

STRATEGIC PROGRAM DELIVERY METHODS: BENEFITS AND CHALLENGES

By

ANUSHREE GAJANAN UPARE

Submitted to the graduate degree program in Civil, Environmental and Architectural Engineering
and the graduate faculty of the University of Kansas in partial fulfillment of the requirements of
the degree of Master of Science.

Chair: Dr. Daniel Tran, Ph.D.

Dr. Brian Lines, Ph.D.

Prof. Michael Panethiere

Date Defended: June 9th, 2017

The thesis committee for ANUSHREE GAJANAN UPARE certifies that this is the approved
version of the following thesis:

STRATEGIC PROGRAM DELIVERY METHODS: BENEFITS AND CHALLENGES

Chair: Dr. Daniel Tran, Ph.D.

Date approved: June 9th, 2017

ABSTRACT

Transportation programming is the process of developing and improving transit facilities using innovation and technology. Transportation programs are often developed with a vision that these facilities sustain and serve for a longer period. Delivering projects on time and within budget, distributing funding effectively, and managing resources are typical driving forces for program delivery. Project delivery methods such as traditional design-bid-build (DBB), design-build (DB), construction manager/general contractor (CM/GC), and public-private partnerships (P3) are used for the successful delivery of the program. Each delivery method has certain performance opportunities in terms of cost, schedule, quality, risk management, and other performance metrics. Developing an effective strategic plan by incorporating these diverse delivery options is critical to the success of the program. The aim of this thesis is to explore the use of transportation program delivery and identify the benefits and challenges of program delivery. This thesis utilized survey and case studies as research tools to fulfill the objective of the research. The results show that the most significant benefits of the strategic approach to transportation program delivery are accelerated delivery, flexibility in reassessing and reassigning risk, flexibility in delivery scheduling, increased innovation, improved performance using bundling, and standardized design technique. The major challenges of using a strategic approach to program delivery are extensive community outreach, organizational changes, coordination of multiple projects, and lack of experienced personnel. The results of this study will provide for practitioners and professionals with proactive measures and guidance on successfully delivering their transportation programs.

DEDICATION

I dedicate this thesis to my parents and family. Their continuous support and prayers have guided me through every difficulty in life and made me who I am today. Love you all.

ACKNOWLEDGEMENTS

First, I would like to express my sincere gratitude to my advisor and committee chair, Dr. Daniel Tran, for his continuous guidance and support during my thesis for its successful completion. He helped me in every possible way during these two years of my stay in the United States and I will be forever grateful to him.

I would like to thank my committee members, Dr. Brian Lines and Prof. Michael Panetheire for their time, support and valuable suggestions they have offered me to complete this thesis.

I would like to thank the University of Kansas, Civil, Environmental and Architectural and Engineering Department for providing me an opportunity to pursue my academics here.

Finally, I would like to thank my parents, friends, colleagues, and well-wishers for their unconditional love and support throughout.

TABLE OF CONTENTS

ABSTRACT.....	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS.....	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
CHAPTER 1 – INTRODUCTION	1
1.1 Introduction.....	1
1.2 Motivation.....	2
1.3 Key Definitions.....	2
1.4 Research Goals.....	3
1.5 Research Contribution	4
1.6 Thesis Organization	4
CHAPTER 2 – BACKGROUND AND LITERATURE REVIEW.....	6
2.1 Introduction.....	6
2.2 Difference Between Project and Program Delivery	6
2.2.1 Definitions.....	6
2.2.2 Use of Project Delivery Methods.....	8
2.2.3 Use of Alternative Contracting Methods	9
2.3 Transportation Program Development.....	10
2.3.1 Program Development Phases	12
2.3.2 Planning Programming Linkage	17
2.4 Strategic Planning and Program Delivery.....	19
2.4.1 Strategic Decision – Making: A Holistic Approach	21
2.4.2 Effective Program Delivery	22
2.5 Program Factors and Performance Measures.....	23
2.5.1 Factors Influencing Program Delivery.....	23
2.5.2 Performance Measures	26
2.6 Summary	28
CHAPTER 3 – RESEARCH METHODOLOGY	29
3.1 Introduction.....	29

3.2 Theoretical Point of Departure.....	29
3.3 Research Questions.....	30
3.4 Research Methodology	30
3.4.1 Content Analysis.....	31
3.4.2 Survey Questionnaire.....	32
3.4.3 Case-Study	32
3.4.4 Analysis of Results	34
3.5 Summary	35
CHAPTER 4 – RESULTS AND DISCUSSION	36
4.1 Introduction.....	36
4.2 Implementation of Program Delivery Practice	36
4.2.1 Implementation of Program Delivery	36
4.2.2 Enabling Legislation for Use of Program Delivery	37
4.2.3 Current Legal Authorization for Use of Alternative Contracting Methods	38
4.2.4 Percentage Use of Alternative Contracting Methods.....	38
4.3 Program Delivery Approach Between Experienced and Non-Experienced DOTs.....	39
4.3.1 Categorization Based on Experience Using Program Delivery	39
4.3.2. Project Delivery Methods Used in Context of Program	40
4.3.3 Percentage of Project Delivery Methods Used for Program Delivery	40
4.3.4 Holistic Approach to Delivering Group of Projects.....	41
4.3.5 Selection of Delivery Methods for Program.....	42
4.4 Factors Influencing Program Establishment	42
4.4.1 Program Factors Considered as Motivation for Program Delivery.....	44
4.5 Use of Bundling to Deliver Program	45
4.6 Corridor Approach of Program Delivery	46
4.7 Summary	48
CHAPTER 5 – PERFORMANCE MEASURES OF PROGRAM DELIVERY	49
5.1 Introduction.....	49
5.2 Performance Measures for program delivery.....	49
5.3 Summary	62
CHAPTER 6 – BENEFITS AND CHALLENGES	63
6.1 Introduction.....	63
6.2 Benefits of Program Delivery	63

6.2.1 Benefits Witnessed Based on Survey Response	63
6.2.2 Benefits Associated with Each Delivery Method	67
6.2.3 Benefits Witnessed Based on Case-Study.....	69
6.3 Challenges of Program Delivery	75
6.3.1 Challenges Witnessed Based on Survey Response	76
6.3.2. Challenges Witnessed Based on Case-Studies.....	77
6.4 Summary	83
CHAPTER 7 – CONCLUSIONS AND SUMMARY	85
7.1 Introduction.....	85
7.2 Conclusions.....	85
7.3 Future Research	87
REFERENCES	90
GLOSSARY	97
APPENDIX A – NATIONAL SURVEY QUESTIONNAIRE	98
APPENDIX B – CASE STUDY QUESTIONNAIRE.....	111

LIST OF TABLES

Table 1 – Program development phases	12
Table 2 – Examples of program delivery performance measures.....	26
Table 3 – Categorization based on experience	39
Table 4 – Factors influencing program establishment.....	43
Table 5 – Cronbach’s alpha test results	44
Table 6 – Program factors considered as motivation.....	45
Table 7 – List of programs based on categorization.....	47
Table 8 – Case studies summary based on type of program.....	48
Table 9 - Measures of project and program delivery (Missouri DOT).....	54
Table 10 - Program goals and outcomes for the S&S bridge program.....	55
Table 11 – Benefits associated with each delivery method	67
Table 12 – Chi-square results for benefits associated with each delivery method	68

LIST OF FIGURES

Figure 1 – Representation of a holistic transportation planning process	14
Figure 2 – Transportation programming process.....	16
Figure 3 – Research methodology	31
Figure 4 – Results for state DOTs implementing program delivery.....	37
Figure 5 – Results for state DOTs having enabling legislation for the use of program delivery .	37
Figure 6 – Current legal authorization of DOTs using ACMs.....	38
Figure 7 – Use of ACMs by state DOTs.....	39
Figure 8 – Project delivery methods used in the context of program based on experience.....	40
Figure 9 – Percentage use of project delivery methods used for program delivery based on experience	41
Figure 10 – Holistic approach to program delivery based on experience.....	41
Figure 11 – Selection of delivery methods for program based on experience.....	42
Figure 12 – Performance measurement of program	50
Figure 13 – Planned vs. Actual Total Number of Bridges Opened	52
Figure 14 – Performance measurement framework by FDOT	58
Figure 15 – UDOT’s scope performance metrics	59

Figure 16 – UDOT’s schedule performance metrics 60

Figure 17 – UDOT’s budget performance metrics 61

Figure 18 – Organizational barriers for implementing program delivery..... 77

CHAPTER 1 – INTRODUCTION

1.1 Introduction

State Department of Transportation (DOTs) and highway administration across the United States continually seek solutions to improve their managerial, organizational, and operational effectiveness and project delivery for much-needed transportation projects (Keck, Patel and Scolaro 2010). Individual highway and other transportation projects are developed under programs which intend to implement agency and legislative initiatives and other public policy. State DOTs and other transportation agencies such as local planning agencies (LPAs) have a wide range of approaches to deliver transportation programs. These approaches range from a traditional design–bid–build (DBB) delivery method to alternative contracting methods (ACMs), including design–build (DB), construction manager/general contractor (CM/GC), and public–private partnerships (P3). A delivery method is selected based on a rigorous analysis of the goals, attributes, constraints, and risks of an individual project or a group of projects, which will be referred to as a program of projects.

Several state DOTs have employed a broader approach to delivering transportation programs. These approaches include combining winning strategies, taking an all-inclusive approach to project delivery, implementing a project management culture, improving delivery processes, and enhancing communication across the organization. Recently, several state DOTs have taken a more holistic approach to maximizing the benefits of time and cost savings when delivering transportation programs rather than delivering individual projects.

1.2 Motivation

While conducting the preliminary literature review for this thesis, it was observed that there was very few documentation or literature available at least since the early '90s with a focus on program delivery. As mentioned, this approach is relatively new to state DOTs; so, there is little research about its implementation. Having identified this gap of lack of research and documentation regarding the implementation of program delivery approach among the state DOTs, there is an expected need to study this approach. The aim of this thesis is to fill the gap of lack of study and document the current state-of-practice. This is accomplished by doing exhaustive literature review which helped in developing the survey questionnaire and further developing case studies.

1.3 Key Definitions

Program: A collection of similar type projects grouped together or an endeavor to deliver a range of improvements (Keck, Patel and Scolaro 2010).

Strategic Programming: The process of clarification of mission and values, development of a vision of success, environmental scanning and assessment of the driving forces behind external threats and opportunities, an analysis of the department's capabilities and performance and assessment of internal strengths and weaknesses, development of strategic goals and objectives to identify the strategic issues facing the department, development of overall strategies and/or strategic initiatives, and definition of associated performance measures (Poister, 2004).

Program delivery: A holistic approach to the entire delivery process from looking at the agency and program context. Program delivery focuses on a collection of projects that are aligned with an organization's strategic goals (Keck, Patel and Scolaro 2010).

Bundling: The consolidation of two or more procurement requirements for goods or services previously provided or performed under separate smaller contracts into a solicitation of offers for a single contract that is likely to be unsuitable for award to a small business concern (Government Contracting Terms & Definitions 2016).

Bundled Contract: A contract where the requirements have been consolidated by bundling. (Government Contracting Terms & Definitions 2016).

Project delivery method: The comprehensive process of assigning the contractual responsibilities for designing and constructing a project. A delivery method identifies the primary parties taking contractual responsibility for the performance of the work (AGC 2004).

1.4 Research Goals

The overarching goal of this thesis is to summarize and document the state-of-practice of program delivery. This summarization and documentation will help to identify the benefits and challenges of using program delivery. The goal was achieved by accomplishing the following objectives:

1. Identifying transportation program process and development phases;
2. Identifying the approaches to group projects under program;
3. Identifying factors influencing the program establishment;

4. Identifying the approaches to select project delivery methods at the programmatic level;
and
5. Identifying the benefits and challenges of program delivery.

1.5 Research Contribution

Very few researchers have addressed the program delivery practice in the transportation industry. The conclusions and recommendations of this study will benefit the highway agencies that do not have much experience with program delivery. The aim of these recommendations is to provide guidance to highway agencies that are willing to use program delivery for the first time or have a very little experience using program delivery.

1.6 Thesis Organization

The thesis is divided into seven chapters:

Chapter 2 provides the background and literature of program delivery. It will discuss the difference between project and program, use of project delivery methods, strategic program delivery.

Chapter 3 provides an overall framework of the research methodology employed in the study. A discussion is made on the point of departure, research question, and in detail methodology of the content analysis, a national survey conducted, case study and analysis of results.

Chapter 4 provides the details of data analysis conducted for this research and discusses the results obtained.

Chapter 5 provides the results for performance measures and discusses the various approaches of performance measurement as per the findings from the research methods of this study.

Chapter 6 provides the results and in detail discussion for the benefits and challenges of program delivery.

Chapter 7 provides the conclusion for the thesis and recommendations for future studies.

CHAPTER 2 – BACKGROUND AND LITERATURE REVIEW

2.1 Introduction

This chapter of the thesis discusses the literature review for program delivery in the transportation sector. The database for literature review was very limited and was obtained from the state DOTs websites, articles, guidebooks, reports and available project profiles under the program from Federal Highway Administration (FHWA) website. The purpose of this chapter is to establish the background and context for the results and findings from this study. The chapter concludes with the summary of the literature review.

2.2 Difference Between Project and Program Delivery

This section will provide discussion on the difference between project and program. It will discuss projects and program definition in general and in transportation industry. Next, the main difference between them will be provided in terms of the scope and deliverable. Lastly, this section will discuss the use of project delivery methods and alternative contracting methods for program delivery.

2.2.1 Definitions

The Project Management Institute (PMI) defines a project as “a temporary endeavor undertaken to create a unique product or service.” A transportation project is a set of distinct activities, tasks, processes, or initiatives that result in the construction of a product or service and has a finite timeline. Transportation construction projects are usually large, horizontal public projects such as highways, airports, subways, dams, and railroads (Zeng, et al. 2014). But in today’s environment, smaller transportation projects, such as those involving maintenance, minor repairs,

resurfacing, and similar types of engineering and planning projects, have been taking a center stage. Projects may be viewed as piecemeal systems; however, this approach fails to tie the much-required projects to overall strategies of the organization. The specific goals of individual projects may fall short of balancing with the organization's culture and mission. This is where program fills the gap (Keck, Patel and Scolaro 2010).

Megaprojects, particularly in the infrastructure sector, are often being managed as a program because they typically consist of multiple components that can be classified as sub-projects (Jeroen, et al. 2014). The PMI defines a program as “a group of related projects, subprograms, and program activities managed in a coordinated way to obtain benefits not available from managing them individually.” Programs may include elements of related work outside of the scope of the discrete projects in the program (Westland 2013).

The definition of a transportation program varies from state to state. To many, it meant a collection of similar type of projects grouped together. To others, a program was an endeavor to deliver a range of improvements. For instance, a state implements a program to improve the condition of their bridges, increase the pavement condition or ride quality, reduce congestion in construction zones, or reduce traffic-related fatalities through a guide rail installation program (Keck, Patel and Scolaro 2010). Transportation programs can be further categorized in the following ways: (1) type of asset (e.g., highway, rail, aviation; or roadway, railway, runway, structures, etc.); (2) transportation policy or system objectives (e.g., mobility, preservation, safety, etc.); and (3) type of improvement or solution (e.g., major capacity improvement, minor capacity/system improvement, pavement preservation, safety, operations, etc.) (Cambridge Systems 2002). A program may include a single deliverable, many deliverables, or can be a

combination of ongoing support activity in addition to desired deliverables, which align with the goals and objectives of the agency.

The difference between a project and a program is that a project delivers output whereas a program delivers the outcome (Keck, Patel and Scolaro 2010). A program has a larger scope than that of projects and is typically run at higher levels in the organization. They require a more sophisticated approach to managing change (Alberg 2008). The outgrowth of the planning process leads to the implementation of a program (Turnbull 2006). Thus, transportation project programming is the process of selecting a final set of projects, submitted on a statewide basis, to be funded by a transportation agency (Niemeier, et al. 1995). Given the limited budget, it is a challenge to select the projects to be funded and implemented from the numerous potential projects. The problem is complicated by the fact that some of the potential projects are interdependent (Huang and Kuo 2013).

2.2.2 Use of Project Delivery Methods

This section will provide discussion on the use of project delivery methods and alternative contracting methods for program delivery. With the background of program delivery, it is now understood that program is a collection of projects grouped together. Project delivery methods are used ultimately to deliver projects and for the successful completion of program. Numerous studies have been done on the project delivery methods and the benefits and drawbacks of these methods. This section will just provide an overview of the use of various delivery methods for program delivery.

A project delivery method is a system for organizing and financing the design, construction, operations and maintenance activities that facilitate the delivery of a good or service (Miller, et

al. 2000). Project delivery methods ranging from traditional design-bid-build (DBB) to alternative contracting methods such as design-build (DB), construction manager or general contractor (CM/GC) and public-private partnerships (P3) are used to deliver transportation programs. A better understanding of the abilities of each delivery method provides rational decision making. The use of alternative delivery methods seems to be driven by the transit agency's need to achieve aggressive delivery schedules for their projects (Touran, Gransberg, et al., 2011). Determining an appropriate delivery method for highway projects is a complex decision. The project delivery selection matrix promotes a better understanding of project goals, risks, opportunities, and enhances alignment among project participants (Tran, et al. 2013).

2.2.3 Use of Alternative Contracting Methods

Since the 1990s, FHWA has started using the innovative alternative contracting methods. The FHWA supports the deployment of ACMs which include design-build (DB), construction manager/general contractor (CM/GC), Alternate Technical Concepts (ATCs) to accelerate project delivery, encourage the deployment of innovation, and minimize unforeseen delays and cost overruns. In traditional highway construction contracting (DBB), cost is generally the one criterion that determines the winning bid. As State and local agencies strive to meet customer needs, factors such as quality, delivery time, social and economic impact, safety, public perception, and life-cycle costs have gained in importance. (Federal Highway Administration 2017). Transportation agencies have a range of delivery alternatives available to them. Several non-traditional delivery techniques have been developed and applied by U.S transportation agencies to reduce time to completion, improve cost-effectiveness, address project complexity, supplement staff skills with specialized expertise, and use in-house resources more effectively. Examples of these techniques include the following –

1. Innovative contracting approaches
2. Performance-based bidding
3. Intergovernmental agreements, and
4. Outsourcing and managed competition

When assessing these and other delivery options, the following issues should be considered –

- Delivery methods should be evaluated on a case-by-case basis. A thorough analysis of the project, owner, and market characteristics will help identify legitimate delivery options.
- Although external issues may constrain delivery alternatives (e.g., state or federal procurement laws may prohibit certain procurement approaches), motivated agencies can often customize procurement strategies to meet their specific needs and constraints.

Since alternative delivery strategies give agencies flexibility in terms of project cost, schedule, and the use of in-house resources, these options should be considered only in the planning and programming processes. (Parsons Brinckerhoff Quade & Douglas, Inc. 2002)

2.3 Transportation Program Development

In the 1950s, the federal transportation program was created and had the vision to build the Interstate system which was successfully accomplished. The identified challenge after it was to restructure the federal program and to maintain the funding stream to finance the program. As development continued issues like system maintenance (example – pavement ride quality on the national highway, bridge maintenance, traffic congestion) were issues that required more concerns with the increase in the use of transit facilities by the year 2004 given that freight and goods movement are key areas of economic vitality for the United States. This led to the

development of policies which have guidelines to develop a program, allocate funds and monitor revenue. The evolution of the transportation planning and programming processes is discussed below:

- 1960 – Highway projects in many urban areas throughout the country were very controversial and did not always reflect local interests.
- 1965 – Legislation added all projects had to be based on a comprehensive, cooperative, and continuing process that involves local officials.
- 1973 – Legislation designated metropolitan planning organizations (MPOs) as the recipients of planning funds and as the agency responsible for the planning process.
- 1975 – Federal guidance required that projects funded by the federal government had to be included in the transportation improvement plan (TIP) and that the TIP had to be endorsed by the MPO. States could not advance any project in an urban area that was not included in the TIP. There has been a gradual shift in authority from the states to local officials and MPOs over the years. For example San Diego Association of Governments (SANDAG) with 75% federal funds for planning, constructing, and maintaining highway system. The Federal Transit Agency (FTA) New Starts Program provides discretionary funding for major transit capital projects.
- Changes over past few decades –Earlier in the Interstate program, decisions were typically made at the state level based on technical analysis. Federal legislation then opened the process to require involvement by local officials, the public, and other stakeholders. (Turnbull 2006)

2.3.1 Program Development Phases

The program development process varies from state to state; but it typically involves five generic phases: planning, programming, preliminary and final design, advertise and bid, and construction (Anderson, Molenaar and & Schexnavder 2009). A project often begins with a concept to meet an identified need. It then moves into the planning phase to determine the purpose and need of the project, whether it is an improvement project or a new required project. After that, the project is programmed and moves through the design to the construction phase. Table 1 below summarizes typical activities associated with the first three phases that are most relevant to strategic program delivery methods followed by a discussion of all the stages.

