VERMONT
AGENCY OF TRANSPORTATION

DEVELOPING A FRAMEWORK FOR DEFINING QUALITY AND CONSTRUCTABILITY OF TRANSPORTATION PROJECTS

Daniel D'Angelo
Applied Research Associates (ARA)
David Hoyne
Greenman-Pedersen Inc. (GPI)

May 2026

Grant Agreement #GR1881
Reporting on VTRC024-601

Final Report 2026-03

Disclaimer

You are free to copy, distribute, display, and perform the work; make derivative works; make commercial use of the work under the condition that you give the original author and sponsor(s) credit. The sponsors for this report include the Vermont Agency of Transportation and the Federal Highway Administration. For any reuse or distribution, you must make clear to others the license terms of this work. Any of these conditions can be waived if you get permission from the sponsor(s). Your fair use and other rights are in no way affected by the above.

The information contained in this report was compiled for the use of the Vermont Agency of Transportation. Conclusions and recommendations contained herein are based upon the research data obtained and the expertise of the researchers and are not necessarily to be construed as Agency policy. This report does not constitute a standard, specification, or regulation. The Vermont Agency of Transportation assumes no liability for its contents or the use thereof.

This material is based upon work supported by the Federal Highway Administration under SPR VTRC024-601. Any opinions, findings and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the Federal Highway Administration.

Artificial Intelligence (AI) was not used in the report, for any image, or during the conduct of the research project.

Technical Report Documentation Page

1. Report No. 2026-03	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Developing a Framework for Defining Quality and Constructability of Transportation Projects		5. Report Date May 2026 6. Performing Organization Code
7. Author(s) D'Angelo, Daniel, Applied Research Associates, ORCID #0000-0002-9916-5184, https://orcid.org/0000-0002-9916-5184 Hoyne, David, Greenman-Pedersen, Inc.		8. Performing Organization Report No.
9. Performing Organization Name and Address Applied Research Associates, Inc. 100 TraSE Centre Dr, Suite 200 Champaign, IL 61820 Greenman-Pedersen, Inc. 80 Wolf Rd, Suite 300 Albany, NY 12205		10. Work Unit No. (TRAIS) 11. Contract or Grant No. GR1881
12. Sponsoring Agency Name and Address Vermont Agency of Transportation (SPR) Research Program 2178 Airport Rd Unit B Barre VT 05641		13. Type of Report and Period Covered Final Report 2024-2026 14. Sponsoring Agency Code
15. Supplementary Notes Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration. https://vtrans.vermont.gov/sites/aot/files/Research/VTrans%20Research_GR1881_Task%208-Final%20Report%20(2026-05-06)_508_Redacted.pdf		

16. Abstract

The Vermont Agency of Transportation (VTrans) is experiencing declining competition for bridge projects and rising construction costs. At the same time, demographic shifts are reducing workforce experience within both the Agency and the contracting community. Project plan content and quality processes have not evolved significantly since the Interstate era, despite major changes in construction materials, equipment, and technology.

Currently, VTrans does not have a formal mechanism for obtaining feedback from the contracting community regarding project plans, risk allocation, and constructability. This research developed a framework to improve engagement with industry partners and enhance the quality and constructability of transportation projects.

It is recommended that an oversight team be established to guide the implementation of the Framework. The Oversight Team would determine the implementation priority of each strategy (for example, addressing high risk themes first), identify the lead(s) of a Working Group for each strategy, identify the initial program areas to be involved, establish a schedule, provide guidance, and monitor progress.

The research gained from this project will assist VTrans with improving efficiency and provide staff with tools to deliver better quality and more easily constructed projects expeditiously at lower costs and increased competition. The administration, construction and maintenance costs of projects will be reduced due to improved quality and constructability of project plans.

The long-term benefit is a relationship that is built on trust, where all collaborators and partners are committed to advancing the state of practice, where voices are heard, challenges are overcome, and the process is respectful, transparent, and effective. Through this framework, the Agency, contractors, suppliers, and consultants will be more efficient because they have been engaged in a development process where the outcomes and results are well defined and understood.

17. Key Words Bridges, Change Orders, Claims, Communication, Competencies, Constructability, Construction, Deliverables, Engagement, Industry, Outreach, Partnering, Process, Quality, Resources, Risk	18. Distribution Statement No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161.

19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 224	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Developing a Framework for Defining Quality and Constructability of Transportation Projects

By
Daniel D'Angelo
Applied Research Associates (ARA)



David Hoyne
Greenman-Pedersen Inc. (GPI)



Prepared for
Vermont Agency of Transportation
(VTrans)

May 2026

Final Report

Report Number, 2026-03, Grant Agreement #GR1881



Acknowledgments

The project team recognizes the following organizations for their contributions to this project:

A . L . St . Onge Contractor, Inc.
Applied Research Associates, Inc.
Associated General Contractors of Vermont
Avery Excavation, Inc.
Cold River Bridges, LLC
D.A. Collions Companies
Engineers Construction, Inc.
Greenman-Pedersen, Inc.
ICC-IMS
Kubricky Construction Corp.
LaRock Construction
Markowski Excavating, Inc
Maxwell Products
Norwich University, New England University Transportation Center
Peckham Road Corp
Connecticut Galvanizing, A Race Rock Company
Richard Reed and Son, Inc.
Sika
Skidabrader Group
Trans Structures Design Section
Vermont Agency of Transportation
W.M. Schultz Construction, Inc.

And several anonymous contributors.

Table of Contents

Executive Summary 1
Chapter 1. Introduction 3
Title: 3
VTrans Champion: 3
Principal Investigators: 3
Project Schedule/Duration: 3
Project Description 3
Objectives 4
Anticipated Results and Benefits 4
Strategic Alignment 5
Chapter 2. Phase I – Data Collection and Analysis 6
Task 1 – Data Collection Summary 6
Task 1A: Literature Search 6
Task 1B: Survey 9
Task 1C: Focus Groups 12
Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims. 22
Change Order Analysis 22
Task 3 – State of Practice 30
Contractor Engagement 31
Partnering 32
Dispute Resolution 32
Constructability & Quality 32
Task 4 – Risk Assessment 33
Task 5 – Interim Report 37
Chapter 3. Phase II – Framework 38
Task 6 – Develop a Proposed Engagement Framework 38
The Framework 39
Strategies 41
Resource Strategies 41
Deliverable Strategies 42
Summary 46
Task 7 – Testing Proposed Engagement Framework 46
Task 8 – Develop Final Report and Technology Transfer 57

References 58
Appendices 59
Appendix A: Literature Review Summary 1
Appendix B: Survey 24
Survey questions 25
Perceived Quality Issues 25
Opportunities for Improvement 27
Prioritization of Solutions 28
Other questions 28
Thank you! 29
Appendix C: Survey Data Analysis 30
Appendix D: Survey Written Responses 80
Perceived Quality Issues – Documents 80
Perceived Quality Issues – Contractor Submittals 80
Perceived Quality Issues – Communications 80
Appendix E: Focus Group Invitations, Agenda, and Presentation 7
Internal Focus Group invitation email to VTrans staff 7
External Focus Group invitation email to Contractors, Suppliers, Engineers, and Fabricators 8
Focus Group Agenda 9
Focus Group Presentation 10
Appendix F: Focus Group Comments 14
Appendix G: State of Practice state-by-state summary 30
Appendix H: Draft Interim Report Meeting Agenda 36
Appendix I: Draft Interim Report Presentation 38
Appendix J: Draft Interim Report comments and responses 48
Appendix K: Draft Framework presentation 60
Appendix L: Fact Sheet 67

List of Tables

Table 1. Literature Sources. 6
Table 2. Literature review themes 8
Table 3. Change order value by program 24
Table 4. Risk themes. 33
Table 5. Compiled themes (risks). 34
Table 6. Probability scale. 35
Table 7. Impact scale. 35
Table 8. Risk Scoring 36
Table 9. Compiled themes (risks). 36
Table 10. Top scored themes (risks). 37
Table 11. Phase I Themes and highlighted top risks. 38
Table 12. Themes by Program Management Components. 45
Table 13. Summary of Framework Strategies 46

List of Figures

Figure 1. Number of projects substantially complete by year. 23
Figure 2. Payments to contractors by year. 23
Figure 3. Number of contracts with change orders. 24
Figure 4. Number of change orders by program. 25
Figure 5. Value of change orders by program 25
Figure 6. Number of change orders by category. 26
Figure 7. Value of change orders by program 26
Figure 8. Distribution of change orders by program 27
Figure 9. Number of change orders by value. 28
Figure 10. Average and median values of change orders. 28
Figure 11. Change order percent of total contract value. 29
Figure 12. Number of change orders per contract by program area. 29
Figure 13. Heat map. 35
Figure 14. Resources/People: Establish Core Competencies strategy. 50
Figure 15. Deliverables/Work Products: Develop Process Controls strategy. 55
Figure 16. Outreach/Contracting Community: Host Facilitated Meetings strategy. 56

List of Equations

none

List of Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ACEC	American Council of Engineering Companies
AGC	Associated General Contractors
ARA	Applied Research Associates
Caltrans	California Department of Transportation
CY	cubic yard
DOT	department of transportation
E&O	Errors & Omissions
FHWA	Federal Highway Administration
GPI	Greenman-Pedersen, Inc.
ID/IQ	indefinite delivery/indefinite quantity
KPI	key performance indicators
LTAP	Local Technical Assistance Program
MAB	Municipal Assistance Bureau
NETTCP	New England Transportation Technician Certification Program
NHI	National Highway Institute
PCC	Portland cement concrete
PM	Project Manager
RE	Resident Engineer
RFI	Request for Information
ROW	Right-of-Way
STIP/TIP	State Transportation Improvement Plan/Transportation Improvement Plan
TRID	Transportation Research International Database
VT	Vermont
VTrans	Vermont Agency of Transportation

Executive Summary

The VTrans Structures Design Section sponsored this research in response to significant transformational changes experienced within the program over the past two decades. The Agency is re-examining how they engage with the contracting community to ensure that bridge projects are biddable and buildable, that risk is properly identified and proportioned, and that the Structures Program supports a healthy and competitive environment for bridge builders. During this period of change, a decline in experience of agency personnel coincided with an aging contractor workforce and a loss of key relationships. The Program is committed to addressing these challenges as it continues to provide safe and resilient bridges for the travelling public.

During this period, the Program has successfully delivered several complex bridge projects but has also encountered projects characterized by significant change orders, claims, or limited bidding competition. These issues, alongside inflated bid pricing, led to unanticipated financial stress on the Program, including the delay or deferral of important bridge projects due to budget concerns.

The Agency recognizes the need to address process deficiencies that contribute to unpredictable bid results, change orders, and construction claims for bridge and other infrastructure projects. This research was framed as developing a framework for defining quality and constructability of transportation projects, noting that a key strategy for achieving these improvements is to engage with the contracting community to restore relationships and leverage their expertise.

The results of this research — including analysis of 879 construction contracts, 3,413 change orders, survey responses from 72 stakeholders, and five industry focus groups —resulted in the development of a practical framework that can be immediately implemented across Agency program areas to improve engagement with industry partners and strengthen project delivery practices. The framework is informed by the Balanced Scorecard management approach developed at Harvard Business School and is designed to support effective program management within VTrans. Similar to the established body of knowledge for project management, the proposed framework provides program managers with a structured approach for managing program resources, work products, and stakeholder relationships.

Effective program management is supported by three primary pillars: managing the people, money and assets (Resources), managing the quality of work products and processes (Deliverables), and the effort to work with key stakeholders, collaborators and partners (Outreach). Each of these pillars consists of several strategies that outline the key actions required for success.

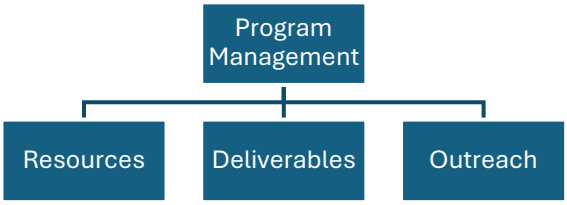


Figure ES - 1. Diagram. Program Management Structure.

The Program Manager is responsible for managing key Agency programs like Structures, Roadway, Pavements, Rail, and Aviation, and the framework provides a roadmap for the Program Manager to be successful. The framework is scalable to meet the needs of different departments and can be adjusted as necessary to reflect current and emerging needs. The framework is generic in the sense that the principles apply to all assets.

The Technical Panel overseeing this project was acutely focused on implementing the research findings and asked the researchers to provide actionable steps to help managers get started. It is important to

acknowledge that achieving the Agency's program management goals requires the framework to be adopted in its entirety. Omitting key strategies from any of the three pillars puts the program at risk. It can also be said that some strategies may already be underway, and some will have a more immediate impact on performance than the others. Finally, it is understood that it's not practical or feasible to try and advance all the strategies simultaneously.

Based on the feedback received from the survey and the focus group meetings the research identified four high priority topics the Structures Program should focus on. They are, the pricing and availability of Portland Cement Concrete, the submittal review process, the oversight of steel fabrication, and communication with the contracting industry. The strategies identified in the framework to address these topics are the Deliverables: Work Processes, and Outreach: Host Facilitated Meetings.

The Technical Panel sought guidance on implementing the framework at the Agency and asked what the first steps might look like. The researchers suggested the Agency create a Framework Oversight Team . to guide the implementation of the Framework. The Oversight Team would determine the implementation priority of each strategy (for example, addressing high risk themes first), identify the lead(s) of a Working Group for each strategy, identify the initial program areas to be involved, establish a schedule, provide guidance, and monitor progress.

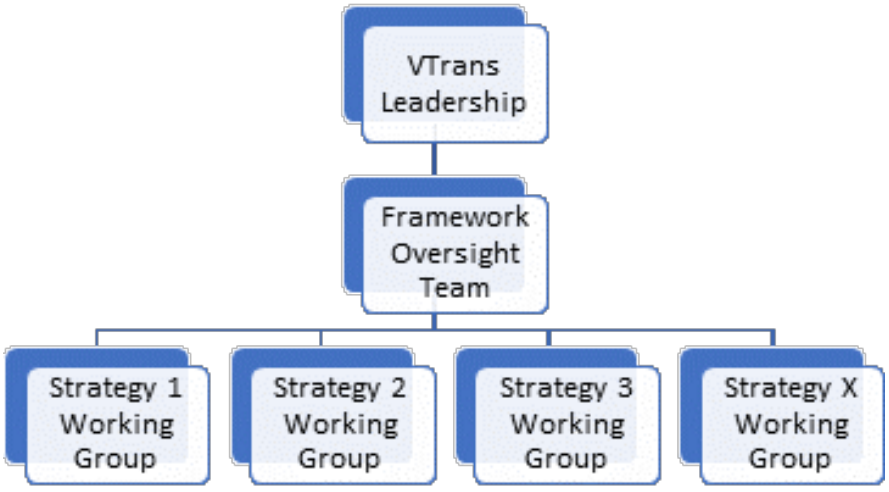


Figure ES - 2. Diagram. Framework Oversight Team.

Program Management is an ongoing effort. The needs and priorities of a program will evolve over time as the challenges faced by a program change, and so the emphasis on strategies will ebb and flow to meet the current demands. However, the principles of managing resources, deliverables, and engaging with stakeholders and partners remain constant. These are the pillars of Program Management, and successful programs will have effective strategies supporting each of the three pillars.

Chapter 1. Introduction

The goal of Task 8 - Final Report is to summarize the research performed in Task 1 through 7. This report documents for the Vermont Agency of Transportation (VTrans) the data collection and analysis and the resulting framework.

Project Information

Title: Developing a Framework for Defining Quality and Constructability of Transportation Projects

VTrans Champion: Carolyn W. Cota, P.E., Structures Section/PDB/HWY, Carolyn.cota@vermont.gov, (802) 917-4891

Principal Investigators: Daniel D'Angelo, P.E., Principal Civil Engineer, Applied Research Associates (ARA), ddangelo@ara.com, (518) 526-5738 and David Hoyne, P.E., VP/Director of Construction Services-VT, Greenman-Pedersen, Inc. (GPI), dhoyne@gpinet.com, (802) 917-4310.

Project Schedule/Duration: June 2024 – May 2026, 24 months

Project Description

The VTrans Structures Design Section has experienced transformational changes in the last twenty years. In response, the department is re-examining how they engage with the contracting community to ensure that bridge projects are biddable and buildable, that risk is properly identified and proportioned, and that the Structures Program supports a healthy and competitive environment for bridge builders. The introduction of accelerated bridge construction, prefabricated bridge elements, and new materials like ultra-high performance and self-consolidating concrete has coincided with a decline in experience of agency personnel and an aging contractor workforce. The Program is committed to addressing these challenges as it continues to provide safe and resilient bridges for the travelling public.

During this period of change, the Program has experienced enormous success delivering very complex bridge projects like the balanced cantilever segmental bridge in Brattleboro, the prestressed and post tensioned continuous concrete girder bridge in Rockingham, the lateral slide of the bridges in Hartford, and many more examples of projects the Agency can be proud of. However, during this period the Program also endured several projects with significant change orders, claims, or limited bidding competition. These issues, alongside inflated bid pricing, led to unanticipated financial stress on the Program, including the delay or deferral of other important bridge projects due to budget concerns. Additionally, these defects are labor intensive for the Program and siphon staff time away from mission critical work.

The Agency and its collaborators and partners recognize the risk the Program took to institutionalize accelerated bridge construction techniques and new construction materials and acknowledges the enormous success the Program has realized over the last two decades. There is also a recognition of the need to correct the defects in the process that can lead to more predictable bid results, fewer change orders, and virtually eliminate construction claims. A key strategy for achieving these improvements is to engage with the contracting community and key collaborators and partners to leverage their

expertise and develop a framework to receive feedback to correctly allocate risk, and enhance the quality and constructability of bridge and agency projects.

The research conducted and products delivered from this project will have the goal of improving the current state of practice in VTrans related to project delivery of bridges and additional infrastructure through actionable and implementable findings. The project will create an effective framework that will incorporate internal agency and external contracting community and stakeholder engagement to improve the quality and constructability of the contract documents and allocate risk responsibly. The framework will support the Agency's Strategic Plan 2023-2025 Goal 5: Modernize and improve government efficiency through innovation, continuous improvement, and quality customer service.

Objectives

The following objectives will be achieved by this project:

1. Define quality, risk, and constructability of transportation projects.
2. Develop a feedback framework with which VTrans can engage the contracting community and key collaborators and partners.
3. Develop Technology Transfer and Guidelines for Implementation.

