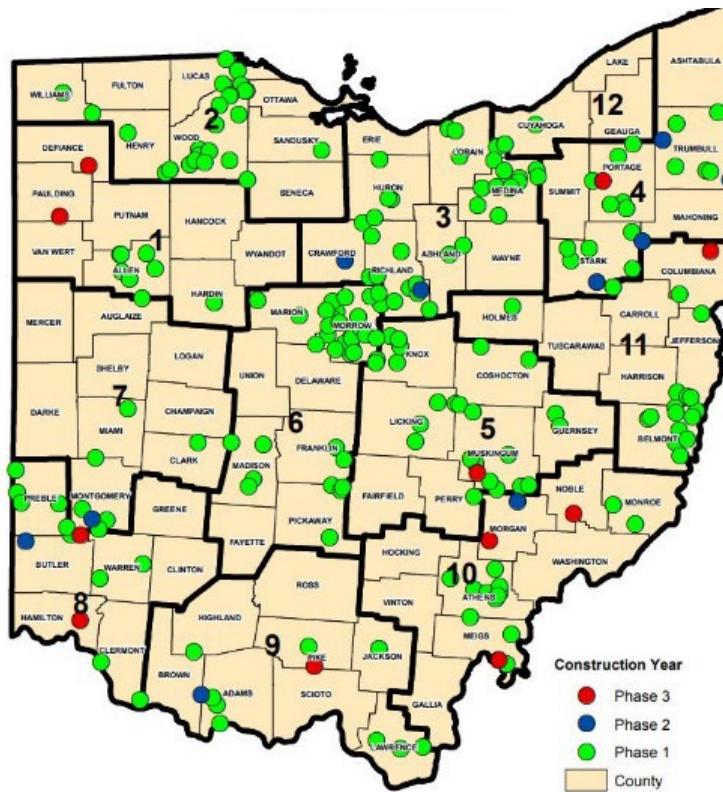


Figure 40. Ohio Bridge Partnership Program bridge locations.

Source: ODOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal was to quickly reduce the percentage of bridges in poor condition on the local system.
Bridge Selection Criteria	<ul style="list-style-type: none"> • Locally owned. • Poor condition. • Open and carrying vehicular traffic. • Not currently funded by other sources. • Greater than 20-foot span, typically 30- to 70-foot single span. • Detour routes available (preferred). • Low volume roads. • No bridges involving a railroad. • No historic bridges. • No individual waterway permits. • No locations with rare and endangered species.
Delivery and Procurement Method	D-B, low bid (Contractors have to be prequalified.)
Funding Sources/Financing Strategy	<p>100 percent federally funded (GARVEE bonds and toll credits). No local match. Bridges were bundled into \$100 million contract for funding, but unbundled into D-B contracts with two to three bridges per contract for construction.</p>
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> • Right-of-way and environmental statements were cleared before advertisement. • Existing utility plans were included in the bid package. ODOT identified potential conflicts. Contractors were responsible for utility coordination. • All bridges were categorical exclusions. Avoided 4f, 6f, etc.
Program Risks	Projects were D-B. ODOT was responsible for proper scope in the request for proposals (RFP). The contractors were responsible for design and construction. The top risk was utility coordination, which was shared. The contractor was responsible for utility coordination, but ODOT absorbed the cost if the utility company failed to perform within the agreed-upon time constraints.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • ODOT did not have dedicated staff to run the program. • ODOT hired a general engineering consultant to put the contracts together. • ODOT outsourced construction administration. • ODOT Central Bridge Office conducted reviews to ensure the plans were in conformance with the RFP.

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Stakeholder Communication	ODOT worked closely with the Ohio General Assembly and the County Engineers Association of Ohio to advance the program. Agency staff also worked with the individual local public agencies to set the scope, schedule, and budget for each location.

Oregon DOT I-5 Willamette River CM/GC Bridge Bundle

Agency Name:	Oregon Department of Transportation (DOT)
Project Location:	Interstate 5 (I-5) over Willamette River, Lane County, OR
Project Delivery Method:	Construction manager/general contractor (CM/GC)
Procurement Method:	Qualifications-based selection (QBS)
Total Project Cost:	\$163 million
Funding Source:	The project was 100 percent State funded with revenues from increased motor vehicle and truck fees.
Construction Schedule:	The schedule was 115 months in total: 30 months for design and 85 months for construction.
Project Description:	<p>With the passage of the third Oregon Transportation Investment Act (OTIA III) in 2003, the Oregon DOT was tasked with delivery of a \$1.3 billion program to repair or replace 365 bridges statewide. One of the projects within this program was the I-5 Willamette River Bridge Bundle. This bundle consisted of the construction of three bridges: two 1,800-foot bridges on I-5 over the Willamette River (north and south) and the 100-foot Canoe Canal Bridge. Detour bridges were built prior to the start of the project to handle traffic during construction. Due to the many complexities of this project, Oregon DOT chose to use the CM/GC project delivery method.</p> <p>For this project, it was very important to limit impacts to the environment and an adjacent city park. To accomplish this, Oregon DOT decided to keep the construction limits within the existing right-of-way (ROW). This resulted in the reconstruction of the freeway and connector ramps within their current footprints and required complicated construction sequencing with nine traffic control stages. To ensure that the phasing plans would work, both the construction manager and the designer developed three-dimensional models of the project site to identify and resolve potential conflicts, an effort that resulted in no significant conflicts during construction.</p> <p>The requirement to keep all construction within the existing ROW also resulted in the decision to construct the I-5 bridge as two separate structures, northbound and southbound, adding 31 months to the schedule. The additional time to construct two bridges instead of one was worthwhile as it resulted in significantly less</p>

impacts and was still finished more than one year ahead of the estimated design-bid-build (D-B-B) schedule.

The collaboration between the owner, the construction manager, and the designer was a consistent, value-added process that contributed to the success of the project. Input from the construction manager, the local community, stakeholders, and public agencies helped Oregon DOT control costs and schedule, develop the design, manage risks, and resolve and adjust outcomes as the project proceeded. The end result was a final product that was under budget and ahead of schedule.

Prior to using the CM/GC delivery method, Oregon DOT performed an exemptions study in which the expected CM/GC results were compared to a hypothetical D-B-B project. It was estimated that using D-B-B would cost \$194 million and take 128 months to complete. The actual project had a total cost of \$163 million and took 115 months to complete. Using these numbers, Oregon DOT concluded that the CM/GC delivery saved \$31 million (16 percent) and 13 months over the traditional D-B-B delivery.

Project website:

<http://www.otiabridge.org/>

http://www.otiabridge.org/static/Leaving_a_Legacy_FINAL_101014_high_res.pdf



Figure 41. The completed arches of the southbound Willamette Bridge.

Source: Oregon DOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	This bundle comprised 3 of 365 bridges identified as needing work based on a load rating analysis. The repairs were funded over a 10-year period (2004–2014) by the Oregon State Legislature under the OTIA III legislation.
Bridge Selection Criteria	<ul style="list-style-type: none"> Bridges were identified as needing repair or replacement based on a load rating analysis that indicated a widespread shear failure issue. These three bridges were bundled by their location.
Delivery and Procurement Method	CM/GC, QBS
Funding Sources/Financing Strategy	The project was 100 percent State funded with revenues from increased motor vehicle and truck fees.
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> To limit impacts, all construction was within existing ROW. The construction manager helped with environmental mitigation using innovative construction practices such as bubble curtains for pile driving, equipment fueled by vegetable-based fuel in lieu of petroleum-based products, fully contained work bridges, and fish bypass systems. The project re-used box girders from temporary bridges.
Program Risks	Through the CM/GC process, risks were shared by the owner, the construction manager/general contractor, and the designer.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> Oregon DOT did not have the internal capacity to deliver the program and therefore hired a private firm, Oregon Bridge Delivery Partners (OBDP), as the program manager. OBDP had a Quality Manager. The architecture, engineering, and construction (AEC) firm responsible for design conducted quality control. OBDP performed quality assurance. OTIA III had an Oversight Committee that made final decisions and had broad authority and responsibilities for cost and schedule. The OBDP had construction inspection responsibilities.
Stakeholder Communication	<ul style="list-style-type: none"> Oregon DOT solicited feedback from the construction industry on contract size, timing/scheduling of bundles, and bundling work types. Oregon DOT solicited input from trucking organizations on mobility and traffic control. Oregon DOT solicited input from the American Automobile Association (AAA) on mobility and timing issues. Oregon DOT worked with local communities throughout the design process.

Oregon Transportation Investment Act III State Bridge Delivery Program

Agency Name:	Oregon Department of Transportation (DOT)	
Location:	Statewide	
Project Delivery Method:	Design-bid-build (D-B-B) – 85 projects Design-build (D-B) – 10 projects Construction manager/general contractor (CM/GC) – 1 project	
Procurement Method:	D-B-B low bid D-B best value CM/GC qualifications-based selection (QBS)	
Total Project Cost:	The project cost was \$1.3 billion to repair or replace 365 bridges statewide (271 were repaired or replaced, 94 did not require work).	
Funding Source:	The project was 100 percent State funded with revenues from increased motor vehicle and truck fees. External Federal grant funding totaled an additional \$5.1 million for innovations in environmental stewardship, workforce development, bridge design and construction, and intermodal transportation.	
Construction Schedule:	All 365 bridges were to be analyzed and corrected from 2004–2014.	
Project Description:	With the passage of the third Oregon Transportation Investment Act (OTIA III) in 2003, the Oregon DOT was tasked with the delivery of a \$1.3 billion program to repair or replace 365 bridges statewide. These bridges were identified as having a widespread shear failure issue based on a load rating analysis. Of these, it was determined that 149 bridges needed to be replaced, 122 bridges needed to be repaired, and 94 bridges did not require repair or replacement. The philosophy of the bridge program was based on stewardship: Take care of what you have so current and future generations can prosper. A well-maintained network of bridges would spur the economy during design and construction and help Oregon's competitiveness in future years.	
	Due to the size of the program, the Oregon DOT decided to outsource the program management. Oregon DOT hired a private sector firm to manage both the design and construction of the	

bridge program. This effort, which was overseen by Oregon DOT's Major Projects Branch, was charged with finding ways to expedite delivery and maximize efficiency. One of the primary tools used for this was bridge bundling.

It was quickly recognized that many of the bridges needing work were near one another or on the same corridor. Instead of a worst-first approach to the work, the bridges were bundled into projects based on locations and work type and strategically sequenced to maximize movement of traffic throughout the corridors. Many aspects of the project delivery, including public involvement, design, environmental permitting and mitigation, right-of-way (ROW) acquisition, maintenance of traffic, and construction were streamlined.

The 271 bridges that were either repaired or replaced were bundled into 96 projects with 2 to 13 bridges per project. Of these bundles, 85 were delivered using D-B-B / low bid, 10 were delivered using D-B / best value, and 1 was delivered using CM/GC / QBS.

Through the bundling program, Oregon DOT reported many efficiencies, including over \$200 million in cost savings from reduced delays for motorists in construction zones. The program took over 10 years to complete and received more than 50 awards.

Project website:

<http://www.otiabridge.org/>

http://www.otiabridge.org/static/Leaving_a_Legacy_FINAL_101014_high_res.pdf

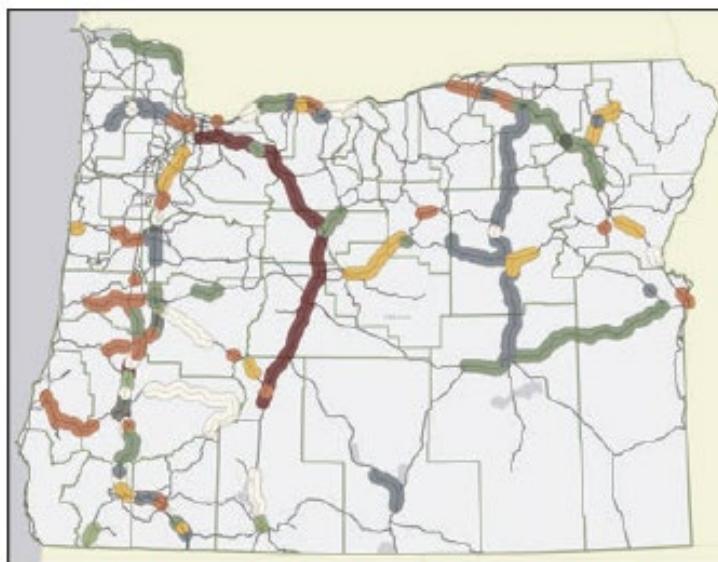


Figure 42. Oregon DOT bundled bridge projects along highway corridors.

Source: ODOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	<p>Based on a load rating analysis, 365 bridges were identified as needing work. The repairs were funded over a 10-year period (2004–2014) by the Oregon State Legislature. These had to be delivered in addition to the normal bridge program. Bundling helped to deliver this program efficiently.</p>
Bridge Selection Criteria	<ul style="list-style-type: none"> • Bridges were identified as needing repair or replacement based on a load rating analysis that indicated a widespread shear failure issue on 365 bridges. • Bridges were bundled by location and corridor. • Bundles were by project type (complex or simple).
Delivery and Procurement Method	<ul style="list-style-type: none"> • D-B-B, low bid • D-B, best value • CM/GC, QBS
Funding Sources/Financing Strategy	<ul style="list-style-type: none"> • Projects were 100 percent State funded with revenues from increased motor vehicle and truck fees. • External Federal grant funding totaled an additional \$5.1 million for innovations in environmental stewardship, workforce development, bridge design and construction, and intermodal transportation.
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> • Environmental Programmatic Agreements were established for OTIA III. Projects that did not meet the agreed-to criteria in the Programmatic Agreement went through a project-specific permit process. • Projects without utility and ROW complications went first.
Program Risks	<p>Oregon DOT performed a formal, program-level risk analysis up-front driven by cash flow concerns. A risk assessment was performed for each bridge and a baseline report created.</p>
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • Oregon DOT did not have the internal capacity to deliver the program, and therefore hired a private firm, Oregon Bridge Delivery Partners (OBDP), as the program manager. • OBDP had a Quality Manager. The architecture, engineering, and construction (AEC) firm responsible for design conducted quality control (QC). OBDP performed quality assurance (QA). • OTIA III had an Oversight Committee that made final decisions and had broad authority and responsibilities for cost and schedule. • The OBDP had construction inspection responsibilities for D-B-B projects. • The D-B firm performed the QA roles for D-B projects. The OBDP Program Manager was at a higher level for D-B projects.

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Stakeholder Communication	<ul style="list-style-type: none"> • Oregon DOT solicited feedback from the construction industry on contract size, timing/scheduling of bundles, and bundling work types. • Oregon DOT solicited input from trucking organizations on mobility and traffic control. • Oregon DOT solicited input from the American Automobile Association (AAA) on mobility and timing issues. • Oregon DOT worked with localities on aesthetics.