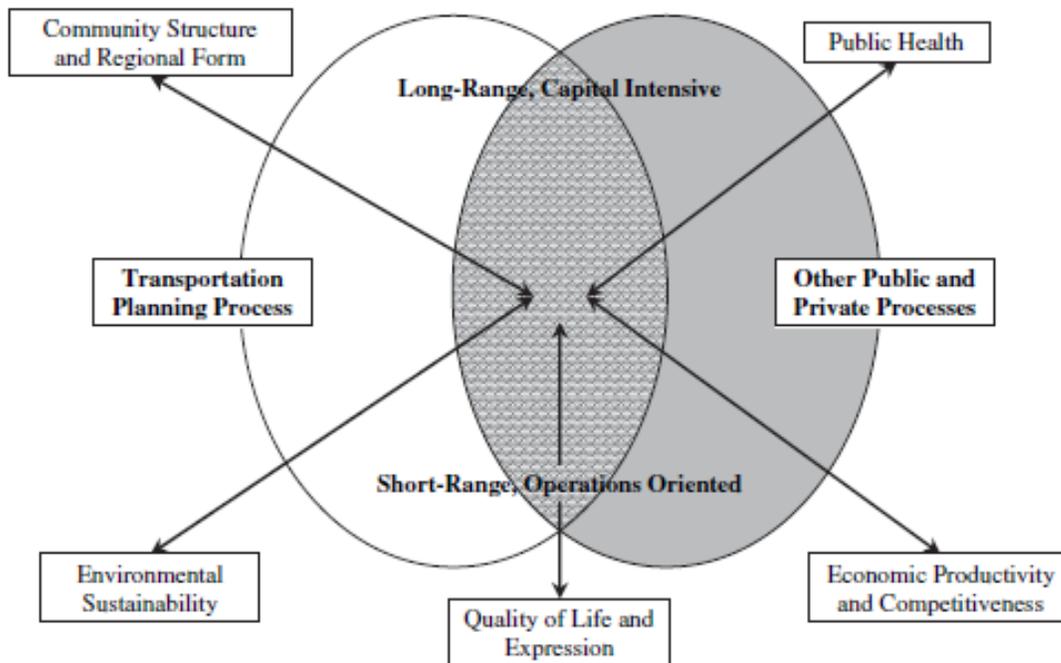
Table 1 – Program development phases

Development Phases	Typical Activities
Planning	Purpose and need; improvement or requirement studies; environmental considerations; right-of-way considerations; public involvement/participation; interagency conditions
Programming	Environmental analysis; schematic development; public hearings; right-of-way impact; project economic feasibility and funding authorization
Preliminary Design	Right-of-way development; environmental clearance; design criteria and parameters; surveys/utility locations/drainage; preliminary plans such as alternative selections; geometric alignments; bridge layouts
Final Design	Right-of-way acquisitions; PS&E development—final pavement and bridge design, traffic control plans, utility drawings, hydraulics studies/drainage design, and final cost estimates

Source: (Anderson, Molenaar and & Schexnavder 2009)

Planning Phase

The timeline of the planning phase for transportation projects, is significantly longer than other phases. With the continuous growth of infrastructure and development; urbanization the planning phase often takes more than 20 years. The objective is to identify the projects that should be advanced to the programming phase. Decisions are made based on estimated costs and benefits, perceived need, and accordance with adopted policies. The decision-making process in this phase often involves two main groups: a) Metropolitan Planning Organization (MPO) and b) State DOT. The MPO develops both a Long-Range Transportation Plan (LRTP) and a Transportation Improvement Program (TIP) for urban areas. State DOTs develop LRTPs and TIPs at the state level. For local areas, the state DOT works with local planning agencies (LPAs) to incorporate their project needs to the state program based on the state law and policy (FHWA, 2012). Federal law requires that state DOTs develop a statewide transportation plan (STP) and that MPOs develop a regional transportation plan (RTP) (Anderson, Molenaar and & Schexnavder 2009). It is important to note that most STPs do not identify specific projects but focus on establishing strategic decisions for state investment in the transportation system (Anderson, Molenaar and & Schexnavder 2009). Figure 1 represents the holistic approach to the transportation planning process. The transportation planning process takes into consideration the community structure and environmental aspects. Also, other public and private processes take into consideration the public health and economic aspects. As shown in figure 1, long range planning process is capital intensive whereas the short-range planning process is operations oriented. Overall, it represents the various social and environmental factors which are considered during planning process and represents the holistic planning process.



Source: (Cambridge Systematics 2007)

Figure 1 – Representation of a holistic transportation planning process

Programming Phase

The objective of the programming phase is to determine which transportation projects will receive funding within the next three to six years through the programming process (FHWA, 2012). During programming, projects concepts are prioritized and based on it they are further selected for funding. For urban projects, federal law requires the TIP for a metropolitan area to become part of the State Transportation Improvement Program (STIP). Each state and MPO develops its own process for allocating funds to program categories and selecting projects. Therefore, state DOTs and MPOs work closely on identifying candidate projects from the TIP for inclusion in the STIP (FHWA, 2012). The programming phase also involves environmental

studies. Federal law requires environmental studies to be performed for any projects that uses federal funding. Many states also require environmental studies for projects using state funding. It is noted that the information collected in the programming phase is typically used during the preliminary design phase and may also be useful during the final design and construction phases. Figure 2 below shows in detail the activities carried out under each phase.

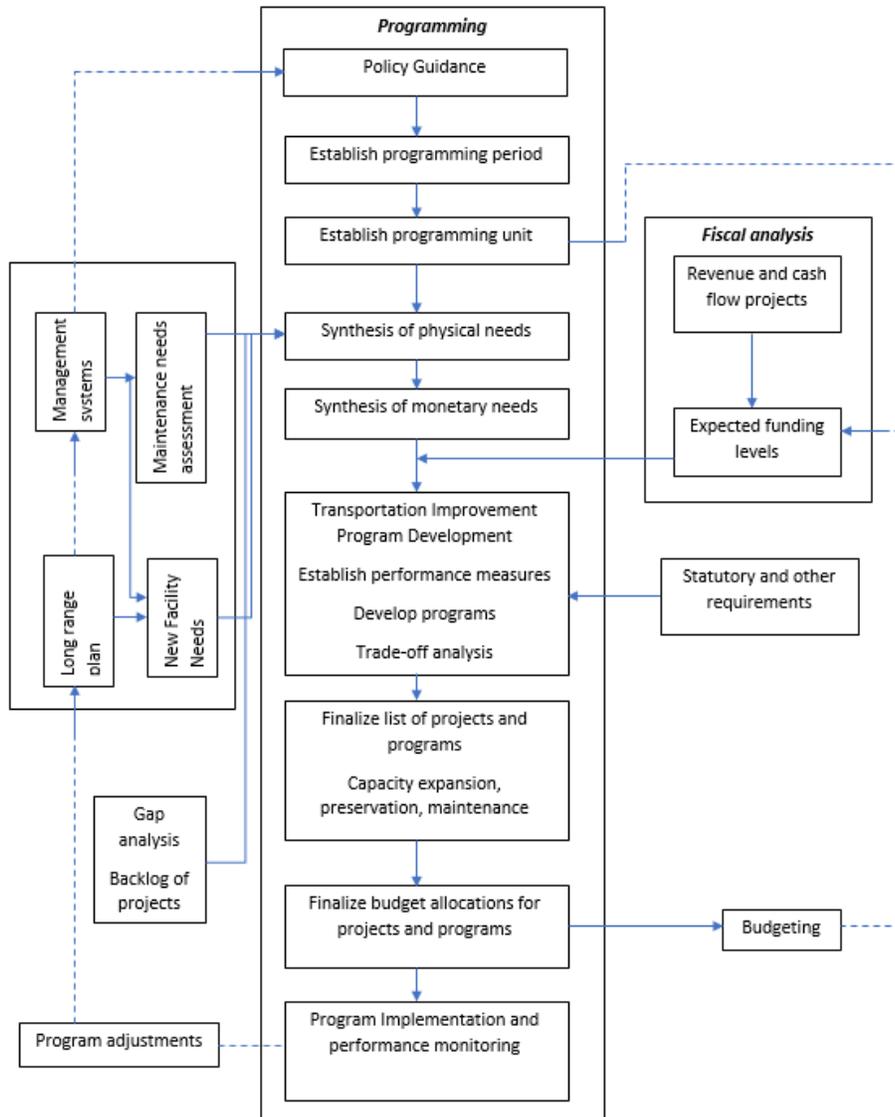


Figure 2 – Transportation programming process

Source: (Sinha and Labi 2007)

Preliminary Design Phase

This phase involves the detailed planning and the beginning of the design process for individual projects in the program. During preliminary design, the general requirements and scope of individual projects are transformed into detailed physical components. Typically, functional

designs are prepared for multiple alternatives to help evaluate the benefits and drawbacks of possible solutions. Transportation practitioners play an important role in this phase because they provide technical input and analysis that largely drive the decision-making process.

Collaboration among stakeholders is also a key element of this phase (FHWA, 2012).

Final Design Phase

The final design provides detailed information to the construction phase. In this phase, plans and specifications typically are nearing completion. The right-of-way necessary for construction of the project is also acquired during this phase. This phase addresses technical issues, and the primary decision-makers often include right-of-way agents, engineers/designers, and planners at the implementing agency. High-level decisions involving policy are typically made prior to this phase (FHWA, 2012).

2.3.2 Planning Programming Linkage

The linkage that is desired between a LRTP and a program of projects for short-term investments can be defined as-

- a) The degree to which progress toward long-range policies, goals, and objectives is being made with funds committed to current projects and improvements.
- b) The degree to which current funding commitments reflect the stated policies, goals, and objectives of the long-range plan.

At the core of the linkage, the issue is longstanding federal law and regulation that governs transportation planning and programming at both the statewide and metropolitan (MPO) levels.

The federal statutory and regulatory language on planning and programming has several important characteristics:

- It applies to both the federal highway and transit planning and programming through nearly identical language affecting both sets of modal programs;
- It defines the scope (substance and timeframes) as well as the content of plans and programs;
- It defines financial constraints in the planning-programming process to encourage a focus on true priorities and achievable investments, particularly in the case of MPOs; and
- It describes varied roles and types of interaction for the states, MPOs, local elected officials, and citizens in the planning process and program development.

Judgments on whether a program of projects is, in fact, “consistent” with the long-range plan typically are made in several ways:

- Through the annual STIP/TIP updating and revision process, where project justifications are required, including references to the planned origin of projects;
- During the public participation process required by federal law where priorities for projects in a STIP or TIP may be discussed and resolved;
- Through the federal grant approval or expenditure authorization processes, where certification of consistency is required; and
- During the periodic federal planning “Certification Reviews” carried out by the FHWA and the FTA.

A key difficulty, however, is that a policy-oriented plan can be so general or vague that it is hard to show that specific projects are consistent with the plan. (Cambridge Systematics 2007)

2.4 Strategic Planning and Program Delivery

State DOTs face several challenges in administering, budgeting and managing transportation programs. These challenges include the following: (1) delivering projects within a program on time and within budget; (2) distributing funding efficiently and equitably; (3) developing projects that protect the physical and social environment; (4) managing resources efficiently and effectively; and (5) coordinating with other agencies, interest groups, and the public in project prioritization and program funding decisions (Henkin, 2008).

In 2005, the Washington State Legislature provided a 16-year expenditure plan of \$7.1 billion for the major capital construction program including 274 projects (WSDOT, 2006). The Washington State DOT (WSDOT) recognized that to deliver this program, it needed to leverage its own internal capabilities, use extensive outsourcing, and improve program management. The Washington State Legislature also required a strategic plan for program delivery to manage this capital construction program. The WSDOT strategic delivery approach focuses on seven main elements as follows:

- Developing and confirming program goals and objectives;
- Assessing program delivery needs, including schedules/costs, project periodization, and risk;
- Conducting gap analysis for successfully delivering a program (i.e., workforce, system, and processes);
- Aligning goals with capabilities;

- Recommending the solutions/improvements to address gaps;
- Communicating transition strategies; and
- Establishing an implementation plan.

WSDOT emphasizes the following strategies to improve its program delivery:

- Implementing staffing, change management, and reporting tools;
- Changing stakeholders' expectations regarding many projects still in the early stages of project development;
- Improving methods to create program-level contingencies for cost and schedule;
- Incentivizing the contractors of major projects to emphasize efficient delivery and transparent accountability; and
- Implementing methods and processes to track and report on program delivery; and
- Promoting accountability, transparency, and communication (WSDOT 2006).

As another example, the Illinois DOT developed strategic planning in 2000. One of the main four quadrants of the Illinois DOT's strategic planning process focuses on program delivery (Poister 2004). Specifically, the Illinois DOT's strategic program delivery emphasizes the following strategies:

- Expediting the delivery of work and services to minimize public inconvenience;
- Assessing and establishing levels of program delivery;
- Designing and developing a mechanism to better integrate and coordinate the delivery of programs; and

- Developing a program risk assessment process relating to external factors (e.g., special interest groups, resources, and components necessary for the completion of the program).

Similarly, MoDOT addresses the strategic planning approach in MoDOT includes four main steps:

- **Strategic Advance:** MoDOT leadership conducts an analysis of its strengths, weaknesses, opportunities and threats (SWOT) after reviewing state and federal mandates and inputs from planning partners, employees, and others.
- **Teams and Action Plan:** The senior management leader forms teams to investigate, research, and recommend innovative solutions to address the issue.
- **Approval and Implementation:** Teams present their findings and recommendations complete with costs, implementation plan, timeline, action plan, anticipated outcomes, impact on the tangible results, and performance indications.
- **Monitoring Results:** Results are made available in the Tracker, and the senior management team meets quarterly to discuss all Tracker measures. For each Tracker measure, strategies are listed for improvement.

2.4.1 Strategic Decision – Making: A Holistic Approach

Strategic decision making is a key element for the success of the transportation program. For transport projects, a complex decision-making process is almost inevitable. For more complex situations, modeling, organization and structuring tools provide an enhanced device for the decision makers (Macharis and Bernardini 2015). As stated Rodney E. Slater “The challenge

before us then will be to put together an effective decision-making framework that allows the entities of the transportation enterprise to make decisions that ensure the safe, effective, and efficient functioning of the enterprise as a whole.” The framework for decision-making has five core principals as – a) a holistic approach, b) collaboration and consensus building, c) flexible and transparent decision making, d) Informed and transparent decision making, and e) Innovation. A holistic approach considers linkages, tradeoffs or impacts on other transportation entities, facilities, systems or users. Moreover, this approach considers issues broader than safety and mobility, such as the environment, economic development, accessibility, and equity. Transportation program decision makers thus, face a challenge with the multi-objective and multi-criteria process of decision-making of transportation program. The typical characteristics of programs include a significant change in the organization, environmental change as well as change in the program, longer duration than projects, deliverables with a strategic intent, and benefits that are achieved throughout the duration of the program. Most importantly, the success of a program is evaluated based on the benefits it provides (Keck, Patel and Scolaro 2010).

2.4.2 Effective Program Delivery

Effective program delivery is achieved through the establishment of sound policies and procedures that address management of projects throughout the project and program delivery process. It is a practice that transcends individual project phases and provides a continuous sequence of sound management throughout the life of the project and a transportation program. The key drivers of transportation program center around four broad functional areas: a) identifying priorities; b) obtaining resources; c) delivering the program; and d) managing finances (Henkin 2008). The identification of priorities involves the program management disciplines of strategic planning, programming, asset management, performance measures, and

economic analysis. Obtaining resources involves program management functions related to securing federal funding, raising state revenue, and attracting private and local financial sources. Delivering a program involves program management activities related to program delivery approaches and tools, the choice between in-house delivery and outsourcing, and roles and responsibilities of in-house staff and private sector partners. Managing finances involves administrative functions associated with financial resources, cost estimation, and control mechanisms.

2.5 Program Factors and Performance Measures

This section will provide an overview of the factors influencing the program delivery and the performance measures of program delivery. Performance measurement is an essential element to improve project and program delivery methods. It will be discussed in this section and the results for same will be discussed in the later chapters.

2.5.1 Factors Influencing Program Delivery

NCHRP Report 662, “Accelerating Transportation Project and Program Delivery: Conception to Completion,” classifies the motivational factors for accelerating transportation project and program delivery into three main areas: internal factors, external factors, and political/administrative factors (Keck, Patel and Scolaro 2010). The internal factors involve schedule, cost savings to program delivery, limited funding, and innovation. The external factors involve reduced public impact, meeting stakeholders’ expectation, quickly delivering the facility and trust gained from the public. The administrative or political factors involve improved agency image, accolades for activity (allowance to apply more options for other projects), better risk management, and best return on tax dollars.

The Washington State DOT (WSDOT) identified nine drivers of successful program delivery (WSDOT, 2008). The brief definitions of these nine program delivery drivers are presented as follows:

- Long-term core competencies—ensure the availability and retention of skilled engineers and construction specialists.
- Workforce capabilities—ensure that an adequate and skilled workforce would be available to deliver the capital program, and ensure the development and implementation of effective project management processes. Those hired have little experience, requiring the allocation of resources for training.
- Vintage legacy systems—any solution should be applicable to all phases of project development and not abandon useful processes or tools of viable legacy systems.
- Rapid program growth—delivery of projects by regions of different size with varying degrees of complexity, and the need for hands-on control.
- New accountability expectations—move toward accountability for aggregate project delivery at the budgeted total program value with commitment to delivering each planned project.
- Railroad & Utility cooperation—seek methods to expedite real estate acquisitions through the formation of a low-interest or interest-free loan program to allow utilities access to the capital to implement timely utility relocations, and employ techniques for facilitating utilities or railroad coordination.

- Market trends—revise upward the “dollar” thresholds established for cost and scope changes to recognize the dynamics of the marketplace in terms of escalation of construction and delivery costs.
- Need for mobility improvements ensure that the WSDOT Strategic Delivery Plan directly supports the priorities improving the mobility of people, goods, and services.
- Management of scope, schedule, and budget trade-off ensure that WSDOT management authority to make modest adjustments to scope, schedule, and budget precipitates a growing potential for needless major project delays.

The factors influencing Department of Transportation (DOT) Program Delivery are:

- Decentralization of project development and delivery functions.
- Outsourcing everything from administration functions to full-scale construction program management.
- Increasing Project Complexity which includes mega projects, multi-modal projects, and projects that consider existing infrastructure and development. Also, explore alternatives of risk management and risk sharing.
- Changing Management Focus which include business management, environmental planning, and finance.
- New Private Sector Capabilities in which private sector firms have established new capabilities to manage the delivery of transportation projects by developing Design-Build and other project delivery approaches. The increased capacity of the private sector to manage transportation projects and program enables State DOTs to consider outsourcing

and take a lead in privatization (Henkin, 2008).

2.5.2 Performance Measures

Performance measurement is an essential element to improve project and program delivery methods. Measures that are tracked during the project and program delivery help state DOTs quantify performance and identify opportunity for improvement. AASHTO (2002) indicated that delivery measurement is a critical tool to communicate the program delivery status to all stakeholders. Some state DOTs have performance measurement tools in place to help them improve their programs. Other state DOTs recognize performance measures as among the demanding needs or are beginning the process of developing their own performance tools. There are numerous ways to measure transportation project and program performance. Performance measures may focus on cost, schedule, or quality metrics. For example, if final construction costs consistently exceed the initial budget, there is a need for revising estimation techniques. Table 2 below provides examples of program delivery performance measures.