Anticipated Results and Benefits

The research conducted and products delivered from this project will have the goal of improving the current state of project delivery practice in VTrans through actionable and implementable findings. A framework will be created that will incorporate the internal agency, the external contracting community, and key stakeholder engagement to improve the quality and constructability of the contract documents and allocate risk responsibly. The Agency is encouraged to adopt the framework as an ongoing feedback mechanism that fosters open and ongoing communication.

The introduction of a communication framework is integral to the holistic field Program Management, where the program manager is charged with managing the resources (people, money, equipment), products (contract documents, reports), and stakeholder needs (engagement with internal and external customers) for an agency program area. All three of these components are required for the program to be successful. The program must be aware of, and in tune with, the needs of all collaborators and partners with a vested interest in the Program. Without such information and ongoing feedback, the Program lacks the information required to make informed decisions. For example, implementing a new concrete mix without consulting the producers would likely result in a shortage of materials, failures, and overpricing. When the Program adopts new design guidance, they must inform the design community of the changes, why the changes are being made, when to apply the new requirement and how to incorporate them into the plans. When the Agency embarked on accelerated bridge construction techniques, the contractors were engaged in the process. The communication and feedback channels need to be continuous rather than driven by a singular issue, and this framework is intended to institutionalize open communication.

The potential benefits of effective communication with contractors, consultants, material suppliers, and other collaborators and partners are immense. Constituents want to be able to solve problems and advance the state of practice in a timely and orderly manner so they can get back to the core mission of running their business. The near-term work should focus on the quality of the contract documents to

improve biddability and buildability, manage risk, and the workforce development challenges facing the Agency and the industry. Mid-term goals may include how to improve competition and how to adopt new materials and construction processes more quickly. The long-term benefit may be a relationship that is built on trust, where all collaborators and partners are committed to advancing the state of practice, where voices are heard, challenges are overcome, and the process is respectful, transparent, and effective. Through this framework, the Agency, contractors, suppliers, and consultants will be more efficient because they have been engaged in a development process where the outcomes and results are well defined and understood.

Strategic Alignment

The results of this research project, including the framework for engagement supports Goal 5 from the Agency's Strategic Plan 2023-2025: Modernize and improve government efficiency through innovation, continuous improvement, and quality customer service. This research project has the potential to improve efficiency; it represents the culture of continuous improvement and directly speaks to improving customer service.

Modernize and Improve Government Efficiency through Innovation: The overarching theme of the research statement is to address the defects present in the delivery of capital projects, thereby reducing additional costs and impacts on the agency. VTrans has identified engagement with key collaborators and partners as one component to improve the efficiency of the Agency, and seeks an innovative engagement strategy to foster the flow of information and enhance the communication channels.

Modernization and Improve Government Efficiency through Continuous Improvement: VTrans has demonstrated over the last two decades that they are not afraid to take risks and implement bold solutions. The success the Agency has demonstrated with alternative contracting, accelerated bridge construction, and tackling the most complex projects clearly embodies continuous improvement. This Project represents the next step in advancing the program by engaging with all collaborators and partners to make great work better.

Modernize and Improve Government Efficiency through Customer Service: The term "collaborators and partners" are synonymous with "customers." The client-customer relationship exists anywhere there is a transaction, whether the transaction is financial, intellectual property, or both. The entities supporting the agency with delivering the annual bridge program include consultants, contractors, and material suppliers; collectively, these groups have a vested interest in the success of the Program and need each other to be successful. This project seeks to create a long-term and meaningful dialogue with the customers of the Agency and inherently supports the goal of improving operations by better engagement with its key collaborators and partners.

The bottom line: the framework will support the Agency's Strategic Plan 2023-2025 Goal 5: Modernize and improve government efficiency through innovation, continuous improvement, and quality customer service.

Chapter 2. Phase I – Data Collection and Analysis

Task 1 – Data Collection Summary

The data collection task was divided into 3 subtasks (1A for a literature search, 1B for a survey, and 1C for the focus groups). The following summarizes these subtasks.

Task 1A: Literature Search

Task 1A focused on examining relevant research on quality, risk, constructability, and engagement strategies to help inform the current state of practice and the remaining tasks and final deliverables. Sources included the Transportation Research Board, Transportation Research International Database (TRID), American Society of Civil Engineers Journal of Management in Engineering, the National Academy of Construction, and others.

Appendix A is an alphabetical table of all research reports, white papers, and other literature reviewed - the table includes the document title, reference, and a summary of the documents key points.

Due to the broad nature of this research – and the potential for issues to be identified and the potential for a wide range of improvements or solutions the literature review covered a variety of topics. 57 research reports, white papers and other literature documents were identified as relevant or aligned with the goals of this research project. Additional literature may be sought depending on the conclusions resulting from the survey results, focus group findings, and risk assessment as the framework is being developed.

The following table summarizes the literature review sources, number from each source and related topics.

Table 1. Literature Sources.

Literature Source	Number	Topics
American Society of Civil Engineers, Journal of Management in Engineering	7	Collaboration Construction Planning Contingency Cost Material Prices Risk
Association of General Contractors	2	Risk Workforce
Construction Dive	2	AI Workforce

Literature Source	Number	Topics
Construction Management Association of America	5	Organizational Culture Recruit and Retain Staff Risk Trends Trust - Relationship Roadblocks
Infrastructures	1	Bridge Construction Innovation
National Academies of Sciences	17	3D Models AI Alternative Technical Concepts Constructability Construction Disputes Design Errors Geotechnical Claims Innovation Non-Destructive Testing Performance-Based Prequalification's Post-Construction Evaluation Procurement Product Evaluation Risk-Based Inspection Quality Control Plans
National Academy of Construction	19	Change Orders Contract Management Constructability Design and Construction Design Review Disputes and Claims Early Contractor Involvement Escalation Innovation Partnering Pricing Risk Scope Baselines Subsurface Conditions Teaming Trust
National Center for Construction Education and Research	1	Training
National Research Council	1	Machine Learning at state DOTs

Literature Source	Number	Topics
U.S. Department of Transportation	1	Change Orders

The topics listed in the previous table were organized, or grouped, into the following overarching literature review themes:

Table 2. Literature review themes

Literature Review Theme	Includes
Change Orders	Change Orders Scope Baselines
Constructability	Constructability Construction Planning Subsurface Conditions
Culture	Organizational Culture Contract Management Post-Construction Evaluation
Design	Design Errors Design Review Design and Construction
Disputes/Claims	Disputes and Claims Construction Disputes Geotechnical Claims
Innovation	Innovation Bridge Construction Innovation Alternative Technical Concepts Product Evaluation
Partnering	Partnering Collaboration
Pricing	Pricing Material Prices Contingency Cost Escalation
Procurement	Procurement Performance-Based Prequalification's Early Contractor Involvement
Quality Control	Quality Control Plans Non-Destructive Testing
Risk	Risk (4x)
Trends	Trends Machine Learning at state DOTs Risk-Based Inspection 3D Models AI
Trust	Trust - Relationship Roadblocks Teaming Trust
Workforce Development	Workforce Workforce Development Training Recruit and Retain Staff

Task 1B: Survey

Task 1B is a survey of the Agency, Associated General Contractors (AGC),, bridge contractors, American Council of Engineering Companies (ACEC), suppliers, fabricators, and other key collaborators and partners to help identify perceived quality issues, barriers to engagement, opportunities for improvement, and prioritization of solutions.

A copy of the survey is included in **Appendix B**.

72 survey responses were received from the following (10 respondents identified in multiple organization types):

VTrans employees	44
Bridge Contractor	12
Highway Contractor	16
Design Consultant	1
Construction Inspector Consultant	3
Supplier	1
Fabricator	3
Steel Coatings	1
Heavy Civil Construction Contractor	1

The analysis of the survey responses included a review of the overall scores, VTrans only scores, and non-VTrans only scores. The largest difference in scoring between VTrans and non-VTrans were identified. Open-ended written comments were compiled.

A presentation, dated January 21, 2025, is included as **Appendix C** and includes the analysis.

Key Findings – Perceived Quality Issues (**bold** text indicates common responses, that is responses shared between VTrans and non-VTrans staff)

- VTrans scores consistently higher
    - VTrans: 3.05-3.88
    - non-VTrans: 2.14-3.36
- Non-VTrans scores exhibited a wider range
- Top VTrans scores
    - Communication: Structures Project Manager (3.88)
    - Communications: Construction Engineer (3.84)
    - Communications: Resident Engineer (3.79)
- Top non-VTrans scores
    - Communications: Construction Finals Team (3.36)
    - Documents: Advertisement (3.25)
    - Communications: Environmental Permitting Team (3.07)
- Written feedback may be more valuable than scores

- Lowest VTrans scores
    - **Contractor Submittals: Pricing for Extra Work** (3.05)
    - Contractor Submittals: Materials Mix Design (3.05)
    - Contractor Submittals: Application or Renewal of Prequalification (3.11)
    - **Completion Dates** (3.15)
    - **Contractor Submittals: Fabrication drawings** (3.20)
- Lowest non-VTrans scores
    - Response time for Contractor Submittals (2.14)
    - **Completion Dates** (2.36)
    - **Contractor Submittals: Fabrication drawings** (2.43)
    - **Contractor Submittals: Pricing for Extra Work** (2.43)
    - Contractor Submittals: Value Engineering proposals (2.46)
- Top 5 Score Differences
    - Communications: Construction Engineer (1.12)
    - Contractor Submittals: RFIs (1.01)
    - Communications: Regional Construction Engineer (0.99)
    - Communications: Structures Project Manager (0.92)
    - Communications: Resident Engineer (0.90)
- Top 5 Closest Scores
    - Communications: Construction Finals Team (0.02)
    - Communications: Environmental Permitting Team (0.20)
    - Response time: Questions during advertisement (0.22)
    - Documents: Advertisement (0.23)
    - Communications: Materials Laboratory Personnel (0.41)

Which topics does the Agency need to improve?

- Top 5 VTrans
    - **Engagement with the bridge contractors** (20)
    - **Communication between Agency staff and contractor/suppliers** (19)
    - Project Plans (18)
    - **Engagement with the material suppliers** (18)
    - **Constructability** (16)
- Top 5 non-VTrans
    - **Constructability** (17)
    - Project Completions Dates (15)
    - **Communication between Agency staff and contractor/suppliers** (15)
    - **Engagement with the bridge contractors** (15)
    - **Engagement with the material suppliers** (15)

Prioritization of Solutions ("Please identify from the list the five most important topics the Structures Program should focus on to improve the delivery of bridge projects (select only 5)")

- Top 5 VTrans
    - **Constructability** (29)
    - **Project Plans** (26)
    - **Engagement with the bridge contractors** (23)
    - **Communication between Agency staff and contractor/suppliers** (22)
    - Project Special Provisions (18)
- Top 5 non-VTrans
    - **Communication between Agency staff and contractor/suppliers** (19)
    - **Constructability** (17)
    - Agency response times (14)
    - **Engagement with the bridge contractors** (12)
    - **Project Plans** (10)

Note: Top 5 overall included "Engagement with the material suppliers" [VTrans (17), non-VTrans (9)].

Appendix D includes the written comments provided by the survey respondents. An analysis of these comments indicates,

The quality of documents and communication are most affected by:

- Process
- Time
- Workforce Development
- Culture

Respondents identified the following future threats and opportunities:

- Workforce Development
- Model Based Design
- Partnering
- Funding
- Rising Costs
- Barrier to Entry
- Submittals
- Innovative Materials
- Specifications
- Environmental Regulations
- Miscellaneous

Respondents offered additional feedback on:

- Partnering
- Quality of Plans
- Submittals
- Workforce Development
- Process
- Question During Procurement
- Burdensome Requirements
- Completion Dates

After analysis of the survey data, the following were determined to be the most important primary and secondary themes:

Primary Themes

- Workforce Development
- Partnering/Culture
- Submittals
- Process
- Quality of Plans
- Time

Secondary Themes

- Barrier to Entry
- Funding
- Rising Costs
- Innovative Materials
- Specifications
- Environmental Regulations
- Burdensome Requirements

Task 1C: Focus Groups

Task 1C consisted of five (5) focus groups to better understand the needs of the collaborators and partners. Small groups of collaborators and partners with relevant expertise delivering bridge projects for the Agency were identified (in part by the survey) and met virtually for approximately 90-minutes to examine relevant questions about quality, risk, constructability, and engagement strategies.

The research team conducted five focus group meetings with collaborators and partners during the month of June 2025. The meetings were facilitated by the research team and were hosted virtually. The meetings lasted approximately 90 minutes each. The group sizes were small, with participation ranging from the smallest group of 3, to the largest group of 12. In total, there were 24 VTrans representatives

and 13 contractor and supplier representatives. The results of the focus group meetings are presented in this section of the report.

The request for volunteers to participate as focus group members was sent out by e-mail from VTrans. The distribution consisted of an internal e-mail to staff at VTrans, and an external e-mail to suppliers, fabricators and contractors (see **Appendix E**). After a period of a few weeks, a reminder e-mail was sent out, encouraging participation. Participants responded directly to the researchers, and then meeting invitations were sent out for June 13, 17, 19, 25, and 27, 2025. Initially there was very little response from the contracting community, so the researchers contacted the local chapter of the Associated General Contractors (AGC-VT) and sent them the meeting invitation. Once specific dates and times were known, many more contractors accepted the invitation and participated in the focus group meetings.

The focus group meetings were scheduled to encourage maximum participation and candor. For this reason, two meetings were dedicated to VTrans staff, and three meetings were for the contracting community. This approach was an attempt to remove any barriers to an open discussion that could be perceived when discussing difficult topics in a mixed audience. The researchers also stated that the participants' comments would be captured but not attributed to any person or entity. Anonymity was provided for all participants. The researchers concluded this approach was correct as the participants freely expressed their observations, concerns, opinions and suggestions.

The focus group meetings followed a structured format (see **Appendix E**). The researchers introduced themselves and provided a brief overview of the project using presentation slides (see **Appendix E**). The project overview described the need to develop a framework to improve partnering and feedback to better define risk, quality and constructability. The researchers then provided an overview of the research methodology consistent with the workplan and reiterated that these focus groups meetings are part of the data collection phase, and that the results will be used to inform the structure of the framework.

After a brief introduction and reminder of meeting etiquette, the researchers provided amplifying questions to inspire comments and conversation. The amplifying questions were as follows:

- What do quality project documents, process, and communication look like, and mean to a contractor, fabricator, and supplier?
- How can the Agency develop constructability skills in-house, and leverage the contractor's expertise to ensure that the construction of projects is practical and achievable?
- How do we promote partnering and effective communication?
- Where do we begin, for example, how do we jumpstart a new framework of communication and cooperation?
- How can my organization participate, contribute, and support this effort?
- How will the agency know it is being successful?

Following the discussion, the researchers provided a summary of what they discussed and availed themselves for additional comments from the participants. A review of the research timeline was provided. The participants were thanked and the meetings concluded.

Summary of Focus Group Comments

The researchers note that the 90 minutes allocated for the focus group meetings passed quickly as participants were eager to share their thoughts. The meetings could have easily run longer as the participants were genuinely engaged in the discussion and wanted to share their perspectives. There was no difficulty in getting participation or keeping the participants engaged.

It was evident that many participants had come prepared with talking points and provided examples to bolster their observations. Participants clearly relished the opportunity to share their experiences and knowledge. The researchers captured the notes and assembled the raw information in a spreadsheet for ease of working with the data (see Appendix F). Analysis of the focus group discussions identified eleven recurring themes related to quality, constructability, and industry engagement. These themes reflect both operational challenges encountered during project delivery and broader structural issues affecting collaboration between the Agency and the contracting community. For example, participants presented information that described a problem with the quality of a deliverable, or a constructability issue, then a theme was created to capture the common concerns. The eleven themes derived from the data are summarized below:

1. **Barrier to Entry.** The comments note that the barriers to doing business with VTrans are so difficult that contractors who may want to work for VTrans are overwhelmed by the barriers and the result is less competition in the marketplace. **Participants noted that VTrans transfers too much risk, the smaller contractors are not prepared to manage the risk, and they are not able to comply with all the requirements contained in the specifications.** The process of becoming qualified as a supplier was cited as too onerous, that small suppliers won't go through the process, and the restrictive specifications were cited as reasons. Participants noted that limited supplier availability can make it difficult to obtain small quantities of specialized materials, which may increase pricing and reduce competition. An example offered is of small quantities of miscellaneous steel plates that are difficult to source and so they are priced very high.

   On a positive note, it was mentioned that smaller contractors look for opportunities to gain knowledge about working for VTrans. Both the indefinite delivery/indefinite quantity (ID/IQ) and Job-Order Contracting methods were cited as good programs that allow smaller contractors the opportunity to bid VTrans work as a prime contractor and to gain more experience working as a prime contractor for VTrans.

2. **Collaboration.** A lot of discussion centered around collaboration and the working relationship and there are many notable quotes taken from the participants. There are a few "sub-themes" to the points, like the overarching nature of the relationship between VTrans and the contracting community and the venues and methods that collaboration could take place to improve the collaboration.

   There was an acknowledgement that both sides have common goals and that we need to establish a culture of which we are all working towards the same goals. The relationship between VTrans and the contractors could be significantly improved, and it is not us versus them, tone down the heat and open honest communication. In noting that the relationship needs more collaboration, it was mentioned that collaboration does not imply compromising

one's goals. For example, the participants stated that VTrans needs to improve their collaboration with contractors without compromising quality and make VTrans easier to work with without compromising quality.

A wealth of solutions to improve collaboration were noted. The TECH PAVE committee was cited as a good example of collaboration between VTrans and the paving industry and that this model could be used elsewhere in the Agency. Other suggestions include conducting year-end postmortem meetings with the industry, consultants, design, and construction staff from VTrans. Other similar suggestions include an after-action meeting with all stakeholders, joint meetings with ACEC, AGC, and VTrans, annual conferences for all stakeholders, and partnering at the agency and project levels.

It is worth mentioning comments made about developing relationships and how the continual movement of staff at VTrans and the use of virtual meetings has made it difficult for contractors to develop relationships with key staff. The contractors noted the difficulty in developing relationships with the new people and cited the lack of any meetings in the last 18 months.

3. **Communication.** Communication was described as low hanging fruit and that communication is about asking the right questions and making the discussion more conversational and not a do-as-I-say approach. A sentiment expressed is that VTrans states they are trying to do the right thing, but that opinion is not validated by the responses contractors receive to questions and it was questioned, is VTrans really listening? On the solutions side, it was stated that the middle ground is found through communication, and we need to stop hiding behind screens and get back out front. It was also pointed out that office staff do not recognize field urgency.

4. **Constructability.** Participants frequently identified constructability as a key factor influencing project risk and cost. Several examples were provided in which design decisions did not fully consider construction logistics, material availability, or equipment requirements, resulting in increased contractor risk and higher bid pricing. A sentiment expressed was for some project components, it becomes clear that the agency has not requested feedback from the industry.