Osceola County (Florida) Roadway and Bridge Bundling Program

Agency Name:	Osceola County
Project Location:	Countywide
Project Delivery Method:	Construction manager/general contractor (CM/GC)
Procurement Method:	Qualifications-based selection (QBS)
Total Project Cost:	\$350 million program (11 projects with 13 bridges)
Funding Source:	100 percent locally funded through impact fees
Construction Schedule:	Eleven major roadway projects were to be in construction within the first year.
Project Description:	<p>In 2000, Osceola County, FL, was faced with the challenge of delivering a large-scale design and construction program funded by newly adopted impact fees. The program required the concurrent construction of 9 to 11 major roadway projects, with an additional 7 being completed in design each calendar year. Less than 7 years into the program using traditional design-bid-build (D-B-B) delivery, the agency was 18 projects behind schedule. Designs were as much as 200 percent over budget and there were over \$5 million in change orders. Eighteen projects were in varying stages of design, with none ready for construction.</p> <p>In 2007, a newly appointed administration tried an innovative approach. Despite concerns from many due to unfamiliarity with alternative contracting methods, agency staff decided to use a construction-manager-at-risk (CMR) program to deliver the projects. CMR differs from CM/GC mainly in the area of self-performance. As practiced in Osceola County, CMR prohibited the construction manager (CM) from self-performing any work. CM/GC, as practiced by many States, requires the CM to self-perform at least 30 percent of the work.</p> <p>Another difference in the way Osceola County ran the program was there was no independent cost estimator (ICE). Instead, the agency relied on highly trained and experienced internal construction staff. It was noted that the program could have been improved had an ICE been acquired. An ICE may have provided more credibility in justifying to the Board of County Commissioners that the prices received from the CM were in line with low-bid prices.</p>

To deliver the CM/GC program, Osceola County issued six requests for proposals (RFPs) for CMs to deliver 11 major roadway projects, including 13 bridges. Using QBS, agency staff chose six CMs. The 11 projects were in various stages of planning, permitting, and design. The county divided the work among these CMs, matching the type of work to the strengths of each.

The CMs worked with the designers to produce efficient construction drawings. Instead of reviews at major milestones, the team met weekly to review plans as they were conceived and drawn. This allowed the CM to be actively involved in maintenance of traffic (MOT) and construction phasing, eliminating wasted efforts by the design team. Also, costs were discussed early and throughout the design process, giving real-time information to the county and the designers instead of waiting for plans to be completed and go to bid.

In many cases, Osceola County used a guaranteed maximum price (GMP). GMPs were priced as each early work package was being developed. Projects were built in mini phases or mini-GMPs. Instead of waiting for the entire project to be completed and cleared for permitting, right-of-way (ROW), and utilities, segments of the projects were constructed as soon as they were ready, greatly accelerating them. This also led to reduced costs as the mini phases were broken out into very specific work types, allowing contractors that usually participate as sub-contractors to bid the work directly.

Within the first year, the 11 major roadway projects were all ready to begin construction, achieving 55 times the production rate of the previous 5 years. In the first year of construction, approximately \$350 million was spent. There was \$105 million in savings due to innovations from the CM/GC process—a reduction of 23 percent. Also, 9 out of every 10 construction dollars was distributed to local contractors, boosting the local economy during a recession.

The use of CM/GC in Osceola County helped deliver a major program with a very aggressive schedule. Through collaboration of county staff, design teams, and a CM and hand-selected subcontractors, innovative solutions were found to quickly advance design and construction of 13 bridges in 11 major roadway projects, saving both time and money. The use of CM/GC was a huge success as it advanced projects that were stagnant under the traditional D-B-B methodology.

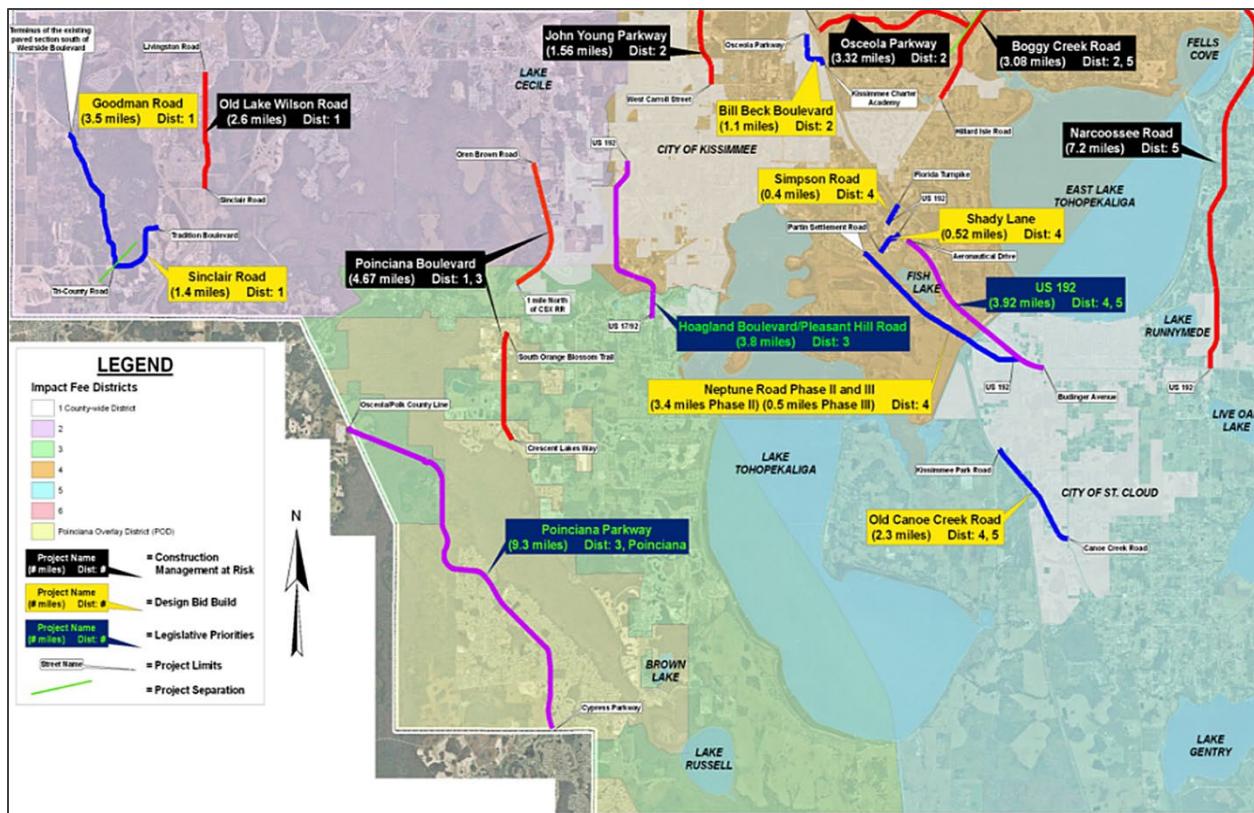


Figure 43. Map of Osceola County, FL, improvement projects.

Source: Osceola County

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	Projects were bundled in a CM/GC program to speed delivery and save money.
Bridge Selection Criteria	Bridges selected were part of roadway projects.
Delivery and Procurement Method	CM/GC and QBS
Funding Sources/Financing Strategy	100 percent locally funded through impact fees
Environmental, Right-of-Way, and Utility Considerations	CMs were involved in planning and design to minimize impacts to the environment, ROW, and utilities. The CM was the lead for all utility coordination efforts. Projects were built in mini phases. Instead of waiting for the entire project to be completed and cleared for permitting, ROW, and utilities, segments of the projects were constructed as soon as they were ready, greatly accelerating them.
Program Risks	The risk was shared between the owner, designer, and CM. All entities worked together to ensure the designs were constructible and within budget. Due to the fact that plans were less detailed, overruns were budgeted for instead of relying on errors and omission contract claims.
Owner Management/Quality Assurance	The construction engineering inspection (CEI) firm was hired by the owner. The CM included the CEI in the plan reviews and development to ensure constructability. The role of the CEI during construction was reduced. The CM, the general contractors, and the CEI ensured quality.
Stakeholder Communication	The Osceola County administration completed an intensive training effort to educate the design firms and contracting community about the benefits of CM/GC. Once chosen, the CM was responsible for communication with the affected community.

PennDOT Local Bridge Bundling Program

Agency Name:	Pennsylvania Department of Transportation (PennDOT)
Project Location:	Statewide
Project Delivery Method:	Design-bid-build (D-B-B)
Procurement Method:	Low bid
Total Project Cost:	<p>2012 pilot project:</p> <ul style="list-style-type: none">○ \$12.9 million (District 4 – 7 bridge replacements, 3 bridge removals)○ \$4 million (District 9 – 12 superstructure replacements)○ \$3.2 million (District 12 – 18 rehabilitations)
	<p>Year 1 – District 6: \$6 million (10 structures)</p>
	<p>Year 2 – District 11: \$6.8 million (17 structures)</p>
	<p>Current funding is \$3 million per year.</p>
Funding Source:	100 percent State funded
Construction Schedule:	Design and construction in less than 18 months, total.
Project Description:	<p>This project started as a pilot in 2012. Bundled bridge projects are confined to one district, preference to one county, within a 15-mile radius. All bridges must be in poor condition and locally owned, with preference given to structures that are posted or closed. PennDOT targets single-span bridges between 20 and 60 feet in length with skews less than 15 degrees.</p> <p>In order to maximize efficiency in design and construction, only bridges with very similar details are chosen. The goal is to have one design for all structures in the bundle and to replace multiple bridges of varying length with one bridge of a standard length. Lengthening a structure in this case is appropriate, as well as eliminating skew.</p> <p>If there are more than three designs per bundle, the bundle may not generate the level of savings desired to make the program viable. Bridge bundles can be as large as desired, but individual contracts should be developed in groups of 7 to 10 structures to optimize construction crews.</p>

PennDOT has documented significant savings in design and construction from using this method. The agency has saved up to 50 percent on design cost and up to 15 percent on construction cost when compared to traditional single bridge projects. Due to the savings, the normal 5 percent local public agency (LPA) contribution to the project is waived.

Participation in the program is voluntary, but it is a popular program due to the fact that the LPAs have no contribution. Because these bridges are locally owned, the LPA signs an agreement which transfers ownership of the bridge to PennDOT for the design and construction of the bridge. Once the project is completed, the bridge ownership is transferred back to the LPA.

Due to its success, the local bridge bundling program has continued to be funded beyond the pilot phase. It is currently funded at \$3 million per year.

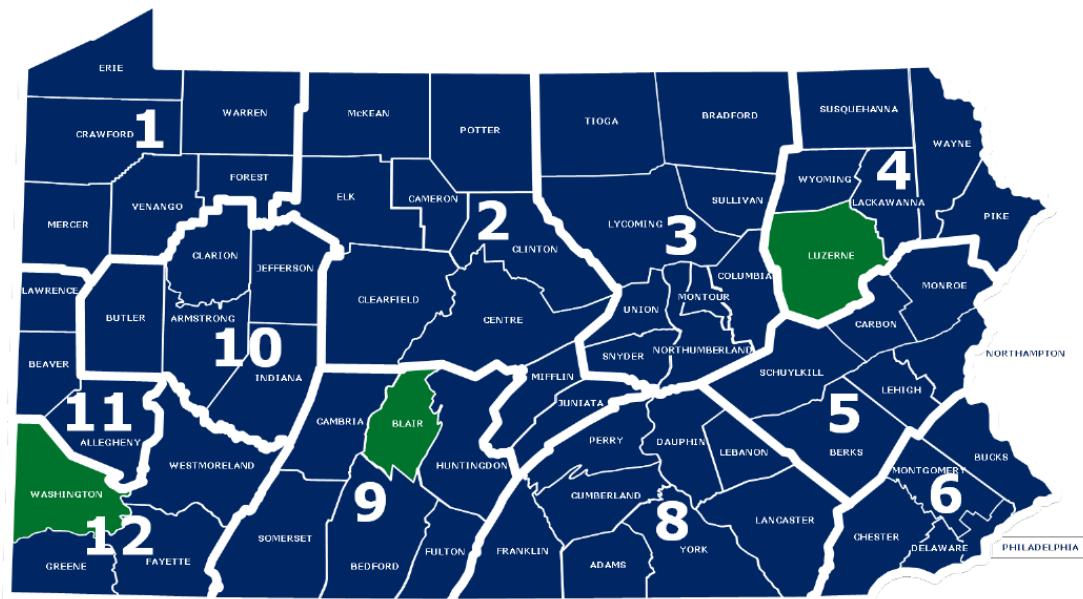


Figure 44. PennDOT Local Bridge Bundling Program pilot project locations.

Source: PennDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	The goal was to save time and money by increasing efficiency by reusing similar design details on bridges in the bundle.
Bridge Selection Criteria	<ul style="list-style-type: none"> • Locally owned. • Poor condition. • 20- to 60-foot single span. • Less than 15 degree skew. • All in one district, preferentially the same county, within a 15-mile radius. • No delays (avoid historic structures, structures near railroads, structures with robust utility attachments, and significant/commercial right-of-way takes).
Delivery and Procurement Method	D-B-B, low bid
Funding Sources/Financing Strategy	<p>100 percent State funded</p> <p>No local match</p>
Environmental, Right-of-Way, and Utility Considerations	Sites selected with limited third-party coordination to streamline efficiency.
Program Risks	Similar risk to traditional projects.
Owner Management/Quality Assurance	D-B-B, so quality assurance and quality control are the same as with a traditional project.
Stakeholder Communication	Coordination with LPAs during the bridge selection process. Communication with stakeholders during design is similar to a traditional project.

**Flowchart to Prepare
Local Bridge Bundling of Non-Complex (Minor) Projects**

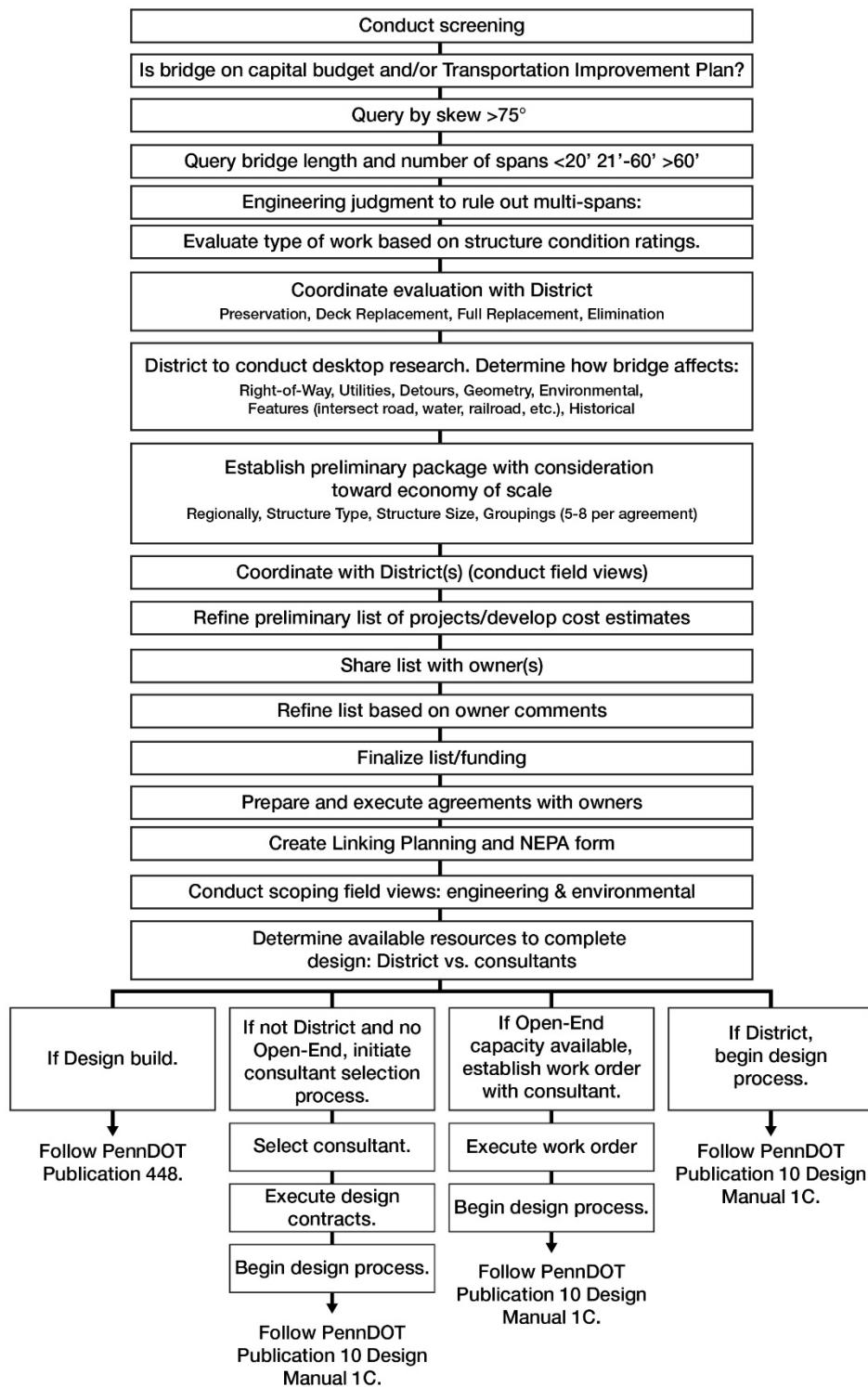


Figure 45. PennDOT local bridge bundling flowchart.