Table 2 – Examples of program delivery performance measures

Category	Example Measures
Cost	Project within budget (yes/no)
	Activity unit cost
	Percent cost increase/decrease
Schedule	Contract milestones (e.g., completion date)
	Project on schedule (yes/no)
	Percent schedule overrun
Scope	Number of change orders
	Activities performed versus planned
	Value of projects programmed versus delivered
	Number of projects programmed versus delivered

Quality	Performance specifications for capital improvements
	Levels of service (LOS) for maintenance and operations activities
	Number of non-compliance reports

Source: (AASHTO 2002)

For example, Wisconsin DOT uses a design quality index (DQI) and a construction quality index (CQI) to measure project and program performance. The DQI is determined by evaluating 16 elements of a design plan. At the completion of a project, the project leader, prime contractor, and designer meet to fill out the DQI form. The project leader then enters the agreed-upon ratings into the Field Information Tracking System and submits them to office personnel. The CQI includes 21 elements on the maintainability of the constructed facility. The project manager and maintenance representative perform the CQI for the project. The project manager will then load the agreed-upon ratings into the Project Tracking System (Wisconsin DOT 2015).

As a final note on performance measures, NCHRP Report 662, “Accelerating Transportation Project and Program Delivery: Conception to Completion,” concluded the following:

“Performance measures are important because they showcase the tremendous needs state agencies face and build confidence that the agencies are spending tax dollars wisely. They provide a customer-based focus that helps state DOTs address public concerns and build public trust. They help ensure cost-effective use of limited funds; provide a tool to improve areas where progress needs to be made; and serve as a barometer of internal performance, delivery, and overall effectiveness” (Keck, Patel and Scolaro 2010)

2.6 Summary

This chapter provides an overview of program delivery and the use of project delivery methods. It also discusses the difference between project and program. Individual projects in the highway design and construction are grouped and delivered under program. Project delivery methods and alternative contracting methods are used to deliver these programs. A holistic approach to decision-making is a key element of program delivery. This chapter also discusses the transportation program development and its various phases. The discussion from previous studies on factors influencing program delivery and its performance measures has also been discussed. In the following chapters the identified knowledge gap and the research methodology will be discussed followed by the results of this study.

CHAPTER 3 – RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology for this thesis. The chapter starts by discussing the theoretical point of departure for research thesis. This chapter also states the research questions that are investigated in chapter 4, 5 and 6. This chapter introduces the research framework and describes the work done in each step of the proposed research framework. A detailed explanation of individual research task is provided. The last section provides an overview of the various statistical tests that were used to validate the findings of the data.

3.2 Theoretical Point of Departure

The thesis starts from the fact that there is a lack of research specifically focused on transportation program delivery and the various approaches to program delivery. The objective of the study is to fulfill this knowledge gap. While, the implementation of program delivery in transportation has been done for a long time, this study utilizes survey questionnaire and case studies as a tool to provide a more comprehensive view of the current state-of-practice. It would specifically discuss the current state-of-practice of the implementation of program delivery, response based on experience of DOTs which have practiced program delivery, factors influencing program establishment, program factors that are considered as a motivation for program delivery, performance measures of program delivery, and benefits and challenges of the program delivery practice.

3.3 Research Questions

To investigate the aforementioned research objectives, this study aimed at investigating the following research questions:

1. How does highway or transportation agency establish their construction program?
2. How does the highway industry implement program delivery?
3. What are the program factors that are motivation for program delivery?
4. What are the performance measures of program delivery?
5. What are the benefits and challenges of program delivery?

Given that there is a dearth of literature on this topic, this study presents one of the first attempts to identify and document the practice of transportation program delivery.

3.4 Research Methodology

To address the aforementioned research questions, the methods adopted for conducting this research include four main steps: (1) content analysis of the literature, (2) survey questionnaire (3) case studies, and (4) analysis of survey data and discussion of findings. Based on the literature available, a formal conventional content analysis was conducted to identify the approaches for program delivery. The second step was to conduct a national survey questionnaire to identify the current state-of-practice, determine program factors considered in decision, benefits and challenges of program delivery. Based on the response of the survey and DOTs having experience with program delivery practice and their willingness to share their experience structured interviews with transportation personnel were conducted to develop case studies. Seven state DOTs were selected for case studies to verify the findings from the survey and content analysis. The last step

was analysis of data i.e., survey response and discussion of the findings. The figure below illustrates the research methodology for this thesis.

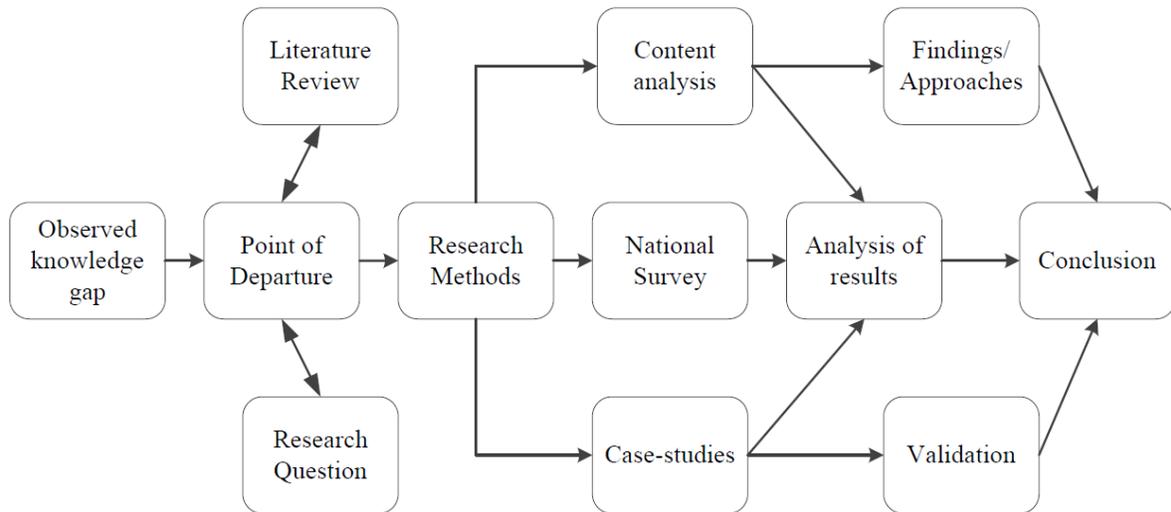


Figure 3 – Research methodology

3.4.1 Content Analysis

A formal content analysis of the program delivery documents was conducted as the first step of the research to measure the current practice of program delivery in the transportation industry. The content analysis performed will create a source for identifying successful practices for program delivery in the transportation industry. “A content analysis is defined as a technique for making valid references by objectively and systematically identifying specified characteristics of a message, written or visual, using a set of procedures” (Holsti 1969). There are several ways to perform the content analysis. The investigator should decide the method of analysis based on his substantial problems (Weber 1990). The content analysis for this research mainly focused on the

conventional approach to content analysis. Conventional content analysis is generally used with a study design whose aim is to describe a phenomenon. This type of design is usually appropriate when existing theory or research literature is limited. The advantage of the conventional approach to content analysis is gaining direct information from study participants without imposing preconceived categories (Hsieh and Shannon 2005). This approach allowed a conclusion to be made regarding the transportation industry's approach to the program delivery. The data from literature review available in the form of reports and project profiles from the DOT websites was studied using categorical classification to identify the program delivery approaches.

3.4.2 Survey Questionnaire

A survey questionnaire was developed based on the literature review and content analysis. The survey questionnaire was distributed in web-based and paper-based forms to the members of the AASHTO Standing Committee on Highways, which includes members representing from 50 state DOTs. Response was received from 41 state DOTs. The overall response rate was 82%. The purpose of the survey questionnaire was to (1) identify if state DOTs are currently implementing program delivery practice; (2) identify the project delivery methods used in the context of program delivery; (3) identify the methods of grouping projects in program; (4) identify selection criteria of delivery methods for program; (5) identify program factors considered in decision and/or motivation of program delivery; (6) identify benefits of program delivery; (7) identify benefits of programmatic decisions associated with each delivery method; and (8) identify challenges of program delivery.

3.4.3 Case-Study

The primary purpose of the case study was to supplement and validate the findings from the survey. Based on the response of the survey questionnaire, DOTs with rich data and experience in program delivery were further contacted to gain more knowledge on the topic. Structured interviews were conducted with seven state DOTs. The participating seven state DOTs are Florida, Utah, Missouri, Oregon, New York, and Washington. The objective of case studies was to (1) supplement and validate the findings from the survey; (2) obtain specific process examples of program delivery approaches; (3) identify performance measures of program delivery; and (4) identify common barriers and benefits of each delivery method in the context of programmatic decision.

All case studies were conducted in accordance with the following protocol.

1. Conduct an opening interview with the DOT administrator or representative and program manager to orient the research team to the program and obtain relevant documentation and contact information for other participants;
2. Conduct additional interviews as necessary with key project and program participants to identify the processes and challenges of implementing program delivery and strategies to overcome such challenges. Specific attention was paid to processes for choosing project delivery methods and how implementing a variety of delivery methods can strategically improve the delivery of an agency's program;
3. Collect examples of key success factors, effective practices, and challenges of using a holistic approach to programming; and
4. Perform a closing interview with the DOT administrator or representative and program manager to verify the results and obtain any additional documentation.

A structured interview protocol was used during discussions and data collection. Each DOT was interviewed using the same list of questions. The general categories for the questions are as follows:

- General information and program structures;
- Use of ACMs;
- Program delivery performance;
- Program delivery benefits and drawbacks; and
- Lessons learned.

3.4.4 Analysis of Results

The survey response was recorded, organized using Excel and descriptive statistics was used to get the frequency count. Further, several statistical tests such as Cronbach's alpha, and Chi-square were conducted using IBM SPSS. Cronbach's alpha is a measure of internal consistency, that is, how closely related to a set of items are as a group. It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional (Institute of Digital Research and Education 2017). Chi-square is a statistical test assessing the goodness of fit between observed values and those expected theoretically. A chi-square test for independence compares two variables to see if they are related. In a more general sense, it tests to see whether distributions of categorical variables differ from each other (Statistics How To 2017). These test results will be discussed later in the results section.

3.5 Summary

Chapter 3 provided the theoretical point of departure for the research thesis. Also, this chapter provided the research questions that will be investigated and serve as a basis of this research. Further, Chapter 3 discussed in detail the research framework that was employed in this research. The proposed research features five major sections which include literature review, content analysis, conducting national survey, conducting case studies, and data analysis and validation. The results from the survey serve as a basis to validate the findings of content analysis and supplement towards conducting case studies. The results for each will be discussed in detail in the following chapters.

CHAPTER 4 – RESULTS AND DISCUSSION

4.1 Introduction

This chapter would discuss the findings from survey and content analysis. The survey results are categorized as implementation of program delivery practice, program delivery approach between experienced and non-experienced DOTs and factors influencing program establishment. The survey results are further presented graphically and the data is computed using descriptive statistics to get the frequency measure of the response received. The findings of content analysis would discuss the type of approaches used to conduct program delivery. This chapter provides the current state-of-practice for program delivery as per the response received from the national survey and findings from content analysis which supplement the findings from case studies.

4.2 Implementation of Program Delivery Practice

This section would discuss the survey response results for implementation of program delivery, enabling legislation for the use of program delivery, current legal authorization of DOTs using ACMs, and percentage use of ACMs by state DOTs.

4.2.1 Implementation of Program Delivery

Out of 41 agency responses to the national survey, 26 agencies (63%) have implemented or are currently implementing program delivery while 15 agencies (37%) are not implementing program delivery.

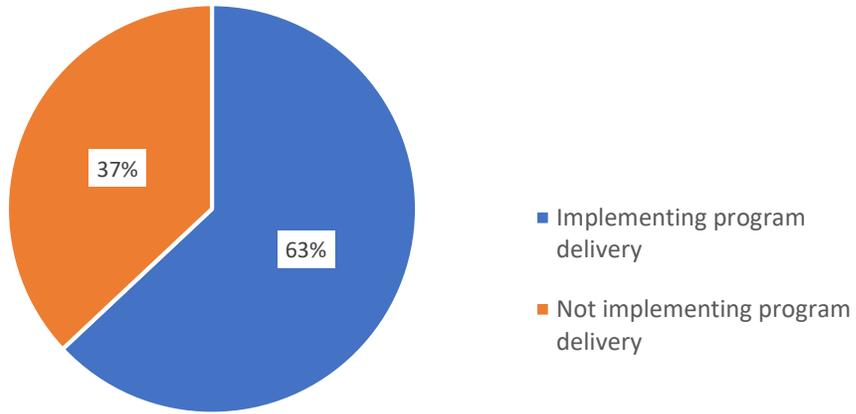


Figure 4 – Results for state DOTs implementing program delivery

4.2.2 Enabling Legislation for Use of Program Delivery

Out of 41 agency responses to the national survey, 22 agencies (54%) have enabling legislation for the use of program delivery, whereas 17 agencies (41%) do not have any enabling legislation for the use of program delivery.

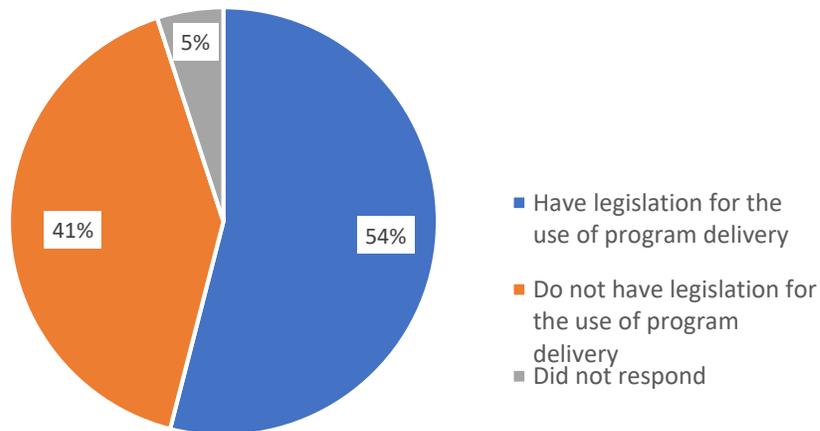


Figure 5 – Results for state DOTs having enabling legislation for the use of program delivery

4.2.3 Current Legal Authorization for Use of Alternative Contracting Methods

State DOTs have a range of delivery methods to choose for their projects and programs. In addition to the traditional DBB method, ACMs, including DB, CM/GC, or P3, are available for agencies to effectively and efficiently deliver their transportation programs. Of the 41 DOT responses to the national survey, 36 agencies (88%) reported that they have authority to use ACMs (i.e., D-B, CM/GC, or P3). Three state DOTs do not have authority to use ACMs: North Dakota, Wisconsin, and Oklahoma. Figure 5 summarizes the responses and the current legal authorizations for using ACMs.

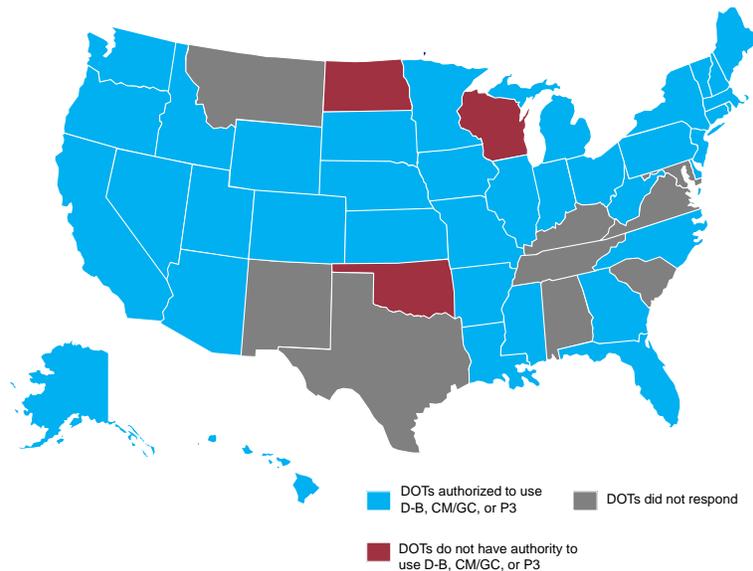


Figure 6 – Current legal authorization of DOTs using ACMs

4.2.4 Percentage Use of Alternative Contracting Methods

Out of 41 agencies, 33 agencies (94%) use DB; 19 agencies (54%) use CM/GC; 19 agencies (54%) use P3; and 6 agencies (17%) gave response as others which include use of DBB, fixed price/variable scope, DBB – best value, prequalification.

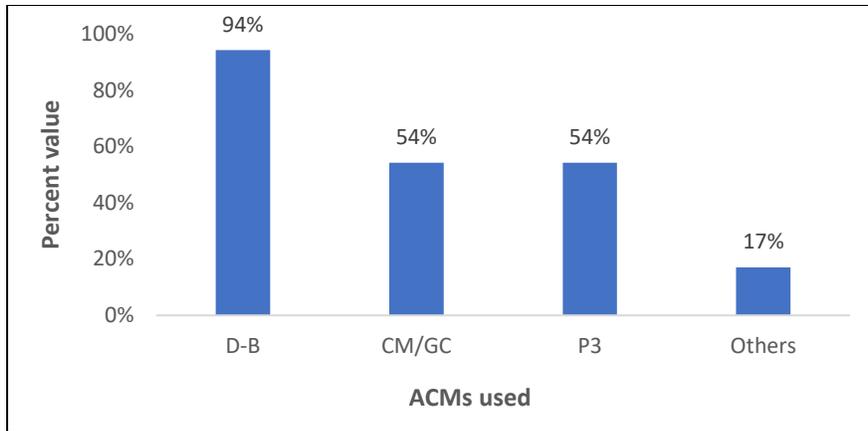


Figure 7 – Use of ACMs by state DOTs

4.3 Program Delivery Approach Between Experienced and Non-Experienced DOTs

This section would discuss the findings of categorization based on experience of using program delivery, use of project delivery methods in the context of program delivery, percentage of use of project delivery methods for program delivery, holistic approach to deliver a group of programs, and selection of delivery methods for program.

4.3.1 Categorization Based on Experience Using Program Delivery

The DOTs which have used program delivery between five and ten times, as well as more than ten times, are categorized as experienced DOTs. Similarly, the DOTs which have used program delivery less than five times are categorized as non-experienced DOTs. Table 3 shows the categorization and the corresponding states.

Table 3 – Categorization based on experience

Category	Responding States
----------	-------------------

Experienced DOTs (>5 times used program delivery) n=16	California, Delaware, Florida, Georgia, Indiana, Iowa, Louisiana, Maine, Massachusetts, Michigan, Missouri, New Jersey, Pennsylvania, Utah, Wisconsin, Wyoming
Non-experienced DOTs (<5 times used program delivery) n=15	Arizona, Arkansas, Colorado, Connecticut, Hawaii, Idaho, Minnesota, Nevada, New Hampshire, New York, Ohio, Oklahoma, Oregon, Rhode Island, Washington

4.3.2. Project Delivery Methods Used in Context of Program

It is observed that 50% of the experienced DOTs use project delivery methods in the context of program delivery whereas, with a marginal difference 40% of the non-experienced DOTs use project delivery methods in the context of program delivery.

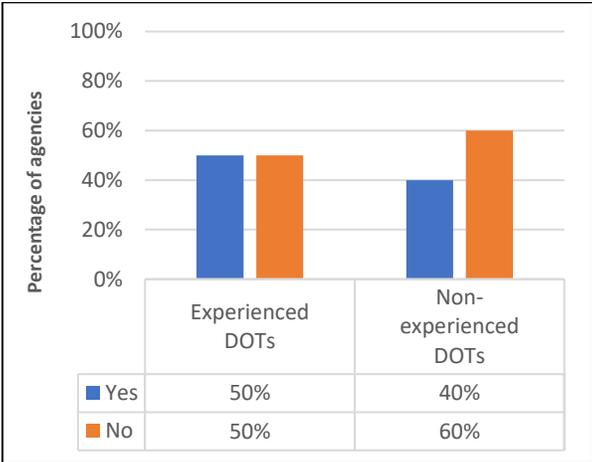


Figure 8 – Project delivery methods used in the context of program based on experience

4.3.3 Percentage of Project Delivery Methods Used for Program Delivery

All agencies (100%) use traditional DBB for program delivery. Thirty agencies (73%) use DB for program delivery. Eighteen agencies (44%) use CM/GC for program delivery. Sixteen agencies (39%) use P3 for program delivery and six (15%) use a single contract that incorporates a combination of one or more project delivery method.