   The examples of constructability presented consisted of VTrans specifying small quantities of high performance concrete on remote projects, no consideration of lay down and yard space for the contractor to work from or stage their operations, the permitting and trucking of very large cranes is very expensive and time consuming, a lack of standard details, providing more space on a project to allow slopes to be laid back instead of a supportive excavation, and using the footings of substructures as part of the falsework for the superstructure.

   The designers need to know basic construction knowledge and how the contractor will build the project, and they need to think like a contractor. **VTrans could do more to develop and adopt standards to simplify plans and construction and obtain early contractor input into the design plans and contract because the contractors are skilled and can assist the design teams with advice during the design phase. VTrans should strive to use more common materials and products like bridge expansion joints that don't require submittals.**

5. **Culture.** Some of the more poignant comments offered were about the culture of VTrans and the culture around working as a contractor or supplier for VTrans. A VTrans employee stated we need to listen to contractors as they have good ideas. One participant expressed there should be a better atmosphere for sharing and understanding each other's needs while another stated it is important to set a positive tone from the beginning.

   The sentiments from contractors were blunter. Contractors expressed a reluctance to speak out, or speak up, for fear of subtle or not subtle retribution. They went on to state that there is no partnering, community, or harmony on the job sites. Suppliers don't want to work with the agency, and sometimes it can feel like the contractors are being force-fed by changes to the specifications. Another frustration heard was that too often contractors hear bid-it-as-you-see-it in response to questions posed during advertisement.

   In a similar theme to what was described about communication, one participant stated that VTrans needs to have key positions available, in person, to develop relationships with the contracting community.

6. **Planning.** This topic mostly centered on recognizing that contractors need time to plan their operations and projects, and they described strategies that VTrans could use to support the needs of the contracting community. A portion of the planning theme was specific to the paving program.

   The contractors stated that the anticipated advertising list gets chopped and moved around too much, and that more accurate and stable lists are important for contractors to plan. They went on to state that the timing and scheduling of projects is important and that the fall is a better time to advertise and award projects as this allows contractors to plan. To continue with this theme, it was noted that late lettings equate to late starts and that the Statewide Projects bid opening has become later into the spring and that makes sourcing labor and materials very difficult to manage.

   The contractors pointed out that quotes from steel suppliers are also challenging as there are competing schedules for a limited fabrication schedule. The timing and availability of materials needs consideration. VTrans needs to understand industry's capacity to deliver and that VTrans needs to do market research ahead of time to understand supply challenges.

   In terms of submitting bids, contractors stated that bidding multiple large projects on the same day is very challenging for prime and subcontractors and contractors need more notice when the project will require them to rent specialized equipment as there can be limited supply.

   There was a lengthy discussion on the paving program and the contractors questioned what is the return on investment for VTrans resurfacing projects? The question stems from the statement that FPAVE projects achieve more mileage with limited specifications, less inherent risk and fewer barriers to entry, and that it is understood that it is desired to achieve more life out of premium liquids but are we really achieving the service life from these so are they worth the extra cost?

Industry noted that throughout New England there are **26 different performance grade liquids and the base rate for liquid asphalt is $600 per ton.** Industry representatives suggested that the states in New England could coordinate to simplify and develop consistent specifications and that the easier it is to bid work, that will drive more competition and lower prices.

7. **Process.** The process related themes expressed by the participants are varied and cover a lot of topics. The premise of this theme is that a change to the existing workflows would result in an improvement to the process that would alleviate the concerns noted. The lack of a formal process, or improvement to an existing process are not distinguished. The sub-themes are noted in the following paragraphs.

   On the topic of constructability reviews a VTrans employee stated, we don't know how to officially communicate with contractors, and I have always wondered how I can communicate with the contractors. **Another question asked is how do we access contractors for constructability reviews?** Some solutions participants offered are to add steps to the Project Development Process to make constructability and quality reviews more managed and followed and VTrans should be conducting site visits to the project closer to the final plans to confirm site conditions and to address any changes. VTrans could share project information during the design phase so experts can weigh in on the projects.

   Some of the work underway at VTrans to improve contractor involvement in projects was captured by statements like VTrans is piloting contractor involvement in digital delivery, and this may lead to a reduction in risk, or better risk allocation, and alternative contracting like CMGC offers promise. VTrans is working on an Alternative Contracting Manual, and contractor input during the design process like CMGC and the 3D modeling project help to vet the design prior to advertisement.

   Some of the process changes focused on communication and collaboration. For example, there could be an evaluation process for contractors to evaluate the agency, or there could be after action reviews to determine what is missing from designs. Similar sentiments offered are that VTrans should engage contractors after the bids are open to better understand what contractors are seeing and why the pricing for items is higher than expected. During the winter months the construction staff should meet with the structures staff to review the previous season projects, like after-action meetings to identify improvement opportunities.

   The positive comments from participants about process improvements are that Doc Express has been great. It has the dates, times and to-do list that is very helpful, and the pivot to precast elements has been positive as it helps to avoid the supply problems. The TECHS and SPECS provide more of a heads up than they used to, and the changes to iCX should lead to a smoother bidding process.

   The more programmatic feedback includes comments like COVID, and emergency declarations streamline the processes, but we don't leverage that going forward to improve our work, and VTrans needs to track RFI's on bids and use the data to drive improvements. **Add 5% contingency to the low bid amount for the contract to help reduce the number of change**

orders. Programmatic feedback specific to the Paving Program, it was stated that the **engineering and construction inspection costs for resurfacing projects are out of hand for a project with a lifespan of seven years; simplify these projects.** Vermont now requires overweight and over height permits to go through the engineering department which takes two weeks to review.

The opportunities for improvement at the project level consist of statements like the way VTrans defines the limits of projects and permits the projects to avoid impacts can be problematic as this approach limits space for construction, and the environmental section review of plans is limited in scope and could be more integrated and valuable. VTrans needs to embrace accelerated decision making as it is in the best interests of the project.

A few comments are related to quality like when a contractor questioned why the Contract Administration Section doesn't provide responses to questions asked during the bid stage to all plan holders. The current practice is to share addendums with all plan holders. There is a need for an improved quality checking process of design plans and the RE's don't have time to do a quality review.

8. **Quality.** The discussion of quality naturally garnered the most comments since substandard work leads to friction at the project level. The main themes are the quality of the plan sets, the submittal review process and a random assortment of other comments on quality. The quality of plan sets had the most comments, while the submittal process had the highest urgency and importance.

   Beginning with a high-level discussion of the quality of plans, the comments suggest including all the information in the contracts to reduce the likelihood of change orders, and the current quality of plans are akin to choosing your own adventure**. There should be a focus on quality and consistency, follow-up on plan review comments, and include all the information the agency has in the contract.** The consultants providing services to VTrans need to be on the same page as VTrans and that VTrans struggles to get consultant firms to adopt and use VTrans details in the plans and this lack of standardization leads to problems in the field. Get the design teams on the same page with standard details.

   The comments offered about the standards used to establish a baseline of quality consist of the plans produced by consultants are of inferior quality to VTrans produced plans and the contractors and VTrans' staff see it too. A participant asked, for quality control, what is the minimum standard to meet? What is appropriate? Quality standards for in-house designs seem to be lacking.

   Some of the participants addressed the organizational challenges as they relate to quality by stating there is pressure to move fast and deliver, and that introduces errors. Design teams need space and time to collaborate, and that VTrans should look at the data from the last two years, it is telling as to the issues with the plans, estimates and risk passed on to the contractors. There doesn't appear to be ownership of the quality of the plans and submittal reviews, and VTrans

needs to assume responsibility for the design addendums decisions. Decisions seem to be made in a vacuum and not considering the project in its entirety.

There were several process related comments **like VTrans has a constructability review process, so what in the process isn't working?** It is difficult for Construction staff to do a thorough review due to capacity issue, and there is too much reliance on Construction to find the problems. Preliminary Plans are where the discussion should take place and **not enough time is spent at Preliminary Plans.** Then when the problems are identified at Final Plans, it is decided to be too late in the process to change. **The reviews from the Construction staff are missing.** The same defects show up in plan sets after plan sets and don't get corrected and carried through. Need better tracking of comments and resolution, and incorporation into practice to avoid repeating. Legacy projects are problematic in terms of quality and standardization.

The more detailed plan quality comments consist of statements like when VTrans conveys a conceptual sequence of the construction, it needs to be viable, and designers need to use the correct pay items. The standard details need to be kept current with the specification book and Final Plans do not appear to be final when lacking ROW and final design elements. Notes on plan sheets get hidden and hinder communication between VTrans intent and the contractors understanding so there is **a need to highlight important notes. The location of borings and associated boring logs lead to changes in the contract.** There are way too many details for the same topic spread across different standards and plan details, creating confusion.

The subject of submittals was perhaps the highest value topic in need of immediate attention as evidenced by comments like **the submittal process at VTrans is a huge issue and the steel fabrication approval process is a major issue.** The contractors are frustrated by new comments made during a subsequent round of a submittal review, and contractors question the value of the reviews and whether the review process is adding value. These comments coupled with other sentiments that VTrans does not have a sense of urgency or ownership of the submittal review process are why the researchers perceived this to be a significant topic.

Other notable comments that are quality related are that the Design Teams are dedicated to quality, and E-ticketing is a big improvement. It is quick, provides easy access to information and better communication. The plans sometimes omit design elements, or require the contractor to submit design elements, and this work is not clear, and subject to interpretation, thereby driving up the pricing to cover the risk. What will be acceptable is not well defined. VTrans is adding risk to bidding projects by the number of bids rejected, re-advertised, or determined to be over budget. Bidding costs money and contractors need to recover these costs. The lack of parity on bids is in part due to the contractor's view of the risk involved and what will be allowed. A contractor may be risk adverse, but providing clearer direction as to what will be acceptable will lead to more competitive bids.

9. **Risk Sharing.** The contractors and suppliers indicated that VTrans is shifting too much risk, and the result is higher pricing for work as noted by the comments like there is too much shifting of risk when making the statement that the contractors will figure it out in the field and that VTrans should retain more of the risk as it will result in cost savings as this will be cheaper than

asking the contractor to carry the risk. Supporting comments include VTrans is paying more for risk than other states. How can we address this issue, so we are getting market value for projects? Identify what items of work transfer too much risk. The contractors noted seeing more work items incorporated in the project that require the contractor to engineer and design project features.

Specific to the Portland cement concrete supply the following statements were made, that the concrete industry wants a shot at PCC pavements and the industry believes there is an unwillingness to try treatments like PCC pavements. The contractors also stated that the percentage of concrete supplied to VTrans is such a small part of the market, the suppliers are saying that the problems are not worth the added volume of work.

In terms of bidding risk, the contractors are bidding items knowing that they will have to give credit back for failing test results and the testing process for materials puts the risk on the contractors in situations where the risk can't be passed on to the supplier. The contractors need options for suppliers as the current situation is stacking the risk of the suppliers and contractors.

More globally a comment recognized that the source of funding impacts risk assessment, bidding, and schedules of projects. The funding sources create challenges as there are strings attached. It was also noted that VTrans operates based on the bad taste from previous experience and ensures that will never happen again. This can add burdensome requirements and process when it's not necessary.

A few projects related comments include rehabilitation projects have a lot of unknowns, leading to hard discussions and change orders, and **VTrans rarely uses "approved as noted"** anymore for submittal reviews and everything is now "rejected." **VTrans should consider accepting contractor test results** to reduce the overhead cost of projects.

10. **Specifications.** A handful of very specific comments were made about specifications including that the **specifications are too burdensome** as evidenced by the new spec book, which is now two volumes. The contractors and suppliers would like to see a multi-state specification committee for more standardization.

    The market for concrete was described as having no competition for concrete and no option for suppliers. Suppliers are quoting $600 per CY for materials alone. The suppliers do not want to supply the State of Vermont, and **the performance base concrete mixes are a huge challenge** as suppliers are not interested in supplying the material. The penalties associated with the performance of concrete specifications are getting built into the risk factor for the work.

    A specific example of the specifications driving up cost are the VTrans requirements for heat straightening work preventing competent contractors from performing the work and driving up prices because **only a few firms meet the strict qualifications**.

The contractors noted that VTrans only accepts MS Projects schedule submittals and contractors prefer Primavera. VTrans should allow options and it's time to upgrade technical abilities.

11. **Workforce Development.** A lot of attention was given to workforce development, including knowledge gaps, identifying training needs for staff, and how VTrans can improve performance.

    The lack of experience was cited with statements that the contractors are speculating that with experienced staff retiring that the quality suffers, and this is true for both VTrans and the contractors. **Less experienced designers should have more field experience, constructability review training, and doing constructability reviews**, and the current staff is less experienced and may be more risk adverse. Making good and timely decisions is important, and there appears to be inexperienced staff in responsible positions as they cross over from one part of the agency to another. At some levels, the lack of experience with the new subject becomes problematic. One participant suggested that **inexperience of the designers and construction staff is 50-60% of the problem.**

    The knowledge gaps identified can also be used to develop training programs. Some of the gaps identified by the participants include the designers who need more knowledge of the specifications, and designers don't know the pricing and other pressures the contractors face. Staff should visit other projects, of similar work, to learn from how other projects are designed, and inexperienced staff refer to the specifications and become guarded in their decision making.

    Training needs are reflected by statements like there should be training for Project Managers and Resident Engineers on leadership, culture, and how to foster collaboration, and the Project Managers and Designers should visit projects to hear from the contractors and Construction about the quality of the plan sets. With less experienced staff a rotation program that encourages designers to spend time in the field during construction would be valuable, and during the off season hold lessons learned meetings to discuss and train on constructability topics.

Regarding organizational improvements, suggestions offered include making improvements to the Construction Section so they can handle more themselves and be less reliant on others. It would help to expedite reviews and decisions, and to empower the field staff to make decisions. The agency works in silos, especially with the review of submittals, and the Design staff should be empowered to achieve standardization.

A few comments were made addressing the culture like there may be a generational gap between young VTrans staff and the older contractor staff, and the attitude of the Project Managers (PM) and Resident Engineers (RE) makes a difference. The role of the PM/RE is to step in and facilitate communication, to take initiative and set the tone to get the process on track. VTrans needs to get out and see the projects, meet the people, communicate, and develop relationships.

Summary

The Focus Group feedback shows that technical issues (plans, submittals, materials) are deeply connected to organizational issues (culture, workforce experience, communication). Collectively, these themes highlight that many challenges affecting project quality and constructability are not purely

technical, but are also influenced by organizational processes, communication practices, and workforce experience.

Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims.

Task 2 involved the analysis of E&O, contract change orders, and claims. The errors and omissions data, contract change order data, and claims data provided by VTrans were analyzed to determine blind spots in the project development process and the corresponding contract documents which may be leading to unnecessary risk and reflected in bid pricing and change orders. This data will help identify high priority topics for the Agency and its collaborators and partners to focus their attention on moving forward.

The change order data from 2010 through 2023 was provided to the researchers. Included in the data are the change orders for the construction claims that have been resolved. VTrans does not track errors and omissions separately. The change order data consists of the relevant contract information, a description and amount of the change order, and the leading program. In early 2023 the data was augmented to include the necessity for revision, and whether the change order is a result of plan quantities, differing site conditions, scope creep, contractor caused, and whether the change order was avoidable. An overview of the change order data and analysis follows below.

The relevance of the change order analysis is to understand the impact on the Program resulting from processing change orders. Change orders impose several costs on the Agency, including unanticipated financial impacts, significant staff time required to identify and process revisions, potential strain on contractor–agency relationships, and possible delays to project progress while changes are evaluated and implemented.

For avoidable change orders, each one represents a problem in the contract that was identified, a solution needed to be engineered, and the pricing and schedule impacts agreed on between VTrans and the contractor. Then, the change order gets drafted, reviewed and revised, and sent around for signatures by all parties. The process takes time and resources to complete.

For some of the problems identified, the solutions are not easy and require time to engineer, plan and execute. During this process not everyone always agrees with the solutions or the impacts. It takes time to navigate these changes, which can impede progress on the site as the contractor waits for direction. The contractor must secure materials, subcontractors or special equipment to perform the work. The process may be contentious as the responsibility for the change is not clear and parties become guarded. All of this can compound and lead to a difficult relationship at the project site, delays to the completion of the work, and disruptions to the contractor's operations.

The financial cost of change orders can be significant. Performing work via change order is not the most economical approach.

Change Order Analysis

During the period of 2010 to 2023 there were 879 contracts that reached substantial completion. Figure 1 shows the number of projects that achieved substantial completion by calendar year.

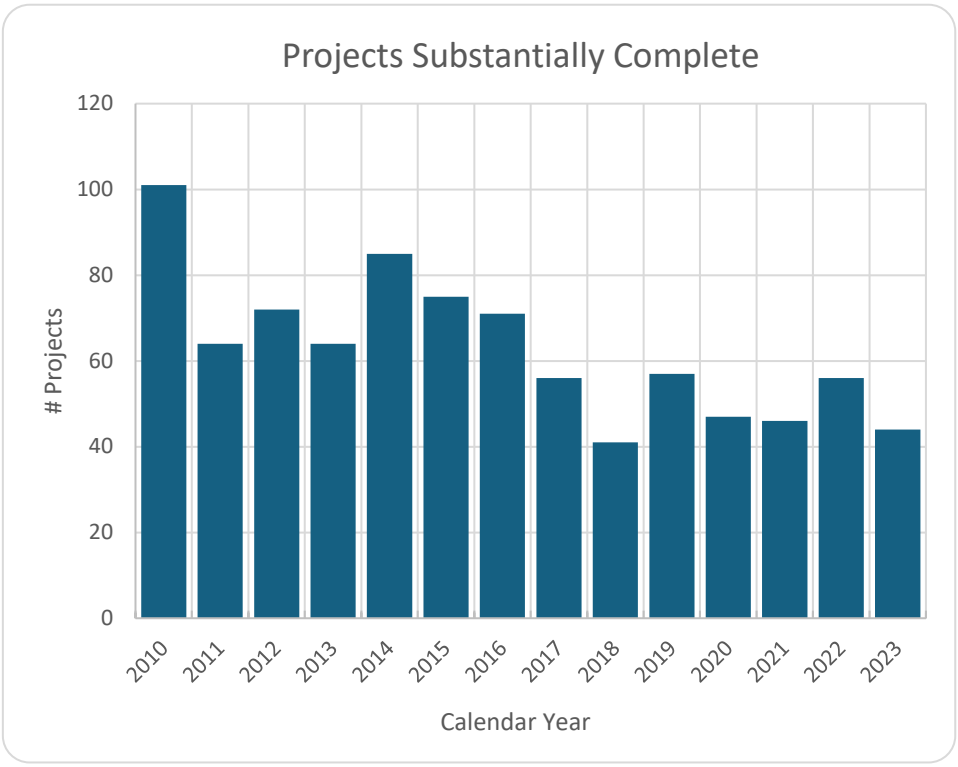


Figure 1. Number of projects substantially complete by year.