Source: PennDOT

PennDOT Rapid Bridge Replacement Program

Agency Name:	Pennsylvania Department of Transportation (PennDOT)
Project Location:	Statewide
Project Delivery Method:	Design-build-finance-maintain (DBFM)
Procurement Method:	Best value (90 percent price, 10 percent technical score)
Total Project Cost:	Bid price \$899 million
Funding Source:	Public-private partnership (P3), State and Federal funded
	Payment structure:
	<ul style="list-style-type: none">○ \$210 million in milestone payments during the construction period.○ \$65 million per year for 25 years.
Construction Schedule:	3 years
Project Description:	The Pennsylvania Rapid Bridge Replacement Project is replacing 558 bridges, the vast majority in poor condition, in 3 years under a single contract through an availability payment-based P3. The bridges are State-owned, smaller spans on roads with low traffic volumes in rural areas. The project accelerated the replacement of the bridges with robust, high-quality new structures that will be well maintained and have longer lifespans. By bundling the replacement of over 500 bridges in a single P3 procurement, PennDOT created efficiencies through economies of scale and by applying asset management best practices throughout the 25-year concession period. The bridges have also been designed to minimize environmental impacts and public inconvenience during construction.
Project Website:	http://parapidbridges.com/

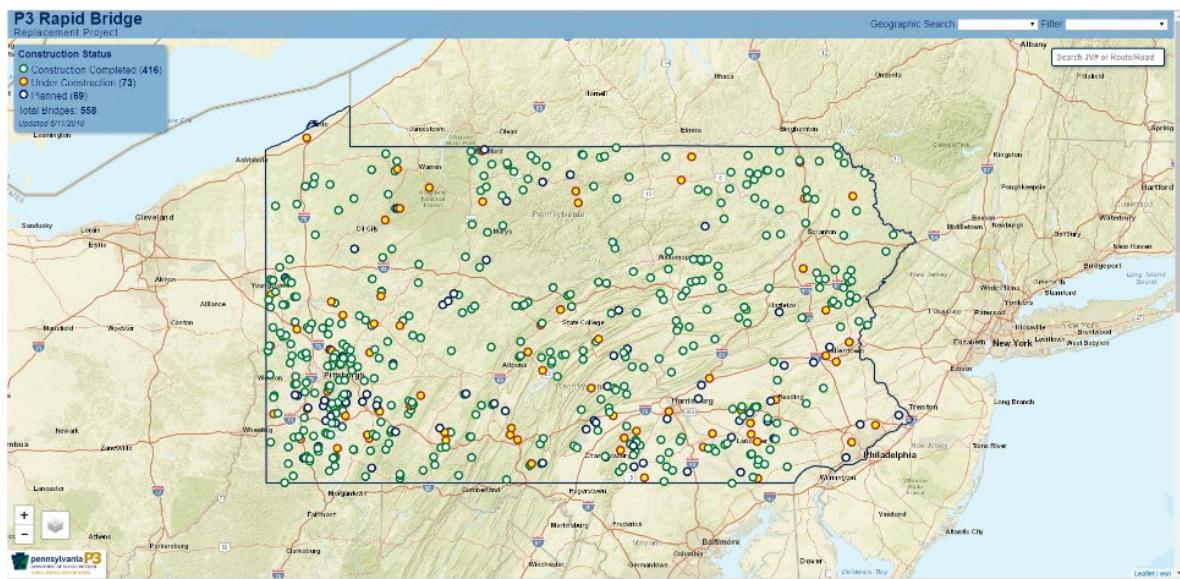


Figure 46. PennDOT Rapid Bridge Replacement Program project map.

Source: PennDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Program Goals	To quickly reduce the number of poor bridges in the State bridge inventory.
Bridge Selection Criteria	<ul style="list-style-type: none"> • Poor condition. • State owned. • Low volume roadway. • 40- to 70-foot single span
Delivery and Procurement Method	DBFM, best value
Funding Sources/Financing Strategy	P3. PennDOT motor license funds supplemented by Federal funds during development.
Environmental, Right-of-Way, and Utility Considerations	<ul style="list-style-type: none"> • PennDOT obtained a special experimental project (SEP-15) waiver to delegate National Environmental Policy Act/permitting responsibility to the private partner. • Private partner responsible for utility coordination. PennDOT intended to have the P3 team pay for the coordination and PennDOT was to pay for the actual utility relocations. Due to unclear language in the request for proposal (RFP), PennDOT paid for the coordination as well. • <i>Lesson Learned:</i> Utility companies had limited resources to move utilities. • Private partner was responsible for preparing right-of-way (ROW) plans. PennDOT purchased the ROW. • PennDOT would intervene when third parties were not responsive to the private partner. • PennDOT coordinated all environmental, utility, and ROW issues for 87 early-completion bridges.
Program Risks	<ul style="list-style-type: none"> • Since this project is DBFM, the risk is primarily on the private partner. • Risk to the owner is loss of control, therefore it is important to have a very good RFP.
Owner Management/Quality Assurance	<ul style="list-style-type: none"> • PennDOT hired a consultant as a program manager. • PennDOT hired a consultant to perform design reviews. • A third-party consultant hired by the P3 team performed construction inspection, but reported to PennDOT. PennDOT provided quality assurance by providing one additional construction inspector per three bridges. • <i>Lesson Learned:</i> It may have been better to have construction inspection paid for directly by PennDOT.

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Stakeholder Communication	<ul style="list-style-type: none"> • PennDOT worked extensively with State lawmakers to pass legislation allowing for the use of a P3. • PennDOT had an industry meeting with the Association of Pennsylvania Constructors to let them know about the process. • PennDOT conducted an outreach program aimed at Disadvantaged Business Enterprises (DBEs) to ensure owners knew how to get involved with the P3 contract.

SCDOT Letter Packages Bridge Bundling Program

Agency Name:	South Carolina Department of Transportation (SCDOT)
Project Location:	Statewide
Project Delivery Method:	Design-build (D-B)
Procurement Method:	Adjusted low bid (best value)
Total Project Cost:	<p>Package A: \$8 million – three bridge replacements (District 5, January 2012)</p> <p>Package C: \$14 million – seven bridge replacements (District 4, March 2012)</p> <p>Package D: \$9.5 million – five bridge replacements (District 6, May 2012)</p> <p>Package E: \$53 million – 13 bridge replacements (District 4, January 2015)</p>
Funding Source:	Federal and State funds (pay-as-you-go program)
Construction Schedule:	The request for proposals (RFP) specified which bridges could be closed and which bridges needed to be staged. The D-B team was given flexibility with the schedule.
Project Description:	<p>South Carolina began bundling bridges with a pilot program in 2003. That project was a D-B contract that included 33 bridges at a cost of \$20 million. SCDOT took the lessons learned from the pilot project and issued a second bridge bundle contract in 2008. Again, it was a D-B contract, but this time the bridges were chosen all within District 4.</p> <p>With lessons learned from the first two efforts, SCDOT put out a series of contracts beginning in 2012 called the Letter Packages. The Letter Packages were made up of four contracts that replaced 28 bridges at a cost of \$84.5 million. These contracts were all D-B and were awarded in a two-step process. In the first step, three to five teams were shortlisted for each contract based on their qualifications. These teams were then given a chance to provide a bid. The award was based on a process that SCDOT calls adjusted low bid. Dollar values were assigned to the time bid and added to the bid price. The value was then adjusted based on the technical score. This is also referred to as best value.</p> <p>The Letter Packages incorporated the lessons learned from the two prior bridge bundles over the previous decade. For the sake of consistency in project delivery and for efficiency in construction,</p>

each package was put together within a single SCDOT District. Also, in order to minimize risks, the following information was provided by SCDOT in the RFP:

- Geotechnical borings.
- Preliminary hydrology and hydraulics and minimum span length.
- Field survey.
- Environmental determinations performed by SCDOT.
- Maintenance of traffic determinations (which bridges could be closed and which bridges needed to be staged construction).

SCDOT largely avoided locations where railroad coordination was necessary. In locations where there was railroad involvement, SCDOT performed the coordination up front and defined a box where the contractor could work. The D-B team had to continue the coordination during construction. The cost for the railroad flaggers was paid for by the D-B team, but had to be passed through SCDOT.

All utility relocations and coordination were the responsibility of the D-B team. Minimal utility information was provided in the RFP. If a utility relocation was necessary and the utility company had prior rights, then SCDOT paid for the relocation. If not, then the relocation was paid for by the utility company. SCDOT did approve time extensions caused by utilities that were beyond the control of the D-B team.

If additional right-of-way (ROW) was needed, the D-B team was responsible for acquiring any ROW needs on behalf of SCDOT. The cost for ROW had to be included in the project bid.

Although environmental determinations were performed by SCDOT and included in the RFP, the acquisition of all environmental permits was the responsibility of the D-B team.

One of the keys to the success of the Letter Packages was the flexibility built into the RFP. SCDOT provided the D-B team with the information needed to minimize risk, but did not make the RFP so restrictive that it inhibited innovation. SCDOT staff reported that more flexibility in the RFP lead to more efficiency on the part of the D-B team.

SCDOT has been very successful at bundling bridges over the past 15 years. Having an established D-B program with dedicated staff

made administration of these bridge bundles easier for SCDOT than it would be for owners without the experience.

SCDOT also benefits from its willingness to incorporate lessons learned from prior bridge bundles into the program. In the time since the Letter Package bridges were completed, SCDOT has twice used bridge bundling to address emergency bridge projects after extreme flooding. Bridge bundling is a tool that SCDOT will continue to use in combination with the D-B program to maximize efficiency and achieve desired goals.

Project Information:

[SCDOT Design-Build Manual](#)

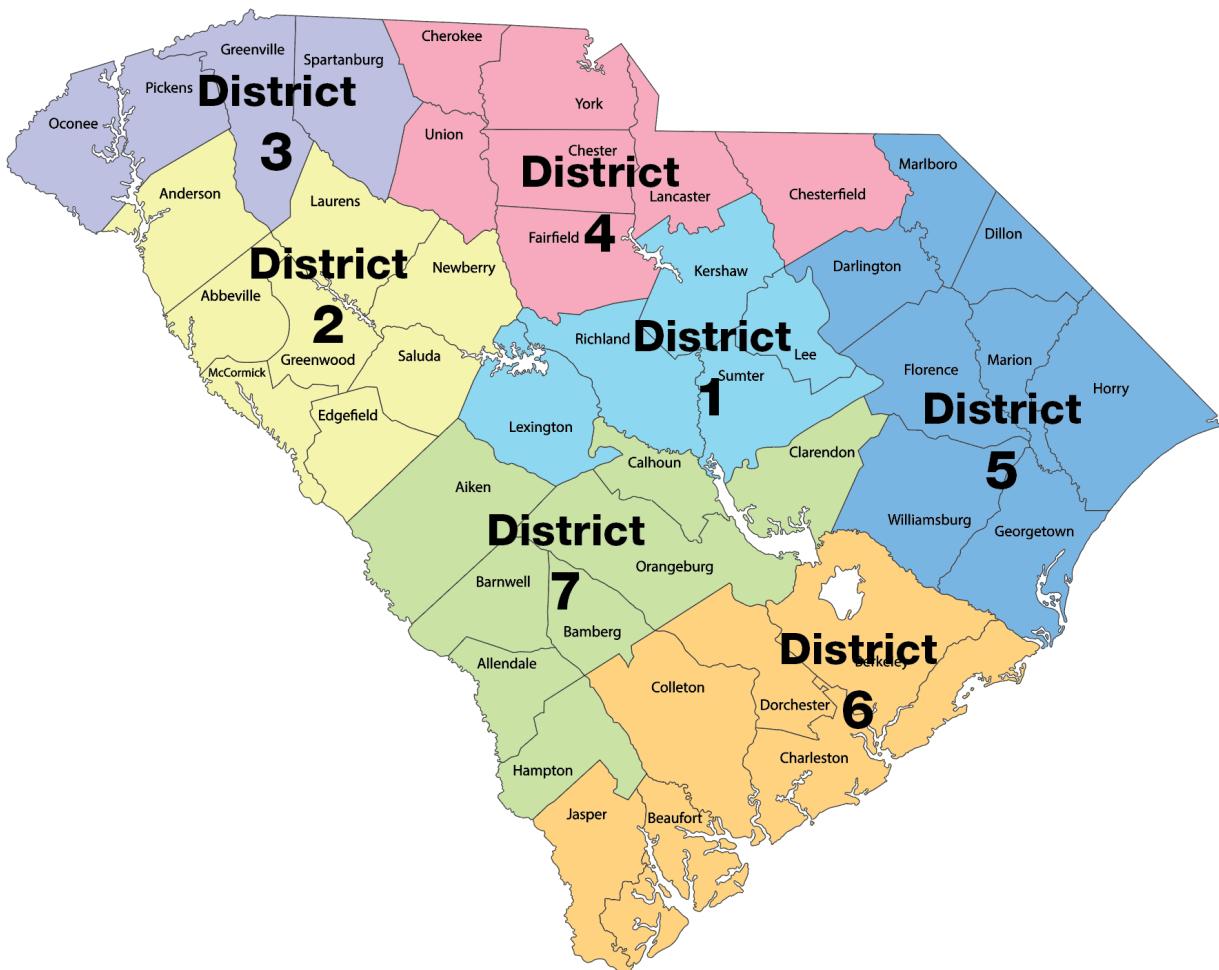


Figure 47. South Carolina DOT Districts.