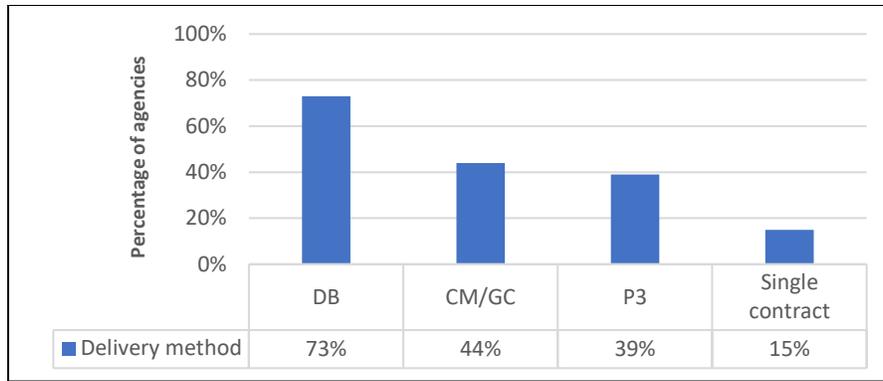


Figure 9 – Percentage use of project delivery methods used for program delivery based on experience

4.3.4 Holistic Approach to Delivering Group of Projects

It is observed that more than 85% of experienced DOTs in comparison to 60% of the non-experienced DOTs consider the holistic approach to delivering a group of projects. Selection of project delivery methods for a program based on holistic approach is a challenge faced by the DOTs.

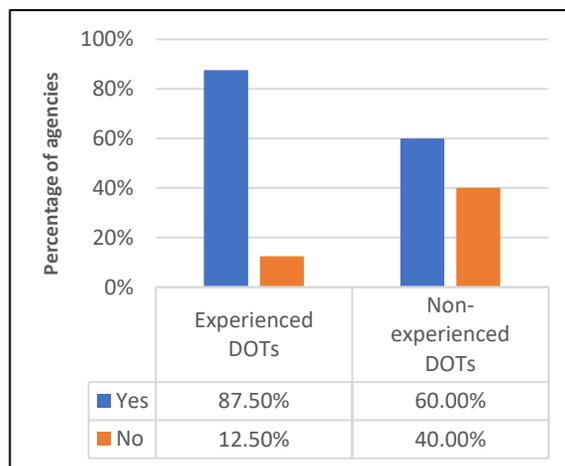


Figure 10 – Holistic approach to program delivery based on experience

4.3.5 Selection of Delivery Methods for Program

It is observed that in case of experienced DOTs, more than 90% of the DOTs chose a delivery method based on a case-by-case basis; more than 40% of DOTs chose a delivery method based on a group of projects; and only 12% of DOTs chose a delivery method based on a holistic approach to program delivery. However, there is the difference in selecting a delivery method for a program between experienced and non-experienced DOTs. It is observed that non-experienced DOTs prefer selecting a delivery method for a program based on a case-by-case basis over based on a group of projects. Further, the non-experienced DOTs have no consideration of using a holistic approach to select a project delivery method for a program.

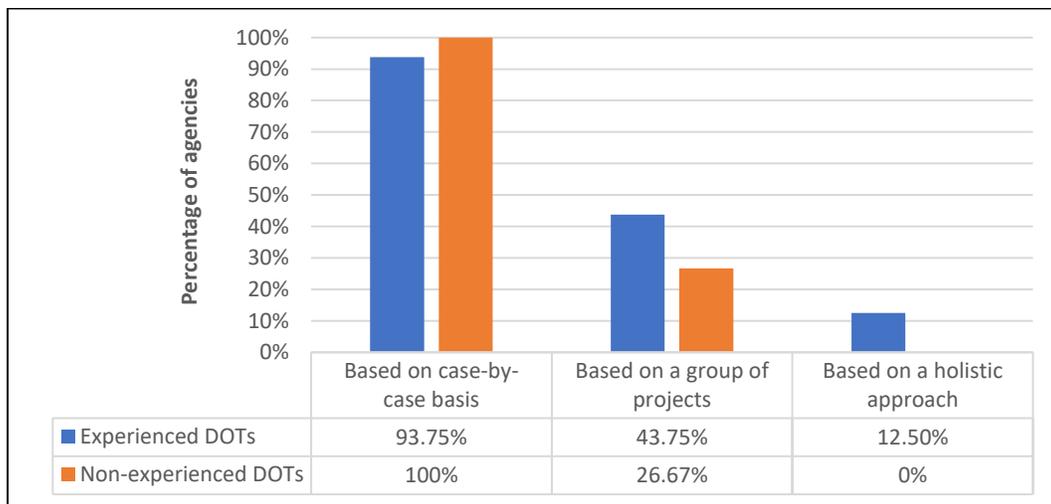


Figure 11 – Selection of delivery methods for program based on experience

4.4 Factors Influencing Program Establishment

The respondents were asked to rank the factors relative to their appropriateness for grouping projects into a program using the following Likert scale: 0 = Not Applicable; 1= Inappropriate; 2 = Slightly appropriate; 3 = Appropriate; 4 = Very appropriate; and 5 = Extremely appropriate.

Based on the responses the weighted average technique was used to rank the methods. Table 6 below shows the response received from survey and evaluation done below based on weighted average.

Table 4 – Factors influencing program establishment

Factors influencing program establishment	NA	1	2	3	4	5	Weighted Average
Project functionalities [PF] (bridges, maintenance, or pavement)	1	0	1	7	15	17	4.2
Project construction type [PCT] (rehab, preservation, or new)	1	0	2	9	16	13	4.0
Funding issues [FI]	2	2	3	14	13	7	3.4
Demand and urgency [DAU]	4	2	1	14	12	8	3.4
Stakeholders' priority and expectation [SP&E]	4	2	5	13	11	6	3.1
Critical completion dates [CCD] (schedule issues)	6	2	3	13	14	3	2.9
Project location [PL]	4	2	10	14	8	3	2.7
State or federal mandates/political influences [PI]	5	3	10	11	9	3	2.7
Financing issues /revenue generator (tolls, special taxes) [FI/RG]	7	9	6	7	7	5	2.4
Agency personnel's experience on similar past projects [APE]	6	10	7	9	2	7	2.4
Project complexity [PC]	5	6	10	12	6	2	2.3

Further, Cronbach's alpha test was used to check the internal consistency of the items in the scale. It is observed statistically, that the Cronbach's alpha coefficient value is 0.813 (Table 7), which satisfies the reasonable goal of test and is closer to 1.0 indicates that the items in the scale are internally consistent for the response received.

Table 5 – Cronbach’s alpha test results

	N	Mean	Variance	SD		
Statistics for Scale	11	35.63	50.934	7.137		
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	3.239	2.630	4.259	1.630	1.620	.326
Item Variances	1.161	.430	2.063	1.632	4.795	.190
Inter-Item Correlations	.283	-.396	.697	1.093	-1.760	.057
	Scale Mean	Scale Variance	Corrected	Squared	Alpha	
Item Total Statistics	<u>If Item Deleted</u>	<u>If Item Deleted</u>	<u>Item-Total Correlation</u>	<u>Multiple Correlation</u>	<u>If Item Deleted</u>	
[PF]	32.96	44.652	.417	.533	.816	
[PCT]	32.74	41.507	.615	.519	.799	
[FT]	33.00	40.385	.569	.731	.803	
[DAU]	32.33	41.231	.718	.736	.792	
[SP&E]	31.96	42.422	.504	.523	.809	
[CCD]	31.37	51.781	-.135	.401	.846	
[PL]	31.63	44.858	.452	.607	.814	
[PI]	32.93	39.533	.517	.602	.810	
[FI/RG]	32.89	42.256	.449	.449	.815	
[APE]	32.41	41.405	.624	.718	.798	
[PC]	32.07	41.148	.618	.600	.798	
Reliability Coefficients for Item 11		<u>Alpha</u>		<u>Standardized Item Alpha</u>		
		.824		.813		

4.4.1 Program Factors Considered as Motivation for Program Delivery

The most important factors with maximum response are program schedule issues, streamlined processes/innovation, project and program risk management. The table below lists the top ten program factors with the percentage response received for program factors which serve as a motivation for program delivery.

Table 6 – Program factors considered as motivation

Program factors motivation for program delivery	Percentage of response (%)
Program schedule issues	46
Streamlined processes/innovation	46
Project and program risk management	42
Project size (dollars)	35
Reduced public impact	35
Program budget control issues/priority projects	31
Program performance	31
Enhance trust/improve agency image	31
Need for nonconventional financing	31
Technical complexity of group of projects	27

4.5 Use of Bundling to Deliver Program

As discussed in the research methodology, the content analysis was conducted to identify the type of approaches used to conduct program delivery. It is found that the use of bundling projects under a contract is one of the approach used for program delivery. Bridge replacement/maintenance/construction projects are delivered using the bundling approach.

The “Fixing America’s Surface Transportation Act” (FAST Act) encourages multiple similar bridge projects to be handled (“bundled”) into a single project. The FAST Act encourages states to save cost and time by bundling multiple projects as one project under one project agreement. Bridge bundling involves awarding multiple, similar bridge replacement/improvement projects to a single contractor. The bundling of design and construction contracts saves procurement time, leverages design expertise, achieves economies of scale, and builds momentum to maintain critical assets that are too often in deficient conditions. At the state DOT level, bridge bundling has been very successful. The bridge bundling becomes a successful practice when a) the specifications are clear; b) maximum size of the bundle is 7-10 and minimum size is 3-4 bridges;

c) standard designs are included in the contract, and d) there are an established uniform selection criteria. (Bridge Bundling Workshop 2016)

State DOTs use bundling technique for maintenance of bridges throughout the state. The findings of case study reveal that four state DOTs which include California, Missouri, New York and Oregon has successfully used the bundling approach for their respective programs and have observed a benefit of improved performance using bundling. For example – Missouri DOT (MoDOT) in 2008, delivered the Safe and Sound Bridge program under which more than 800 individual bridge projects were repaired and replaced using the bundled contract (MoDOT, 2013a). Similarly, the Oregon state conducted the repairs and replacements of 365 bridges under the OTIA III Bridge Program Delivery (ODOT, 2015c) and New York state conducted repairs of more than 120 deficient bridges under the New York’s Accelerated Bridge Program (NYSDOT, 2012) using the bundling approach for program delivery.

4.6 Corridor Approach of Program Delivery

The second approach of program delivery from the findings of content analysis is the corridor approach to deliver new construction and/or improvement/replacement projects under the Transportation Improvement Programs of the state.

A transport corridor is a generally linear area that is defined by one or more modes of transportation like highways, railroads or public transit which share a common course. A corridor is developed under the statewide transportation improvement program to provide better transportation facilities and urban development. For example, Washington state DOT (WSDOT) delivers the I-405 corridor program which is a \$20 billion program. The work includes adding new lanes to both the northbound and southbound lanes, developing a bus rapid transit line along

I-405, improving arterial streets, creating 1,700 new vanpools, constructing 5,000 new park-and-ride parking spaces, building eight new pedestrian and bicycle crossings over the freeway, increasing local transit by 50 percent, and adding a managed lane system to the Interstate (WSDOT, 2015).

The table 7 below shows the summary of the project profiles and the type of delivery method used for the program. These project profiles served as a basis of study to understand the concept of program delivery and frame survey questionnaire.

Table 7 – List of programs based on categorization

Category	State	Name of program	Delivery method used
Bridge replacement	Pennsylvania	Pennsylvania Rapid Bridge Replacement Project	DBFM
	Kentucky	Ohio River Bridges East End Crossing	DBFOM
		Ohio River Bridges Downtown Crossing	DB
	New York	New NY Bridge (Tappan Zee Bridge Replacement)	DB
	Rhode Island	Iway (I-195 Relocation Project)	DB
New Jersey	Goethals Bridge Replacement	DBFM	
New Construction/Improvement projects	Dallas	North Tarrant Express Segment 1 and 2A	DBFOM
	Georgia	Northwest Corridor	DBF
	California	SR 91 Corridor Improvement Project	DB
	Florida	IROX I-75 Roadway Expansion	DBF
		I-595 Corridor Roadway Improvements	DBFOM
	Utah	I-15 Corridor Reconstruction Project	DB
	Virginia, Kentucky and Ohio	Heartland Corridor	DBB, DB
	Virginia	I-495 Capital Beltway HOT Lanes	DBFOM
Route 28 Corridor Improvements		DB	

The case studies were developed based on structured interviews with DOTs willing to participate further in the study and having rich data. The table 8 below shows the summary results for case

studies profiles with the type of program as witnessed in the literature review, participating state DOT, and the delivery method used for the program.

Table 8 – Case studies summary based on type of program

Category	State	Delivery method used
Bridge replacement	California	DB, CM/GC
	Missouri	DBB, DB, A+B, & DBFM
	New York	DBB, DB
	Oregon	DB, CM/GC & A+C+D
New Construction/ Improvement projects	Florida	DBB, DB, CM/GC & P3
	Utah	DBB, DB, & CM/GC
	Washington	DBB, DB, & CM/GC

4.7 Summary

This chapter describes the current use of program delivery methods through the findings of content analysis and summary of the national survey of state DOTs. The survey findings reveal that twenty-six state DOTs have already implemented or consider implementation of program delivery. Over the last ten years, sixteen state DOTs have experience of using program delivery more than five to ten times. It is also observed that DOTs use project delivery methods in the context of program delivery and adopt a holistic approach to delivering programs. The chapter also discusses the program factors that influence program establishment. The most important factors are program functionalities and program construction type. The content analysis findings reveal that there are mainly two approaches adopted to program delivery which include delivery using bundling of projects and delivery using the corridor approach. Lastly, the findings from this chapter help to conduct the case studies with DOTs with more experience of using program delivery, the findings of which will be discussed in detail in Chapter 5 and 6.

CHAPTER 5 – PERFORMANCE MEASURES OF PROGRAM DELIVERY

5.1 Introduction

This chapter presents the projects and program performance measures for the use of program delivery in the transportation industry. The findings of survey and case studies are discussed in detail. This chapter will discuss the findings from survey and provide an overview of the current state-of-practice. It will further discuss the findings from the case study on the performance measures adopted by the state DOTs for program delivery. The chapter concludes with the summary of findings.

5.2 Performance Measures for program delivery

Performance measurement is an essential element to improve project and program delivery methods. Measures that are tracked during the project and program delivery help state DOTs quantify performance and identify opportunity for improvement. This section will discuss the survey results for performance measurement of program delivery and performance tracking of projects that are grouped under program. Of the 41 state DOTs that responded to the survey, 17 state DOTs (42%) stated that they measure the performance whereas, 24 state DOTs (59%) stated that they do not measure the performance of programs that are implemented. State DOTs reported that cost and schedule metrics are typical performance metrics for their transportation projects and programs. Some state DOTs measure the performance of their projects and programs based on the DOT's strategic goals. Further, 23 state DOTs (56%) stated that they track the performance of the projects selected for a program, and 18 state DOTs (44%) reported that they have a process to measure the performance of program delivery.

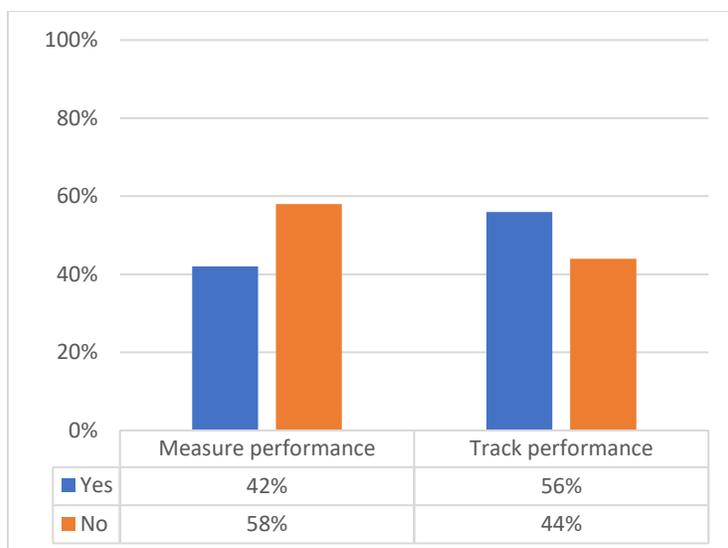


Figure 12 – Performance measurement of program

The case-studies conducted with the seven state DOTs identify that each state DOT adopts a different practice to measure performance. In case of NYDOT, ODOT, and WSDOT performance measurement is done at both the project and program level. Whereas, MoDOT and UDOT have their own performance measurement tools which measure performance based on certain specified drivers and metrics. FDOT has developed a framework in which performance is measured at each stage. Lastly, Caltrans use performance measures as a driving force for delivering their programs and have distinct measures for each program. The data available for each of the performance measures for the above-stated DOTs will be discussed in detail in this section.

Oregon Department of Transportation

Performance for the program was measured on a project-by-project basis and at the programmatic level. Most of the program-level measures relate to the program. Utilizing the OTIA III State Bridge Delivery Program Final Report (2015a), the following section summarizes

the performance measures used to track the progress and overall success in achieving the program goals. OTIA III was delivered with a vision to achieve five program goals: stimulate economy; employ efficient and cost-effective delivery practices; maintain freight mobility and keep traffic moving; build projects that are sensitive to surrounding communities and landscape; and capitalize funding opportunities for the program. A discussion is provided on the two goals of employing efficient and cost-effective delivery practices and maintain freight mobility.

The measured goal to employ efficient and cost-effective delivery practices was achieved by using D-B and CM/GC as well as ODOT bundling bridges as single projects. The expedited programmatic permitting process used is estimated to have saved the program more than \$70 million. Tracking of expenditures and schedules were two performance measures that ODOT collected throughout the program. Each of the measures included the comparison of planned versus actual expenditures for each year of the program. In many years, actual expenditures exceed the planned expenditures, but that was because ODOT completed more bridges in those years than originally planned. Next, for the goal to maintain freight mobility and keep traffic moving, ODOT developed a three-tier approach to managing traffic from the project, corridor, and statewide levels so that ODOT could minimize disruptions in travel for motorists, truckers, businesses, and communities during construction (ODOT, 2015a). A work zone traffic analysis tool was developed to determine the times for lane, shoulder, and roadway closures that would be the least disruptive to traffic movement (ODOT, 2010). Additionally, the central office would coordinate with the other regions of the state to limit the number of simultaneous work zones that motorists would encounter on any of the major highways and Interstates that run through the state. One measure used to track this goal was comparing the planned versus an actual number of bridges opened in a given year. Figure 13 illustrates this measure.