Figure 2 shows the value of payments made to contractors by calendar year. This is the total payments for all work performed in the calendar year on all projects regardless of whether they achieved substantial completion. The total value of payments made to contractors during the analysis period is $2.5 billion.

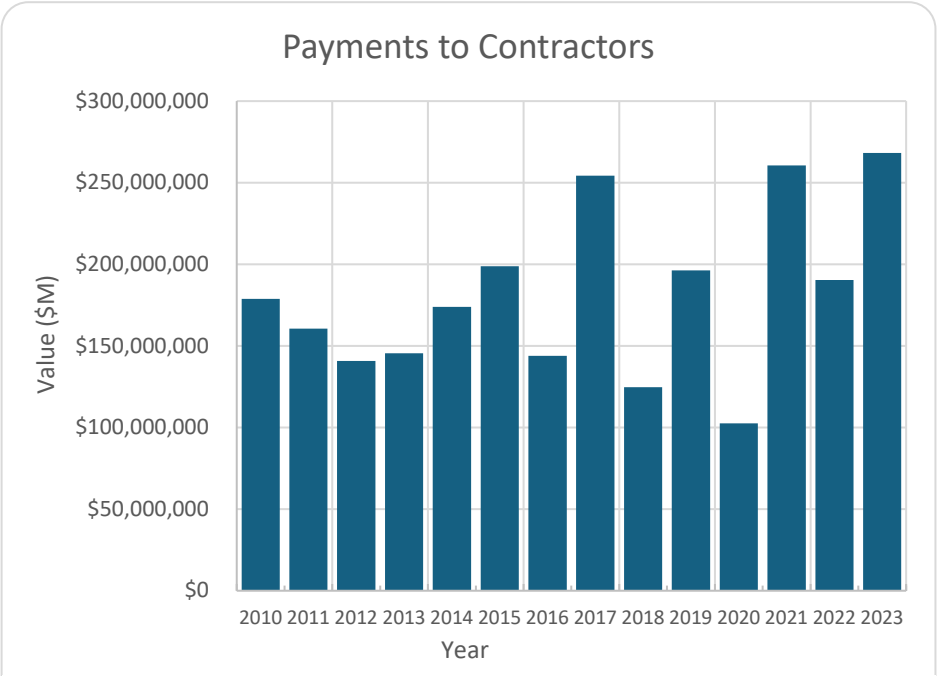


Figure 2. Payments to contractors by year.

There were 721 projects, or 82% of all projects, which required at least one change order. Table 5 provides a summary of the number of construction contracts, the value of those contracts, the number and value of change orders by Program from 2010-2023. An aggregate of the data was utilized to better inform the analysis as projects durations and project work types can vary from year to year.

Table 3. Change order value by program.

Program	Number of Construction Contracts	Value of Construction Contracts	Number of Change Orders	Value of Change Orders	Change Order Percentage of Construction
Structures	243	$884,939,526	1,255	$48,510,316	5.5%
Pavement Management	203	$1,114,640,246	905	$53,085,362	4.8%
Roadway	79	$213,802,868	561	$19,199,240	9.0%
MAB	26	$33,498,238	117	$5,498,631	16.4%
Rail	76	$98,678,782	265	$5,330,854	5.4%
Traffic & Safety	94	$117,536,961	310	$6,251,392	5.3%
Totals	**721**	**$2,463,096,621**	**3,413**	**$137,875,795**	**5.6%**

Figure 3 represents the number of contracts with change orders issued by Program.

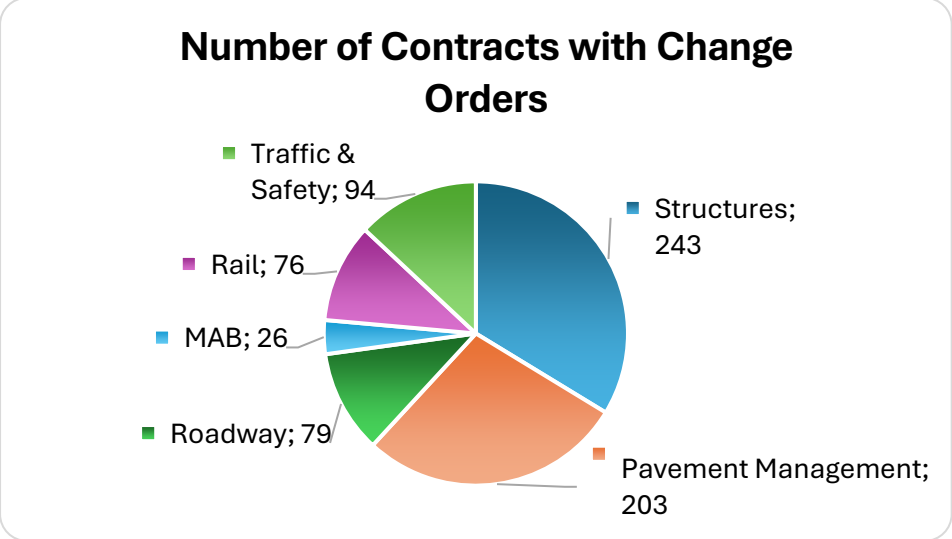


Figure 3. Number of contracts with change orders.

There was a total of 3413 change orders generated totaling $137 million in added costs. Figure 4 shows the number of change orders issued by Program.

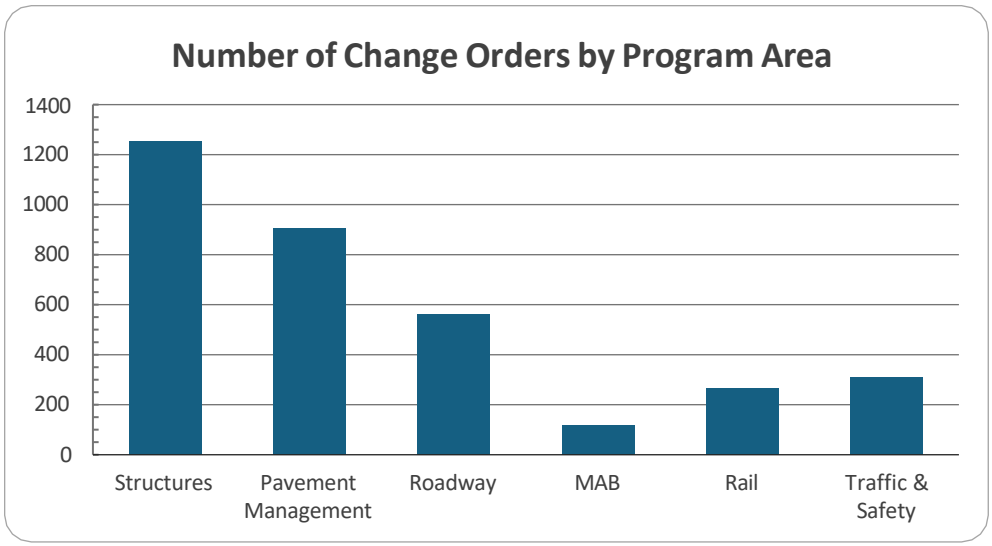


Figure 4. Number of change orders by program.

The total value of the change orders is $137 million and is broken out by Program in Figure 5.

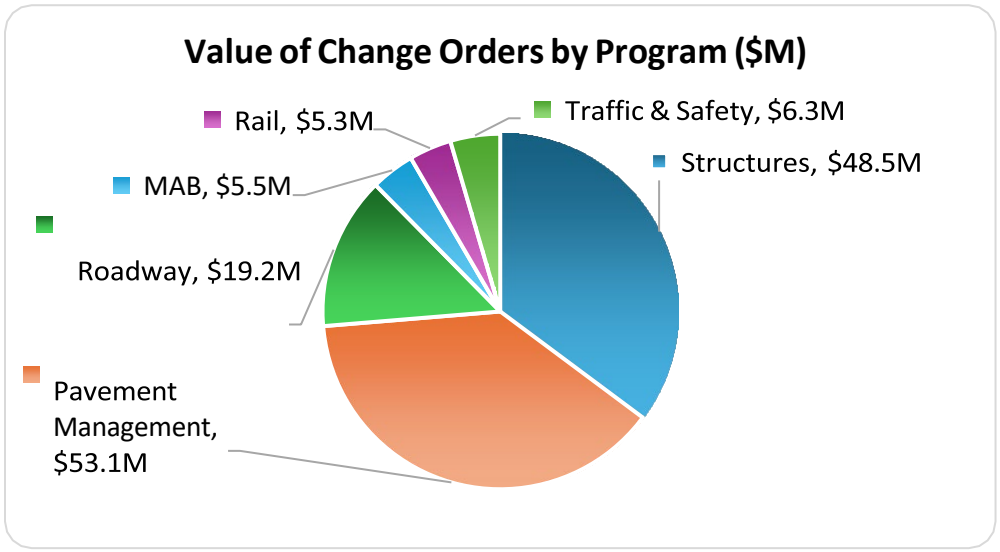


Figure 5. Value of change orders by program.

The change order data was examined and then grouped a few common themes like:

- Savings to the contract (Value Engineering, eliminating items of work)
- No-cost changes to the contract (Time extensions, material substitutions)
- COVID related (Time Extensions)
- Price adjustments (Incentive/Disincentive, Asphalt and Fuel Price Adjustments)
- Claims settlements (Cost and time extensions)

Figure 6 shows the number of change orders by the common themes and Program.

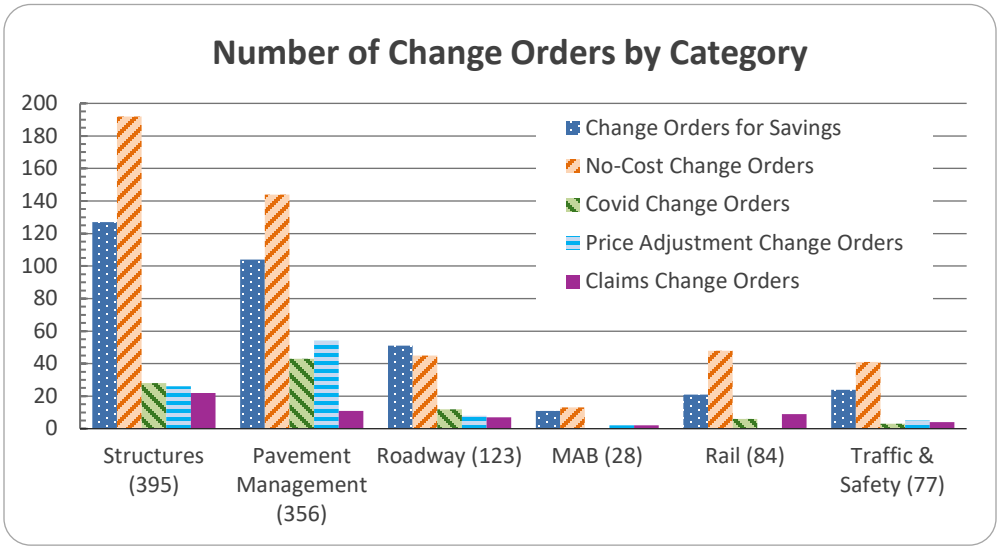


Figure 6. Number of change orders by category.

Many of these types of change order may be unavoidable. There will always be value engineering proposals, time extensions granted, items with incentives or price adjustments, and claims. The goal is to reduce the number of avoidable change orders to the greatest extent possible. Figure 7 shows the value of these change orders.

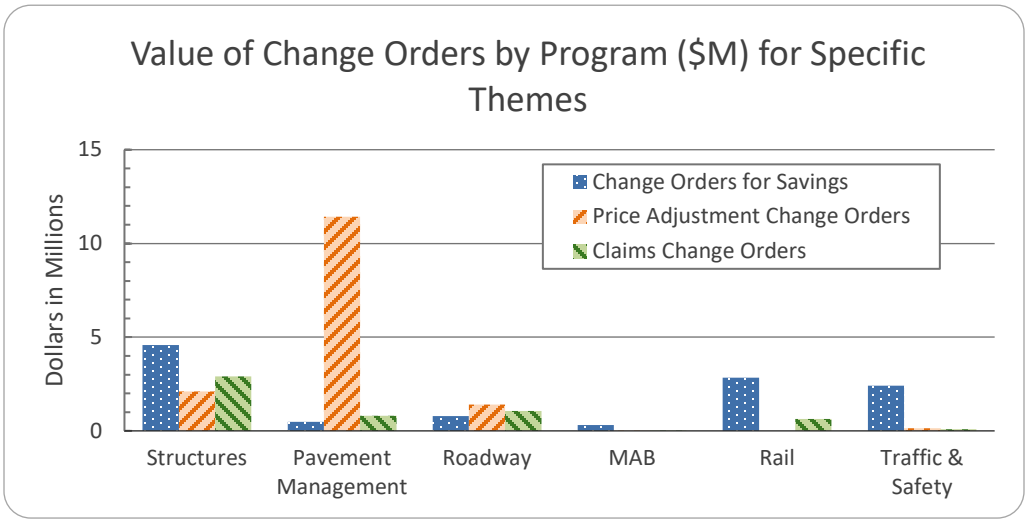


Figure 7. Value of change orders by program.

The value of the change orders for the common themes is relatively low, except for the price adjustments for the Paving Program. No surprise as both asphalt and fuel price adjustments can be significant. As described previously, the direct cost of the change orders in this category may be nominal, but there is still an impact on staff time, relationships, and the project schedule.

The change orders for claims are also relatively small when compared to the overall program budget and the value of the change orders taken as a whole.

The remaining change orders represent changes in project scope, changes to the plan quantities, clarification of plan details or specifications, differing site conditions, errors and omissions. There is no perfect set of plans and documents, but minimizing the number and value of these change orders means the projects are running smoother, there is less impact on the budget from the overruns, and staff can focus on building projects. Figure 8 shows the distribution of change orders by Program.

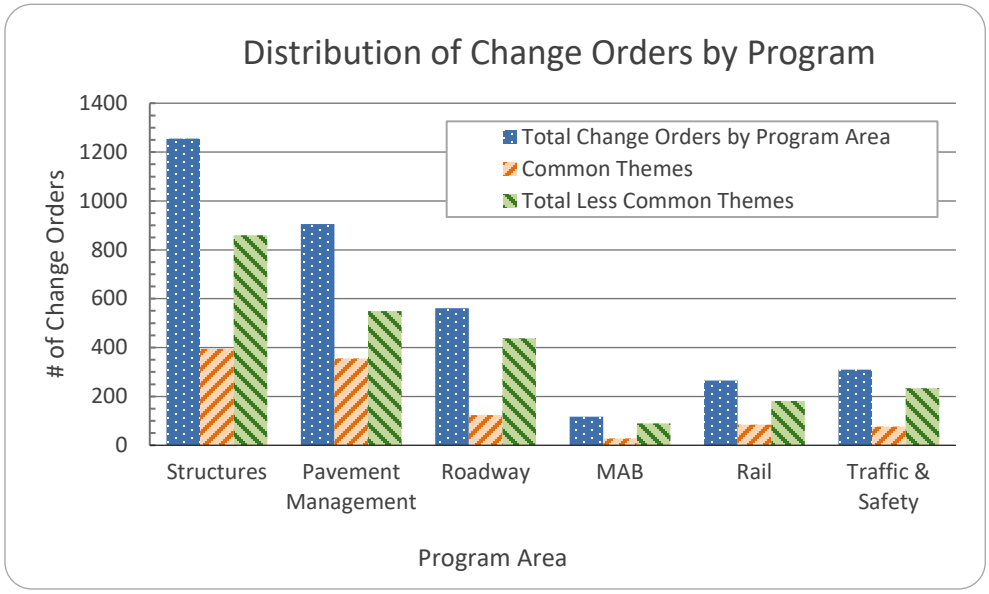


Figure 8. Distribution of change orders by program.

The distribution of change orders by program shows most change orders are not the common themes and may be considered avoidable. Figure 9 shows the distribution of change orders by a range of dollar values. For example, the Structures Program saw 99 change orders valued between $50,000 and $100,000, 60 change orders valued between $100,000 and $250,000, 12 change orders valued between $250,000 and $500,000, 8 change orders valued between $500,000 and $1,000,000, and 4 change orders valued over $1,000,000. The same data is provided for all Programs.

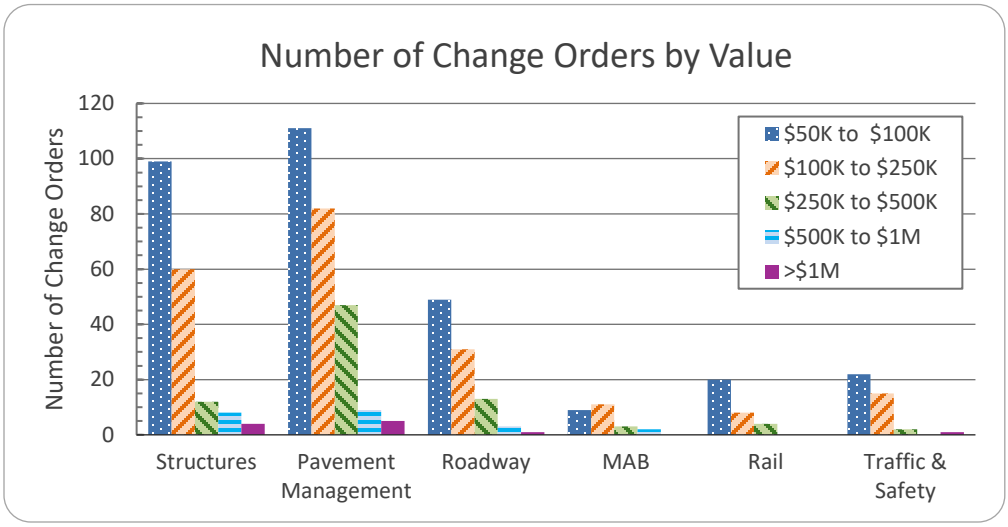


Figure 9. Number of change orders by value.

The data demonstrates a significant number of high value change orders. This would seem to imply that the changes reflected by these change orders are more than minor quantity adjustments or additions of minor project features. Change orders above $50,000 generally reflect a consequential change to the terms of the contract.

Figure 10 shows the average and median values for change orders by Program. The average value of a change order is $46,000 so the average value of $117,000 for Pavement Management is large in comparison.