Source: SCDOT

SUMMARY	
PROGRAM DETAILS	DESCRIPTION
Project Goals	To reduce the number of bridges in poor condition. SCDOT hoped to save time and money by bundling bridges together purposely.
Bridge Selection Criteria	<ul style="list-style-type: none"> • State owned. • Poor condition. • Railroad involvement avoided. • All in one district.
Delivery and Procurement Method	D-B, two-step process (short list and adjusted low bid)
Funding Sources/Financing Strategy	Federal and State dollars (pay-as-you-go program)
Environmental, Right-of-Way, and Utility Considerations	<p>Utility coordination: Completed by D-B team.</p> <p>ROW: D-B team acquires ROW on behalf of SCDOT. D-B team handles all coordination. Cost is included in the bid.</p> <p>Environmental: SCDOT makes environmental determinations. D-B team does all coordination and acquires permits.</p>
Program Risks	Most risk is on the D-B team. SCDOT has tried to reduce risk by providing geotechnical borings, preliminary hydrology and hydraulics, minimum span length, and field survey in the RFP.
Owner Management/Quality Assurance:	D-B team performs design and provides construction inspection. SCDOT reviews designs for conformance with the RFP. SCDOT provides construction inspection quality control. Alternative technical concepts are permitted with the D-B process and were utilized on the Letter Packages, although none were significant.
Stakeholder Communication	Communication with stakeholders during design is similar to a traditional project.

Appendix D. National Bridge Condition and Bridge Asset Management

The National Bridge Inventory Highway Bridge Condition data¹⁴ demonstrate the extent of the challenge of managing bridge assets across the nation. For 2017, the national data show there are 615,002 highway bridges with a total bridge deck area of 374,362,285 square meters. Table 25 shows the number and percentage for bridges and deck area by condition.

Table 25. National Bridge Inventory (2017).

BRIDGE:	TOTAL	GOOD	FAIR	POOR
Number	615,002	288,030	279,270	47,619
Percent	100.0%	46.8%	45.4%	7.7%
Deck Area (m ²)	374,362,285	172,484,745	180,767,814	21,084,089
Percent	100.0%	46.1%	48.3%	5.6%

Bridges are typically inspected every 24 months or more frequently as needed. The National Bridge Inventory (NBI) provides a single condition rating for four components—deck, superstructure, substructure and culverts—supplemented with additional condition data at an element level (from 0-failed condition to 9-excellent condition). A bridge is classified in good condition if the minimum condition rating of the deck, superstructure, or substructure is either a 9, 8, or 7. A bridge classified as fair has a minimum condition rating of a 6 or 5; poor classification is 4 or below. The element-level data provides a better indication and quantification of needs than the component or overall bridge condition data, which are too broad for determining specific activity on a bridge.

In addition, a review of the ages of highway bridges indicates another bridge management challenge: of the 615,002 bridges in the NBI, more than 4 in 10 (43 percent) are 48 years or older, and an additional 13 percent are between the ages of 38 and 47. According to the American Society of Civil Engineers' Report Card for America's Infrastructure,¹⁵ the average bridge in the United States is 43 years old. Figure 48 shows the percent of highway bridges in the NBI by age.

The decision to bundle bridges depends on several factors unique to each bridge agency's inventory and condition of bridges or bridge elements. In general, bridge bundling for bridge preservation and preventive maintenance can be done for bridges or bridge elements in good and fair condition, for rehabilitation of bridges or bridge elements in fair and poor condition, and for replacement when bridges or bridge elements are in poor or severe condition.

¹⁴ FHWA [National Bridge Inventory Highway Bridge Condition data](#)

¹⁵ American Society of Civil Engineers [Report Card for America's Infrastructure](#)

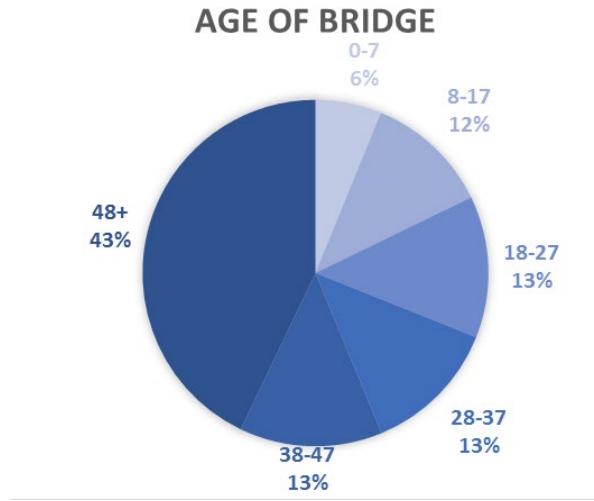


Figure 48. Percentage of highway bridges in the National Bridge Inventory by age (2017).

Source: FHWA

Figure 49 represents a bridge's condition over time, showing the three bridge work types based on condition. A bridge preservation program can extend the service life of a bridge or bridge element when it is in good or fair condition. This results in achieving the greatest value from the original construction cost by delaying the need for rehabilitation or replacement. Typically, when a bridge element enters into poor condition, bridge preservation ends until that bridge element is rehabilitated back into good or fair condition, or replaced.

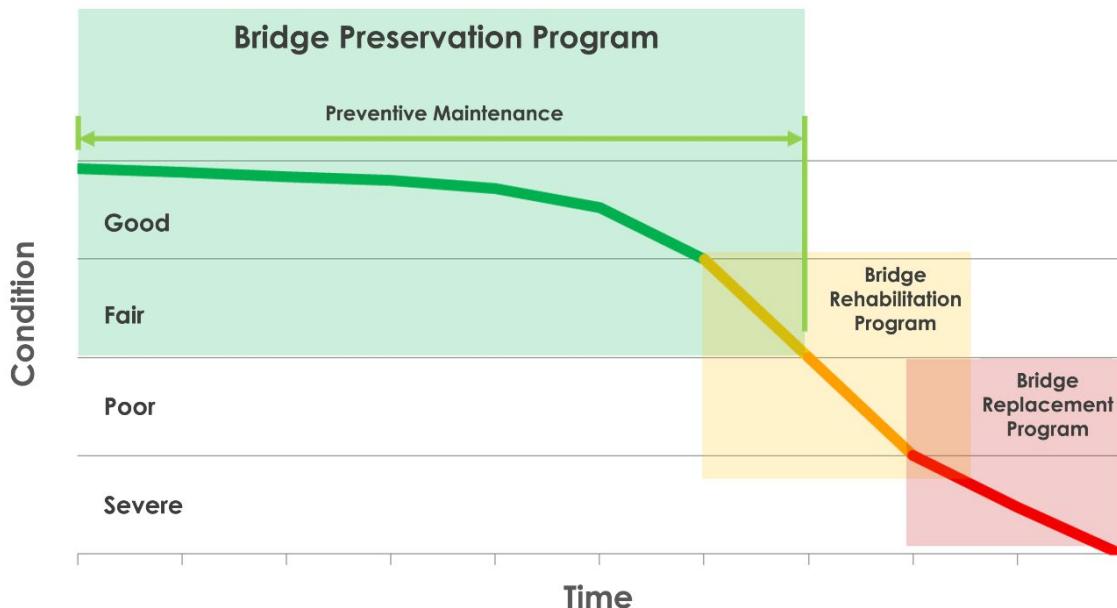


Figure 49. Bridge condition over time with work types.

Source: FHWA Bridge Preservation Guide, Spring 2018

A bridge preservation bundling program can consist of performing cost-effective cyclical and condition-based preventive maintenance activities that seek to slow deterioration and prolong the service life of bridges and delay the need for rehabilitation or replacement. Figure 50 represents this dynamic between bridges with and without preservation treatments.



FHWA [Bridge Preservation](#) web page.

Solid-colored lines = With Preservation (cyclical and condition-based maintenance)
Dashed-colored lines = Without Preservation

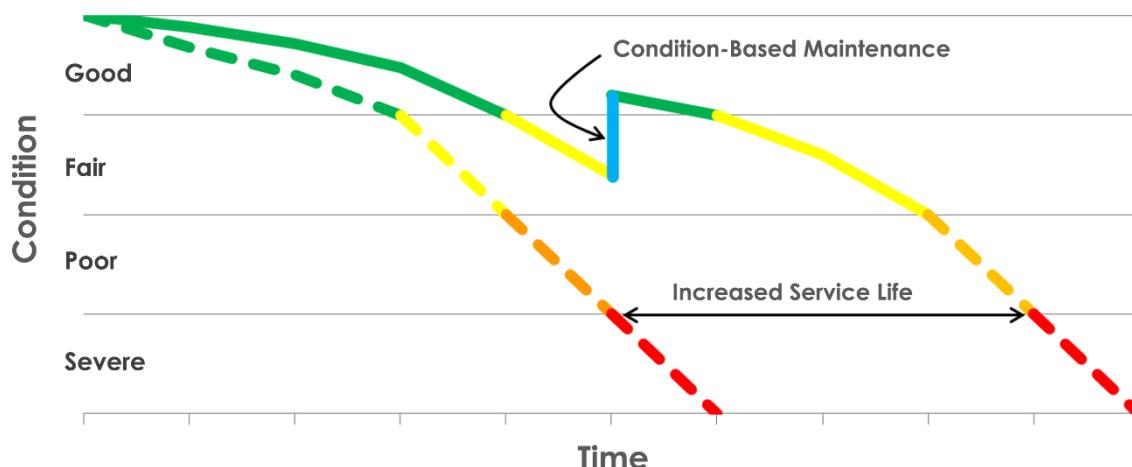


Figure 50. Bridge condition over time with and without bridge preservation.

Source: FHWA Bridge Preservation Guide, Spring 2018



FHWA [National Bridge Inventory](#) web page.

Definitions

Bridge Element Condition State: This categorizes the severity and extent of damage or deterioration of a bridge element. The American Association of State Highway and Transportation Officials (AASHTO) Manual for Bridge Element Inspection provides information on bridge elements and their corresponding condition states. Each bridge element has a unit of measure and four condition states (1—good, 2—fair, 3—poor, and 4—severe) as shown in Table 26.

Condition states are denoted as CS1, CS2, CS3, and CS4. A higher condition state indicates a higher severity of the damage and/or deterioration of the element. An element's total quantity is assigned to four condition states as applicable.

Good, Fair, Poor: These terms are defined in accordance with the Pavement and Bridge Condition Performance Measures final rule, published in January 2017. Bridge condition is determined by the lowest rating of NBI condition ratings for Item 58 (deck), Item 59 (superstructure), Item 60 (substructure), or Item 62 (culvert). If the lowest rating is greater than or equal to 7, the bridge is classified as good; if it is less than or equal to 4, the classification is poor. Bridges rated 5 or 6 are classified as fair (see Table 27).

Structurally Deficient: This term was previously defined in a non-regulatory supplement to the Title 23 Code of Federal Regulations, Part 650 D, as having a condition rating of 4 or less for Item 58 (deck), Item 59 (superstructure), Item 60 (substructure), or Item 62 (culvert), or, having an appraisal rating of 2 or less for Item 67 (structural condition) or Item 71 (waterway adequacy). *As of January 1, 2018*, this term is defined in accordance with the Pavement and Bridge Condition Performance Measures final rule, published in January 2017, as a classification given to a bridge that has any component (Item 58, 59, 60, or 62) in poor or worse condition (code of 4 or less).

Functionally Obsolete: This term was previously defined in Title 23 Code of Federal Regulations, Part 650 D, as having an appraisal rating of 3 or less for Item 68 (deck geometry), Item 69 (under clearances), or Item 72 (approach roadway alignment), or, having an appraisal rating of 3 for Item 67 (structural condition) or Item 71 (waterway adequacy). Functionally obsolete is a legacy classification that was used to implement the Highway Bridge Program, which was discontinued with the enactment of the Moving Ahead for Progress in the 21st Century Act (MAP-21). As a result, fiscal year 2015 was the last year outstanding Highway Bridge Program funds could be obligated on eligible projects, including ones with bridges that were once classified as functionally obsolete. Therefore, starting with the 2016 data, FHWA no longer tracks this measure *nor publishes it on the FHWA website*. FHWA's focus has shifted to a performance-based program as established in MAP-21 and continued in the Fixing America's Surface Transportation Act (FAST Act). As such, the use of the good-fair-poor bridge condition measures outlined in the Pavement and Bridge Condition Performance Measures regulation published in January 2017 is encouraged.

Highway Bridge: A public vehicular structure more than 6.1 meters (20 feet) in length that spans an obstruction or depression. In data terms, all of the following apply: Item 5a=1; Item 49>=6.1 meters; Item 112=Y; and Item 42a=1 or 4 or 5 or 6 or 7 or 8.

All codes for all items in the NBI can be found in the Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges.



Definition of the [National Highway System](#) (NHS)

Table 26. Bridge element condition states and common actions.

Source: FHWA Bridge Preservation Guide, Spring 2018

AASHTO Condition State	Description	Common Actions
1	Varies depending on element—Good	Preservation/Cyclic Maintenance
2	Varies depending on element—Fair	Cyclic Maintenance or Condition-Based Maintenance when cost effective.
3	Varies depending on element—Poor	Condition-Based Maintenance, or Rehabilitation—when quantity of poor exceeds a limit that condition-based maintenance is not cost effective, or Replacement—when rehabilitation is not cost effective.
4	Varies depending on element—Severe	Rehabilitation or Replacement

Table 27. National Bridge Inventory general condition ratings and common actions.

Source: FHWA Bridge Preservation Guide, Spring 2018

Code	Description	Common Actions
9	EXCELLENT CONDITION	Preservation/Cyclic Maintenance
8	VERY GOOD CONDITION —No problems noted.	
7	GOOD CONDITION —Some minor problems.	
6	SATISFACTORY CONDITION —Structural elements show some minor deterioration.	Preservation/Condition-Based Maintenance
5	FAIR CONDITION —All primary structural elements are sound but may have some minor section loss, cracking, spalling, or scour.	
4	POOR CONDITION —Advanced section loss, deterioration, spalling, or scour.	Rehabilitation or Replacement
3	SERIOUS CONDITION —Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.	
2	CRITICAL CONDITION —Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present, or scour may have removed substructure support. Unless closely monitored, the bridge may have to be closed until corrective action is taken.	
1	IMMINENT FAILURE CONDITION —Major deterioration or section loss present in critical structural components, or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put it back in light service.	
0	FAILED CONDITION —Out of service. Bridge is beyond corrective action.	