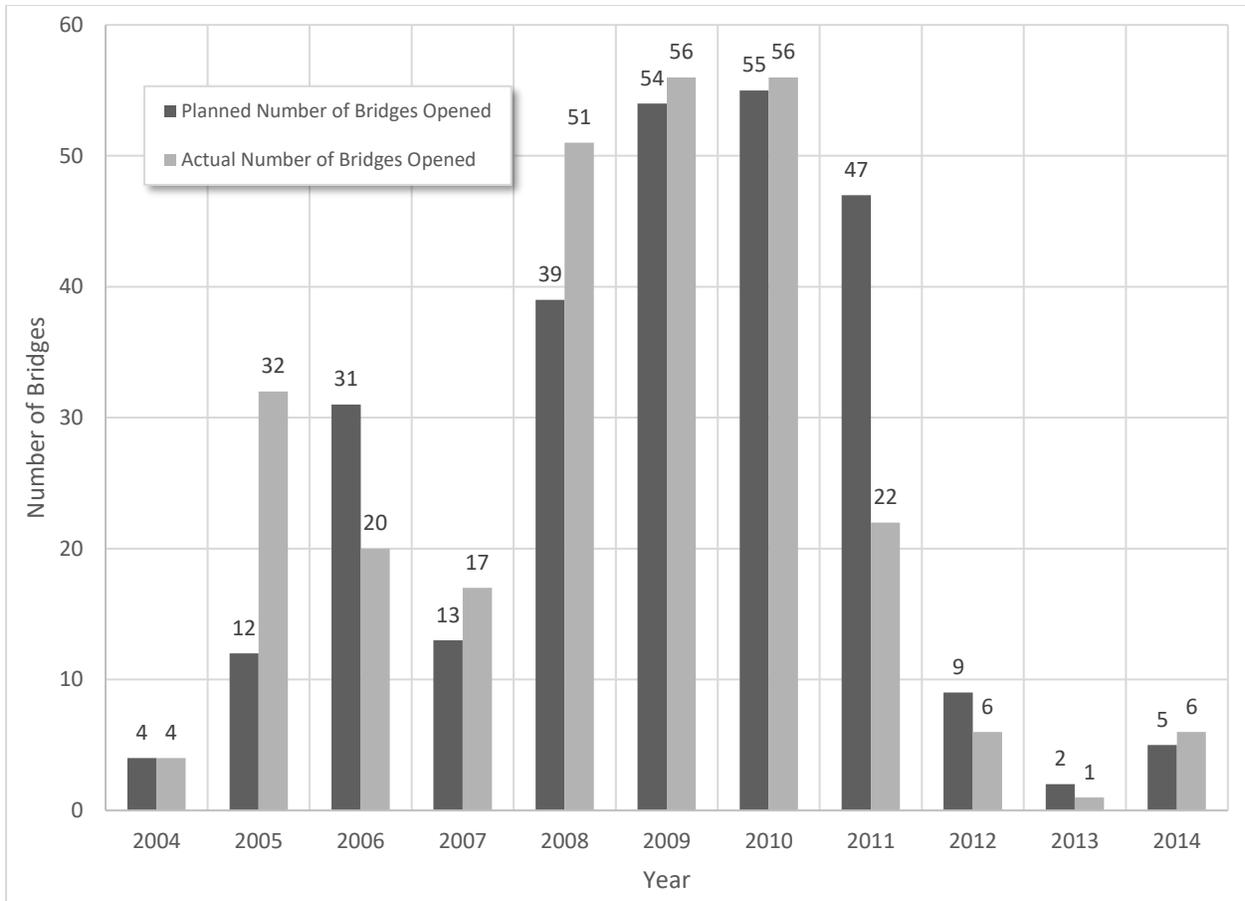


Figure 13 – Planned vs. Actual Total Number of Bridges Opened

(Source: ODOT, 2015a)

Washington Department of Transportation

WSDOT measures performance at the project and program levels. At the project level, WSDOT measures project performance on a monthly basis in terms of deliverable cost, schedule, and budget. WSDOT upper management and executives tend to evaluate and monitor certain specific projects (e.g., high-profile or high-risk projects) on a quarterly basis. At the program level, WSDOT measures whole program performance on the same yearly basis or for every legislative session. From a program level, the information collected and measured for the I-405 program

shows that WSDOT has consistently delivered every project in the program since its inception on time. The use of ACMs provides an opportunity to overlap design with construction and improve collaboration among team members that lead to delivering projects on time or early. In terms of budget, the I-405 program show costs either on budget or under budget. A bonus of the legislation in place for the I-405 program is that any savings realized from individual projects stays with the program. WSDOT can reinvest those savings to perform more work, accelerate, or gain a head start on early planning or early right-of-way acquisitions and environmental requirements for future projects (WSDOT, 2016). Another performance feature of the I-405 program is that the contingency amounts were set low for most projects (4% or less).

Missouri Department of Transportation

The Missouri DOT's (MoDOT) *Tracker* is published quarterly to help decision makers generate the best resolution. The January 2016 *Tracker* (MoDOT Tracker, 2016) lists 60 total measures spread out over seven tangible results as to: keep customers and ourselves safe; keep roads and bridges in good condition; provide outstanding customer service; deliver transportation solutions of great value; operate a reliable and convenient transportation system; use resources wisely; and advance economic development.

Of these seven tangible results, "Deliver Transportation Solutions of Great Value" is directly related to project and program delivery. The *Tracker* reports on the status of each measure for each tangible result. For example, under the "Deliver Transportation Solutions of Great Value" tangible result, MoDOT stated that they have used innovative contracting methods to improve efficiency, increase flexibility, mitigate limited resources, meet each project's unique challenges, and maximize collaboration with the public and private sectors (MoDOT Tracker, 2016). Table 9

shows the level of detail measured and monitored on a quarterly basis for each of six measures under the “Deliver Transportation Solutions of Great Value” tangible result.

Table 9 - Measures of project and program delivery (Missouri DOT)

(Source: MoDOT Tracker. Measure of Departmental Performance, January 2016)

Measure	Purpose of Measure	Results
Percent of programmed project cost as compared to final project cost	This measure determines how close total project costs are to the programmed costs. The programmed cost is considered the project budget.	214 road and bridge projects were completed in the fiscal year 2016 at a cost of \$483 million. This represents a deviation of 2.08 percent (or \$10 million) less than the programmed cost of \$493 million.
Percent of projects completed on time	This measure tracks the percentage of projects completed by the commitment date established in the contract. This includes road, bridge, local public agency and multimodal projects – rail, aviation, waterway and transit.	To date in the fiscal year 2016, 67 percent of the closed-out projects were completed on or ahead of schedule.
Percent of change for finalized contracts	This measure tracks the percentage difference of total construction payouts to the original contract award amounts. This indicates how many changes are made on projects after they are awarded to the contractor for the road, bridge, local public agency and multimodal projects – rail, aviation, waterway and transit.	MoDOT’s performance in the fiscal year 2016 is 0.9 percent so far. (\$561 million worth of projects completed \$5.0 million over the award amount.)
Innovative contracting methods	This measure tracks the use of innovative contracting methods on MoDOT projects including A + B contracts, alternate technical concept contracts, and design-build contracts.	In the fiscal year 2015, the four projects delivered using innovative contracting methods accounted for \$113.2 million of the \$767.77 million program.
Value Engineering	This measure tracks the use of value engineering during design and construction on traditional MoDOT projects including value analysis during the design phase, construction value engineering proposals, and	So far for the fiscal year 2016, 10 VE proposals were approved resulting in MoDOT savings of \$337,000

	implementation of best practices into standards and policies.	
Average highway lane-mile and bridge construction costs	This measure tracks the costs to construct a variety of common highway and bridge construction projects including the costs for equipment, labor and fringe benefits and materials to construct a project	Minor road asphalt resurfacing costs have increased due to a combination of fluctuating fuel and oil prices and increased material costs

Measuring performance of the program occurred on a project-by-project basis along with monitoring specific measures that relate to the overall program goals. Project performance measures focused on the major areas of cost, schedule, quality, and safety. An example of project performance measures is as follows:

- Planned versus actual expenditures;
- Planned versus actual schedule durations;
- Safety by tracking reportable incidents; and
- Quality by tracking repeated Non-Performance Reports.

MoDOT also developed a process to track repeated issues on projects and throughout the program. MoDOT collected and compiled the repeated issues and the solutions, which were then documented in the best practices manual that was revised each time a repeated issue was found. This process helped improve performance continually throughout the program duration.

In terms of the high-level program goals, MoDOT and the design-builder tracked and measured their performance throughout the program. Table 13 summarizes the program goals along with the outcomes reported by MoDOT for the S&S program.

Table 10 - Program goals and outcomes for the S&S bridge program

(Source: MoDOT, 2013a; Gapstur and Warbritton, 2013).

Program Goal	Outcome
Meet the needs of the highway system and traveling public	Positive feedback from the traveling public on the improvements made. S&S Program has received numerous awards and accolades for its success.
Deliver good bridges at a great value	Program finished under budget and project locations returned to better than before conditions.
Minimize public inconvenience through increased construction speed and flexible schedule	Use of D-B for most critical and high-risk projects to accelerate schedule. MoDOT moved bridge projects on the schedule to lessen inconveniences to the traveling public. The average closure for any bridge was only 42 days, when many expected this to be in the range of 60 to 90 days.
Complete all construction by October 31, 2014	MoDOT's completion date was October of 2014. The design-builder's completion date was December 2013. The actual completion date of the project was October 2012, which was 14 months ahead of the design-builders schedule and 24 months ahead of MoDOT's schedule.

Florida Department of Transportation

Performance measures are usually indicators of progress toward attaining a goal, objective, or target (a desired level of future performance. Because Florida's transportation system improvement needs exceed available funding, resources must be invested in the most strategic, effective and efficient ways possible. Performance measures provide useful "feedback" and are integrated into FDOT's business practices on three levels:

- At the strategic level – Performance measures help to establish and inform goals and strategic objectives, and to monitor progress in carrying out FDOT's Mission.

Performance measures also communicate progress toward achieving goals in various

programs and plans such as the Florida Transportation Plan, the Strategic Highway Safety Plan, and the Freight Mobility and Trade Plan.

- At the decision-making level – Performance measures are used to inform and assess the financial policies for allocating funds across programs such as highway preservation, system expansion, and public transportation. These programs are defined in the Program and Resource Plan.
 - At the project delivery level – After projects are selected, performance measures help to monitor the efficiency and effectiveness of projects and services in the Five-Year Work Program. The measures also support organizational and operational improvements.
- As shown in the Performance-Based Planning and Programming Process graphic below, performance management is at the heart of FDOT's planning and programming process.

FDOT uses performance measures to assess how well Florida's multimodal transportation system is functioning; provide information to support and inform decision-making; assess how effectively and efficiently transportation programs, projects and services are being delivered; determine customer satisfaction levels; demonstrate transparency and accountability to Florida's citizens and to foster collaboration with FDOT's transportation system stakeholders (FDOT 2015). The framework for FDOT's performance measurement is shown in the figure below.



Figure 14 – Performance measurement framework by FDOT

Utah Department of Transportation

The Utah DOT (UDOT) uses the executive dashboard to conduct a regional program update, which provides an internal look at where individual regions stand with their projects as a whole. For each region, three main metrics are used in the dashboard: scope, schedule, and budget. The scope metric involves the measurement of contract payments, change orders, and final expenditures in comparison with the original contract. Figure 15 shows an example of UDOT’s scope performance metrics.

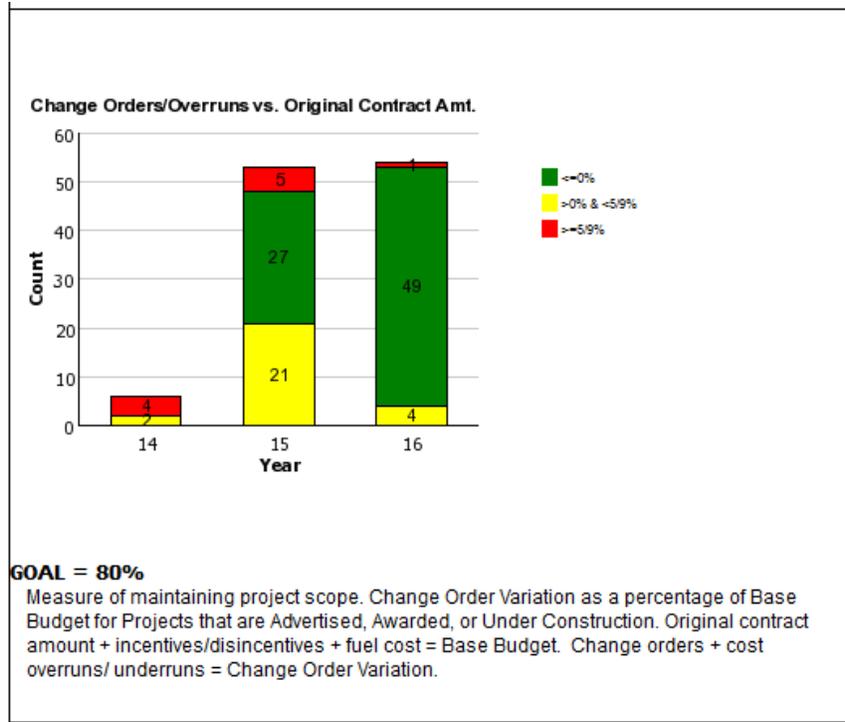


Figure 15 – UDOT’s scope performance metrics

The schedule performance metric involves measuring conformance to the schedule and on-time delivery. This metric measure active projects approaching their advertising date or projects in the scoping or conceptual phases. The metric provides information related to early, on-time, and late delivery schedule. Figure 16 shows an example of UDOT’s schedule performance metrics.

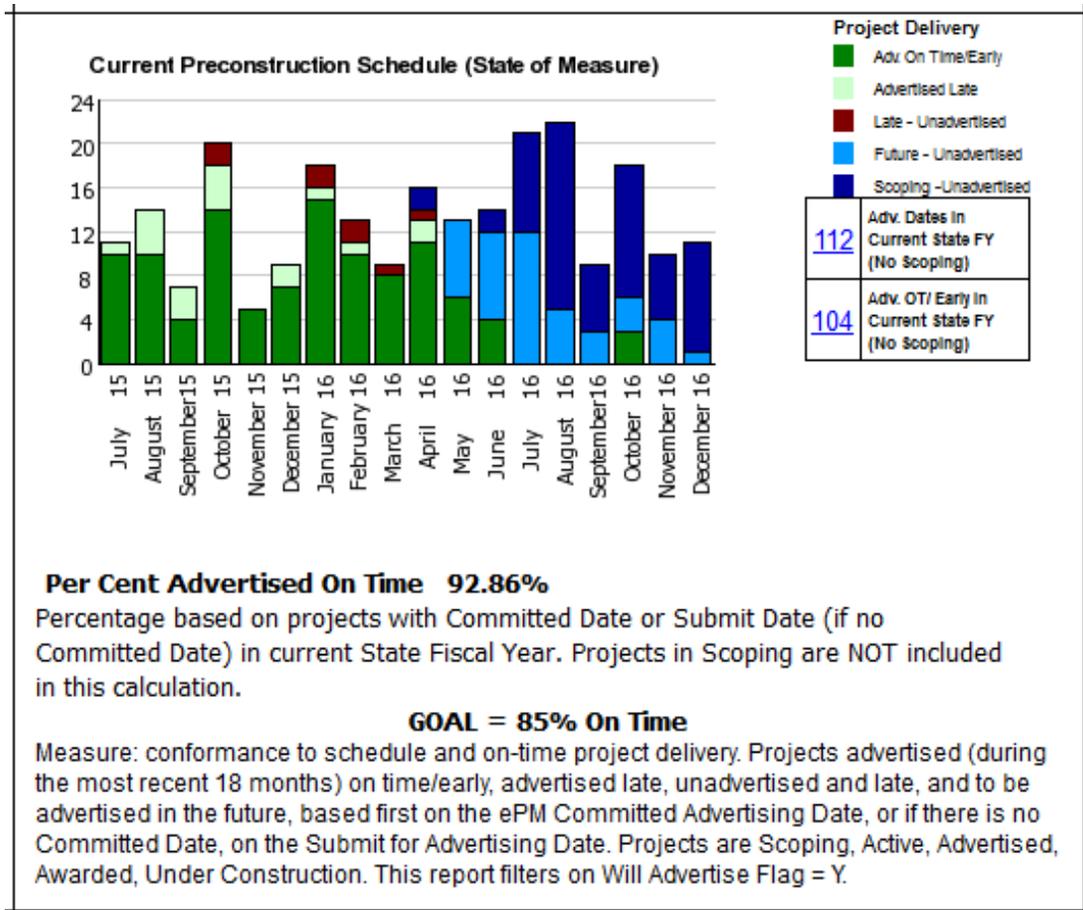


Figure 16 – UDOT’s schedule performance metrics

The budget performance metric involves comparing the total project cost estimate to the approved project value in the preconstruction phase and measures calculated total projected expenses as a percentage of project value in the construction phase. The result of this metric provides a summary of current program funding, totaled by month. Figure 17 shows an example of UDOT’s budget performance metrics.

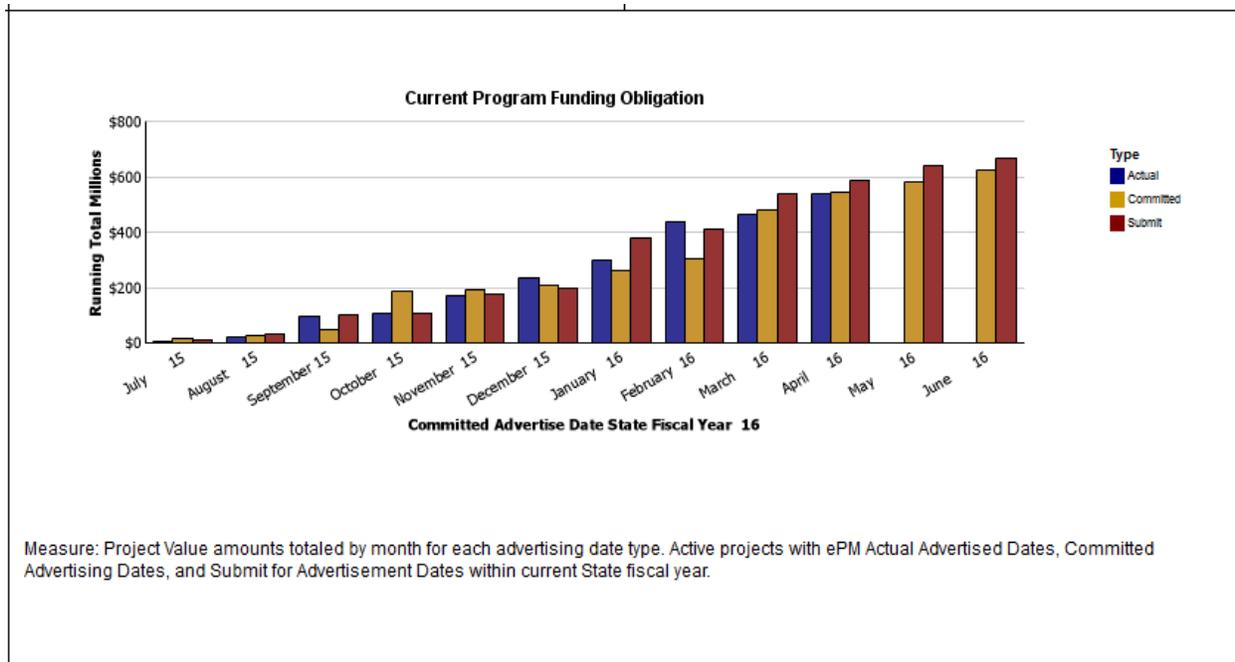


Figure 17 – UDOT’s budget performance metrics

UDOT measures performance at the program level. Utah has four regions and is a decentralized DOT. For individual projects, each region handles its own projects and measures its own performance. However, the central office is in charge of all programs and measuring program performance. The performance measures include scope, schedule, budget, and quality. UDOT uses a dashboard to report the performance.

The dashboard, called the executive dashboard, can show the status of projects and programs (UDOT, N.D.) (i.e., behind schedule vs. on schedule; under budget vs. over budget, etc.). Based on the dashboard, the program team can make adjustments to improve project and program performance. The dashboard has collected performance data for quite some time, so UDOT can now analyze the data. Trends from the data analyses tend to identify areas needing improvement in the state transportation system.

UDOT also has a set of measures for a program in regard to safety. Safety is a critical issue, and UDOT does enforce strict safety measures and management for every project and program. One realization in terms of safety performance is that program delivery is the most important aspect of providing safety. This is because as a program is developed, UDOT considers safety not only for construction but also for the traveling public during and after construction.

5.3 Summary

This chapter discusses the findings from survey and case studies for performance measures adopted by state DOTs to measure the success as well as to identify improvements for their projects and programs. State DOTs do not have a standardized performance measurement tool or practice. Several state DOTs like NYDOT, ODOT and WSDOT measure performance at both project and program level which aligns to the respective goals of the projects. Whereas, other DOTs have developed their own tools, framework for performance measurement. This chapter discussed in detail all the data and findings for performance measurement variations observed.

CHAPTER 6 – BENEFITS AND CHALLENGES

6.1 Introduction

This chapter presents the benefits and challenges of the program delivery in the transportation industry. The findings of the survey and case studies are discussed in detail. This chapter is further divided into two sections. Section one will discuss the findings of survey and case-study for the benefits of program delivery. Section two will discuss the findings of survey and case-study for the challenges of program delivery. The chapter concludes with the summary of findings.