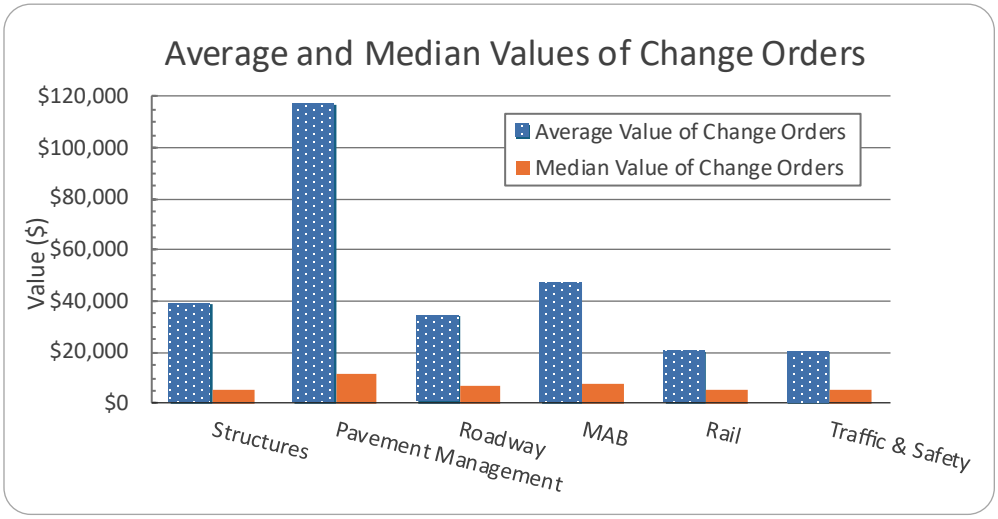


Figure 10. Average and median values of change orders.

Figure 11 shows the value of the change orders as a percentage of the total contract value by Program. Generally speaking, over the analysis period the total impact is around 5% which is well within the normal range of contingencies. The Roadway and Municipal Assistance Programs are running slightly higher than average. As noted above, the great impact is likely to staff time, the relationship and the project schedule.

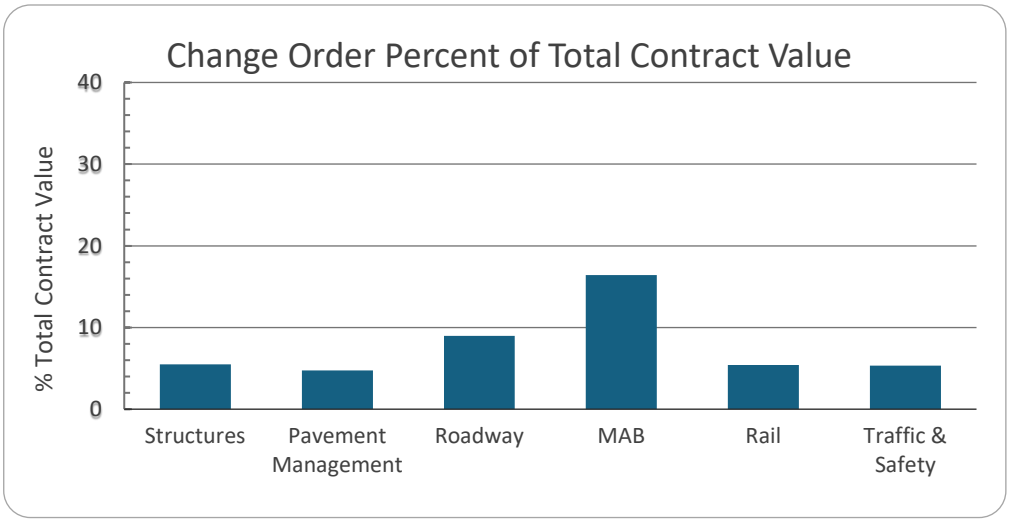


Figure 11. Change order percent of total contract value.

Figure 12 shows the average number of change orders per contract by Program area. This data reflects that most projects will experience at approximately five change orders. If the Construction Section manages approximately 50 contracts per year, and each contract generates an average of five change orders, roughly 250 change orders must be processed annually. This equates to nearly one change order requiring evaluation, negotiation, and administrative processing on every business day of the year. The administrative cost component needs to also be considered and a feedback loop from the change order data to the design groups is critical to understand the reasons why, and to avoid in future projects.

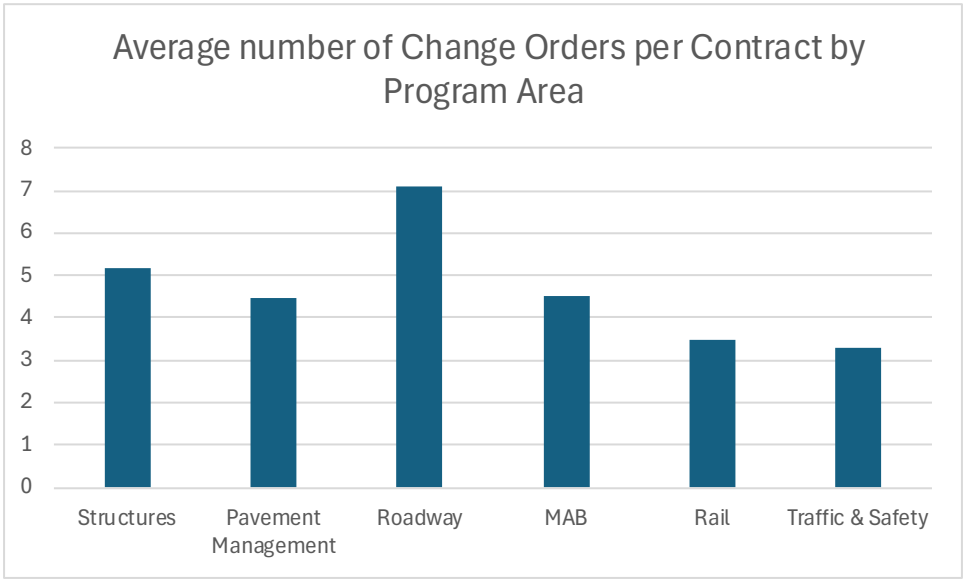


Figure 12. Number of change orders per contract by program area.

In summary, for the analysis period, the data shows that the total value of change orders is within the normal contingency range, the data also shows many high, and very high dollar value change orders as shown in Figure 10. Change orders of these magnitudes should give pause to better understand what is occurring and why. An average of five change orders per contract appears to be high.

Task 3 – State of Practice

Task 3 consisted of a desk audit to capture the current state of practice at transportation agencies for engagement between the Agency and key collaborators and partners focused on feedback to help improve the overall quality and risk of delivered projects.

Appendix G includes a state-by-state summary of the desk audit.

The desk audit consisted of a review of the 49 other DOT websites to identify the current state of practice for engagement between the DOT and key collaborators and partners. The results of the desk audit follow below, however before describing the findings it is worth noting a few caveats associated with this method of data collection. For instance, DOT's websites are not always current. The information available may be outdated and no longer reflects the current state of practice. In addition, the website may be silent on the collaboration with key partners since the typical audience for the websites are often public facing and provide resources for contractors and consultants trying to do business with the DOT. DOT's may view the collaboration efforts with industry as an operating procedure and do not feel there is a need to post the process or results to the website. Another way to say this is, the lack of information found from the website should not imply that the DOT is not collaborating with the contracting industry.

The review of the DOT's websites focused primarily on collaboration efforts between the agency and the department, but also looked for the topics of constructability reviews, quality of plans and documents, and related topics that speak to the culture of the organization as it relates to working collaboratively with industry partners. This data is also provided in the overview.

One observation noted is that the majority of DOT's have dedicated webpages, manuals, and guidance documents devoted to engaging the public in the project development process. Here are a few examples of the ways in which DOT's have embraced public engagement:

1. Dedicated webpages or portals easily accessible from the DOT landing page (Caltrans, Indiana, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nevada, New Jersey, New Mexico, Oklahoma, South Carolina, South Dakota, Tennessee, Utah, Virginia, Washington)
2. Posts project plans during the plan development stage for review on the website (Caltrans, Minnesota, South Carolina)
3. Posts public engagement meeting information for projects on the website (Caltrans, Michigan, Minnesota, Nevada, Oklahoma, South Carolina, South Dakota, Tennessee, Utah, Virginia)

DOT's have recognized the need and value of engaging with the public as part of the project development process. The collaboration often yields valuable information to incorporate in the project like design features or amenities, preferred timing and scheduling conflicts, use cases, and local knowledge of the project area. The end results are hopefully projects that meet the needs of the traveling public, the community, and are in context of the natural and built environment. Projects with robust public engagement often achieve more success and are considered successful by the public. Another observation found from the review of the websites is that some DOTs have programs and initiatives to support the development of small businesses. These efforts are separate and distinct from the programs targeting disadvantaged business enterprises. Providing materials and services to DOT's is challenging and requires knowledge of a myriad of technical and contractual requirements, specialized skill sets, and the ability to assess and accept risk. DOT's need competition to achieve the best value so

encouraging business to operate in this space by reducing the barriers to entry may prove to be a worthwhile strategy. States with small business program information on the websites are Michigan, Oregon, South Carolina, Tennessee, and Virginia.

It was also noted that several DOT websites are structured around the idea of making the information for key stakeholders easy to find. These sites often have a primary heading like “Doing Business with the DOT” for contractors, consultants and material suppliers to find what they need. Much of the information is the routine content like how a contractor get prequalified, how to submit a bid, or the forms used for a business process. A few states (California, Missouri, Ohio) have web pages focused on providing contractors with new information and important notices that they need to be aware of. Providing contractor centric important information in one place promotes timely communication.

Contractor Engagement

The review identified several strategies for contractor engagement like formal in-person dialogue between the DOT and industry. The in-person dialogue occurs in a variety of venues like scheduled meetings, conferences, summits and technical work sessions. While the venue may differ, the premise of the gathering is to promote dialogue and collaboration. Other strategies include formal partnering and the use of dispute resolution process at the project level. Notable practices for engaging contractors include:

1. Alabama has the Alabama Road Builders Association providing exclusive representation of the industry. The association speaks for the industry and works closely with the DOT.
2. Caltrans has a Bridge Contractors/Caltrans Liaison Committee whose stated objective is to foster productive discourse between bridge design and the contracting community. The committee is focused on structural matters, meets twice a year, and has a focused meeting with agenda, presentations and minutes.
3. Kansas has the Kansas Contractors Association. KDOT created a task force to improve relationships between KDOT and contractor’s personnel. Annual workshops are held.
4. Missouri DOT staff meets with AGC members and has specific committees to discuss bituminous pavement, concrete pavements, bridges, grading, safety and specialty items.
5. Nevada DOT (NDOT) has a Construction Industry and NDOT Liaison Committee and uses subcommittees to tackle specialty topics.
6. Ohio DOT hosts regional roundtable meetings for prime contractors, subcontractors, DBE’s and consultants.
7. Oregon DOT hosts joint annual meetings between the DOT and AGC.
8. South Carolina DOT hosts a joint annual meeting between the DOT and AGC.
9. South Dakota DOT hosts an annual webinar and annual Summitt between the DOT and AGC.
10. Texas DOT hosts a joint committee meeting for the DOT and AGC. The DOT Districts have co-hosted workshops with contractors to discuss accelerated bridge construction.
11. Utah DOT hosts a Utah Transportation Conference for all partners.
12. Washington DOT hosts a joint annual meeting with AGC.
13. Wisconsin DOT has separate technical committee meetings with industry representatives for project development, structures, technical services and traffic operations.

The language used by the DOTs on their web pages to describe the gatherings often uses the phrase "hosts a joint meeting" between the DOT and its partners. The implication appears to be that the meeting is co-owned by the DOT and AGC, that both entities take ownership of the meeting, which could be an important distinction for meaningful engagement.

Partnering

According to the U.S. General Services Administration, Partnering is a formal management process in which all parties to a project voluntarily agree at the outset to adopt a cooperative, team-based approach to project development and problem resolution to eliminate or at least reduce conflicts, litigation and claims. DOT's have adopted partnering as a project tool to help navigate the task of building complex projects.

Based on information taken from the DOT's webpages, at least 14 states identify support of partnering and provide partnering resources on the web site. Only Arizona DOT stated that partnering is required on all projects. Caltrans, Nevada, and Ohio DOT resources to support partnering are robust. Utah DOT offers training for partnering.

Dispute Resolution

There are several methods for resolving disputes including mediation, negotiation and legal proceedings. A few states avail themselves of the process of engaging a dispute resolution board, which consists of impartial professionals who are engage throughout the life of the project to help resolve conflicts. There are many names used for dispute resolution boards, and there are several models available for use. Only Caltrans, Idaho, Minnesota, Nevada, Ohio, and Washington DOT promote the use of dispute resolution on their website.

Constructability & Quality

The research study envisions a framework for defining quality and constructability of transportation projects. As a subset to the desk audit research, DOT websites were reviewed for process, guidance, or strategies that promote the constructability of projects, and the quality of plan sets or contract documents. Notable practices were captured with the review and reported as follows:

1. Georgia DOT has a constructability guidance tool to use during the project development process.
2. Indiana DOT has a constructability review guide as part of the project delivery process.
3. Louisiana has a Plan Quality Unit to optimize constructability and performance while mitigating costs.
4. Michigan DOT has preliminary and final constructability reviews embedded on the Design Process Flowchart. The constructability review steps are contained in the Design Manual with specific action items.
5. Minnesota DOT has an Industry Constructability Review Guidelines document as part of the innovative contracting process. Also, a Quality Management Process for final plan development of design-bid-build projects that include quality reviews, independent reviews, constructability reviews and checklists.
6. Nevada DOT has a dedicated position of Constructability Manager.
7. New Jersey has a constructability review manual, with concepts to consider, checklists and implementation plans. They have a guidance document on how to review plans from a constructability perspective and have process maps for constructability during the project

development cycle. In addition, has a well-documented customizable Capital Project Development Process overing all project phases (problem screening through construction).

8. New York State DOT offers training on designing bridges for constructability.
9. Oregon holds virtual constructability review meetings and one-on-one meetings with contractors for projects. They also have a Project Delivery Quality Program Manual.
10. Tennessee DOT has a constructability review procedures manual. Contractors can request to participate in constructability reviews; the constructability reviews and projects are posted to the website. They also have a Quality Manual and a Project Quality Management Plan.
11. Washington DOT has a Manual for Instruction for the Implementation of the Constructability Review Process.
12. Wisconsin DOT has a Construction Quality Management toolkit.

As the Framework described later in this report is implemented, these practices should be further reviewed for incorporation or improvement of VTrans current documented practices.

Task 4 – Risk Assessment

The data compiled and analyzed from Tasks 1 through 3 identified issues that may be leading to unnecessary risk, cost overruns, change orders, claims, extensions of time, and inflated bid pricing. The goal of Task 4 is to identify, compile and assess the risk of these issues to allow the Agency to understand the topic and their implications, and to help form the preliminary issues list that can be used in discussion with the collaborators and partners.

For the risk assessment, the issues identified (i.e., risks to VTrans quality and constructability) in the data collection tasks (literature review, survey, and focus groups), the data analysis (errors and commissions, change orders, and claims), and state of practice were compiled into common themes. These themes were then evaluated for probability (likelihood of affecting VTrans) and severity of impact on VTrans operations. Based on the risks scores, a priority list of issues to address in the framework was prepared.

Note: a risk can be either a threat or an opportunity.

The following sections take you through this process step by step.

1. Issues (risks) identified by task, listed alphabetically.

Table 4. Risk themes.

Themes (risks)				
Task 1			Task 2	Task 3
Literature Review	**Survey**	**Focus Groups**	**E&O, CO & Claims**	**State of Practice**
Change Orders	Barrier to Entry	Barrier to Entry	Claims Settlement	Constructability
Constructability	Burdensome Requirements	Collaboration	Material Substitution	Contractor Engagement
Culture	Environmental Regulations	Communication	Price Adjustments	Dispute Resolution
Design	Funding	Constructability	Scope Change	Partnering
Disputes/Claims	Innovative Materials	Culture	Time Extensions	Quality
Innovation	Partnering/Culture	Planning	Value Engineering	
Partnering	Process	Process		

Themes (risks)				
Task 1			Task 2	Task 3
Literature Review	**Survey**	**Focus Groups**	**E&O, CO & Claims**	**State of Practice**
Pricing	Quality of Plans	Quality		
Procurement	Rising Costs	Risk Sharing		
Quality Control	Specifications	Specifications		
Risk	Submittals	Workforce Development		
Trends	Time			
Trust	Workforce Development			
Workforce Development				

2. The 49 themes by tasks as shown in step 1 were organized, or compiled, into the following 23 overall risks affecting VTrans quality and constructability.

Table 5. Compiled themes (risks).

ID #	Compiled Themes (risks)	Includes
1	Barrier to Entry	Barrier to Entry
2	Change Orders	Change Orders
3	Constructability	Constructability
4	Contractor Engagement	Contractor Engagement
5	Culture	Culture
6	Design	Design Scope Changes
7	Disputes/Claims	Claims Settlement Disputes/Claims Dispute Resolution
8	Environmental Regulations	Environmental Regulations
9	Funding	Funding
10	Innovation	Innovation Innovative Materials Material Substitution
11	Partnering	Partnering Partnering/Culture Collaboration Communication
12	Planning	Planning
13	Pricing	Pricing Price Adjustments Rising Costs
14	Process	Process Submittals Burdensome Requirements
15	Procurement	Procurement
16	Quality	Quality Quality Control Quality of Plans

ID #	Compiled Themes (risks)	Includes
17	Risk	Risk Risk Sharing
18	Specifications	Specifications
19	Time	Time Time Extensions
20	Trends	Trends
21	Trust	Trust
22	Value Engineering	Value Engineering
23	Workforce Development	Workforce Development

3. These 23 compiled themes, or risks, were evaluated qualitatively using the following scales for probability, impacts, and risk score/rank. The qualitative probability–impact scoring framework was selected because it is widely used in transportation risk management and allows qualitative insights from surveys and focus groups to be incorporated alongside quantitative data.

Table 6. Probability scale.

Probability (of the risk occurring on a construction project or program) Matrix				
Very Unlikely	Unlikely	Possible	Likely	Very Likely
1	2	3	4	5
< 15%	15 – 39%	40 – 59%	60 – 85%	>85%

Table 7. Impact scale.