Appendix E. Finance Mechanisms

State	State Tools			Federal Tools					Public-Private Partnerships (P3)
	General Obligation Bonds	Revenue Bonds	State Infrastructure Bank (SIB)	GARVEE Bonds	TIFIA Credit Assistance	Advance Construction	Partial Conversion of Advance Construction	Federal-Aid Matching Strategies	
Alabama		•	•	•		•			LA
Alaska	•		•		LA	•			Selective
Arizona		•	Inactive	•	LA	•			•
Arkansas	•			•		•			LA
California	•		•	•	•	•			•
Colorado		•	•		•	•		TM, TC	•
Connecticut	•			LA		•			LA
Delaware	•	•		•	•	•			LA
Florida	•	•	•	LA	•	•		TC	•
Georgia	•	•	•	•	•	•			•
Hawaii		•				•			
Idaho				•		•	•	FM, TM, TC	
Illinois	•	•			LPAs	•		TC	LA
Indiana		•	Inactive		•	•	•	FM, TM, TC	•
Iowa			Inactive			•		TM	
Kansas		•	•			•	•	TM, TC	
Kentucky		•		•	•	•		TC	LA
Louisiana	•	•	Inactive	LA	•	•		TM, TC	LA
Maine	•	•	•	•		•		TC	LA
Maryland		•		•	•	•		TC	•
Massachusetts	•	•		•		•	•	TC	•
Michigan		•	•	I		•	•	FM, TM, TC	•
Minnesota	•		•			•	•	FM	
Mississippi	•	•		•		•			LA
Missouri		•	•	I		•			
Montana		LA			•		•	FM	
Nebraska			Inactive			•			
Nevada		•		LA		•			LA
New Hampshire	•	•	Inactive	•	•	•		TC	LA
New Jersey		See Note		•		•		TC	
New Mexico		•	•	•		•		TM	
New York	•		Inactive			•			
North Carolina	•	•	•	•	•	•	•	TM	•
North Dakota			Inactive	•		•			
Ohio	•		•	•	•	•		TC	•
Oklahoma		•	Inactive	•	LA	•		TC	
Oregon	•	•	•	LA	LA	•		TM	LA
Pennsylvania	•	•	•			•	•	TC	•
Rhode Island	•		•	•		•		TC	
South Carolina	•	•	•			•	•	FM, TM, TC	•
South Dakota			•			•	•		
Tennessee			Inactive			•			LA
Texas	•	•	•		•	•		TM, TC	•
Utah	•		•			•			LA
Vermont	•	•	•			•		TM	
Virginia		•	•	•	•	•		TC	•
Washington	•		•	•	•	•			LA
West Virginia	•		Inactive	•		•			•
Wisconsin	•	•	•	•		•	•		LA
Wyoming			Inactive			•			
	27	32	37	31	20	50	12	28	33

LA = legislatively authorized, FM = flexible match, TM = tapered match, TC = toll credits, I = indirect GARVEE bonds.

Figure 51. Finance mechanisms used by States for roads and bridges.
(AASHTO, 2016)

Appendix F. Risk Management Process Overview

The risk management process is simple, and the effort necessary should be tailored to the scope, duration, and size of the project or program. Basic steps in a formal risk management process include the following:

1. Develop a risk management plan.
2. Identify risks (threats and opportunities).
3. Evaluate the identified risks (qualitatively and quantitatively, if necessary).
4. Develop risk-response strategies.
5. Monitor the risks and risk management plan.

The process is iterative: best practices indicate that regular updates to the initial risk assessment serve to identify additional risks (threats and opportunities) and allow for adjustment to the risks previously identified based on current information as the project progresses.



Figure 52. Risk management process.

Source: FHWA

One of the significant products resulting from a formal risk management process is the risk register. This is typically a spreadsheet that lists all the risks, their rankings, response strategies, and responsible parties for implementing the identified strategies. The risk register serves as an excellent communication tool for the team.

The benefits of conducting risk assessment include:

- Better utilization of resources.
- Increasing what goes right (opportunity identification and responses).
- Decreasing what goes wrong (threat identification and responses).
- Minimizing contingency (cost and schedule).

- Increasing likelihood of achieving project goals and objectives.
- Improving project communication among team members.
- Improving project management.
- Improving decision-making.
- Reducing bias of team members and others.
- Prioritizing actions.

Common reasons for not doing formal risk management and responses to each are outlined in Table 28.

Table 28. Risk management: arguments against and responses.

WHY HAVE A FORMAL RISK MANAGEMENT PROCESS?	
ARGUMENTS AGAINST	RESPONSES
It takes time and costs money.	Proper application saves time and money.
Responding to identified risks costs money.	Responses are an investment in the future to save (spend now to gain later).
Risk management does not work.	It is proven in many other industries and a key knowledge area for successful project management.
It is scaremongering.	Real risks are uncertainties that matter and include opportunities.
The benefits are not quantifiable.	The benefits can be measured.
We are too busy doing day-to-day work.	It will save time in the long run.
We do it every day; it is what we do.	A structured approach is better than a haphazard one or a false sense that it is being done properly.

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Identification of Risks (Threats and Opportunities)

There are numerous tools available to assist in the identification of risks (threats and opportunities). The most common method is brainstorming during a risk identification meeting that includes all the stakeholders in the project. Ideally this would include external and internal stakeholders. Following are brief descriptions of the more common risk identification methods:

Brainstorming: an informal method for obtaining a variety of ideas and inputs. It occurs in a group setting where each member provides suggestions for solutions to a particular problem.

Delphi Technique: a structured method for using informed judgment for decision making or long-range forecasting. It involves a panel of experts answering rounds of questions on a topic and receiving opinion feedback from fellow group members.

Subject matter expert: a person who possesses bona fide expertise and knowledge about what is needed to accomplish a particular job, task, or process.

Crawford Slip Method: a method involving gathering input from people on slips of paper. This is a simple yet effective type of brainstorming that gives all team members' opinions equal weight, however quiet they are.

Partnering: a collaborative process normally set up at the outset of a project. It typically involves facilitated sessions, attended by the major decision-makers, where project goals and issues are discussed. Partnering sessions occur throughout the life of the project.

Risk Responses

Risk responses fall into one of seven categories as noted in Table 29 and described below. One or more of these response methods may be deployed on individual risks.

Table 29. Risk response strategies.

THREATS	OPPORTUNITIES
Transfer	Share
Avoid	Exploit
Mitigate	Enhance
Accept (Actively or Passively)	

Response options available for an identified threat include:

- **Risk transfer:** Transfer the risk to the party best suited to handle the risk, such as an insurance carrier or another project participant (for example, from metropolitan council to the contractor). This methodology also includes risk allocation, which is a way to transfer risks through contractual mechanisms to the supply chain.
- **Risk avoidance:** Prohibit the process or procedure that results in risk too high to manage or accept.
- **Risk mitigation:** Accomplish through a reduction in the likelihood or consequence of a risk or some combination of the two.
- **Risk acceptance:** Typically taken if the risk is uncontrollable or the cost of risk reduction measures exceeds the potential risk exposure.

Response options available for opportunities:

- **Share opportunity:** an opportunity response strategy that involves efforts to increase the probability of an identified opportunity event by shifting some or all of the opportunities to a third party.
- **Exploit opportunity:** an opportunity response strategy that involves ensuring an identified opportunity will definitely occur in the project's favor.
- **Enhance opportunity:** an opportunity response strategy that involves efforts to increase the probability or impact or both of the identified event.
- **Accept opportunity:** a decision to accept or retain an opportunity is typically taken if the opportunity is uncontrollable. The acceptance can be either active or passive.

Risk-based project delivery selection tools

In addition to the University of Colorado selection model discussed in Chapter 7, other project delivery selection models, all risk-based decision-making tools built off the University of Colorado-developed tool, are available at the Georgia Institute of Technology, Georgia Department of Transportation (DOT), and New York State DOT.



South Carolina DOT (SCDOT) has advanced its risk management practices significantly over the last few years, recognizing its importance in project delivery method selection and in being able to properly allocate risk in contract documents. SCDOT's Design-Build Procurement Manual outlines the agency's process for requiring a Project Definition Report and completing a Project Delivery Selection Matrix. This includes, "an assessment of primary evaluation factors along with a risk assessment" before determining the "optimal delivery method." If the design-build delivery method is elected, a more detailed risk assessment is conducted for preparing contract documents.



Texas DOT has developed a quantitative risk-based decision-support tool based on 12 project characteristics and four project goals. Conducting a risk analysis based on these characteristics and goals for bridge bundling is particularly relevant not only for determining the project delivery method, but also for developing contract language. The four goals are: lower capital cost, higher cost predictability, higher schedule predictability, and lower capital maintenance costs.

The 12 project characteristics to be analyzed are:

1. The project has well-known site conditions that will not cause significant field changes.
2. The project will benefit from the introduction of innovative methodologies early in the planning/design phase.
3. The project design (plan, specification, and estimate) is currently at an advanced stage; the agency wants to avoid changes or rework in design.
4. The project requires the benefit of designer-contractor integration to reduce coordination challenges.

5. Prescriptive project requirements for methods, materials, and/or procedures limit contractor innovation in terms of alternatives.
6. The incremental costs of alternative delivery will exceed the savings from innovation on the project.
7. Early completion will add significant extra value for key project stakeholders.
8. The completion date of right-of-way acquisition is highly uncertain, and the project will benefit from the integration of innovative design and construction sequencing.
9. Utility relocations have not been completely identified and are likely to result in important changes in the design, cost, and/or schedule of the project.
10. The project includes permits requiring coordination and regulatory approval during the design and/or construction phases.
11. The agency is better equipped than the contractor to manage third-party issues.
12. The project is likely to benefit from shifting the risk of third-party issues to the contractor.

Appendix G. Bridge Selection Matrix

Selecting bridges to be included in a bridge bundle contract will depend on many factors. Some of the factors are iterative, while other are sequential. The order in which they are implemented will depend on the specific goals and objectives of the project and the associated risks (threats and opportunities). The following decision support model may need to be adjusted to reflect an agency's particular circumstances.

The factors listed are broad items that should be further detailed to align with specific goals. Each step should be documented in a decision record.



Figure 53. Bridge selection criteria.

Source: FHWA

Appendix H. Alternative Contracting Methods

Often, the traditional design-bid-build (that is, low-bid) method is hindered by project delays, as well as paying for the risks versus strategizing as a team early on about how to minimize them. Traditional low-bid designs often build in risk, but this costs the owners and results in reducing or de-scoping the project. Moreover, in traditional contracting models, the owner owns the design and therefore is responsible for the cost of any errors or omissions encountered during construction.

“Dealing with risks requires rethinking established practices and changing individual mindsets. In terms of measurable cost and time savings, nontraditional procurement methods—commonly known as alternative contracting methods (ACMs)—can benefit transportation programs substantially by offering several advantages that result in flexibility in project delivery.

Above all, project owners need to think critically to solve problems. Early contractor involvement, fueled by ACMs, is the key to improved thinking and hence better project planning and design. Achieving these results requires removing transportation industry fears of involving a contractor too early in the process. Ultimately, early contractor collaboration results in smart construction, transportation benefits, and life-saving improvements delivered faster and more efficiently, along with added value to the owners, as pointed out by the National Cooperative Highway Research Program (NCHRP) in Report 787, published in 2014. When used early in the planning and design phases, ACMs outshine design-bid-build (D-B-B) in harnessing contractors’ technical expertise and construction management experience.

Today, ACMs are thoroughly vetted. The transportation industry is now in a prime position to take advantage of the ability of ACMs to work successfully for all project partners. This advantage equates to being free to discuss the means and methods before plans are drawn and design budgets are spent. All in all, ACMs—especially construction manager/general contractor (CM/GC)—are a win-win for transportation agencies as well as the public.” (Peters & Atkins, 2018)

Departments of transportation can achieve remarkable time savings through early partnering and collaboration between the contractor and the entire project team. In fact, strategically employing CM/GC offers the greatest opportunity to fast-track construction. To illustrate, CM/GC procurement can deliver projects reliably up to 50 percent faster than traditional contracting methods. In turn, this saves the owners money, according to a 2016 Federal Highway Administration webinar, “Quantification of Cost, Benefits and Risk Associated with Alternative Contracting Methods and Accelerated Performance Specifications.”



Figure 54. CM/GC: an integrated approach.

Source: FHWA

“According to NCHRP Report 787, the most effective type of ACM for mitigating project risks is the CM/GC delivery method. Enhanced results from using CM/GC arise from collaborating early and sitting down often with the entire project team, including the owner, designer, independent cost estimator, and subcontractors. It is important to note that the subcontractors are not traditional low-bid subcontractors. On the contrary, the subs are preselected with the contractor’s original proposed team. In other words, CM/GC, if used optimally, requires that subcontractors in each specialty area be present from the project’s inception and available to assist in the development of the project.” (Peters & Atkins, 2018)

In CM/GC, the owner holds two contracts, one with its designer and one with its contractor. This varies from design-build, where the designer and contractor are united contractually. CM/GC enables the project owner to retain complete control of the design because the designer works directly for the owner agency. More important, this phase enables the owner to have input from the builder prior to making costly design decisions.

Perhaps the most important feature of CM/GC is the way this contracting method encourages, allows, and even requires innovation during the design process. Unquestionably, CM/GC incentivizes innovation more than any other delivery system. What makes this possible is the owner, the designer, and the contractor’s team coming together at the project’s conception.

This early relationship facilitates critical thinking because the intensity of the design effort is focused on planning construction versus producing plans. This focus ultimately leads to smart engineering—and innovations—as well as defining the true problems prior to construction. By generating innovations, CM/GC provides improved quality and performance: smart construction.

Furthermore, CM/GC generates measurable overall project savings because the owner, contractor, subcontractors, independent cost estimator, design consultants, and stakeholders work cooperatively to develop and maintain an aggressive and cost-effective schedule and to minimize project risks or to assign them to the party best equipped to mitigate those risks. The schedule and budget drive the project and all project decisions, not the other way around.

“In other words, when decisions are being made, the team needs to ask whether the decision will contribute to bringing the project in ahead of schedule and under budget. If the answer is no, then it is not a good decision. In short, design details do not drive the weekly team meetings, the schedule and budget do.” (Peters & Atkins, 2018)

A No-Frills Approach to Design

Unlike D-B-B, CM/GC brings the builder into the design process at a stage where definitive input can have a positive impact on the project. Using a no-frills, bare-bones approach to design plans, CM/GC can rapidly deliver early work packages for a quality project, under budget, while also maximizing the project scope within the available funds.

In addition to speed, another advantage of CM/GC is control. Projects are designed basically around a table, during weekly project meetings with the entire team present, rather than in a design office where the team members have little or no active interaction with each other. One goal of CM/GC is to review the plans during those weekly design/production meetings and produce construction-ready drawings rather than bid sets. There is no need for bid sets, because the owner is not using the low-bid system.

The contractor obtains prices from the preselected subcontractors also working around the design table. Rough order of magnitude estimates become available as designs are discussed. The final pricing simply involves fine-tuning those estimates.

The CM/GC delivery method removes the requirement to have 100-percent signed and sealed drawings to bid the work. Plans need only to be at a level of completion that enables the contract manager to price the work. Moreover, traditional 30-, 60-, and 90-percent reviews are no longer necessary, because the entire team reviews the plans weekly.

CM/GC projects do not need a fully developed design package, as with low-bid projects, or a complex performance specification, as with design-build projects. In addition, CM/GC gives the owner the ability to specify verbally the vision, goals, and objectives for the overall project.

A Cultural Change

Notably, a change in design philosophy from traditional D-B-B projects is necessary to implement a CM/GC program successfully. Early and continuous innovations, right-of-way phasing, real-time pricing, and accelerated design may require additional cultural and educational shifts because of the change in responsibility for managing the project schedule and budget from the owner and designer to the contractor.