6.2 Benefits of Program Delivery

This section will discuss the benefits of program delivery. The section is sub-divided as benefits witnessed from survey, benefits associated with delivery method and benefits witnessed from case-studies. A detail discussion for each of the benefits is provided based on the findings from data available from the websites of state DOTs, survey and case-study.

6.2.1 Benefits Witnessed Based on Survey Response

As stated in the literature review the success of a program is evaluated based on the benefits it provides. The survey asked the respondents to provide benefits of program delivery. The top three benefits of program delivery with a response rate of more than 50% are accelerated project delivery, flexibility in reassessing/reassigning risk and better risk management, and flexibility in delivery scheduling.

6.2.1.1 Accelerated Project Delivery

Out of 41 agency responses, 31 agencies (76%) identified accelerated project delivery as a benefit of program delivery. Accelerated project delivery (APD) method is a practice implemented under the Transportation Innovation Act. The Transportation Innovation Act (TIA) is an opportunity to deliver roads projects faster through innovative project delivery methods such as design-build and construction manager/general contractor. Over half of the United States utilizes some form of accelerated project delivery method with success. Currently, 46 states have the ability to use CM/GC and/or DB specifically for transportation-related projects. However, use of accelerated project delivery does not mean replacing design-bid-build. APD method is used on largest and most complex projects. It means build projects faster with the right tools.

Examples include the transportation improvements on I-80 and I-15 in Salt Lake City in preparation for the 2002 Winter Olympics, as well as the Johnson County, Kansas Gateway project along the I-435, I-35, and K-10 interchanges (AGC Nebraska Chapter 2017). Accelerated project delivery is achieved by (a) fast-tracking design and construction, (b) close coordination between designer and contractor, and (c) early contractor involvement to enhance constructability of plans (Trauner Consulting Services 2007). Further, the use of high-performance teams, specialized functional teams, or self-directed work teams supports the underlying finding that a team approach can lead to accelerated project delivery. Also, the constraints of accelerated project delivery were found to be (a) utility coordination and relocation, (b) railroad coordination and involvement, (c) ROW acquisition, (d) interagency coordination, and (e) lack of funding (Keck, Patel and Scolaro 2010).

6.2.1.2 Flexibility in Reassessing/Reassigning Risk and Better Managing Risk

Out of 41 agency responses, 22 agencies (54%) identified flexibility in reassessing/reassigning risk and better managing risk as a benefit of program delivery. Risk management is the act or practice of dealing with risk and includes planning, assessing, and monitoring risks throughout the project. The risk is inherent in all projects. Project risk management is the systematic process of identifying, analyzing, planning, responding and monitoring project risk. It involves processes, tools, and techniques that will help the Project Manager minimize the probability and consequences of adverse events. Risk management is most effective when first performed early in the life of a project and is a continuing responsibility throughout the project. Project risk is an uncertain event or condition that, if it occurs, will have an effect on project success. Project success is defined as meeting the goals of the project. The four critical goals of every project include objectives, schedule, budget, and quality (Project Management Handbook 2014).

For example, California Department of Transportation or Caltrans specifically designed risk analysis method for transportation projects. Typically, during the risk monitoring and control phase project risk manager and the project team ensures that the new and changing risks are detected and managed and that the risk response actions are implemented and effective. Risk monitoring and control keeps track of the identified risks, residual risks, and new risks. It also monitors the execution of planned strategies for the identified risks and evaluates their effectiveness. Risk monitoring and control continues for the life of the project. The list of project risks changes as the project matures, new risks develop, or anticipated risks disappear. Risk ratings and prioritization can also change during the project lifecycle. Better risk management is identified as a benefit for program delivery as the cost-schedule analysis is done at an earlier stage of program and also lessons learned from past experience in case of similar projects

grouped (say maintenance projects) in a program provide a better insight or forecast of the type of risk that may occur along with solutions taken to mitigate those risks (Project Risk Management Handbook: A Scalable Approach 2012).

6.2.1.3 Flexibility in Delivery Scheduling

Out of 41 agency responses, 22 agencies (54%) identified flexibility in delivery scheduling as a benefit of program delivery. Flexibility in scheduling is an advantage of design-build project delivery method. In this study of program delivery, an observation is made with survey results and supporting case studies that DOTs use design-build as a project delivery method for program delivery. Studies have shown that DB is faster on average than DBB or CM/GC. Design-build provides the following advantages: provides a single point responsibility for schedule control; provides early schedule certainty; and provides opportunities for flexibility in schedule compression (Touran, Gransberg, et al., 2009).

For example, MoDOT initiated several incentives/disincentives within the D-B contract to help accelerate the program schedule for the Safe and Sound Bridge Improvement program to reduce the overall schedule from more than 5 years to 3.5 years. In addition, MoDOT implemented a “flexibility move” requirement in the contract. This requirement essentially reserved the right for MoDOT as the owner to move the schedule on a limited number of bridges. As compensation, the design-builder was allowed the use of weighted timetables and standard DOT schedule tools to show the different number of typical working days available for each bridge under different conditions. This process worked well because the contractor collected additional revenue, and yet at the end of the program, the allotted funds for the incentives were not exhausted. Thus,

depending on the type of program and contract flexibility in scheduling is perceived as a benefit to program delivery (MoDOT, 2013a).

6.2.2 Benefits Associated with Each Delivery Method

Further, the question asked to list the top five benefits associated with each delivery method. The table below summarizes the results for the top five benefits associated with DBB, DB, CM/GC and P3.

Table 11 – Benefits associated with each delivery method

Delivery method	Benefits
Design-bid-build	Increased control of scope, schedule, and cost
	Greater and/or earlier cost certainty
	Effectively managing changes
	Managing and leveraging resources
	Flexibility in delivering scheduling
Design-build	Accelerated project delivery
	Flexibility in innovation
	Flexibility in delivery scheduling
	Greater and/or earlier cost certainty
	Cost savings
Construction Manager/General contractor	Flexibility in innovation
	Flexibility in reassessing and reassigning risk
	Greater partnership between the public and private sector
	Greater and/or earlier cost certainty
	Cost savings
Public-private partnership	Greater partnership between the public and private sectors
	More choices in funding and delivery methods
	Flexibility in delivery scheduling
	Accelerated project delivery
	Flexibility in innovation

The results for benefits associated with each delivery method were further analyzed based on experience as discussed in section 4.1.2 using Chi-square test. The hypothesis is stated as follows:

H₀ – There is no statistical difference between experienced and non-experienced DOTs of the benefit observed for particular project delivery method.

H₁ – There is a statistical difference between experienced and non-experienced DOTs of the benefit observed for particular project delivery method.

Table 10 below summarizes the results of Chi-square test between experienced and non-experienced DOTs. The significance values are denoted with an asterisk (*) symbol. For example, accelerated project delivery as a benefit of design-build (chi-square = 7.258 and p-value = 0.007). The null hypothesis was rejected given that p-value < 0.05. Thus, there is statistically significant difference between how experienced and non-experienced DOTs perceive the benefit of accelerated project delivery. The remaining benefits were tested and the p-value > 0.05, indicated that the null hypothesis should be retained and there is no statistically significant difference in perceptions of the experienced and non-experienced DOTs.

Table 12 – Chi-square results for benefits associated with each delivery method

Delivery method	Benefits	Chi-square	Significance (p-value)
Design-bid-build	Increased control of scope, schedule, and cost	0.806	0.369
	Greater and/or earlier cost certainty	0.032	0.857
	Effectively managing changes	3.903	0.048*
	Managing and leveraging resources	7.258	0.007*
	Flexibility in delivering scheduling	5.452	0.020*
Design-build	Accelerated project delivery	7.258	0.007*
	Flexibility in innovation	0.032	0.857
	Flexibility in delivery scheduling	3.333	0.068
	Greater and/or earlier cost certainty	7.258	0.007*
	Cost savings	5.452	0.020*
Construction Manager/General contractor	Flexibility in innovation	1.581	0.209
	Flexibility in reassessing and reassigning risk	3.903	0.048*
	Greater partnership between the public and private sector	7.258	0.007*
	Greater and/or earlier cost certainty	10.800	0.001*
	Cost savings	16.133	0.000*
Public – private partnership	Greater partnership between the public and private sectors	9.323	0.002*
	More choices in funding and delivery methods	14.226	0.000*
	Flexibility in delivery scheduling	11.645	0.001*
	Accelerated project delivery	14.226	0.000*
	Flexibility in innovation	14.226	0.000*

6.2.3 Benefits Witnessed Based on Case-Study

The benefits witnessed from the case study are increased innovation, improved performance using bundling and standardized design. Each of these benefits will be discussed in detail in this section followed by the experience of state DOTs.

6.2.3.1 Increased Innovation

The increase in innovation is a result of the use of Alternative Contracting Methods within a program. The Federal Highway Administration supports the deployment of Alternative Contracting Methods –DB, CM/GC, ATCs to accelerate project delivery, encourage the

deployment of innovation, and minimize unforeseen delays and cost overruns (Federal Highway Administration 2017). Alternative contracting methods include the early involvement of key participants. The hiring of design and construction firms early in the project development process results in more innovation and value engineering.

Specifically, with the use of Alternative Technical Concepts (ATC) which is flexible highway contracting process, contractors can submit innovative, cost-effective solutions that are equal to or better than the State's design and/or construction criteria. ATC process is most commonly used with DB project delivery (Federal Highway Administration 2016).

Florida Department of Transportation

FDOT has taken an initiative known as “Invitation to Innovation” with a goal to utilize newly developed technology or employ creative thinking to generate greater value for every transportation dollar invested (Florida DOT 2017). So far, they have various innovative techniques for the structure of the bridge, roadway design, and surveying (Florida DOT 2017). Using these innovation techniques and design elements improve the overall program. FDOT officials stated in the interview process that “innovation is a huge benefit of using alternative delivery programs.”

FDOT mainly has new construction/ improvement projects which use DB delivery method. The officials further stated that the advantage to using D-B delivery is that the designs are not as conservative as the departments. Design-builders tend to infuse more innovation and design elements that really improve the overall program. Many times, contractors have developed and used methods and techniques to perform the work at a level above FDOT's expectation.

For example – The I-4 Ultimate project is a \$2877 million project which incorporates 25 approved technical concepts that exceed the minimum requirements established by FDOT for basic configuration, project scope, and design criteria. These include innovations in traffic flow, safety, community connections, sustainability, and use of technology (Federal Highway Administration 2016).

Utah Department of Transportation

UDOT has built a culture of innovation that gives every employee the opportunity to make changes to improve their utilization of resources and service (Utah Department of Transportation 2016). The Utah Department of Transportation (UDOT) uses a variety of programs. Program development in UDOT supports four major business actions: (1) transportation system conditions; (2) transportation needs; (3) transportation plans; and (4) program and project schedule (UDOT, 2016b). The case example conducted with UDOT focuses mainly on the alternative delivery program that handles the delivery of all D-B and CM/GC projects. The alternative delivery program has experienced vast innovation. UDOT has realized that projects relying on innovative processes or procedures would benefit from the use of ACMs. Typical D-B processes limit innovation, which is not a problem for small and standard projects. For larger projects within a program, a UDOT official stated, “Innovation influences the overall success of the program.”

For example – I-15 Corridor Reconstruction Project is a \$1.3 billion design-build project involved demolishing, designing, and reconstructing more than 16 miles of freeway and 142 bridges (Kiewit 2017). Use of advanced bridge construction is the innovative technique which replaced the interchange’s old bridge over I-15 while adding a completely new span in little

more than 10 months and finally, adding the innovative diverging diamond traffic pattern was added to the design to solve the problem of congestion and safety. “What UDOT and the project team eventually chose to do was not only innovative but a brilliant solution to an extremely difficult situation with many built-in constructions,” said Bradley Humpherys, a Senior Transportation Project Manager for Stanley Consultants (Utah DOT 2017).

6.2.3.2 Improved Performance Using Bundling

Bridge bundling involves awarding multiple, similar bridge replacement/improvement projects to a single contractor. The bundling of design and construction contracts saves procurement time, leverages design expertise, achieves economies of scale, and builds momentum to maintain critical assets that are too often in deficient conditions. At the state DOT level, bridge bundling has been very successful.

The bridge bundling becomes a successful practice when a) the specifications are clear; b) maximum size of the bundle is 7-10 and minimum size is 3-4 bridges; c) standard designs are included in the contract, and d) there are an established uniform selection criteria.

Bundling of projects allowed state DOTs to combine several projects into one project, which increased contractor competition and lessened the logistical burden of the state DOT from coordinating more projects within a program. In the case of MoDOT, NYSDOT (will be discussed in next benefit), and ODOT, each of these state DOTs had numerous bridges to repair and replace across the entire state. Some of the projects were small, whereas others were large. To increase competition and reduce the number of bridge projects to coordinate and manage, each of these states utilized a bundling process to combine several projects into one larger project. These bundles were created to ensure projects of all sizes to allow small, medium, and

large contractors to gain work in the program. Additionally, bundling occurred based on the location and delivery method used. Utilizing these approaches to bundling helped the state DOTs realize improved performance within the program.

Oregon Department of Transportation

ODOT's OTIA III State Bridge Delivery Program is part of the Oregon Transportation Investment Act. For more than a decade, the award-winning \$1.3 billion OTIA III bridge program proactively updated critical links in Oregon's highway network to increase safety, improve mobility and facilitate the free movement of goods on which the state's economy depends (Oregon DOT 2015).

In 2003, with the passage of the third Oregon Transportation Investment Act, the Oregon Department of Transportation was tasked with delivering a \$1.3 billion program to repair or replace hundreds of aging highway bridges statewide. ODOT used innovative methods and processes to deliver the OTIA III State Bridge Delivery Program, such as grouping - or bundling - nearby projects so local firms across the state could compete for contracts.

One of the major benefits that ODOT acknowledged was the decision to bundle bridges together along similar corridors or geographic locations. This helped contain the projects and coordinate construction within a bundle so that construction could progress while reducing any travel delays as much as possible. Additionally, the ability to monitor delays and the work being performed across the state from the central office assisted in minimizing delays. ODOT was able to coordinate and organize construction on multiple bridges in the same highway corridor so that delays were held to a minimum through the entire corridor rather than just one construction zone. Without the program being run statewide, it would have been difficult to bundle bridges into one

project, and monitoring of delays and coordination of work would have been performed on a regional basis rather than statewide.

6.2.3.3 Standardized Design

Standardization is a technique that aims to reduce the number of different processes within a project. Standardization of design elements helped several state DOTs streamline the design and material procurement processes. This technique is mainly used in case of bundling of projects. The projects included in a bundle could be designed to utilize similar materials and construction means and methods to deliver the project under the program.

Missouri Department of Transportation

In 2008, the Missouri Department of Transportation (MoDOT) embarked on a revolutionary program for delivering many deficient bridges across the state. This program named the Missouri Safe and Sound (S&S) Bridge Program set out to repair or replace as many deficient bridges as possible (MoDOT, 2013a). Safe & Sound Bridge Improvement Program is a two-phase program to improve 802 of the state's lowest-rated bridges. MoDOT realized that most of the bridges in the program would not be technically challenging or difficult to design or construct.

Furthermore, many of the bridges were located in rural or sparsely populated areas, so disruptions to motorists would be limited. Based on these situations, MoDOT, and the design-builder began standardizing elements of the bridges. The standardized elements would then allow for ordering materials in bulk, which would save on material costs. The standardized elements and bridge types allowed for interchangeable parts such that an alternate bridge could be constructed, if a local scheduling issue impacted another bridge schedule. MoDOT included a

provision to substitute a limited number of alternate bridges within the original contract. This technique results in time and cost savings for the entire program.

New York Department of Transportation

New York DOT addressed the most deficient bridges under the New York Accelerated Bridge Program. New York State's bridges are, on average, 46 years old; the average lifespan of a bridge is 50 years. The Department's objective is to reduce the number of deficient bridges through accelerated investment. This program will improve bridge conditions across the state and decrease the cost of maintaining bridge system over time. Overall costs are reduced by bringing a significant group of deficient bridges to a state of good repair, which lessens the need for corrective maintenance and repair of these bridges. The contracts are expected to include the removal and replacement of bridge decks, bearing repair and replacement, and other miscellaneous improvements (Accelerated Bridge Program Contract Information 2015).

Within each zone of bundled projects, the design–builder took advantage of standardizing design elements and their construction means and methods across all bridges within a zone. Between the acceleration experienced and the standardization process, NYSDOT realized cost savings because schedules were shorter, ordering and fabrication of materials occurred in bulk, and contractors established similar tasks across all bridges, which improved productivity.

6.3 Challenges of Program Delivery

This section will discuss the challenges of program delivery. The section is sub-divided as challenges witnessed from survey, and challenges witnessed from case-studies. A detail

discussion for each of the challenges is provided based on the findings from data available from the websites of state DOTs, survey and case-study.

6.3.1 Challenges Witnessed Based on Survey Response

State DOTs state that there are several challenges for the implementation of program delivery as the practice is relatively new and DOTs continuously seek solutions for improvement to deliver much-needed projects within the stipulated budget and time. The survey asked the respondents to provide challenges of program delivery. DOTs have mainly considered several organizational barriers as a challenge, the results of which will be discussed in this section.

6.3.1.1 Organizational Barriers for Implementing Program Delivery

Of the 41 responses to the survey, 27 agencies (66%) identified cultural change required toward alternative delivery methods as a major barrier for implementing program delivery. Other barriers with the percentage response received are lack of prior expertise (19 agencies, 46%); lack of training (14 agencies, 34%); and lack of outsourcing capacity (7 agencies, 17%). Twelve state DOTs also mentioned additional organizational barriers such as: lack of contractor ability to handle large volumes of work, legislative authority, and funding issues.

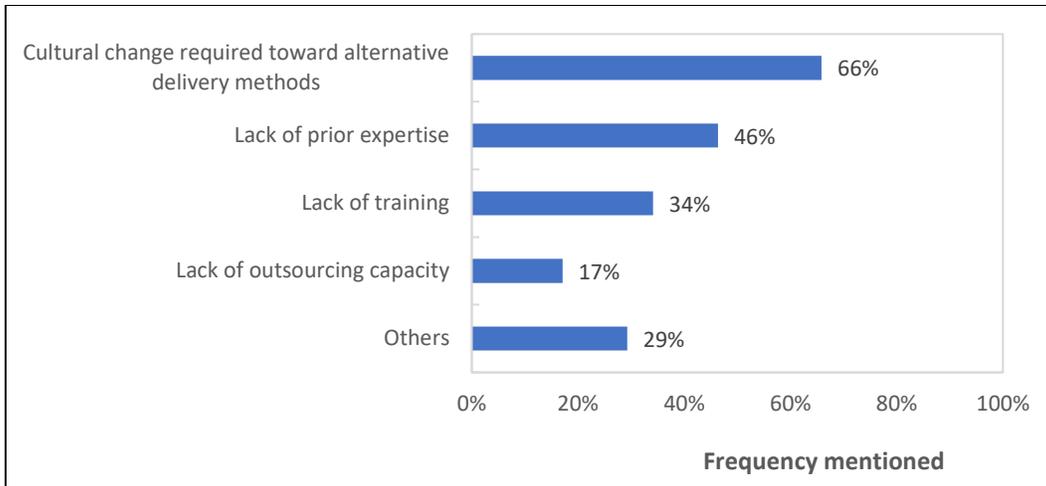


Figure 18 – Organizational barriers for implementing program delivery

6.3.2. Challenges Witnessed Based on Case-Studies

The challenges witnessed from the case study are community outreach, organizational changes to roles and responsibilities, coordination of multiple projects simultaneously, use of local contractors and lack of experienced personnel to address and implement program delivery. Each of these challenges will be discussed in detail in this section followed by the experience of state DOTs.

6.3.2.1 Community Outreach

As is the case with most of the programs studied, programs tend to be large in size and magnitude, which means that programs typically comprise high-profile work that captures the attention of the general public and policymakers. Therefore, state DOTs have had to implement extensive community outreach and public relations approaches to continually and consistently inform the public of the program and its progress. Although community outreach requires a significant amount of time and resources, several state DOTs acknowledged the importance of

community outreach to the success of program delivery. Without public and political support and trust in the program, a state DOT would face a challenge to justify the amount of time, effort, and money spent on a large program. Maintaining transparency and open communication with the public proved to be a critical task that state DOTs should consider when developing a program of projects.