Impact (on the quality and constructability of transportation projects) Matrix				
Insignificant	Minor	Moderate	Significant	Severe
1	2	3	4	5
< 15%	15 – 39%	40 – 59%	60 – 85%	>85%

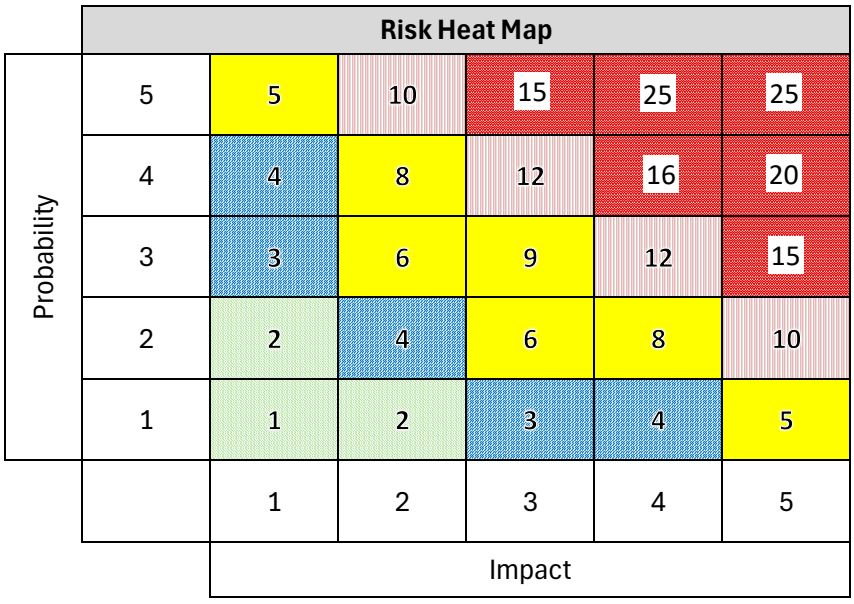


Figure 13. Heat map.

Table 8. Risk Scoring.

Risk Score	
Very High	>14
High	10-14
Medium	5-9
Low	3-4
Very Low	1-2

4. These 23 compiled themes, or risks, were evaluated and scored as shown in the following table. It is noted that since these risks were identified in tasks 1-3 as affecting the quality and constructability of a project or the construction program in general, that Low and Very Low risk scores were not expected.

Table 9. Compiled themes (risks).

ID #	Compiled Themes (risks)	Probability	Impact	Risk Score
1	Barrier to Entry	4	3	12
2	Change Orders	4	3	12
3	Constructability	3	4	12
4	Contractor Engagement	5	4	20
5	Culture	3	5	15
6	Design	3	4	12
7	Disputes/Claims	3	4	12
8	Environmental Regulations	3	3	9
9	Funding	5	4	20
10	Innovation	3	4	12
11	Partnering	4	4	16
12	Planning	3	4	12
13	Pricing	4	4	16
14	Process	4	5	20
15	Procurement	3	3	9
16	Quality	4	4	16
17	Risk (sharing)	5	5	25
18	Specifications	4	4	16
19	Time	3	4	12
20	Trends	5	4	20
21	Trust	4	4	16
22	Value Engineering	3	3	9
23	Workforce Development	5	5	25

Based on the above analysis, the risks scored “very high” for priority addressing in the proposed framework are:

Table 10. Top scored themes (risks).

ID #	Compiled Themes (risks)	Probability	Impact	Risk Score
4	Contractor Engagement	5	4	20
5	Culture	3	5	15
9	Funding	5	4	20
11	Partnering	4	4	16
13	Pricing	4	4	16
14	Process	4	5	20
16	Quality	4	4	16
17	Risk (sharing)	5	5	25
18	Specifications	4	4	16
20	Trends	5	4	20
21	Trust	4	4	16
23	Workforce Development	5	5	25

Task 5 – Interim Report

The goal of Task 5 was to summarize the research performed in Task 1 through 4 by consolidating the information into an interim report. This allowed the Agency to digest the research findings, comment on the information, and provide input to the remaining tasks 6-8.

Draft Interim Report issued August 12, 2025 (***VTrans Research_GR1881_Task 5-Interim Report.pdf***).

The research team presented the interim report to VTrans representatives in person on August 20, 2025. The agenda and PowerPoint presentation of the Draft Interim Report can be found in **Appendix H** and **Appendix I** respectively.

VTrans Technical Advisory Panel provided 80 comments on the Draft Interim Report on August 25, 2025. The comments and proposed responses (**Appendix J**) were shared on October 3, 2025 (filename: ***VTrans Research_GR1881_Task 5-Interim Report_comment response.docx***). The Final Interim Report was issued October 25, 2025 (filename: ***VTrans Research_GR1881_Task 5-Interim Report_final.pdf***).

Chapter 3. Phase II – Framework

Task 6 – Develop a Proposed Engagement Framework

The second objective of this project was to develop a framework with which VTrans can engage the contracting community and key collaborators and partners. Phase I of this project focused on the data collection to help inform VTrans of what information was available from existing literature, to more fully understand the concerns and observations of Agency employees and the contracting community, the analysis of change order and claims data, and the current state of practice at DOT's across the nation. The results of phase I identified common themes that represent the issues and sentiments shared with the research team. Table 11 represents the themes captured in phase I and presented is a format to help identify commonality and the source of the theme (the top ranked risks are highlighted). This approach will help the development of the framework.

Table 11. Phase I Themes and highlighted top risks.

Task 1			Task 2	Task 3
Literature Review	**Survey**	**Focus Groups**	**E&O, CO & Claims**	**State of Practice**
	Barrier to Entry	Barrier to Entry		
	Burdensome Requirements			
Change Orders			Scope Change	
Disputes/Claims			Claims Settlement	Dispute Resolution
		Collaboration		Contractor Engagement
		Communication		
Constructability		Constructability		Constructability
Culture		Culture		
Design				
	Environmental Regulations			
	Funding			
Innovation	Innovative Materials		Material Substitution	
Partnering	Partnering			Partnering
		Planning		
Pricing			Price Adjustments	
	Process	Process		
Procurement				
	Rising Costs	Risk Sharing		
Quality Control	Quality of Plans	Quality		Quality
Risk				
	Submittals			
	Specifications	Specifications		
	Time		Time Extensions	
Trends				

The Framework

To begin the discussion of a framework, and how the framework can assist the Agency with advancing the state of practices captured by the themes identified in Phase I, consider the following review of program management. The Agency has programs like Structures, Highway, Paving, Rail and Aviation, and the department head is referred to as the Program Manager. At the organizational level, their responsibility is to deliver capital projects approved through the legislative process, abide by state and federal law, regulations and policies, and ensure value for taxpayers. At the operational level, managing a program is akin to a three-legged stool, where each leg represents the key components the Program Manager must manage for the program to remain balanced and upright. The three legs of the stool are represented by the resources, deliverables, and outreach efforts. Each of these components is further described as follows:

1. Resources. The program manager has resources under their purview in the form of people, funding and equipment necessary to deliver the program.
    a. People. Each program relies on staff to help fulfill its mission. These are engineers, technicians and other skilled positions that perform the work. They can be government employees or consultants, and they require the knowledge, skills and abilities to perform their tasks proficiently. The program will employ workforce development strategies to provide core competencies, guidance and training for all positions, and to maintain a skilled workforce.
    b. Funding. The program is allocated funding through the budgeting and legislative processes and is expected to manage its budget and fulfill its programmatic responsibilities and provide the best value for the taxpayers. The budget must be planned, allocated and tracked to deliver value and to guard against waste and fraud.
    c. Equipment. Programs have a wide range of equipment like office space, computers, software, testing equipment, vehicles and so forth used to perform the work. Managing these assets requires careful planning to provide staff with the right tools in working condition, while planning for the replacement. Leveraging new technology like LiDAR, Artificial Intelligence, and 3D design and modelling is a constant task for the program to remain current.

2. Deliverables. Deliverables for the Agency have two basic forms: work products and work processes. These are deliverables that represent the efforts by staff to prepare and produce information required to fulfill their programmatic responsibilities.
    a. Work products are documents produced by the program like sets of plans, contract documents, studies, reviews, letters, memorandums, and reports. Essentially any product that supports the core mission is considered a work product.
    b. Work processes are a form of deliverable the programs need to manage to sustain quality, transparency and efficiency. Examples of processes include the project development process, the submittal review process, design quality checks, plan quality checks and constructability reviews. The program develops and maintains work processes to inform the staff of the standards and expectations.

3. Outreach. The program cannot operate in a vacuum and needs support from key partners and stakeholders to fulfill its mission. The Agency cannot build bridges, roads, and other

infrastructure without the support from key constituents, and with this dependency comes the need for dialogue with stakeholders and partners so the Agency is positioned to foster an effective working relationship. The four key constituencies a program develops relationships with are:

a. The contracting community, which is the collection of contractors, subcontractors, fabricators, and suppliers.
b. The legislature, the executive branch, sister agencies, and other divisions and sections of the agency.
c. Local governments, property owners and business owners impacted by specific projects.
d. Regulators like the Federal Highway Administration, the US Army Corps of Engineers, FEMA, and utilities that share transportation corridors to deliver their services.

When we examine the themes identified in Phase I as they relate to the three legs of program management, each theme can be attributed to one or more of the three components of program management. For example, quality, process, and the submittal themes all relate to deliverables. The barrier to entry, risk sharing, collaboration and partnering themes belong to the outreach component. While constructability, specifications and innovations, themes belong to outreach and deliverables. There may be overlaps, where themes may be part of more than one program management component, and the Agency can adjust the allocation based on the scope of the specific topic.

Making the connection between the theme and one or more of the three key components of program management informs the strategies the Agency can employ when focusing on any specific theme. For example, the agency may deploy a training strategy as a subset of workforce development by using a combination of offerings from AASHTO, NHI and the Vermont Technical Training Center (VTTC). Delivering technical training becomes one strategy to address the quality and constructability of transportation projects. Another example is to recognize that risk, pricing, and innovation require collaboration with industry to better understand the risk assigned by the terms of a contract, the pricing pressures faced by contractors, and the successful deployment of innovations all benefit from constructive dialogue.

In this context, the proposed framework can be viewed as the collection of strategies used to address the themes identified in Phase I, and any other topic that is identified in the future. The themes identified are broad and complex and no single strategy can address every theme. The Program Manager needs to make the connection between the topic of interest and the three program management components to select the most appropriate strategy that will result in improvements to the state of practice.

Strategies

The framework and strategies are depicted in Table 13. The strategies employed may be unique to one theme or apply to several themes. In other words, it may require more than one strategy to address complex topics.

The Task 7 section of this report provides a recommended process for prioritizing strategy implementation through an oversight team and identification of working groups to implement each strategy. Many of the strategies apply directly to one program but examples from one program can be

emulated by another program and thus spread implementation of these ideas and improvements to the Agency's overall constructability and quality.

This following identifies examples of strategies for the three program management components: **resources, deliverables**, and **outreach**.

Resource Strategies

The strategies for **resources** are:

People

1. **Establish core competencies** for job classifications (knowledge, skills and abilities). The core competencies identified are specific to the position and their role in the organization. The standard job classification used for recruitment lacks the detail necessary to develop training needs and promote professional development. The core competencies need to be job specific.
2. Develop programs to deliver **core competency training**. Once the core competencies are developed, then training needs can be assessed based on individual proficiency. Training is more effective when targeted to meet specific needs and is timely. Training modalities may be a combination of in-person instructor led, virtual or web based. These trainings may be developed in house, or leverage existing resources like National Highway Institute (NHI),New England Transportation Technician Certification Program (NETTCP), American Association of State Highway and Transportation Officials (AASHTO), and Local Technical Assistance Programs (LTAP) , colleges and universities.
3. **Establish career ladders** based on demonstrated proficiency. Employees are motivated to learn, grow and take on more responsibility. Providing a clear pathway that rewards and promotes professional development helps empower employees to invest in their careers, knowing that more responsibility and compensation will follow. Career paths are very important retention tools.
4. **Provide professional development opportunities** that lead to career advancement. The talent needs to be challenged, and leadership can look for opportunities to promote professional growth. Examples include providing exposure to the next level of leadership in the organization, seeking challenging technical problems or projects, and appointments to tasks forces and working groups.

Funding

1. **Develop asset management tools** for forecasting network level condition of the assets. Asset management systems are essential to forecasting the network level conditions based on available funding and to select the right mix of preservation, rehabilitation and replacement projects. The program manager must have robust data collection, modelling and analysis tools to make informed investment decisions.
2. **Institute tools to develop sound estimates and scopes** when programming new projects. The scoping phase of a project identifies the preferred treatment and sets in motion the funding commitments. When the scopes change and estimates increase, the program must absorb these increases with cuts to other projects. This fluctuation in the program creates turbulence with the agency partners in the project development cycle as plans evolve and change.

3. **Develop a fiscally constrained program** of projects for each fiscal year, with a three-to-five-year planning horizon. Establishing a predictable and stable list of projects that will be delivered annually to construction informs the capacity of support services needed and allows the contracting community to plan.
4. **Track expenditure** on payroll, consultants, payments to contractors and related expenses. Budget tracking is essential to future planning, avoiding over-expenditures and maximizing the investment in the assets and the workforce.

Equipment

1. **Develop an inventory of equipment**. Agency owned or leased equipment is inventoried by program area to understand the financial commitments with its maintenance, use and replacement. Knowing the use rates informs capacity decisions.
2. **Develop an annual maintenance schedule** for large equipment. Large equipment requires costly maintenance and keeping the equipment in service allows the organization to meet their operational needs. The cost of large pieces of equipment is very expensive so budgeting for proper maintenance is essential to preserve capital investments.
3. **Develop a replacement schedule** for computers and software. Technology is the backbone of a transportation agency and without the software and hardware functioning the workforce is sitting idle. Both have lifespans and require upgrades and replacements. Developing schedules and budgets for the replacement of hardware and software is essential to the workplace.
4. **Create an equipment budget**. Develop, track and report on the budget for equipment.

Deliverable Strategies

The strategies for **deliverables** are:

Work Products

1. **Develop and maintain guidance documents** setting quality standards. Large organizations and the consultants providing services benefit from operations manuals, directives, policies, and standards that bring clarity and predictability to the development of the deliverables. Staff require direction that promotes quality and consistency expectations. The absence of these guidance documents opens the door to errors, inconsistencies and substandard quality.
2. **Checklists and process controls** help ensure quality standards are achieved. Checklists and process control data points bring accountability to the process. Supervisors measure performance to identify improvement opportunities.
3. **Track key metrics** to help measure performance. Departments and programs develop key performance indicators (KPI's) to monitor quality, timeliness, defects, costs, and other measures. These are separate from Agency level KPI's and are unique to each program area.

Work Processes

1. **Develop and document workflows** and work instruction to capture business practices. A subset to the guidance manuals is graphic representations of the process illustrated as workflows. These workflows provide a step-by-step path for practitioners to follow as they perform their work. Work instructions supplement the workflows by providing clear instructions, required

forms, and helpful links to supporting information. Together, the workflows and instructions direct practitioners every step of the way.

2. **Provide staff training** in the workflows and instructions.
3. **Use business process improvement strategies** to update and streamline business processes.
4. **Use key metrics** to track compliance and efficacy of processes

The task 3 summary of practices, processes, and guidance documents from other state DOT agencies should be further reviewed for incorporation or improvement of VTrans current documented practices as the above strategies are implemented.

Outreach Strategies

The strategies for **outreach** described below consist of a recognition of existing campaigns and a selection of proposed efforts based on themes presented in phase I.

Existing outreach campaigns are as follows:

1. The Association of Consulting Engineering Companies (ACEC). VTrans meets quarterly with ACEC to receive updates from the Chief Engineer's Office, FHWA, Contract Administration, Specifications Committee, and the Standards Committee. There is open discussion.
2. The Associated General Contractors of Vermont (AGC-VT). VTrans leadership meets with leadership of AGC-VT to discuss current matters. The agenda is ad-hoc and evolves as required.
3. Specification Committee. The VTrans Specification Committee meets monthly to review proposed revisions to the specifications. ACEC and AGC have representatives on the Specifications Committee.
4. The Standards Committee. VTrans experts gather to review and update the Standard Drawings, which are incorporated by reference in most contracts. ACEC has representation on the Standards Committee.
5. The Technical Pavement Committee. TECHPAVE is a working group to discuss all pavement matters, from the pavement mix designs, operations at the plants, laydown, and the governing specifications. This is a collaboration of VTrans staff, producers, suppliers, and contractors.
6. The Contractors Workshop. The Construction Section hosts an annual workshop and invites contractors and consultants to discuss successes and opportunities for improvement.
7. The Statewide Transportation Improvement Plan (STIP/TIP) Development. VTrans involves the Regional Planning Commissions and Metropolitan Planning Organizations during the development of the STIP/TIP to receive input on priorities for transportation projects.
8. Local Concerns Meetings. As part of the scoping process, VTrans will hold local concerns meetings to present the purpose and need of a project and receive input which will inform the selection of the preferred alternative.
9. Concrete Producers Committee. For a period, VTrans hosted meetings with the concrete producers to develop performance based concrete specifications. This committee was sunset after the deliverable was achieved.

The above list demonstrates VTrans has a robust outreach effort and working collaboratively with key stakeholders is not a new concept for the Agency. Many of the above efforts have been in place for

many years and have produced notable achievements like the implementation of Superpave, the development of performance based concrete specifications, community involvement in projects, clear contracting and management of consultant services, and clear communication channels at the executive level of the Agency, contractors and consultants to name a few. The existing efforts have clearly demonstrated value, however based on the feedback received during Phase I and the genesis for this research, there are gaps which could benefit from a more complete approach.

The strategies for **outreach** are as follows:

Contracting Community

1. **Host facilitated meetings**
2. **Participation by key decision makers**
3. **Oversight from Chief Engineer's Office**

Legislature and State Government

1. **Deliver presentations to Committees**
2. **Engage with members of committees, Representatives, and Senators**
3. **Prepare responses to inquiries**

Project Stakeholders

1. **Ensure effective engagement with elected officials**
2. **Ensure business owners are engaged and informed**
3. **Ensure property owners are informed and treated fairly**
4. **Ensure public engagement process is followed**

Regulators

1. **Engage regulators at the program and project level**
2. **Work with the FHWA Division Office**
3. **Engage utilities at the program and project level**

The most notable gap in Agency outreach is at the program level. Each Agency program would benefit from a dialogue with the industry. Industry representation includes consultants, material suppliers, fabricators, contractors and subcontractors. The program level meetings require careful stewardship to derive the maximum value. Successful meetings require an independent skilled facilitator, participants empowered to make decisions, a professional code of conduct, meeting agendas and minutes carefully captured. Gathering participants in a meeting in of itself is not enough to achieve success. The work is hard, and it requires professionals capable of delivering the commitments to improve the state of practice.

The program level outreach will benefit from the support and oversight of executive leadership. The Chief Engineer's office would take an active oversight role of the program outreach efforts by receiving meeting agendas and minutes, participating when required, receiving quarterly briefings from the program managers and independent facilitators, making decisions, and supporting the outcomes. The Chief Engineer' office is instrumental for establishing a culture of collaboration and problem solving, which are a key focus of these meetings. This oversight will help sustain the efforts and ensure progress is made.