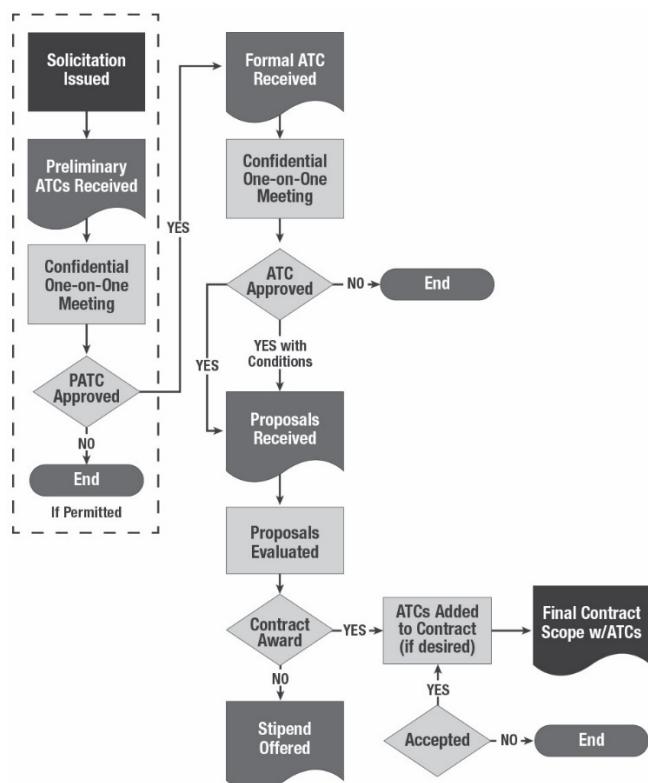
In many cases, CM/GC requires a significant and aggressive change in the culture of the owners, contractors, and designers. For instance, the standard design methods, schedules, and plan review stages that are frequently used in designing D-B-B projects may prove to be inadequate to realize the advantages of CM/GC. Designers are required to take a much more active role in working with the owner and contractor during the entire design process. (Ptchelinzew, et al., 2013)

Appendix I. Alternative Technical Concepts

State departments of transportation (DOTs) often look to contractors to provide innovative solutions that promote efficiencies, reduce risks, accelerate project delivery schedules, and reduce project costs. Through a flexible highway contracting process known as alternative technical concepts (ATC), contractors can submit innovative, cost-effective solutions that are equal to or better than the State's design and/or construction criteria.

The ATC process is most commonly used with design-build (D-B) project delivery, where a State DOT issues a request for proposal (RFP) that may contain basic project configurations and design and construction criteria. D-B teams submit ATCs based on their industry expertise. The DOT reviews the submissions and grants approval of the concept on a pass-fail basis. If the concept is acceptable, the D-B team may incorporate this concept in its technical and price proposal. This process allows contractors to submit innovative concepts and solutions in a confidential manner.

The DOT selects a best-value proposal that meets, or potentially exceeds, the RFP requirements. Best-value considerations may include concepts that accelerate project delivery, reduce travel impacts, or include features desired by the DOT and/or the general public. The ATC approach fosters a best-value solution that also increases the value of the project to the public.



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Figure 55. ATC generic evaluation and review process.
(NCHRP 455, 2014)

ATCs are typically used on large design-build projects where the best-value selection may depend on the degree of innovation in the technical solutions offered by the teams. Many States have evaluated and benefited from the use of ATCs on large D-B or public-private partnership projects. While there is less experience with the use of ATCs in design-bid-build project delivery, the Missouri DOT has evaluated this approach in a traditional low-bid environment with some degree of success.

The ATC approach promotes competition and the exchange of innovative methods early in the design process, giving DOTs the opportunity to select proven design and construction solutions that offer the best value.

“The use of alternative technical concepts gives contractors the opportunity to propose innovative, cost-effective solutions that are equal to or better than the contracting agency’s design and construction criteria for a project. This contracting approach promotes competition and enables highway agencies to choose design and construction solutions that offer the best value.” (Gransberg, Pittenger, & Chambers, 2017)



The information in this appendix is based on content from the Federal Highway Administration’s [Every Day Counts](#) and [Construction Program Office](#) websites. ATC topics on the Construction Program Office website include:

- [Legal Authority or Enabling Legislation](#)
- [Sample Manuals of Instruction](#)
- [Procurement Documents & Templates](#)
- [Contracting](#)
- [Confidentiality Requirements](#)
- [RFP or Invitation for Bid language](#)
- [Contract Provisions](#)
- [Lessons Learned and Benefits Data](#)
- [Other Handy ATC Resources](#)
- [Webinar Series](#)



An AASHTO Guidebook for implementing ATCs into project delivery methods is being prepared under National Cooperative Highway Research Program [\(NCHRP\) project 08-112](#).

Appendix J. Sample Contract Documents

The following descriptions contain links to examples of bridge bundle contract documents employed by agencies at the State and local level. All descriptions were taken from the relevant websites. Table 30 provides a summary of the links, whether State or local level, the funding sources, and the project delivery method.

Table 30. Contract Document Matrix.

ORGANIZATION	AGENCY		FUNDING SOURCE(S)				DELIVERY METHOD				
	STATE	LOCAL	FEDERAL	STATE	LOCAL	OTHER	D-B-B	IDIQ	CM/GC	D-B	P3
GDOT	-	X	-	X	-	-	X	-	-	X	-
MassDOT	X	-	-	-	-	-	-	-	-	-	-
MoDOT	X	-	X	X	-	-	-	-	-	X	-
NDOT	X	X	-	X	X	-	X	-	-	-	-
NYSDOT	X	-	X	X	-	-	X	-	-	X	-
Ohio DOT	-	X	X	X	-	-	-	-	-	X	-
Oregon DOT	-	-	-	-	-	-	X	-	X	X	-
PennDOT	X	-	-	-	-	X	X	-	-	-	-

CM/GC = construction manager/general contractor, D-B = design-build, D-B-B = design-bid-build, IDIQ = indefinite delivery/indefinite quantity, P3 = public-private partnership, DOT = department of transportation

Georgia Department of Transportation (GDOT)

The GDOT website allows users to [search for bridge bundle contracts](#) and read about [current design-build projects](#). It also hosts a SharePoint site for [public downloads from GDOT offices](#).

Massachusetts Department of Transportation (MassDOT)

The MassDOT [Accelerated Bridge Program](#) website includes a list of the program's goals and objectives, active project listings, and graphics that communicate jobs created and the projected number of structurally deficient bridges per county in the absence of Accelerated Bridge Program funding. MassDOT and the State's Department of Conservation and Recreation are using innovative techniques to complete this program. More projects are completed on-time, on-budget, and with minimum disruption to people and commerce.

Missouri Department of Transportation (MoDOT)

The Safe & Sound program improved more than 800 bridges divided into two groups: 248 rehabilitations and 554 replacements. MoDOT's [Safe & Sound Bridge Improvement Program](#) website includes program documents such as the request for proposals for the design-build contract.

Nebraska Department of Transportation (NDOT)

The objective of NDOT's [County Bridge Match Program](#) is to create a process that empowers and encourages local partnerships in order to promote innovative solutions and streamline repairs and replacement of deficient bridges on Nebraska's county road system.

Program details from the NDOT website:

- It dedicates up to \$40 million to accelerate the repair and replacement of deficient bridges on county road systems.
- It pilots innovative solutions like bridge bundling.
- NDOT worked closely with bridge partners to develop program criteria.
- County participation is voluntary.

A working group of county officials, bridge authorities, and NDOT personnel was formed to use a collaborative process to develop the program, including the selection criteria and matching fund requirements. The working group met extensively the first few months to establish the program and now meets throughout the year to further review and define the program in preparation for the annual request for proposals and selection process.

New York State Department of Transportation (NYSDOT)

Design-build bridge bundle projects on the [NYSDOT website](#):

D900041 – Region 11 Rehabilitation of I-278 Bridges

D900037 – Region 11 Deck Replacements for 3 Bridges (Queens, Bronx, Kings)

D900036 – Region 8 Bridge Replacement (Westchester County)

D900031 – Contract 7, Region 8 Bundled Bridges (Ulster County)

D900030 – Contract 6, Region 8 Bundled Bridges (Columbia & Dutchess Counties)

D900029 – Contract 5, Region 8 Bundled Bridges (Orange County)

D900028 – Contract 4, Region 1 Bundled Bridges

D900025 – Contract 3, Region 8 Bundled Bridges

D900022 – Superstructure and Bridge Replacements in Regions 2 and 9

D900020 – Superstructure (4) and Bridge (3) Replacements in Region 9

Design-bid-build bridge bundle projects on the [NYSDOT website](#):

D262785 – Contract 3, Scour Critical/Flood Prone Bridge Program (Rensselaer County)

D262779 – Contract 12, Scour Critical/Flood Prone Bridge Program (Cortland & Cayuga Counties)

D262788 – Contract 13, Scour Critical/Flood Prone Bridge Program (Genesee County)

D262773 – Contract 17, Scour Critical/Flood Prone Bridge Program (Erie County)

- D262786 – Contract 19, Scour Critical/Flood Prone Bridge Program (Clinton County)
D262719 – Contract 28, Scour Critical/Flood Prone Bridge Program (Nassau & Suffolk County)
D262801 – Contract 29, Scour Critical/Flood Prone Bridge Program (Nassau & Suffolk County)

NYS DOT's website also details the [Scour Critical/Flood Prone Bridge Program](#), an initiative developed to harden New York State's at-risk bridges to withstand the new reality of extreme weather. In the past three years, NYS has suffered nine presidentially declared disasters due to extreme weather, many involving severe flooding.

For this initiative, 105 scour critical/flood prone bridges throughout New York State were identified as most at risk from repeated flooding at locations encompassing 78 communities within 30 counties across the State.

Ohio Department of Transportation (Ohio DOT)

Through the [Ohio Bridge Partnership Program](#), approximately \$120 million will be invested to repair or replace nearly 220 county and city bridges statewide through Fiscal Year 2017. Projects meeting eligibility criteria will be designed and constructed through the Ohio DOT-let process with 100 percent Federal funds, meaning no local match funding will be required.

Oregon Department of Transportation (Oregon DOT)

With the passage of the third Oregon Transportation Investment Act (OTIA III), the Oregon DOT was tasked with delivering a \$1.3 billion program to repair or replace hundreds of aging highway bridges statewide. To deliver the [OTIA III State Bridge Delivery Program](#), the agency bundled nearby projects so local firms across the State could compete for contracts.

The Oregon DOT's philosophy for the bridge program was based on stewardship: Take care of what you have so current and future generations can prosper. The improved network of bridges spurred job growth during design and construction and helped preserve the highway infrastructure fundamental to Oregon's economy. The website was developed to provide a comprehensive overview of work performed on the program and highlight its many successes."

Pennsylvania Department of Transportation (PennDOT)

The [Rapid Bridge Replacement Project](#) was awarded as a public-private partnership by PennDOT as an initiative to replace 558 aging bridges throughout Pennsylvania. The bridges are primarily crossings on smaller State highways, many in rural areas, rather than interstate bridges or large river crossings.

Appendix K. Other Bridge-Related Innovation

Following are links to resources on additional bridge and project delivery innovations to consider incorporating into bridge bundling projects and programs or that may assist with project delivery. All descriptions are taken directly from the relevant websites.

Federal Highway Administration Every Day Counts (EDC) program

EDC promotes these and other proven innovations to shorten the project delivery process.

[Collaborative Hydraulics: Advancing to the Next Generation of Engineering \(CHANGE\)](#)

Current modeling techniques used for hydraulic design apply several assumptions that can lead to overly conservative or inaccurate results. Advanced hydraulic modeling technologies offer planners, scientists, and engineers tools to depict specific physical, environmental, and habitat characteristics more accurately through 3-D visualization of flow, velocity, and depth.

[Community Connections](#)

Many cities have highways that have reached, or exceeded, their useful lives. The timing is ripe to hold forums for transportation professionals to discuss and consider highway retrofitting, rehabilitation, or removal options to improve connections between urban cores and neighboring communities. This innovation underscores the value of transportation in community revitalization, such as improving connectivity between disadvantaged populations and essential services.

[e-Construction and Partnering: A Vision for the Future](#)

State DOTs have traditionally administered contracts and managed construction of highway projects using extensive, paper-based documentation systems. By using digital e-Construction technologies, DOTs can enhance partnering among stakeholders on project teams, while improving communications and workflow to streamline the delivery of projects.

[Integrating NEPA and Permitting](#)

Integrating the National Environmental Policy Act (NEPA) and permitting processes seeks to transform how agencies and stakeholders conduct concurrent, synchronized environmental and permitting reviews, saving time and cost for the agencies involved.

[Ultra-High Performance Concrete Connections for Prefabricated Bridge Elements](#)

Ultra-high performance concrete can be used to create the simple, strong, long-lasting connections needed for successful construction using prefabricated bridge elements.

[3D Engineered Models: Schedule, Cost, and Post-Construction](#)

Using 3D engineered models enables the highway community to effectively connect a project's design and construction phases. 3D applications can be used to manage roadway inventory and assets, improve schedule and cost management, and create accurate as-built records.

e-Construction

An electronic project document management system, e-Construction replaces paper with common technology tools to improve workflow and save time and money. e-Construction is also an American Association of State Highway and Transportation Officials Innovation Initiative focus technology.

Geosynthetic Reinforced Soil-Integrated Bridge System (GRS-IBS)

GRS-IBS technology can help meet the country's demand for small, single-span bridges by delivering low-cost, durable structures that can be built with readily available equipment and materials. A GRS-IBS project can be built in weeks instead of months, saving time and cutting work zone congestion.

Improving Collaboration and Quality Environmental Documentation (eNEPA and IQED)

Tools are available to foster collaborative, concurrent, and transparent interagency reviews that save time and money on and improve the quality of NEPA documents for highway projects. These include strategies to implement quality environmental documentation and eNEPA, an online workflow tool for projects that require NEPA documents.

Improving DOT and Railroad Coordination (SHRP2 R16)

Transportation departments and railroads can work together to identify issues and negotiate agreements to expedite development of highway projects involving railroad rights-of-way using a model agreement library, tools, and training developed under the second Strategic Highway Research Program (SHRP2) R16 project.

Locally Administered Federal-Aid Projects: Stakeholder Partnering

Stakeholder partnering brings local, State and Federal agencies together to increase program compliance and streamline the project delivery process under the Federal-Aid Highway Program. Stakeholder partnering groups identify program-level issues, review project development processes, and work on solutions through a defined decision-making process and action plans.

Regional Models of Cooperation

Regional models of cooperation help highway agencies, regional groups, and other stakeholders coordinate transportation planning across jurisdictions to cut project delivery times and traffic congestion. This framework and process for developing multijurisdictional agreements can improve collaboration, policy implementation and performance management.

Smarter Work Zones

Efficient work zone strategies can minimize travel delays and enhance safety. Project coordination involves construction planning that minimizes the impact of work zones and generates time and cost savings. Technology applications use intelligent transportation systems to manage work zone traffic dynamically.

Accelerated Bridge Construction

Accelerated bridge construction (ABC) enables highway agencies to replace bridges in hours and reduce planning and construction efforts by years, reducing traffic delays and potentially lowering project costs. ABC technologies include:

- Geosynthetic reinforced soil-integrated bridge system
- Prefabricated bridge elements and systems
- Slide-in bridge construction

Construction Manager/General Contractor (CM/GC)

In the CM/GC project delivery process, the project agency hires a contractor to provide feedback during the design phase on issues such as innovation use, cost and time savings, and constructability. This helps the project agency make better decisions and manage projects with accelerated construction schedules and greater cost certainty.

Design-Build

The design-build project delivery method combines a project's design and construction phases in one contract, allowing the contractor flexibility to choose design, materials and construction methods while assuming the risk and responsibility for both design and construction. This can accelerate project delivery, lower costs, and improve quality.

Geospatial Data Collaboration

Geospatial data collaboration facilitates information sharing among project delivery stakeholders and improves the quality and speed of project decisions. Advances in technology facilitate project collaboration by making geographic information system tools, data, and maps accessible online.