California Department of Transportation

Caltrans face the challenge of substantial community outreach process that Caltrans must manage for any program. Caltrans attempts to be as transparent as possible with all stakeholders. Knowing the challenge of informing the public, Caltrans starts the implementation process for every program by providing extensive details to the public via announcements and their website. As the program commences, Caltrans can utilize personnel to continuously provide the public with information to keep everyone up to date and maintain transparency. However, the challenge is the availability of proper internal staff and knowing what information to share with the public. Therefore, the public relationship is a continuous and dynamic process that Caltrans must address and adapt to throughout a program's duration.

Missouri Department of Transportation

MoDOT had to handle the majority of public relations for the S&S program. With a program of this size, MoDOT had to rely on their staff throughout the state to help manage the public concerns for the program. Knowing that this would be a huge undertaking, MoDOT included in the D-B contract for the design-builder to support MoDOT in its public relations efforts.

Additionally, MoDOT developed a website for the program, which included a statewide map with an icon for each bridge in the program. When a user clicked on any of the bridge icons, the

icon would then provide links to background information, pictures, schedule, contractor, detours, closing, and other pertinent information. The bridge icons were also color-coordinated, denoting complete, scheduled for completion within 90 days, scheduled for completion next year, or scheduled for completion in more than one year. This allowed the public to look up the timeline for when bridges in their area would be under construction and what detours or closing would be in place and for how long.

Florida Department of Transportation

One of the most significant challenges of the I-405 corridor program is to ensure that the program has continuous support from communities and agencies along the corridor; and also necessary political and legislative support. The attention and focus in maintaining communication with all key stakeholders were paramount, which could be affected by changes in leadership within WSDOT and within the state legislature. To overcome this challenge, a continual communication effort was developed to help maintain the trust that has been developed along the corridor. WSDOT developed strong partnerships and trust with all local agencies and transit groups. WSDOT maintained the partnerships and trust through communicating any changes with these agencies and seeking help to move the program forward.

6.3.2.2 Coordinating Multiple Projects Simultaneously

The logistics of delivering multiple projects simultaneously in a program proved to be a challenge, particularly for programs that covered projects spanning an entire state. Many of the state DOTs included in the case examples operate using a decentralized organizational approach, in which the individual regions deliver projects within their region while the DOT headquarters acts as administrative support. However, to overcome the challenge of managing multiple

projects within a program, state DOTs may choose to operate the program from the DOT headquarters. Not only did this process help with the coordination of projects, it also reduced the redundancy that would have occurred if the individual regions handled the program projects within their regions. State DOTs typically do not have the staff or resources to redundantly complete tasks, so centralizing the program eliminates the redundancy and creates resources needed to deliver the program. This works best with small states.

Missouri Department of Transportation

Overall, MoDOT realized early that one of the most significant challenges for the S&S program would be the logistics and coordination of handling so many projects over a set period. Thus, MoDOT prepared for what was envisioned based on the substantial amount of time that MoDOT personnel invested into planning for this program. However, even with massive amounts of planning, the major advantage MoDOT had for overcoming the “logistical nightmare” was the team structure and the overall cooperation and collaboration among MoDOT, the design–builder, and the other contractors involved in the program. When MoDOT hired the design–builder for the program, they faced the same logistical issues. MoDOT and the design–builder then worked together to develop a plan to address the bridges along major routes to ensure that a limited number of bridges along a route would be under construction at the same time. In addition, the design–builder had access to deliver their prefabricated and standardized parts to each bridge location. MoDOT integrated their management with the design–builder’s team and overall management of the department was run from headquarters rather than the individual regions. MoDOT staffed a lead field engineer to jointly manage the work in each region with the design–builder’s personnel. In addition, all bridges in the D-B bundle had a design–builder subcontract handler, a MoDOT inspector, and a subcontractor superintendent, which had to work as a team.

This matching of the design–builder and MoDOT staff at all levels led to an effective level of teamwork and coordination, which was critical for this logistically driven program.

New York Department of Transportation

Another challenge was the rejection of all proposals for zone three of the D-B bundle. The size and magnitude of the zone turned out to be too large. The zone three D-B bundles included 16 bridges, which would have been the largest contract in the program. The projects located in the western and central parts of the state were too limited in scope to be packaged separately in terms of using D-B. The contract needed to be large enough to attract many contractors. However, the locale of the bridges limited the opportunities for the zone, and proposals ultimately came in high. After rejecting the high proposals, the work was divided into smaller bundles and was let using D-B-B. Although the work was completed, it was not completed in the manner that NYSDOT had intended.

6.3.2.3 Use of Local Contractors

Another common challenge of program delivery was for state DOTs to involve local contractors. In the case of MoDOT, NYSDOT, and ODOT, their programs included provisions to stimulate the local and state economy. To this end, a majority of the design and construction work would need to be completed by state consultants and contractors rather than national or international firms performing the work. Therefore, state DOTs had to be creative in developing project packages of different sizes and magnitude to spark competition and to allow local and state contractors of all sizes to bid for the work.

Missouri Department of Transportation

Another major challenge that MoDOT had to address was to leverage the use of local contractors. At the beginning, local contractors provided many questions and comments regarding the volume of work of the program to be conducted by a “big” consortium. To overcome this challenge, MoDOT included a recommendation in the DB RFP that the awarded team would need to gain the support of the local contractors for the individual and the overall program to be successful. Although this was just a recommendation, the design–builder team relied primarily on local contractors. The design–builder realized that mobilizing their own crews and equipment was not typically as cost effective as working with local contractors, which were already located and equipped/staffed all across the state. The design–builder team took on the local contractors as partners, which resulted in very favorable results.

New York Department of Transportation

When bundling projects into zones, fewer contractors and design–builders could bid the jobs. One concern at the beginning of the program was that NYSDOT’s mandate was not only to rehabilitate deficient bridges but also to stimulate the state’s economy. However, with a program of this size, there was the potential for larger national and international transportation construction firms to come in and perform the work. To better stimulate the economy, the local contractors would need to have a chance to gain the bulk of the bridge construction work instead of the larger national firms. NYSDOT avoided this problem in the Accelerated Bridge Program by bundling projects into different zones with different sizes to attract local and regional contractors.

6.3.2.4 Lack of Experienced Personnel

The use of alternative contracting methods plays an important role in the success of strategic program delivery. However, several state DOTs from the case examples acknowledged that internal personnel did not have extensive experience or training in delivering a program using a variety of delivery methods. The lack of experience along with the changes in roles and responsibilities proved to be challenging during the initial stages of a program. As the program advanced, the gained experience helped the state DOT personnel understand their roles and responsibilities during the program delivery process.

Florida Department of Transportation

One challenge that FDOT acknowledged is that the program team must be talented and experienced in using ACMs to manage the complexities of delivering a program. Having the right team in place can significantly affect the success of the program. For a specific program, FDOT must rely on both internal D-B staff and the industry including consultants, engineers, contractors, and legal experts to effectively deliver the program.

6.4 Summary

This chapter describes the benefits and challenges of program delivery through the findings of the national survey and case studies. The section one of the chapter discussed the benefits of program delivery in detail. The top three benefits of program delivery witnessed from the survey with a response rate of more than 50% are accelerated project delivery, flexibility in reassessing/reassigning risk and better risk management, and flexibility in delivery scheduling. The response received for the top five benefits associated with each delivery method was

analyzed using the statistical Chi-square test and it is found that nearly for forty percent of the benefits there is a statistical difference between the experienced and non-experienced DOTs for the benefits they have observed by the implementation of program delivery. Further, the benefits witnessed from the case study are increased innovation, improved performance using bundling and standardized design.

The section two of this chapter discusses the challenges of program delivery in detail. DOTs have mainly considered several organizational barriers as a challenge for implementation of program delivery. This data was supplemented by the findings from the case studies which reveal that community outreach, coordination of multiple projects simultaneously, use of local contractors and lack of experienced personnel to address and implement program delivery are the challenges that state DOTs face for implementing program delivery.

CHAPTER 7 – CONCLUSIONS AND SUMMARY

7.1 Introduction

This chapter concludes this thesis by providing an overview of the tasks performed in the research as discussed in the research methodology. It summarizes vast information obtained from Chapter 4, 5 and 6. The chapter also provides an overview of the findings of performance measures, benefits and challenges of using a strategic approach to program delivery. This chapter concludes with the recommendations for future research.

7.2 Conclusions

The objective of the study was to understand and study the practice of program delivery in the transportation sector, examine and document the current state-of-practice based on survey response, and identify the benefits and challenges of program delivery.

The findings from the literature review reveal that a program is a group of projects delivered to gain benefits of cost and schedule and aligns to the goals of the agency. The main difference is that success of a program is measured on the benefits it provides. State DOTs have taken into consideration a holistic approach which considers linkages, environmental issues, economic development, and equity. The two typical and most practiced type of programs are bridge replacement/maintenance /construction projects which are delivered using the bundling technique and new construction/improvement project which are delivered as corridor projects as identified by the content analysis and validated by the case studies. Driving forces of the strategic program delivery selection process include project size, budget issues, technical complexity, third-party issues, construction types, schedule issues, risk management,

environmental issues, innovation and streamlined processes, and community outreach. Further, reduced schedule, streamlined processes, innovation, improved risk management, and enhanced trust of policymakers and the public are driving forces to the success of implementing strategic program delivery.

Performance measurement is an essential element practiced by state DOTs for continuously improving program and project management. Performance measures play an important role in strategic program delivery, and state DOTs commonly set programmatic goals as well as individual project goals. Performance measures vary from state to state, depending on the purpose of the measurement and which performance metrics are chosen. Some state DOTs have performance measure tools in place to help them improve their program delivery. Other state DOTs lack adequate tools or mechanisms to assess project and program performance or are beginning to develop the process of performance measurement. The response received from the survey revealed the current state-of-practice of state DOTs. It was found that sixteen DOTs have implemented or are currently implementing program delivery practice. State DOTs select delivery methods for program based on a case-by-case basis. The main factors that influence program establishment are project functionalities (bridges, maintenance or pavement); project construction type (rehab, preservation or new); funding issues; and demand and urgency of the projects. The factors considered as motivation for program delivery include program schedule issues, streamlined processes/innovation, and project and program risk management.

As evident from the literature review the success of a program is evaluated based on the benefits it provides. The top three benefits of program delivery with a response rate of more than 50% are accelerated project delivery, flexibility in reassessing/reassigning risk and better risk management, and flexibility in delivery scheduling. The results show that the most significant

benefits of the transportation program delivery are increased innovation, improved performance using bundling, and use of standardized design.

The major challenges of using strategic approach to program delivery are cultural change required towards the use of alternative delivery methods, lack of expertise, lack of training, lack of outsourcing capacity, extensive community outreach, coordination of multiple projects, use of local contractors and lack of experienced personnel. This project was largely an exploratory study in that it was the first attempt to examine the practice of program delivery. The findings from this study also help state agencies to better understand the practice of program delivery.

7.3 Future Research

In building on the conclusions above, the research team found gaps in the current knowledge regarding strategic program delivery. Most state DOTs select a delivery method for a program on a case-by-case basis. For state DOTs to become more consistent, efficient, and effective in delivering their programs, the following items are potentially worthwhile topics for future research studies.

When reviewing the national survey and the case examples, it became clear that the project and program management processes and procedures vary among state DOTs. The lack of consistency in program management demonstrates inefficiencies in program delivery. Therefore, a future study can investigate the best practices of strategic program delivery to develop an efficient and effective program management system that any state DOT can utilize to work toward achieving a successful program.

Strategic program delivery changes the culture and organizational structure of the DOT and associated management. Addressing major needs within a state's transportation system can result in many different types of projects within a program. For the more complex and high-risk projects, state DOTs typically look to alternative contracting methods such as D-B and CM/GC to infuse more innovation into a project. However, state DOTs tend to be resistant to change, and using alternative contracting methods inherently changes their established delivery culture and organization. Future research can look at how state DOTs can develop a strategic approach to program delivery culture within the department and understand the modifications that occur to the overall organizational structure of a state DOT.

Another potential area of investigation is to determine and develop program delivery performance measures. State DOTs use performance metrics to track the progress and performance of a project, typically focusing on cost, schedule, quality, and safety. At the program level, state DOTs typically compile the measures from the individual projects within a program to determine the program's performance. However, state DOTs lack tools and mechanisms to assess the performance of program delivery. The ability of state DOTs to develop and use program delivery metrics to track program budget, schedule, quality, safety, and other measures that relate to the overall goals of the program would provide program teams with proper tools for program-level performance evaluation. Future research can investigate what types of performance metrics work effectively for program delivery and develop a process for creating and using performance metrics at the program level.

Finally, the literature review, national survey, and case examples provide evidence that program and enterprise risk management is an important aspect to successfully implement program delivery. However, program and enterprise risk management is still new to state DOTs. Future

research on this topic could help promote the effective use of project and program delivery in the transportation construction industry. The results could provide guidance, policies, and risk-based approaches to program delivery.

REFERENCES

1. 2015. *Accelerated Bridge Program Contract Information*. Accessed February 07, 2016. <https://www.dot.ny.gov/main/business-center/ABPphase1>.
2. "AGC Nebraska Chapter." Accessed April 25, 2017. <http://agcne.org/wp-content/uploads/2016/02/Accelerated-Project-2-9-16.pdf>.
3. American Association of State Highway and Transportation Officials (AASHTO), *Transportation Asset Management Guide*, Washington, D.C., 2002, 138 pp.
4. Alberg, A. 2008. *Definition of Program vs Project - Making Things Happen*. April 9. Accessed February 21, 2016. <https://thesavvypm.wordpress.com/2008/04/09/definition-of-program-vs-project/>.
5. Anderson, S., K. Molenaar, and C. & Schexnavder. 2009. *Procedures Guide for right-of-way cost estimation and cost management*. NCHRP Report 625, Washington, D.C.: Transportation Research Board of National Academics.
6. Associated General Contractors (AGC) *Project Delivery Systems for Construction*, 2004, Arlington, VA.
7. 2016. *Bridge Bundling Workshop*. Workshop proceedings, FHWA.
8. Cambridge Systematics, Inc. 2007. "Factors that Support the Planning-Programming Linkage."
9. Cambridge Systems, Inc. 2002. *Transportation Asset Management Guide*. Guidebook, Washington, D.C: American Association of State Highway and Transportation Officials.
10. Caltrans, *Caltrans' Strategic Plan 2007-2012*, California Department of Transportation, Dec., 2007 [Online]. Available: HYPERLINK "<http://www.dot.ca.gov/perf/>" <http://www.dot.ca.gov/perf/> [Accessed April 24, 2016].

11. Caltrans, *Caltrans' Strategic Plan 2015-2020*, California Department of Transportation, 2015 [Online]. Available: HYPERLINK
"http://www.dot.ca.gov/perf/library/pdf/Caltrans_Strategic_Mgmt_Plan_033015.pdf"
http://www.dot.ca.gov/perf/library/pdf/Caltrans_Strategic_Mgmt_Plan_033015.pdf
[Accessed April 24, 2016].
12. FDOT, *2015 Performance Report*, Florida Department of Transportation, Office of Policy Planning, 2015a [Online]. Available: HYPERLINK
"http://www.dot.state.fl.us/agencyresources/performance.shtm"
<http://www.dot.state.fl.us/agencyresources/performance.shtm> [Accessed April 29, 2016].
13. FHWA, *Going the Distance Together: Context Sensitive Solutions for Better Transportation A Practitioner's Guide*, 2012, [Online]. Available: HYPERLINK
"http://www.fhwa.dot.gov/context/practitionersguide/index.html"
<http://www.fhwa.dot.gov/context/practitionersguide/index.html> [accessed April 27, 2016]
14. 2017. *Federal Highway Administration*. February 21. Accessed March 15, 2017.
<https://www.fhwa.dot.gov/construction/contracts/acm/>.
15. 2017. *Federal Highway Administration*. March 03. Accessed April 25, 2017.
<https://www.fhwa.dot.gov/construction/contracts/acm/>.
16. 2016. *Federal Highway Administration*. July. Accessed April 25, 2017.
<https://www.fhwa.dot.gov/innovation/everydaycounts/edc-2/atc.cfm>.
17. 2016. *Federal Highway Administration*. Accessed February 3, 2016.
https://www.fhwa.dot.gov/ipd/project_profiles/fl_i4ultimate.aspx.
18. Florida Transportation Commission, *Performance and Production Review of the Florida Department of Transportation*, State of Florida, Nov. 2015 [Online]. Available:
<http://www.ftc.state.fl.us/documents/reports/PPR/FY14-15Final%20Report.pdf>
[Accessed April 29, 2016].

19. 2017. *Florida DOT*. Accessed April 26, 2017.
<http://www.fdot.gov/agencyresources/innovation/>.
20. 2017. *Florida DOT*. Accessed April 26, 2017. <http://www.fdot.gov/design/Innovation/>.
21. Gapstur, C. and Warbritton, K., *Statewide Teamwork: The Lessons Learned from Safe & Sound*, Design-Build in Transportation Annual Conference presentation, Design-Build Institute of America, Orlando, FL., Mar. 18-20, 2013.
22. 2016. *Government Contracting Terms & Definitions*. Accessed April 26, 2016.
<http://www.sapdc.org/business/government-contracting-terms-definitions>.
23. Henkin, T. *NCHRP Project 20-24(31): Effective Program Delivery in Constrained Fiscal Environment*, Transportation Research Board of the National Academies, Washington, D.C., 2008, 44 pp.
24. Holsti, O.R. (1969). *Content Analysis for the Social Sciences and Humanities*, Addison-Wesley publishing, Massachusetts.
25. Hsieh, H.F., and S.E. Shannon. 2005. "Three approaches to Qualitative Content Analysis." 1277-1288.
26. Huang, K., and Y. Kuo. 2013. "A transportation programming model considering project interdependency and regional balance." *Procedia - Social and Behavioral Sciences* 80 416-426.
27. 2017. *Institute of Digital Research and Education*. Accessed January 13, 2017.
<https://stats.idre.ucla.edu/spss/faq/what-does-cronbachs-alpha-mean/>.
28. Jeroen, R, H. Sebastiaan, C. Zevenbergen, R. Ashley, M. Hertogh, and & Ernst ten Heuvelhof. 2014. "Adaptive programme management through a balanced performance/strategy oriented focus." *International Journal of Project Management* (32) 1197-1209.

29. Keck, D., H. Patel, and A.J. Scolaro. 2010. *Accelerating Transportation Project and Program Delivery: Conception to Completion*. NCHRP Report 662, Washington, D.C: Transportation Research Board.
30. 2017. *Kiewit*. Accessed April 26, 2017.
<http://www.kiewit.com/projects/transportation/roads/i-15-corridor-reconstruction/>.
31. Miller, J.B., M.J. Garvin, C.W. Ibbs, and S.E. Mahoney. 2000. "Toward a new paradigm: Simultaneous use of multiple project delivery methods." *Journal of Management in Engineering*, 16(3) 58-67.
32. Missouri Department of Transportation (MoDOT) Tracker: *Measures of departmental performance*. website, 20116, [Online] available: HYPERLINK "<http://www.modot.org/about/Tracker.htm>" <http://www.modot.org/about/Tracker.htm> (accessed May 2016).
33. MoDOT, "Safe and Sound Fact Sheet," Missouri Department of Transportation, 2013a [Online]. Available: HYPERLINK "<http://www.modot.gov/safeandsound/Facts.htm>" <http://www.modot.gov/safeandsound/Facts.htm> [Accessed Feb. 11, 2016].
34. Niemeier, D.A., Z.B. Zabinsky, Z. Zeng, and G.S. Rutherford. 1995, 121(1). "Optimization Models for Transportation Project Programming Process." *Journal of Transportation Engineering* 14-26.
35. NYSDOT, "NY Works Accelerated Bridge Program," New York State Department of Transportation, 2012. [Online]. Available: www.dot.ny.gov/main/business-center/ABPphase1 [Accessed April 14, 2016].
36. ODOT, *Context Sensitive and Sustainable Solutions (CS³) Guidebook*, OTIA III Bridge Delivery Program, Oregon Department of Transportation Office of Project Delivery, 2015b [Online]. Available: HYPERLINK "<http://www.otiabridge.org/static/cs3-guidebook.pdf>" <http://www.otiabridge.org/static/cs3-guidebook.pdf> [Accessed Mar. 1, 2016].