Table 12 allocates the themes identified in Phase I (Table 11) by the three components of program management as a starting point to help inform a path forward to address the feedback. The top ranked risks are shown in bold text and are highlighted in red. This is meant as a guide, to get the process started and will evolve.

Table 12. Themes by Program Management Components.

Resources	Deliverables	Outreach
	Scope Change	Barrier to Entry
	Change Orders	Burdensome Requirements
	Disputes	Dispute Resolution
Collaboration		**Collaboration**
Contractor Engagement		**Contractor Engagement**
Communication		**Communication**
	Constructability	
Culture		
	Design	
Funding		**Funding**
Innovation		Innovation
Partnering		**Partnering**
		Pricing
	Process	
	Procurement	
		Risk Sharing
	Quality	
	Submittals	
	Specifications	**Specifications**
	Time	Time
		Trust
	Value Engineering	
Workforce Development		

Summary

In summary, the framework for defining quality and constructability of transportation projects is the collection of strategies used by the Program Manager when managing their resources, deliverables and outreach efforts. Program Management is the umbrella that captures the three components. The Program Manager builds out strategies for each component to suit their needs. The emphasis on which strategies and components are priority will evolve over time as the organization matures. The key to managing quality and constructability is to implement the discipline of program management as described above and deploy strategies that each program has determined will advance the state of practice, achieve the quality levels and work in concert with its key constituents.

Task 7 – Testing Proposed Engagement Framework

The proposed framework developed in Task 6 was submitted to VTrans on September 23, 2025, and presented to the Technical Advisory Committee on September 30, 2025, for feedback. The presentation is included in Appendix K. The proposed framework was vetted and reviewed by the Agency to validate the format, and tools will achieve an improved dialogue and open communication in a simple and easy to use format.

Feedback on the Proposed Framework was received on October 6, 2025, and used to refine the framework strategies and ensure they reflect both agency and industry perspectives. Based upon this feedback and discussions during the September 30th meeting, the specific strategies were organized under resources, deliverables, and outreach as shown in Table 13. Three specific strategies were identified for more detailed development, these are highlighted and are Resources/People: **Establish Core Competencies**, Deliverables/Work Products: **Develop Process Controls**, and Outreach/Contracting Community: **Host Facilitated Meetings**.

Table 13. Summary of Framework Strategies

Summary of Framework Strategies		
Resources	**Deliverables**	**Outreach**
People:	Work Products:	Contracting Community:
• **Establish Core Competencies** • Develop Training Program • Establish Career Ladders • Provide Professional Development Opportunities	• Develop Guidance Documents • **Develop Process Controls** • Develop Key Performance Indicators	• **Host Facilitated Meetings** • **Participation by Key Decision Makers** • Oversight from Chief Engineer's Office
Funding:	Work Processes:	Legislature & State Government:
• Develop Asset Management Tools • Develop Scoping and Estimating Tools • Develop Fiscally Constrained Programs • Track Expenditures	• Document Workflows & Instructions • Provide Training • Apply Process Improvement Techniques • Develop Metrics to Track Performance	• Deliver Presentations to Committees • Engage with members of Committees, Representatives and Senators • Prepare Responses to Inquiries

Summary of Framework Strategies		
Resources	**Deliverables**	**Outreach**
Equipment: • Develop Inventory of Equipment • Develop Maintenance Schedules • Develop Replacement Schedules • Develop and Track Equipment Budget		Project Stakeholders: • Ensure Effective Engagement with Elected Officials • Ensure Business Owners are Engaged and Informed • Ensure Property Owners are Informed and Treated Fairly • Ensure Public Engagement Process is Followed
		Regulators: • Engage Regulators at the Program and Project Level • Work with the FHWA Division Office • Engage Utilities at the Program and Project Level

In addition, other feedback centered on implementation issues, such as who should receive the framework, what should they do with it, what priorities are, and who has overall responsibility for implementation.

It is recommended that an oversight team be established to guide the implementation of the Framework. The Oversight Team would determine the implementation priority of each strategy (for example, addressing high risk themes first), identify the lead(s) of a Working Group for each strategy, identify the initial program areas to be involved, establish a schedule, provide guidance, and monitor progress.

Each Working Group, to implement their strategies, is recommended to follow a change management process such as the eight-step process of creating major changes developed by John P. Kotter (1996), These steps are as follows:

1. Establish a sense of urgency
2. Create a guiding coalition
3. Develop a vision and strategy
4. Communicate the change vision
5. Empower broad-based action
6. Generate short-term wins
7. Consolidate gains and produce more change
8. Anchoring the new approaches in the culture

VTrans agreed with advancing the three strategies identified above. As such a goal, urgency, timeline, and specific action steps were identified to implement each as a fillable form to document progress (security protocols with files that include macros prevent the forms being included in this report, as such they were provided on a thumb drive). The following are the three strategies (pdf files were submitted to VTrans). Details for these three strategies are shown in Figures 14-16.

Resources/People: Establish Core Competencies strategy.
Deliverables/Work Products: Develop Process Controls strategy.
Outreach/Contracting Community: Host Facilitated Meetings strategy.

A description of the forms was provided, and the functionality was demonstrated to the Technical Advisory Committee on November 17, 2025. Positive feedback was received.

Pillar:	**Resources**
Theme:	**People**
Action:	**Establish Core Competencies**
Goal:	To improve the professional development of staff by providing training and opportunities based on the core competencies of their role in the organization.
Urgency:	Professional development that leads to career advancement is an important employee retention strategy. Establishing core competencies is the cornerstone of training programs and promotional opportunities. Increasing staff skills and experience should directly lead to better products and external interactions.
Timeline:	This effort should take 6 months to complete. Regular updates are needed when roles change or new positions are created.
Specific Actions:	1. **Personal Development:** Personal development is a career-long process and is a way to regularly assess your skills and capabilities, consider your goals and maximize your potential. There are several ways in which you can improve your own development in the workplace, such as re-evaluating your time, conducting skills appraisal, reviewing your transferable skills or overcoming any barriers to acquiring a new skill. **a. Commitment to Excellence** **b. Mind Mapping and Structured Thinking** **c. Career Progression** 2. **Leadership:** Leadership competencies help businesses determine which level of management requires certain skills. When selecting and developing management professionals, organizations should consider a candidate's competencies and compare these with the skills that need further development to succeed within a leadership role. Approaching leadership competencies in this manner can help businesses make accurate decisions about recruiting, developing and promoting the highest quality candidates. **a. Strategic Management**

Specific Actions:	**b. Future Planning** **c. Persuading and Influencing Staff** **d. Change Management** 4. **Communication:** In any business, communication skills are essential. Being able to share information verbally and in writing is an integral part of any position. **a. Commitment to Customer Excellence** **b. Collaborative Working** **c. Customer Relationship Management** **d. Social and Emotional Learning** **e. Persuasive Techniques** **f. Writing Skills** **g. Speaking and Listening Skills** 5. **Logical Reasoning:** Sound reasoning skills are important. You need to be able to demonstrate that you can consider all the facts, thinking them through intelligently to reach important decisions. **a. Making Decisions** **b. Methodical Approach** **c. Identifying Patterns or Connections** **d. Research** **e. Problem Solving** 6. **Transferable Competencies:** While some of the above competencies relate to specific industries, there are several competencies which are 'transferable'. This means that you can take them from one industry and apply them to another. **a. Resourcefulness** **b. Trustworthiness** **c. Stress Reduction** **d. Moral Principles and Ethical Standards** **e. Planning and Organization** **f. Business Acumen** 7. **Technical Competencies:** Competencies in this category relate not only to computer skills but also to your ability to comprehend complex requirements, think creatively, devise innovative systems and processes and develop policies to facilitate operations. **a. Creative thinking** **b. Technical Capabilities** **c. Computer Literacy** **d. Data Management** **e. Equipment and Program Knowledge** **f. Policies and Planning**

Figure 14. Resources/People: Establish Core Competencies strategy.

The core competencies for a technical position in the Structures Program are as follows:

Core Competency	Subcategory	Example
People Management	Coaching and Mentoring	Sharing your expertise with others
		Listening and responding to questions effectively
	Team Building	Responding constructively to others' ideas and suggestions
		Encouraging active participation and cooperation within the team
Personal Development	Commitment to Excellence	Fact-checking your work
		Actively seeking new ways of working to improve productivity
	Mind Mapping and Structured Thinking	Using mind maps to display complex information
		Communicating technical information clearly and concisely
	Career Progression	Working to develop existing competencies to a higher proficiency
		Actively seeking training opportunities that facilitate career progression
Leadership	Persuading and Influencing Staff	Using audience-specific language and examples to best illustrate your point
		Presenting multiple arguments in support of your position
	Change Management	Embracing change and proposing more effective ways of working
Communication	Commitment to customer excellence	Speedy and effective completion of assignments
	Collaborative Working	Expressing an interest in others' experience and ideas
		Working to build strong channels of communication
	Customer Relationship Management	Ensuring interactions with service providers are always polite and positive
	Writing skills	Using concise, clear, and appropriate language
		Structuring ideas clearly
	Speaking and Listening Skills	Speaking clearly and at a measured pace
		Maintaining eye contact to hold listeners' attention
	Job Specific	Establish and maintain effective communication with stakeholders (Project Manager, Maintenance Workers, Bridge Inspectors, Senior Management)

Core Competency	Subcategory	Example
Communication	Job Specific	Establish and maintain effective communication with Consultants, FHWA, Contractors, Municipal representatives, local legislators, Utilities, Railroad, Regulators, property owners)
		Thoughtful, professional, factual responses to media inquiries
		Appropriate documentation of all communications with the Consultants and Contractors
		Be aware of your social media footprint and how to use social media to benefit the project
		Prepare and submit professional and accurate weekly reports on time
		Attend and participate in public meetings
		Attend, participate and record project meetings
Logical Reasoning	Making Decisions	Analyzing data and information to make considerate decisions
		The ability to prioritize multiple tasks
	Methodical Approach	Breaking complex tasks into manageable segments
		The ability to identify possible problems or stumbling blocks
	Identifying Patterns or Connections	Understanding the impact of specific decisions and actions
		Identifying inconsistencies in data and information
	Research	The ability to identify relevant sources of information
		Effectively using data and research to reach informed, effective decisions
	Problem Solving	The ability to identify the cause and effects of problems
		Analyzing existing information to come up with appropriate solutions
	Technical Documents	Ability to comprehend the technical documents (Specifications, Special Specifications, Permits, Agreements and Estimates)
	Requirements	A working knowledge of overarching guidance documents (Structures Design Manual, CFR, AASHTO, AWS, ASTM, AREMA and MUTCD)
Transferable Competencies	Resourcefulness	Using existing information to devise new ways of working
		The ability to tackle unforeseen challenges using existing resources

Core Competency	Subcategory	Example
Transferable Competencies	Trustworthiness	Communicating openly and honestly with colleagues and customers
		Taking personal responsibility for the quality and content of your work
	Moral Principle and Ethical Standards	Taking responsibility for mistakes and errors in your work
		Respecting confidentiality agreements
	Planning and Organization	Prioritizing your workload to ensure deadlines are met
	Business Acumen	Understanding how your performance can influence the success of the team
Technical	Safety	A working knowledge of the OSHA Safety Standards for General Industry and Construction
		Ability to identify and use appropriate Personal Protective Equipment
		Ability to follow a Job Hazard Analysis
	Managing Project Correspondence	Track and record the status of all submittals (project milestones, fabrication drawings, construction drawings, value engineering proposals)
		Develop and track requests for engineering related services (traffic studies, borings, Right-of-Way, Utilities, environmental studies)
		Track, research and respond to contractor-initiated correspondence (RFI's, VE proposals, Fabrication and Construction drawings, questions during procurement)
		Ensure documents are distributed in a timely manner to the correct recipients
	Project Records	Prepare the document management framework for the project records during the design phase and maintain the project record throughout life of the project
	Design	The ability to understand the purpose and need of a project and translate that into plans and specifications to be used for bidding and construction
		The ability to independently research and prepare oneself to perform engineering tasks associated with bridge and highway design
		Ability to follow design procedures and provide documentation of the engineering (AASHTO

Core Competency	Subcategory	Example
Technical	Design	Design Manuals, Structures Design Manual, Structures Engineering Instructions)
		Possess the knowledge and technical ability to operate software used for bridge and highway engineering
		The ability to perform engineering calculations
		Possess the knowledge and experience to review and correct engineering calculations prepared by others
		The ability to develop pay item quantities consistent with the specifications and develop an accurate engineer's estimate
		Possess the experience to utilize best practices when designing bridge projects
	Plan Development	The ability to comprehend design documents and transform the information into plan sets
		The ability to follow plan development guidelines (e.g. Structures Plan Generation Manual)
		The ability to produce plan sheets using drafting applications and standards (e.g. MicroStation V8i, CADD Standards and Procedures Manual, CADD Standard Supplemental)
		Possess the knowledge and experience to review plans prepared by others for accuracy and completeness
	Quality	Adhere to the Structures Quality Control and Quality Assurance Program Manual
		The ability to review the quality of your own work
		Adopt the process control measures and checklists
		Demonstrate a commitment to quality for all work products, communications and interactions

Pillar:	**Deliverables**
Theme:	**Work Products**
Action:	**Develop Process Controls**
Goal:	To improve the quality and constructability of bridge projects through the development and implementation of process controls.
Urgency:	The quality and constructability of some bridge projects have resulted in higher bid prices, increased change orders and in some instances claims.
Timeline:	The initial development of the process controls should be within 6 months, and full deployment and application of the controls in 12 months. Monitoring will be ongoing.
Specific Actions:	Develop the following Process Controls (begin by documenting current process, determine desired state, develop a plan to get there): 1. Develop a checklist to substantiate the development of plans and special specifications for each milestone (conceptual, preliminary, final, contract). The checklists should address specific content requirements of the plans and supporting documents. Ensure the checklists are completed by the people performing the work and review by the technical lead. Checklists are designed to confirm the quality and completeness of the plans, and that they conform to standards and guidance manuals, including the independent review of the documents. This checklist can build throughout the life of the project. 2. Develop a checklist to substantiate the design and engineering of the project to ensure it is completed according to the design manuals and guidance (AASHTO, VTrans Structures Design Manual, Structures Engineering Instructions, Policies etc.). Include tasks for the independent reviewer of the engineering material. The checklist is completed by the lead engineer, reviewer and approved by the technical lead. This checklist can build throughout the life of the project. 3. Develop a checklist to ensure the project development process is followed as part of each milestone submission, and the information from supporting studies is incorporated in the design and contract documents (environmental permit conditions, ROW agreements, utility agreements, traffic studies, geotechnical information, local concerns meetings etc.). Ensure the information incorporated is aligned with the purpose and need and that the technical challenges are addressed. This checklist can build throughout the life of the project.

Figure 15. Deliverables/Work Products: Develop Process Controls strategy.

Pillar:	**Outreach**
Theme:	**Contracting Community**
Action:	**Host Facilitated Meetings**
Goal:	To improve bridge projects through an effective working relationship with industry
Urgency:	There is an immediate need to address prices, competition, and risk allocation.
Timeline:	This effort is required to be ongoing and continuous.
Specific Actions:	The key elements of successful Working Groups are the following: 1. The meetings should be run by an independent skilled facilitator. A person with experience navigating complex technical matters and someone with no vested interest in the outcome. 2. Continuity and consistency are critical to build momentum. All the stakeholders must understand that this is the venue where issues are raised and where decisions are made. Stakeholders should come to perceive this working group as decisive and effective, and as the venue guiding the future of the program. 3. The working group participants must be empowered and capable of making informed decisions that are binding. Representatives must be selected based on their knowledge and ability to speak on behalf of their organization. 4. The representation of the working group should reflect industry at large and not favor large companies over small entities. The agency should be represented by the program, materials, contracting, and the construction section. 5. The working group should be guided by its bylaws. The bylaws should address: a. The purpose, goals and objectives of the working group b. The representation of the working group c. The role of the facilitator d. The role of the members e. How a member is appointed, their term, and why a member may be removed or resign f. The frequency of the meetings g. Rules of Order h. How decisions are made i. How to add an item to the agenda

Figure 16. Outreach/Contracting Community: Host Facilitated Meetings strategy.

Task 8 – Develop Final Report and Technology Transfer

This Final Report consolidates the Interim Report from Phase I and the information developed from tasks 6 and 7. The final framework and supporting documentation are included in this Final Report and its appendices. A Final Fact Sheet is included in Appendix L (also available as a separate document).

This Final Report incorporated feedback from the VTrans Technical Advisory Committee presentation on February 11, 2026, of the Draft Final Report and subsequent comments.

References

Kaplan, R. S., & Norton, D. P. (1996). *The balanced scorecard: Translating strategy into action*. Harvard Business School Press.

Kotter, J. P. (1996). *Leading Change*. Boston, MA: Harvard Business School Press

Appendices

Appendix A: Literature Review Summary

Appendix B: Survey

Appendix C: Survey Data Analysis

Appendix D: Survey Written Responses

Appendix E: Focus Group Invitations, Agenda, and Presentation

Appendix F: Focus Group Comments

Appendix G: State of Practice state-by-state summary

Appendix H: Draft Interim Report meeting agenda

Appendix I: Draft Interim Report presentation

Appendix J: Draft Interim Report comments and responses

Appendix K: Draft Framework presentation

Appendix L: Fact Sheet

Appendix A: Literature Review Summary

Title	Reference	Summary
3D Digital Models as Highway Construction Contract Documents (2022)	National Academies of Sciences, Engineering, and Medicine. 2022. 3D Digital Models as Highway Construction Contract Documents. Washington, DC: The National Academies Press. https://doi.org/10.17226/26683.	Documented the current state of DOT practices for delivering 3D digital models to highway contractors and the use of these models as part of the legal construction contract document. The synthesis focuses on the use of 3D digital models as contract documents at four levels: policies, technical, process, and people.
5 Ways of Addressing the Labor Shortage to Recruit and Retain Staff (2024)	The Construction Management Association of America. Retrieved from https://www.cmaanet.org/sites/default/files/resource/Labor_Shortage_Recruit_CBO.pdf	The labor shortage is by far the largest challenge for most contractors, according to Ken Simonson, ACG's chief economist. With that in mind, how can you adapt your workforce strategy today? Here are five practical steps. 1. Step Up Scenario Planning 2. Enhance Workforce Utilization 3. Increase DEI Efforts 4. Design Compensation for Your People 5. Be Strategic About Medical and Mental Health Benefits
Accelerating Project Delivery through Early Contractor Involvement (2020)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Early contractor involvement (ECI) provides a contractor the opportunity to make substantive input to a project's final design. • Historic cost databases are typically out-of-date and do not reflect current market conditions. • Optimism bias in the early stages of a project can be misleading • in decision making. • Real-time pricing is a benefit due to early contractor involvement in the planning process. • Project development that uses a construction-centric focus maximizes cost and time certainty. • As schedule and cost certainty increases, everyone wins.