Implementing Quality Environmental Documentation (IQED)

The IQED strategy includes best practices for simplifying and expediting the development of NEPA documents required for construction projects. It focuses on three principles: tell the project story, keep the document brief, and ensure that it meets legal requirements.

Locally Administered Federal-Aid Projects

A three-pronged strategy can help local public agencies navigate the complexities of the Federal-Aid Highway Program. The strategies include stakeholder partnering, certification and qualification programs, and consultant services flexibilities.

Programmatic Agreements

Programmatic agreements establish streamlined approaches for handling routine environmental requirements on highway projects, reducing review times, and accelerating project delivery. The agreements usually set procedures for complying with Federal laws, but they can also address tribal, State or local laws.

Clarifying the Scope of Preliminary Design

This strategy identifies the amount of design work allowable under law before completion of the NEPA review process for highway projects. It allows better decision making, saves time, promotes cost-effectiveness, and fosters environmental responsibility on projects.

Enhanced Technical Assistance with Ongoing Environmental Impact Statements

Enhanced technical assistance targets transportation agencies addressing major challenges with environmental impact statements on highway projects and helps resolve those challenges. FHWA facilitates interagency collaboration to identify and find solutions and get stalled projects moving.

Flexibilities in Right-of-Way

The flexibilities in right-of-way strategy encourages transportation agencies to take advantage of the many areas of flexibility allowed under FHWA regulations and statutes when developing highway projects. Using these flexibilities can help agencies save time and money on the right-of-way acquisition process while meeting legal requirements.

Flexibilities in Utility Accommodation and Relocation

The flexibilities in utility accommodation and relocation strategy spotlights flexibilities in place under Federal law and regulations that foster timely completion of transportation projects. It encourages widespread use of techniques that help transportation departments and utilities collaborate effectively when highway projects require moving or accommodating utilities.

Second Strategic Highway Research Program (SHRP2)

SHRP2 has undertaken more than 100 research projects designed to address critical State and local challenges, such as aging infrastructure, congestion, and safety. The research results are available in a series of effective solutions that will improve the way transportation professionals plan, operate, maintain, and ensure safety on America's roadways. Additional information on the program and resulting products can be found on the following websites:

- [Transportation Research Board](#)
- [Federal Highway Administration](#)
- [American Association of State Highway and Transportation Officials](#)

Several SHRP2 products relate directly to bridges and project delivery, including the following:

GeoTechTools (R02)

GeoTechTools is a web-based decision-making tool that has identified more than 46 geotechnical solutions for design and construction of embankments on soft soils, embankment widening, and pavement foundations. The website's extensive and organized engineering tools collectively help engineers and project managers select and apply the most appropriate solution to site-specific problems and conditions.

[Innovative Bridge Designs for Rapid Renewal \(R04\)](#)

SHRP2's Bridge Designs for Rapid Renewal product provides State and local departments of transportation with a design toolkit for prefabricated bridge projects. Standardized approaches streamline the activities required to get bridge replacement systems designed, fabricated, and erected in less time, and installed in hours or days, rather than weeks or months.

[Nondestructive Testing for Concrete Bridge Decks \(R06A\)](#)

The web-based, open-source NDToolbox helps identify and characterize testing technologies that are available to locate the primary deficiencies in concrete bridge decks. With the toolbox, users can explore different NDT technologies and examine their use in detecting deterioration for conditions relevant to the project. The NDToolbox describes the technology and the physical principle behind it, applications, performance, limitations, equipment, test procedures and protocols, and sample results. It also provides recommendations regarding the best technologies for a particular deterioration detection application.

[Performance Specifications for Rapid Renewal \(R07\)](#)

To help transportation agencies develop and implement performance specifications, SHRP2 created model performance specifications for various project types (pavements, geotechnical, bridges, etc.) and project delivery methods (design-bid-build, design-build, design-build-warranty, and design-build-operate-maintain). These specifications address issues related to project selection, specification development, procurement, and various other cultural and organizational changes that are necessary to achieve desired performance. The benefits of clarifying the desired performance of roads and bridges include: accelerated construction, greater control and ingenuity by construction contractors in deciding how to build, reduction of costly construction oversight, and more effective uses of construction management resources. This product provides agencies with the tools to reduce contract claims and inspection costs and accelerate construction.

The product suite specifically includes a two-volume guide to writing specifications with a section targeted to the needs of executives and a "how to" section for specification writers. Also included are guide specifications in the areas of hot-mix asphalt and portland cement concrete pavement, concrete bridge deck, embankment/pavement foundations, other geotechnical application areas, work zone management, and quality management that can be used as templates.

[Managing Risk in Rapid Renewal Projects \(R09\)](#)

Managing Risk in Rapid Renewal Projects (R09) helps managers quantify risks and provides guidance on the level of risk management needed. It presents a formal risk management process that optimizes performance for accelerated reconstruction on projects. R09 offers practical methods to identify, assess, mitigate, allocate, and monitor risk. Also, it fills the gaps that current risk management practices do not address by adding project performance measures and different project delivery and construction methods.

The process described in the R09 Guidebook allows users to factor in project scope, strategy and conditions, structuring, risk identification, risk assessment, risk analysis, risk management planning, and risk management implementation. It also provides objective guidance that can be

applied to various types and sizes of rapid renewal projects, as well as other rehabilitation efforts.”

Project Management Strategies for Complex Projects (R10)

Project Management Strategies for Complex Projects (R10) expands the three-dimensional analysis typically used by departments of transportation. It creates a model that facilitates project management in five areas: cost, schedule, technical, financial, and context. Methods for assessing complexity factors will help managers make rational resource allocations and guide planning and implementation.”

Service Life Design for Bridges (R19A)

The Service Life Design Guide for Bridges is a comprehensive reference document that complements AASHTO specifications and equips bridge engineers with the tools to develop specific solutions for given conditions and constraints. It represents a new approach to designing for service life that results in longer-lasting bridge components and systems that are both easier to inspect and better suited to their environments. The guide focuses on typical bridges with one or multiple spans and a maximum single span length of 300 feet. It addresses design, fabrication, construction, operation, maintenance, repair, and replacement issues applicable to both new and existing bridges. It includes standard plans, model specifications for design and construction, and fault tree flow charts.

Expediting Project Delivery (C19)

SHRP2 has developed a Solution for Expedited Planning and Environmental Review. The lists of constraints and strategies in the final report are not exhaustive. The strategies included are those that met specific criteria and that could be completed within the time restrictions of the study. The research team began drafting a list of fundamental expediting themes during the initial phase of the research and refined this list as the research progressed. The six final expediting themes, with expediting strategies organized by theme, are introduced in the following sections:

1. Improve public involvement and support.
2. Improve resource agency involvement and collaboration.
3. Demonstrate real commitment to the project.
4. Improve internal communication and coordination.
5. Streamline decision making.
6. Integrate across all phases of project delivery.

Appendix L-1. Research: Capital Program Cost Optimization through Contract Aggregation Process

The following excerpt is from Chapter 7, pages 156-162, of the draft final report on *Capital Program Cost Optimization through Contract Aggregation Process* by Julie Qiao, Jon Fricker, and Samuel Labi, reprinted here with permission of the author and the Indiana Department of Transportation.

Overview of the Research Study

This study explores the effects of various factors on project cost, including the economies of scale, economies of bundling, economies of competition, and other influential factors such as the similarity between bundled projects. The main objective is to investigate the possible benefits of project bundling. To what extent does bundling lead to savings in project cost? Do the savings depend on the types of projects being bundled? Are there any other issues that could affect the decision to bundle projects into multi-project contracts?

Findings and Conclusions

This study yielded the following findings:

1. Economies of scale – the decline in unit cost as the project size increases – have been documented for all project types analyzed in this study. This is true for both single-project contracts and multiple-project contracts.
2. Economies of bundling – the reduction in project cost as projects are bundled into a contract – have been found for all bridge work types, and most traffic, small structure and miscellaneous work types. For road work types, however, the reduction in project cost due to project bundling was only found for four project types (R3, R4, R7 and R9), but not seen for other road project types. This indicates that, for most road work, having one big project in a contract is more cost-effective than bundling several small projects into one contract. In practice, R3, R4, R7 and R9 were the road project types most likely to be bundled by INDOT with projects in the same work category, based on the data examined. It is therefore reasonable to infer that road work can benefit from project bundling when the project is bundled with similar project types.
3. Economies of competition – contract prices reflect increased market competition – is a significant influential variable in overall project cost models for most bridge projects.
4. The relationship between market competition and contract size – a larger contract can lead to less competition – has been investigated and modeled using both deterministic and probabilistic methods. It was found that, although the highest number (upper bound) of bidders generally decreases as the contract size (measured in terms of number of des) increases, the average (mostly likely) number of bidders is not necessarily higher when the contract is very small. According to the probabilistic model used in this study, the average number of bidders tends to be the highest when the number of des is 2 to 4.
5. Optimal contract size under optimistic market condition – Larger contracts lend themselves to economies of scale, but they can discourage all but the largest firms from bidding on the work. As a result, there appears to be a threshold of contract sizes

(measured in this study in terms of the number of des) beyond which the estimated optimistic unit project cost (under the best market condition) might start increasing. In Section 5.1.3, the optimal thresholds (the most appropriate Nr of des) were found, based on the deterministic upper bound model developed for the number of bidders, for bridge project types B3-Superstructure Replacement, B5-Bridge Widening, B6-Bridge Deck Overlay and B7-Thin Deck Overlay.

6. Uncertainty on the estimated project cost – Due to the uncertainty of market competition, the project cost estimated using the overall project cost models can vary to a certain degree, depending on the marginal effect of the number of bidders on project cost. In Section 5.1.3.2, the 95% confidence bound on the project cost was estimated for bridge work using the probabilistic Beta distribution model developed for the number of bidders. From the results of confidence bound estimation, B1- New Bridge and B2 - Bridge Replacement were each found to have a very small interval between the upper and lower bounds, indicating that uncertainty about the number of bidders will not make much difference in the estimated unit cost. The interval between the upper and lower bounds is very wide for B3-Superstructure Replacement, B4-Deck Replacement, B5-Bridge Widening and B6-Bridge Deck Overlay, indicating high uncertainty regarding the estimated cost. This suggests that the project unit cost will be greatly affected by the uncertainties associated with the number of bidders. It is worth mentioning that INDOT has limited direct control on the number of bidder for a contract.
7. Project similarity (compatibility) – The similarity between different project types is quantified as “similarity distance”, based on their constituent pay items using a Euclidean distance method described in Section 4.4.2. It was verified that project types in the same work category have a better (smaller) similarity distance compared to those in different work categories. In addition, within the same work category, a project type can have a smaller degree of similarity distance with certain project types compared to other types. For example,
 - B1-New Bridge and B2-Bridge Replacement are more similar to each other — with a much smaller similarity distance (0.14) — than other project types.
 - B3-Superstructure Replacement and B4-Deck Replacement are found to be the most similar work types, with a distance of 0.074.
 - B6-Bridge Deck Overlay is found to be most similar to B7-Thin Deck Overlay, with a similarity distance of 0.261.
 - The similarity between B8-Misc. Bridge Rehab & Repair and all other bridge projects is strong, because this project type itself is a mix of several different work types.
8. The effect of project similarity— higher similarity between projects bundled in a contract can lead to lower project cost – has been identified as an important factor included in the overall project cost regression models for most project types. Also, the effect of project similarity on reducing project cost has been found to be most significant for road work.
9. Maintenance of Traffic (MOT) Cost – MOT can be a major component of project cost. For some work types, MOT as a percentage of the total des award is very high (e.g., 23.7 % for Thin Deck Overlay). The results of the regression models developed for MOT cost in Section 5.2 indicate that, for bridge work, the MOT cost for B1-New Bridge, B4-Deck

Replacement, and B6-Bridge Deck Overlay can be slightly reduced by project bundling, while the MOT cost for other project types might increase due to project bundling. The MOT cost for most road, traffic, and small structure work types was found to be generally reduced by project bundling. Of all work categories, road work was found to benefit the most from project bundling in terms of MOT cost saving.

10. Past bundling strategy – According to the current dataset, the most frequent combinations of work categories in the past bundled contracts include bridge with road work, traffic with road work, bridge with traffic and road work, and bridge with small structures work. The most common combinations of different project types include Intersection Improvement with Traffic Signals, New Bridge with New Road Construction, Bridge Replacement with Bridge Deck Overlay, and New Bridge with Signing and New Road Construction.
11. Bundling strategy for the future – According to the scenario analysis results in Section 6.2, the project cost generally decreases as projects are bundled into a contract, and the reduction in project cost is typically most significant when the number of des in a contract increases from 1 to 2. The project cost might start increasing when the contract becomes too large, therefore, identifying the appropriate number of projects to bundle is important when developing bundling strategies. In addition, when comparing the project cost after projects are bundled by random selection and after projects are bundled by project similarity, a significantly greater cost saving was found for the latter. Therefore, bundling projects using a carefully-designed bundling strategy is critical in achieving reduced overall contract costs.

7.3 Limitations and Recommendations for Future Research

The various statistical models established in this research study can be applied to estimate market competition, project cost, maintenance traffic cost, and the overall contract cost. However, there are some limitations involved in the application of these models. At a future time, when more project cost data are available, this study can be extended to address these limitations.

1. The models developed in Chapter 4 to predict the number of bidders for a contract is only based on the number of des, due to the lack of data on other influential variables. The upper bound model established in this study can provide an estimate of the highest number of bidders expected for a contract with a certain number of des, and can be therefore used to estimate the lowest possible project unit cost under the predicted market condition. Due to this limitation, the upper bound models were only used in comparison of various bundling scenarios, and identify the optimal bundling strategy that yield the highest cost savings under the optimal market condition. In the future, when more variables (in addition to the number of des) that influence the number of bidders in a contract become available, a regression model based on all data points – not just those that form an upper bound on number of bidders – can be developed to replace the upper bound model for analyzing the bundling scenarios under the average, rather than optimistic, market condition. That approach would predict the most likely number of bidders (rather than the expected highest number) and the average expected project unit (instead of the lowest expected) cost.
2. In seeking to bundle projects, an agency may defer a project to later year when its prospective kin project becomes eligible for implementation. However, delaying a project

too long beyond its originally-scheduled letting date may allow unacceptable deterioration in asset condition and/or cause unacceptably high project cost and/or user costs in the subsequent years. The model developed in this study does not consider the change in cost caused by shifting the letting dates of projects to be bundled. Future research could help identify an appropriate methodology to quantify the extra cost caused by delaying a project, and investigating the trade-off between the cost reduced by project bundling and the cost increase due to project delay.