37. ODOT, "Program Awards," OTIA III Bridge Delivery Program, Oregon Department of Transportation, 2015c [Online]. Available: <http://www.otiabridge.com/awards/> [Accessed April 21, 2016].
38. ODOT, *OTIA III State Bridge Delivery Program: Final Report*, Oregon Transportation Investment Act, Oregon Department of Transportation, April 2015a [Online]. Available: HYPERLINK "http://www.otiabridge.org/static/Program_Final_Report_04152014.pdf" http://www.otiabridge.org/static/Program_Final_Report_04152014.pdf [Accessed Mar. 1, 2016].
39. ODOT, Web-based Work Zone Traffic Analysis Tool Users' Guide, Oregon Department of Transportation, Technical Services, Fall 2010 [Online]. Available: HYPERLINK "https://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/docs/pdf/wzta_manual.pdf" https://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/docs/pdf/wzta_manual.pdf [Accessed April 21, 2016].
40. 2015. *Oregon DOT*. Accessed February 03, 2016.
http://www.oregon.gov/ODOT/HWY/OTIA/pages/bridge_delivery.aspx.
41. Parsons Brinckerhoff Quade & Douglas, Inc. . 2002. *Transportation Asset Management Guide*. Washington, D.C: American Association of State Highway and Transportation Officials.
42. Poister, T., H. *NCHRP Synthesis 326: Strategic Planning and Decision-making in State Department of Transportation*, Transportation Research Board of the National Academies, Washington, D.C., 2004, 72 pp.
43. 2014. "Project Management Handbook." *Florida DOT*. September 09. Accessed April 26, 2017. <http://www.fdot.gov/designsupport/pmhandbook/1-PMHB-Complete.pdf>.
44. 2012. "Project Risk Management Handbook: A Scalable Approach." *California DOT*. June. Accessed April 27, 2017.
http://www.dot.ca.gov/hq/projmgmt/documents/prmhb/PRM_Handbook.pdf.

45. Sinha, K.C., and S. & Labi. 2007. *Transportation Decision Making - Principles of Project Evaluation and Programming*.
46. 2017. *Statistics How To* . Accessed January 14, 2017.
<http://www.statisticshowto.com/probability-and-statistics/chi-square/>.
47. Touran, A., D.D. Gransberg, K.R. Molenaar, and K. & Ghavamifar. 2011. "Selection of Project Delivery Method in Transit: Drivers and Objectives." *Journal of Management in Engineering*, 27(1) 21-27.
48. Touran, A., D.D. Gransberg, K.R. Molenaar, K. Ghavamifar, D.J. Mason, and L.A. & Fithian. 2009. *A Guidebook for the evaluation of project delivery methods*. Washington, D.C.: Transportation Research Board.
49. Tran, D., C.M. Harper, K.R. Molenaar, N.F. Haddad, and M.M. Scholfield. 2013. "A Project Delivery Selection Matrix for Highway Design and Construction." *Journal of the Transportation Research Board* 3-10.
50. Trauner Consulting Services, Inc. 2007. "Construction Project Delivery Systems and Procurement Practices: Considerations, Alternatives, Advantages, Disadvantages."
51. Turnbull. 2006. *Key Issues in Transportation Programming*. Summary of Conference, Washington, D.C.: Transportation Research Board of the National Academies. Accessed July 25, 2016. <http://www.trb.org/Main/Blurbs/158197.aspx>.
52. Utah Department of Transportation. 2016. "Innovation and Efficiencies Report."
53. 2017. *Utah DOT*. Accessed April 26, 2017. <http://blog.udot.utah.gov/tag/innovation/>
54. Washington State Department of Transportation (WSDOT), *A Strategic Delivery Plan for the Washington State Department of Transportation's Capital Construction Program*, 2006, 135 pp.

55. Washington State Department of Transportation (WSDOT), *Phase 2 Update of the Strategic Delivery Plan for the Washington State Department of Transportation's Capital Construction Program*, 2008, 67 pp.
56. Westland, J. 2013. "Managing Projects of all sizes." *projectmanager.com*. Accessed November 26, 2015. <https://www.projectmanager.com/books/managing-projects-of-all-sizes>.
57. Weber, R.P. (1990). *Basic Content Analysis*, 2nd Ed., Sage Publications, Inc, California.
58. Wisconsin Department of Transportation (Wisconsin DOT), Construction and Materials Manual, [Online], 2015, available: HYPERLINK "<http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/rdwy/cmm.aspx>" <http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/rdwy/cmm.aspx> (accessed May 2016)
59. WSDOT, "I-405 Congestion Relief and Bus Rapid Transit Program – Project FAQs," 2016 [Online]. Available: HYPERLINK "<http://www.wsdot.wa.gov/Projects/I405/corridor/faq.htm>" <http://www.wsdot.wa.gov/Projects/I405/corridor/faq.htm> [Accessed April 22, 2016].
60. Zeng, Z., E. Minchin, L. Ptschelinzew, and Y. and Zhang. 2014. "Multi-objective decision-making to select multiple project delivery methods for multi-project transportation systems." *Sustainable Solutions in Structural Engineering and Construction*. Bangkok: ISEC Press. 477-482.

GLOSSARY

AASHTO – American Association of State Highway and Transportation Officials

ACM – Alternative Contracting Methods

AGC – Associated General Contractors of America

ATC – Alternative Technical Concepts

Caltrans – California Department of Transportation

CDOT – Colorado Department of Transportation

CM/GC – Construction Manager/General Contractor

DB – Design–Build

DBB – Design–Bid–Build

DOT – Department of Transportation

FDOT – Florida Department of Transportation

FHWA – Federal Highway Administration

GDOT – Georgia Department of Transportation

MnDOT – Minnesota Department of Transportation

MoDOT – Missouri Department of Transportation

NCDOT – North Carolina Department of Transportation

NYSDOT – New York State Department of Transportation

ODOT – Oregon Department of Transportation

PPP or P3 – Public–Private Partnerships

UDOT – Utah Department of Transportation

WSDOT – Washington State Department of Transportation

APPENDIX A – NATIONAL SURVEY QUESTIONNAIRE

DEFINITIONS

Alternative Contracting Methods (ACMs): ACMs are mainstreamed as viable delivery options for highway construction projects to accelerate project delivery, encourage the deployment of innovation, and minimize unforeseen delays and cost overruns. These options include design-build (D-B), construction manager/general contractor (CM/GC), alternative technical concepts (ATC), and other innovation techniques (FHWA, 2016).

Program: A collection of similar type projects grouped together or an endeavor to deliver a range of improvements (i.e., bridge conditions, pavement improvement, etc.)

Program Delivery: A holistic approach to delivering groups of projects that are aligned with an organization's strategic goals.

Strategic Programming: The process of clarification of mission and values, development of a vision of success, environmental scanning and assessment of the driving forces behind external threats and opportunities, an analysis of the department's capabilities and performance and assessment of internal strengths and weaknesses, development of strategic goals and objectives to identify the strategic issues facing the department, development of overall strategies and/or strategic initiatives, and definition of associated performance measures (Poister, 2004).

Design–Bid–Build (D-B-B): A traditional project delivery method in which the design is completed before the construction contract is advertised.

Design–Build (D-B): A project delivery method where both the design and the construction of the project are simultaneously awarded to a single entity.

Construction Manager/General Contractor (CM/GC): A project delivery method where an agency engages a construction manager during the design process to provide input on scheduling, pricing, phasing and other input that helps design a more constructible project.

Public–Private Partnership (P3): A contractual arrangement between public and private sector partners, involving a government agency contracting with a private partner to renovate, construct, operate, maintain, and/or manage a facility or system, in whole or in part, that provides a public service.

Best Value: An award method that utilizes cost and other factors to select the winning bidders (e.g., cost-plus-time bidding, qualifications, design approach) to minimize impacts and enhance the long-term performance and value of construction.

Qualification-Based Selection: An award method that utilizes qualifications alone (no price component included) to select the winning contractors.

GENERAL INFORMATION

1. Please provide the following contact information:

First Name:

Last Name:

Phone Number:

E-mail:

U.S. state in which
you are employed:

2. You are employed by what type of organization?

State Department of Transportation

Federal Agency; Name of Agency: _____

Other Public Transportation Agency; Name of Agency: _____

Other, please describe: _____

3. What group/section do you work in? (Check all that apply)

Design group/section

Program delivery group/section

Construction group/section

Contracts/procurement group/section

Operations group/section

Maintenance group/section

Alternative project delivery group/section

Other: _____

4. Does your agency have authority to use alternative project delivery methods (i.e. D-B, CM/GC, or P3)?

Yes No, please proceed to Question 6

5. Which alternative project delivery methods is your organization allowed to use? (Check all that apply)

D-B

CM/GC

P3

Other, please specify: _____

6. Please estimate approximately the percentage of projects associated with each delivery method that your agency uses

Delivery Method	% Used
D-B-B	
D-B	
CM/GC or CM at Risk	
P3	
Others	

PROGRAM INVENTORY AND POLICIES

7. Please rank the following methods relative to their importance in grouping projects into a program in your agency. (1 = Unimportant, 2 = Slightly Important, 3 = Moderately Important, 4 = Very Important, 5 = Extremely Important, and NA = Not Applicable)

Methods	1	2	3	4	5	NA
1. Projects are programed based on state or federal mandates/political influences	<input type="checkbox"/>					
2. Projects are programed based on location	<input type="checkbox"/>					
3. Projects are programed based on technical complexity	<input type="checkbox"/>					
4. Cost savings	<input type="checkbox"/>					
5. Projects are programed based on critical completion dates (schedule issues)	<input type="checkbox"/>					
6. Projects are programed based on funding issues	<input type="checkbox"/>					
7. Projects are programed based on functionalities (bridges, maintenance, or pavement)	<input type="checkbox"/>					
8. Projects are programed based on construction type (rehab, preservation, or new)	<input type="checkbox"/>					
9. Projects are programed based on financing issues /revenue generator (tolls, special taxes)	<input type="checkbox"/>					
10. Projects are programed based on agency personnel's experience on similar past projects	<input type="checkbox"/>					
11. Projects are programed based on stakeholders' priority and expectation	<input type="checkbox"/>					
12. Projects are programed based on demanding and	<input type="checkbox"/>					

urgency						
13. Others, please specify: _____	<input type="checkbox"/>					

8. Is your agency currently implementing or considering program delivery (a holistic approach to delivering groups of projects)?
- Yes
- No

If NO, please provide reasons (Check all that apply)

- Traditional and alternative project delivery methods are adequate
- Agency upper management is unwilling to use it
- Agency expertise not available
- Legal or regulatory prohibitions
- Lack of staffing to oversee program delivery approaches
- Political/policy issues prevent its use
- Required organizational culture changes
- Lack of stakeholder confidence
- Industry oppositions prevent its use
- Not currently in use, but could be applied in the future
- Not sure how to implement program delivery
- Other, please explain: _____

9. Please indicate number of times your agency has used program delivery
- None
- Less than 5
- Between 5 and 10
- More than 10

10. Do you have enabling legislation for the use of program delivery?
- No
- Yes, please explain: _____

11. What project delivery methods is your agency allowed to use for program delivery? (Check all that apply)

D-B-B

D-B

CM/GC

P3

Single contract that incorporate combination of one or more of the above

Other, please specify: _____

12. What procurement methods is your agency allowed to use for procuring contractors for a program? (Check all that apply)

Low bid

A+B (Cost + Time)

Best Value

Qualification-based

Single contract that incorporate combination of one or more of the above

Other, please specify: _____

13. What payment methods are used for program delivery in your agency? (Check all that apply)

Lump sum

Cost reimbursable

Unit price

Single contract that incorporate combination of one or more of the above

Other, please specify: _____

14. Does/would the consulting engineering industry in your state support the use of program delivery?

Yes

No

Don't know

15. Do other transportation-related public agencies in your state that use program delivery?

- Yes No Don't know

If YES, what type of agency?

- Transit agency
- Local government agency
- Airport authority/operator
- Power companies
- Other, please specify: _____

16. What do you consider to be organizational barriers for implementing program delivery?
(Check all that apply)

- Lack of prior expertise
- Lack of training
- Cultural change required toward ACMs
- Lack of outsourcing capacity (i.e. consultant, third-party, and agency staff limitations)
- Others, please specify: _____

PROGRAM DELIVERY SELECTION INFORMATION

17. Does your agency choose project delivery methods in the context of program delivery?

- Yes
- No

Comments (optional):

18. Does your agency have guidelines/tools to determine delivery methods for a program?

- Yes
- No

If YES, could you provide the website address if the document is located online or send a hard copy?

- Yes, I can send a hard copy to your mailing address.
- No, the document is not allowed to share.
- The website address: _____

19. Does your agency have a strategic approach to selecting delivery methods?

- Yes
- No

20. How does your agency select project delivery methods for a program? (Check all that apply)

- We select delivery methods based on a project by project basis
- We select delivery methods based on a group of projects
- We select delivery methods using a holistic approach to programming
- Others, please specify: _____

21. What program factors are considered when making the program delivery method decision? (Check all that apply)

Program Factors	Considered in decision	Motivation for program delivery methods
Program size (Dollars)	<input type="checkbox"/>	<input type="checkbox"/>
Program budget control issues/priority projects	<input type="checkbox"/>	<input type="checkbox"/>
Need for nontraditional financing	<input type="checkbox"/>	<input type="checkbox"/>
Program cost savings	<input type="checkbox"/>	<input type="checkbox"/>
Generating revenue (tolls, special taxes, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Program schedule issues	<input type="checkbox"/>	<input type="checkbox"/>
Technical complexity of groups of projects	<input type="checkbox"/>	<input type="checkbox"/>
Streamlined processes/innovation	<input type="checkbox"/>	<input type="checkbox"/>
Location (urban vs. rural projects)	<input type="checkbox"/>	<input type="checkbox"/>

Program construction type (new construction vs. rehabilitation projects)	<input type="checkbox"/>	<input type="checkbox"/>
Program facility type (road vs. bridge projects)	<input type="checkbox"/>	<input type="checkbox"/>
Third party issues (utilities, railroad, Right-of-Way) involved in a program/ groups of projects	<input type="checkbox"/>	<input type="checkbox"/>
Environmental issues required for a program/groups of projects	<input type="checkbox"/>	<input type="checkbox"/>
Project and program risk management	<input type="checkbox"/>	<input type="checkbox"/>
Agency staff experience with delivery methods	<input type="checkbox"/>	<input type="checkbox"/>
Agency staff availability to oversee projects development	<input type="checkbox"/>	<input type="checkbox"/>
Program performance	<input type="checkbox"/>	<input type="checkbox"/>
Reduced public impact	<input type="checkbox"/>	<input type="checkbox"/>
Enhance trust/Improve agency image	<input type="checkbox"/>	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>	<input type="checkbox"/>

PROJECT AND PROGRAM DELIVERY PERFORMANCE INFORMATION

22. Does your agency have a systematic process to measure benefits of ACMs?

- Yes
- No

If YES, could you provide the website address if the document is located online or send a hard copy?

- Yes, I can send a hard copy to your mailing address.
- No, the document is not allowed to share.
- The website address: _____

23. Does your agency track the performance of the projects selected for a program?

- Yes
- No

If YES, please specify the type of performance indicators/measures your agency uses:

24. Does your agency have a process to measure the performance of program delivery?

Yes

No

If YES, please specify the type of performance indicators/measures your agency uses:

25. Which of the following are benefits of program delivery that you have observed/perceived?
(Check all that apply)

Benefits	Program Delivery
1. Accelerated project delivery	<input type="checkbox"/>
2. Flexibility in delivery scheduling	<input type="checkbox"/>
3. More choices in funding and delivery methods	<input type="checkbox"/>
4. Cost savings	<input type="checkbox"/>
5. Greater and/or earlier cost certainty	<input type="checkbox"/>
6. Distributed funding efficiently and equitably	<input type="checkbox"/>
7. Managing and leveraging resources	<input type="checkbox"/>
8. Enhanced workforce management	<input type="checkbox"/>
9. Flexibility in innovation	
10. Better managing risk and uncertainty/ Flexibility in reassessing and reassigning risk	<input type="checkbox"/>
11. Effectively managing changes	<input type="checkbox"/>
12. Improved trust and agency reputation	<input type="checkbox"/>
13. Fostered relationships among agencies (local, regional, and department)	<input type="checkbox"/>
14. Greater partnership between the public and private sectors	<input type="checkbox"/>
15. Reduced public impact	<input type="checkbox"/>

16. Enhanced safety attributes	<input type="checkbox"/>
17. Improved quality parameters of simultaneous projects	<input type="checkbox"/>
18. Increased control of scope, schedule, and cost	<input type="checkbox"/>
19. Ability to select multiple firms under a single contract	<input type="checkbox"/>
20. More sustainable and livable communities	<input type="checkbox"/>
21. Other: _____	<input type="checkbox"/>

26. Based on your knowledge and experience, from the list in Question 34, please indicate the **top 5 benefits** to programmatic decisions associated with each delivery method.

Benefits to programmatic decisions	D-B-B	D-B	CM/GC	P3
1. Accelerated project delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Flexibility in delivery scheduling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. More choices in funding and delivery methods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Cost savings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Greater and/or earlier cost certainty	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Distributed funding efficiently and equitably	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Managing and leveraging resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Enhanced workforce management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Flexibility in innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Better managing risk and uncertainty/ Flexibility in reassessing and reassigning risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Effectively managing changes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Improved trust and agency reputation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Fostered relationships among agencies (local, regional, and department)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Greater partnership between the public and private sectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Reduced public impact	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16. Enhanced safety attributes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Improved quality parameters of simultaneous projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Increased control of scope, schedule, and cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Ability to select multiple firms under a single contract	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. More sustainable and livable communities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. Other: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27. What has been the biggest challenge with implementing program delivery in your agency?

28. What are the lessons learned in the process of implementing program delivery in your agency?

29. Would you be willing to discuss your **project and program delivery selection process** with the research team in a structured interview?

- Yes
- No

If NO, please refer us to someone else in your agency:

Contact name:

Phone number:

E-mail:

30. Do you have any other information that you would like to share with the research team that might add value to this study?

APPENDIX B – CASE STUDY QUESTIONNAIRE

The goal of this synthesis is to provide a summary of the state-of-practice related to processes for choosing project delivery methods. The objectives of the case examples are to: (1) supplement and validate the findings from the survey; (2) obtain specific process examples of program delivery approaches; (3) identify examples of success factors on developing program delivery; and (4) identify common barriers and benefits of each delivery method in the context of the programmatic decisions.

A. General Information and Program Inventory

1. How does your agency develop a program of projects?
2. What are general goals/objectives for delivering a program of projects?
3. How does your agency prepare for and implement the delivery of a program of projects?
4. How successful do you feel is program delivery at your agency?
5. How is decision-making and problems solving affected by program delivery?

B. ACMs

6. Does your agency use multiple delivery methods to deliver a program of projects? If yes, what delivery *methods* are used? If no, what delivery *method* is used? Please explain.
7. When strategically planning a program, does your agency use multiple different delivery methods or just one delivery method for each project in the program?
 - a. If yes, how does your agency decide what delivery method to use for *each project* in the program?
 - b. If no, how does your agency decide what delivery method to use for *all projects* in the program?
8. Does your agency prepare a program based on the delivery method to be used? Please explain.
9. How does your department's approach differ in determining delivery methods for a program of projects when compared to determining a delivery method for a single project?

C. Program Delivery Performance

10. How is performance measured for a program of projects? Do you measure performance for each project, for the entire program, or for both? Please explain.
11. How does delivering a program of project affect:
 - A) Safety?
 - B) Quality?
 - C) Innovation?
 - D) Risk and risk management?
12. Do you have any performance measure data from the program and/or the projects within the program that you would be willing to share with us for research purposes?

D. Program Delivery Benefits/Drawbacks

13. What benefits may have been experienced in delivering programs for your agency?
14. What drawbacks may have been experienced in delivering programs for your agency?
15. What factors do you think affect the success of delivering a program of projects?
16. What barriers do you think challenge the potential success of delivering a program of projects?

E. Lessons Learned

17. What lesson learned would you share with other agencies about using a holistic approach to programming?
18. What critical factors that need to be considered to select delivery methods for an agency's program?
19. Would you send the relevant documents to the research team that might add value to this study?