3. It was believed that contracts containing projects that are located closer to each other would benefit more from project bundling. However, the cost models developed in this study do not contain an explicit “distance” term, because the distance variable was neither significant nor intuitive when tested using the regression models. A reason for this might be the lack of variability in the values of the factor in the observed data; projects bundled into a contract are often located along the same corridor. Therefore, there is inadequate data in the current dataset on contracts that contain projects that are located far apart. As a result, the average distance between projects bundled in different contracts does not vary enough to make a distinguishing difference in project costs. At a future time, if more data with more widely dispersed projects become available, the effect of the distance variable can be discerned.
4. The cost model developed in this study includes only agency costs. However, the user cost is also a consideration in infrastructure maintenance and rehabilitation decisions. In a future study, in addition to measuring the effectiveness of project bundling in terms of agency cost savings, the analysis could quantify the impact of project bundling in terms of roadway user costs. User costs associated with work zones may differ for different bundling strategies, due to differences in the duration and location of bundled projects. If bundling multiple projects into a single contract can lead to significant reductions in road user costs, this would be further justification for a sound bundling strategy.
5. The cost model developed in the current study can predict, at a project level, the cost of each individual project type. In estimating the overall contract cost, the project-level cost model can be applied to determine the expected project cost (des award) for each project in the contract, and summed to yield the total contract award. By doing this, the impacts of different project combinations on project costs are largely ignored. In realizing this problem, the study proposed including the average similarity between bundled projects as an influential variable in the cost model, while a better way to take different project combinations into account may be to build a mixed cost model, at a contract level, for estimating directly the overall cost for a contract that involves different project types. This approach was not pursued in the current study, because the current dataset has 235 different combinations of project types in the past bundled contracts, but only ten of them have more than ten observations, and most combinations only appear once. This makes it infeasible to develop a uniform model that can take all these combinations into account. As INDOT undertakes more bundled projects, and as the number of observations for each combination becomes larger in the future, it may be possible for a future study to build a contract-level mixed cost model to guide bundling decisions. A possible way to do this is to consider each contract as an observation, and to use a binary variable (0 or 1) to represent the project type.

6. This study provides information for determining appropriate bundling strategies. In Chapter 6, bundling strategies were compared and selected through conducting several scenario analyses. This method, however, does not consider all the possible combinations of project candidates for bundling. Due to the large number of projects eligible for bundling, enumeration for computing the cost savings for all strategies of project combinations would be time-consuming, if not impractical. Therefore, an important task for the future is to develop an efficient optimization model (or a good heuristic) to minimize the overall project cost or maximizing the total cost savings, with an acceptable time complexity. By considering constraints on geographic proximity, project type similarity, project letting schedule and contract size (e.g. overall contract cost, number of projects bundled in the contract), some project combinations could be screened out as candidates. As a result, instead of exhaustive enumeration, a method that produces an “optimal” bundling strategy from a reduced set of combinations would present the decision makers with choices that might not otherwise be known.

Appendix L-2. Research: Quantification of Cost, Benefits, and Risks Associated with ACMs and Accelerated Performance Specifications

Quantification of Cost, Benefits and Risk Associated with Alternate Contracting Methods and Accelerated Performance Specifications

TRB 2018 – Project Delivery Committee

Keith R. Molenaar
University of Colorado



January 9, 2017

1

How do delivery methods relate to project performance?

- FHWA-funded, 3-year research study
- More than 15 investigators and research assistants
- Data collected from 291 completed projects
- Deliverables include data analysis and lessons learned



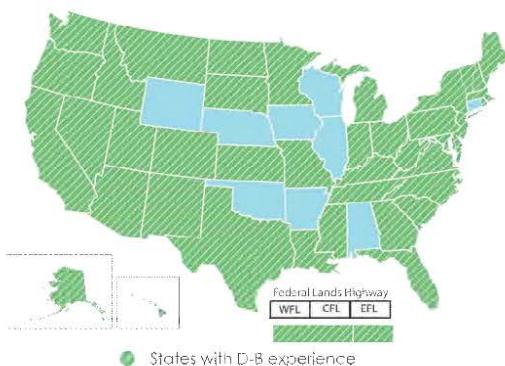
January 9, 2017

2

FHWA Tech Brief of Empirical ACM Performance

- Introduction
- Data Collection
- Results and Discussion
 - Contracting Methods
 - Complexity
 - Project Risks
 - Procurement Methods
 - ATCs
 - Payment Methods
 - Project Costs
 - Project Duration
 - Schedule/Cost Certainty
 - Project Intensity
 - Award Growth
 - Cost Growth
 - Change Orders
 - Schedule Growth
- Project Delivery Selection
- Summary

Data Collection



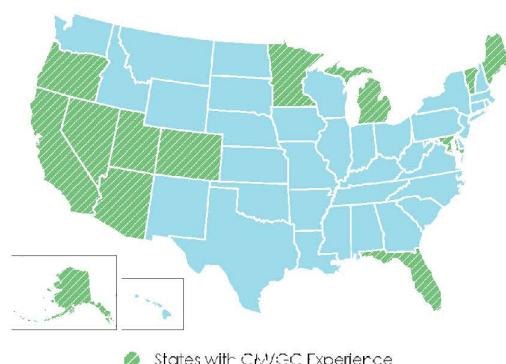
- Two-step approach
 1. Contract admin databases
 2. Project manager questionnaires
- Follow-up calls for data validation



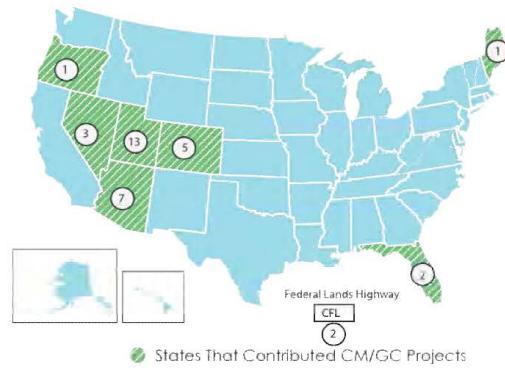
Data Collection



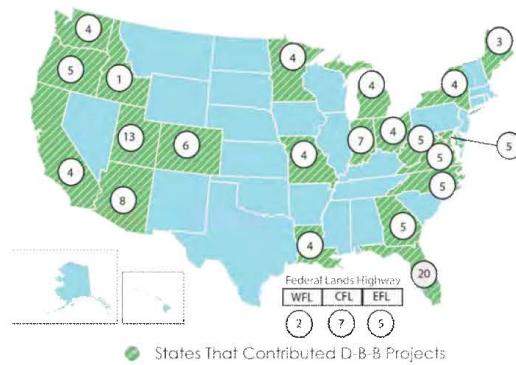
Data Collection



Data Collection



Data Collection

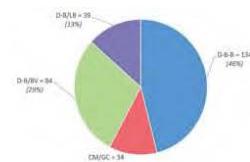


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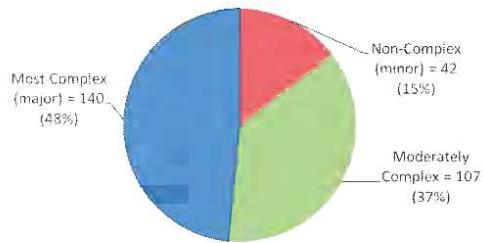
Research Data Collection

- 291 projects
 - 134 D-B-B projects
 - 34 CM/GC projects
 - 39 D-B/LB projects
 - 84 D-B/BV projects
- 28 agencies
- Completed 2004-2015



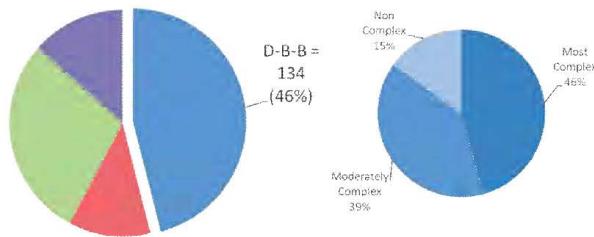
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Project Complexity

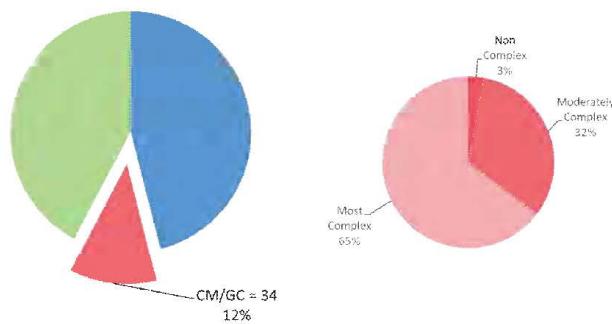


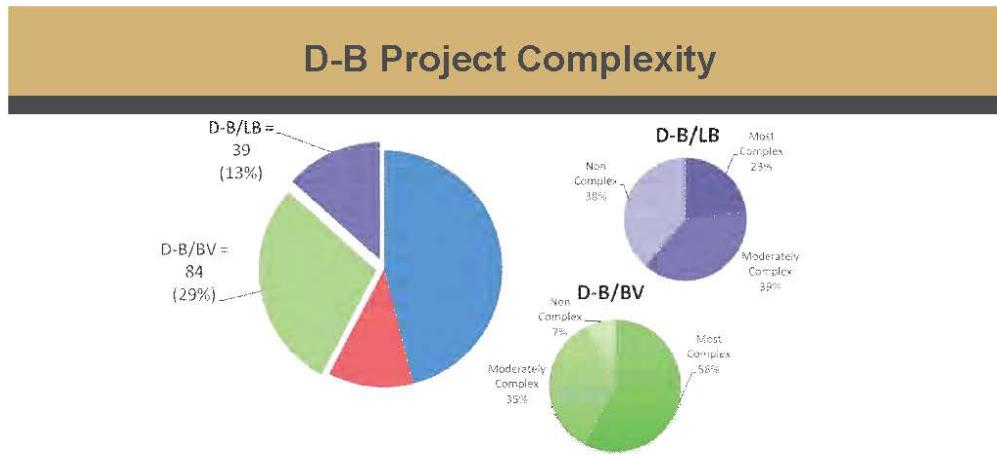
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D-B-B Project Complexity



CM/GC Project Complexity





Project Size

Average Project Cost

Contract Method	Mean	< \$20M	< \$10M
D-B-B (n=134)	\$20,286,637	63%	39%
CM/GC (n=24)	\$36,328,010	47%	29%
D-B/LB (n=39)	\$10,646,348	82%	70%
D-B/BV (n=77)	\$43,364,854	38%	27%

Tech Brief of Empirical ACM Performance

Average Project Duration

Contract Method	Mean Cost (\$)	Mean Project Duration (Days)	Mean Agency Design Duration (Days)	Mean Construction Duration (Days)*
D-B-B (n=74)	\$21,687,447	1,774	932	642
CM/GC (n=24)	\$41,368,952	929	361	511
D-B/LB (n=18)	\$12,249,585	889	268	435
D-B/BV (n=21)	\$48,532,458	1,516	662	837

* Note "Construction Duration" for D-B projects includes design-builder design and construction (D-B contract duration).

Tech Brief of Empirical ACM Performance

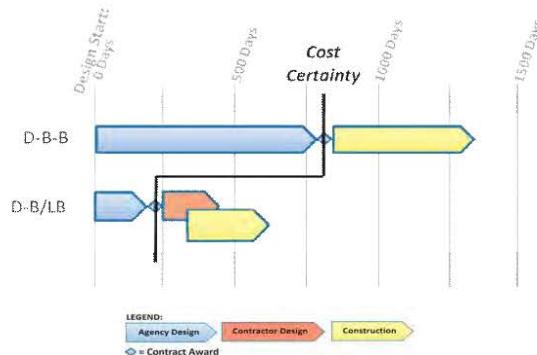
Ave Duration for D-B-B & D-B/LB projects between \$2M-10M

Contract Method	Mean Cost (\$)	Mean Project Duration (Days)	Mean Agency Design Duration (Days)	Mean Construction Duration (Days)*
D-B-B (n=19)	\$4,958,329	1,506	795	508
D-B/LB (n=10)	\$4,745,533	773	181	380

* Note "Construction Duration" for D-B projects includes design-builder design and construction (D-B contract duration).

Tech Brief of Empirical ACM Performance

Timing of Award for D-B-B & D-B/LB projects between \$2M-10M



Tech Brief of Empirical ACM Performance

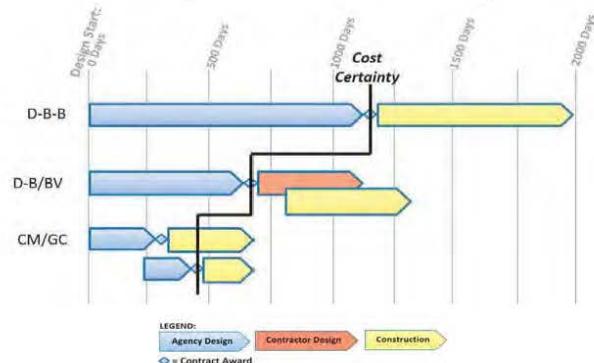
Ave Duration for D-B-B, CM/GC and D-B/BV Projects between \$10M-50M

Contract Method	Mean Cost (\$)	Mean Project Duration (Days)	Mean Agency Design Duration (Days)	Mean Construction Duration (Days)*
D-B-B (n=34)	\$21,188,585	2,130	1,139	818
CM/GC (n=10)	\$23,912,981	662	281	349
D-B/BV (n=10)	\$18,604,503	1,420	638	639

* Note "Construction Duration" for D-B projects includes design-builder design and construction (D-B contract duration).

Tech Brief of Empirical ACM Performance

Timing of Award for D-B-B, CM/GC & D-B/LB Projects between \$10M-50M



Relationship between ACMs and Award Growth

Project Award Growth per Delivery Method

Contract Method	Mean (%)	Standard Deviation
D-B-B (n=129)	-9%	18%
CM/GC (n=31)	3%	6%
D-B/LB (n=37)	-5%	32%
D-B/BV (n=78)	-7%	22%

Relationship between ACMs and Change Orders

Average Impact (% of cost growth) of Change Order Categories

Change Orders	D-B-B (n = 65)	CM/GC (n = 19)	D-B/LB (n = 21)	D-B/BV (n = 57)
Agency Directed	1.2%	0.7%	1.6%	1.9%
Plan Quantity Changes	1.1%	0.3%	0.6%	0.2%
Unforeseen Conditions	2.4%	1.5%	1.8%	1.8%
Plan Errors and Omissions	0.9%	0.6%	0.1%	0.5%
Other	0.1%	0.2%	0.8%	0.3%
Total	5.8%	3.4%	5.0%	4.7%

Selecting Project Delivery Methods

- Project Delivery Selection Matrix
 - Colorado Department of Transportation
 - Next Generation Transportation Construction Management Pooled Fund Study



<http://www.colorado.edu/tcm>



Selecting Project Delivery Methods

- Create project description checklist
- Develop project goals and identify project constraints
- Evaluate the primary factors
 - 1. Delivery schedule
 - 2. Complexity and innovation
 - 3. Level of design
 - 4. Cost
 - 5. Initial project risk assessment
- Evaluate the secondary factors
 - 6. Staff experience / availability
 - 7. Level of oversight and control
 - 8. Competition and contractor experience



Tech Brief of Empirical ACM Performance

- Summary
 - Agencies using ACMs on all project sizes
 - ACMs delivered 40-60% time savings on projects studied
 - ACM cost certainty was significantly earlier
 - ACM project intensity was significantly higher
 - Award growth, cost growth and schedule growth were comparable to traditional methods

Quantification of Cost, Benefits and Risk Associated with Alternate Contracting Methods and Accelerated Performance Specifications

TRB 2018 – Project Delivery Committee

Keith R. Molenaar
University of Colorado



U.S. Department of Transportation
Federal Highway Administration

Bridge Bundling Guidebook
*An Efficient and Effective Method for
Maintaining and Improving Bridge Assets*
FHWA-HIF-19-057