Title	Reference	Summary
Agency Use of Quality Control Plans for Administering Quality Assurance Specifications (2022	National Academies of Sciences, Engineering, and Medicine. 2022. Agency Use of Quality Control Plans for Administering Quality Assurance Specifications. Washington, DC: The National Academies Press. https://doi.org/10.17226/26664.	Identified and documented the various QC requirements used by state DOTs. Specifically, the synthesis (1) examined the process that state DOTs review, accept, and monitor contractor compliance with QCPs; (2) identified the actions that state DOTs take when QCPs are not followed; and (3) identified knowledge gaps and provided suggestions for future research to address these.
Artificial Intelligence Opportunities for State and Local DOTs: A Research Roadmap (2024)	National Academies of Sciences, Engineering, and Medicine. 2024. Artificial Intelligence Opportunities for State and Local DOTs: A Research Roadmap. Washington, DC: The National Academies Press. https://doi.org/10.17226/27865.	This web-only document discusses possible steps for state and local departments of transportation (DOTs) to adopt AI in their pipeline. Explored a large corpus of literature to study the complexity and maturity at the intersection of AI and transportation. Based on discussions with DOT personnel through multiple workshops and interview sessions to understand their needs in infrastructure, workforce, and the desired solution space, identified strategies that may help DOTs and facilitate the progressive inclusion of AI solutions. The 11 research problem statements proposed focus on key areas of development: (1) workforce development and infrastructure development, (2) readiness and evaluation of AI, (3) challenges in adopting AI, (4) current practices and prioritization, (5) external collaboration, and (6) equity, policy, and planning.
Assumption, Risk Driver and Constraint Tracking (2019)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Assumption migration is identified as a key risk driver in largescale, long duration projects. • The full potential of risk drivers may not be understood without an understanding of the dynamic nature of the program execution. • Programmatic impacts resulting from constraint-coupled projects and activities can have significant performance results, and, as such, constraints, both first order and second order, should be routinely identified and tracked.

Title	Reference	Summary
Best Value Procurement for Highway Construction: Legal Issues and Strategies (2023)	National Academies of Sciences, Engineering, and Medicine. 2023. Best Value Procurement for Highway Construction: Legal Issues and Strategies. Washington, DC: The National Academies Press. https://doi.org/10.17226/27175.	The use of best value procurement has gained considerably more use with local and state transportation agencies over the last 20 years due to its ability to consider evaluation factors beyond just cost and the increased use of alternative project delivery methods, such as DB, CMGC, and PPP. While best value selection procurement offers agencies material benefits, it comes with its own challenges that need to be addressed to mitigate any legal issues related to complaints and protests in the selection process.
Building a better workforce: What's working in construction training (2025)	ConstructionDive.com. Retrieved from https://www.constructiondive.com/spons/building-a-better-workforce-whats-actually-working-in-construction-traini/749835/	Companies that do so successfully implement training that delivers measurable results. They deploy structured, scalable workforce development programs that help workers get started, stay engaged and build long-term careers. Here's what they're doing and why it's working: • They define the path forward • They use curriculum grounded in industry expertise • They train for performance and measure impact • They build pipelines, not enforce silos

Title	Reference	Summary
Building Amid Uncertainty: How Risk Management Became Everyone's Job (2022)	Associated General Contractors of America. Retrieved from https://www.agc.org/sites/default/files/Files/Whitepaper_AGC-FMI_May2022%20Final.pdf	This paper looks at other key strategies and the shifting nature of risk management in an era and industry defined by risk. Key Findings: Opportunities as a Margin Call; Risky Business: The Labor Market; Increased Project Selectivity. When everything teeters on a landscape of risk, success comes down to balance. Companies that operate with strong alignment between owner and general contractor, and between general contractors and subcontractors, can minimize the surprises that threaten to derail a project. Firms that prioritize talent will be able to capitalize on the opportunities of the post-pandemic boom, both in terms of being able to do staff jobs and instill in their people a risk management mindset. Many risks remain. Energy prices are a key unknown in a complex geopolitical landscape, as are supply chain hijinks, tightening of U.S. monetary policy, climate events and subcontractor balance sheets 12 months from now.
Collaborative Management Framework for Interorganizational Risk in Megaprojects Based on Meta network (2024)	American Society of Civil Engineers. Journal of Management in Engineering. DOI: 10.1061/JMENEA.MEENG-6073.	A proposed risk collaborative management (RCM) framework extends the existing literature on RCM by integrating risk management processes and considering the interorganizational risk transmission directions, contributing to the optimization of the RCM resources of the participating organizations and the minimization of risk propagation.
Common Causes of Disputes and Claims in Large Complex Projects (2020)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Common causes of disputes and claims on large complex projects • are identified. • Initial strategies to reduce their likelihood or consequences are • developed. • New emergent areas for future claims and disputes are • suggested. • Relevant Executive Insights are extensively referenced.

Title	Reference	Summary
Constructability Review Before Design Commences (2020)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Constructability reviews are a value-adding process. • Constructability reviews are a multi-discipline effort. • Benefits of constructability reviews are identified. • Constructability goals and objectives are defined. • In conducting constructability reviews, it is important to "build the project." • Solving issues at the constructability stage reduces Requests for • Information (RFIs), change orders, and project delay. • Constructability reviews drive interdisciplinary coordination, • which is key to project success. • Constructability reviews are most impactful when first conducted • at project initiation. • The process undertaken in a constructability review at project initiation is broader than at a later project stage, but it is this breadth which drives its value. • The elements and focus of the constructability process at project • initiation are detailed.
Control of Project Risk for Owners (nd)	The Construction Management Association of America. Retrieved from https://www.cmaanet.org/sites/default/files/resource/Control%20of%20Project%20Risk%20for%20Owners_Chris%20Carson.pdf	Control of Owner risks is not a universal one-step panacea, but rather an integrated program of cost and schedule risk management that starts pre-project and does not end until all outstanding issues are resolved with the project complete. For the most effective control of Owner risk, the risk management process cannot be a one-time effort or a casual approach, but an integrated cost/schedule/risk culture embedded in the construction management process.
Design and Construction of Concrete Structures (2020)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Concrete is an extensively used building material. • Delivering quality concrete requires appropriate aggregates and • carefully planned field operations.

Title	Reference	Summary
		• Technical fundamentals for concrete work include appropriate properties of materials, design of concrete mixes, construction resources, and field operations. • The important field operations for concrete construction include batching, testing, transporting, placing, consolidating, finishing, and curing. • Formwork used to hold and mold fresh concrete until it gains • strength is a key part of the concrete construction process.
Design and Construction of Structural Steel Work (2021)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Structural steel construction offers economical bay sizes that are • much larger compared to using concrete. • Structural steel construction offers high seismic performance. • Structural steel construction offers flexibility to match current • architectural trends for "building statements."
Design Review (2020)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Design review ensures the effective transformation of the owner's project requirements (OPR). • Design review is a primary element of the design management • control process. • It also is the backbone of the project's quality system. • Alternate delivery methods (design-build) and emerging technologies (3D models; Artificial Intelligence or AI) create new challenges and opportunities in design reviews. • Design reviews are often underpinned by robust checklists.
Developing a Research Roadmap for Highway Bridge Infrastructure Innovation: A Case Study (2025)	Ebrahimpour, A.; Baibordy, A.; Ibrahim, A. Developing a Research Roadmap for Highway Bridge Infrastructure Innovation: A Case Study. Infrastructures 2025, 10, 133. https://doi.org/10.3390/infrastructures10060133	Key findings from this three-phase methodological approach highlight that ultra-high-performance concrete (UHPC), bridge deck preservation, and maintenance strategies are high-priority research areas across many DOTs. Furthermore, according to the DOT responses, funding is most commonly allocated to projects related to superstructure and deck elements. Finally, ITD found

Title	Reference	Summary
		that the most deficient elements in Idaho bridges are reinforced concrete abutments, reinforced concrete pile caps and footings, reinforced concrete pier walls, and movable bearing systems.
Eight Steps for Changing Organizational Culture in Companies of All Sizes (nd)	The Construction Management Association of America. Retrieved from https://www.cmaanet.org/sites/default/files/resource/Changing%20Organizational%20Culture.pdf	1. IDENTIFY DESIRED OUTCOMES 2. PLAN A CULTURE CHANGE ROLLOUT 3. WEAVE NEW CULTURAL VALUES INTO RECRUITMENT INITIATIVES 4. GET EXECUTIVE BUY-IN 5. BE PATIENT 6. DEFINE MESSAGING, INSIDE AND OUT 7. ADAPT TRAINING BASED ON EMPLOYEE FEEDBACK 8. START NOW
Embracing New Strategies to Build the Future Workforce (2025)	Associated General Contractors of America. Retrieved from https://www.agc.org/sites/default/files/Files/Communications/2025%20AGC%20Workforce%20Conference%20After%20Action%20Report%20Final%201.29.25.pdf	The outcomes of the National Construction Industry HR & Workforce Conference are compiled in this report by AGC of America and Arcoro. Detailed within the report are successful workforce solutions that have been proven successful by firms across the country. To make this report more user-friendly, we organized these solutions into the categories of recruitment, retention and workforce training. However, it is important to note that several of the approaches detailed in this report address two or more of those areas.
Enhancing Reliability of Construction Contingency Estimation at the Scoping Phase through Historical Cost Data Analysis (2024)	American Society of Civil Engineers. Journal of Management in Engineering. DOI: 10.1061/AJRUA6.RUENG-1260.	Using various statistical methods, the study creates probability distribution curves that show the likelihood of different contingency costs occurring, along with their associated confidence levels. These probability distribution curves provide cost estimators and project managers with a reliable way to improve the accuracy of early cost estimates during critical planning phases. This study will benefit project agencies by providing a more accurate and informed approach to budgeting and contingency management, thereby improving project cost reliability.

Title	Reference	Summary
Escalation (2022)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• The potential for relief under current contract documents is • outlined with an emphasis on public infrastructure projects. • The scope of a review for a contractor's claim for escalation • impacts is outlined. • Materials of construction particularly vulnerable to escalatory • impacts are called out. • Construction material indices are presented, demonstrating historical and recent price movements and future trajectories are forecasted. • Strategies to address supply chain cost and schedule challenges are laid out, segregated to include client and contractor mitigation strategies. • Labor related escalation is not covered in this Executive Insight.
Estimating Construction Change Orders (2022)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Change orders are an inevitable part of construction. Both owner • and contractor should expect changes to occur. • Development of change orders requires a high-quality estimate to protect both the contractor and owner. • Change logs must be current, comprehensive, and well • documented. • Change order estimate processes and procedures should be clearly established and reviewed and agreed to by the client before the first change order and are best incorporated into the contract. • Change order estimates must clearly describe the change for which relief is being sought by contrasting the changed state with the contract baseline. • Projects with high degrees of change experience stress, which • limits communication when more communication is required. • Trust is essential, but complete and timely records facilitate trust.

Title	Reference	Summary
Five Trends Expected to Drive E&C Industry Growth in 2024	The Construction Management Association of America. Retrieved from https://www.cmaanet.org/sites/default/files/resource/E%26C%20Growth.pdf	1. HEIGHTENED FOCUS ON SUSTAINABILITY AND EFFICIENCY 2. UNLOCKING NEW VALUE IN DIGITALIZATION AND GENERATIVE AI 3. DIFFERENTIATED IMPACT OF MARKET UNCERTAINTY ACROSS RESIDENTIAL AND NONRESIDENTIAL SEGMENTS 4. E&C FIRMS LIKELY TO BE MORE STRATEGIC TO NAVIGATE PERSISTENT COST VOLATILITY 5. NEW WORKFORCE NORMS TO HELP BRIDGE THE LINGERING TALENT AND SKILLS GAP
Five Ways to Navigate Relationship Roadblocks with Trust & Positivity	The Construction Management Association of America. Retrieved from https://www.cmaanet.org/sites/default/files/resource/Navigate%20Relationship%20Roadblocks.pdf	1. Character 2. Problem-Solving 3. Preparation 4. Negotiation 5. Bridge-Building
Forecasting Construction Material Prices Using Macroeconomic Indicators of Trading Partners (2024)	American Society of Civil Engineers. Journal of Management in Engineering. DOI: 10.1061/JMENEA.MEENG-6106.	The authors adopted a multi-step methodology that included: (1) collecting data on the target variables and the candidate leading indicators; (2) identifying the structural breaks in the collected data sets; (3) conducting causality tests to identify short-term associations and cointegration tests to examine long-term relationships; (4) developing vector error correction (VEC) models to forecast the prices in the short and long terms; and (5) evaluating the performance of the proposed models against existing forecasting models in the literature.
Framework for Implementing Constructability Throughout Project Development from NEPA to Final Design (2023)	National Academies of Sciences, Engineering, and Medicine. 2023. Framework for Implementing Constructability Throughout Project Development from NEPA to Final Design. Washington, DC: The National Academies Press. https://doi.org/10.17226/27446.	Developed a constructability review decision-making framework that is scalable to all contract delivery methods and that complies with all environmental statutory requirements.

Title	Reference	Summary
Future-Proofing the Construction Workforce: The Value of Training and Credentials (2025)	The National Center for Construction Education and Research (NCCER).Retrieved from https://www.nccer.org/media/2024/02/Value-of-Training-NCCER-Whitepaper-Final.pdf	With the increasing need to find solutions for the workforce shortage, craft training and upskilling should be part of every contractor's workforce development toolkit. Furthermore, a standardized credentialing program supported by industry reduces the resources required to implement craft training programs.
Georgia Department of Transportation (GDOT) Quality Control and Quality Assurance Program Manual (2016)	https://www.dot.ga.gov/PartnerSmart/DesignManuals/OtherResources/GDOT_QCQA_Program.pdf	The GDOT Quality Control and Quality Assurance (QC/QA) Program has been developed by the Engineering Division of the Georgia Department of Transportation to ensure that engineering, design, plans and quantities developed by our design offices are supported by comprehensive studies and sound engineering judgment, comply with established policies, guidelines and standards, and contain appropriate design flexibility and cost saving measures.
How AI can be used in construction bidding, negotiation (2025)	ConstructionDive.com. Retrieved from https://www.constructiondive.com/news/ai-construction-bidding-negotiation/756936/?utm_source=Sailthru&utm_medium=email&utm_campaign=Issue:%202025-08-11%20Construction%20Dive%20Newsletter%20%5Bissue:75776%5D&utm_term=Construction%20Dive	As inflation, labor and tariffs continue to pressure the construction industry, contractors are looking for opportunities to protect profit margins. Artificial intelligence offers builders new ways to remain competitive and profitable before projects even start.
Implementing Alternative Technical Concepts in All Types of Highway Project Delivery Methods (2020)	National Academies of Sciences, Engineering, and Medicine. 2020. Implementing Alternative Technical Concepts in All Types of Highway Project Delivery Methods. Washington, DC: The National Academies Press. https://doi.org/10.17226/25865.	Resulted in a Guidebook published as NCHRP Research Report 937 and is available on the TRB website by searching "NCHRP Research Report 937."

Implementing Machine Learning at State Departments of Transportation: A Guide (2024)	National Research Council. 2024. Implementing Machine Learning at State Departments of Transportation: A Guide. Washington, DC: The National Academies Press. https://doi.org/10.17226/27880.	Machine Learning (ML) is a vast topic that continues to evolve at a rapid pace. Given the breadth and depth of ML, this guide does not attempt to synthesize the entire spectrum of knowledge related to ML methods and applications. Instead, it seeks to highlight valuable insights, best practices, and opportunities for ML specifically for state DOTs and other transportation agencies. The top takeaways EXPECTATIONS: ML is not a panacea and will not work for every transportation use case; however, it is becoming increasingly powerful and widespread. Agencies should understand which transportation problems are currently conducive to ML solutions. DATA: ML is a bottom-up, data-driven approach capable of discovering highly complex patterns in data, whereas traditional approaches tend to be rule-based. BENEFITS: ML can bring many benefits, such as improving operational efficiency (e.g., by replacing manual processing of large data) and generating new strategies by discovering hidden opportunities. GAPS: ML may have different needs than traditional approaches, particularly with respect to digital infrastructure (e.g., computing, big data, storage, etc.). APPLICATIONS AREAS: Many agencies have found success deploying ML in various application areas, such as operations and asset management. RISKS: ML project implementations and ML solutions in operation introduce new challenges and risks to agencies such as their black-box nature; these risks should be well understood and managed. APPROACHES: There are a variety of approaches an agency can take in deploying ML (e.g., custom in-house model development, purchasing ML as a service), with each approach having different benefits and risks. EVALUATION: Agencies looking to deploy ML solutions should understand typical evaluation metrics for ML applications (e.g., false negative rate), what metrics are desirable to measure for

Title	Reference	Summary
		their project, and how these metrics tie into the performance of the transportation system. SCALING: As with other emerging technology deployments, it is considered a best practice with ML to start small, show value, and then scale up. COSTS: Data processing and transmission costs could play a significant role in overall ML costs. WORKFORCE: While agency staff do not have to be ML experts, it is important for them to understand whether and how ML is used by vendors/consultants and be cognizant of potential pitfalls in deployment (e.g., model drift).
Improving Construction Meeting Effectiveness: Trade-Offs between Reactive and Proactive Site-Level Planning Discussions (2024)	American Society of Civil Engineers. Journal of Management in Engineering. DOI: 10.1061/JMENEA.MEENG-6087.	This research contributes to the body of knowledge by innovatively developing an information theory-based approach to quantify the uncertainty in proactive and reactive discussions for construction planning. Using the information theory approach, this research enables project managers to quantify the uncertainty in reactive and proactive planning discussions. By adjusting the framework and parameters, the approach can have general applications in planning meeting
Incorporating Nondestructive Testing in Quality Assurance of Highway Pavement Construction: Manual (2023)	National Academies of Sciences, Engineering, and Medicine. 2023. Incorporating Nondestructive Testing in Quality Assurance of Highway Pavement Construction: Manual. Washington, DC: The National Academies Press. https://doi.org/10.17226/27443.	Designed to assist state departments of transportation (DOTs) in selecting and incorporating applicable nondestructive testing (NDT) methods into their quality assurance (QA) programs for highway pavement construction. NDT techniques considered applicable to the QA process are explained in adequate detail. State DOTs and others interested in using the NDT methods in their pavement construction QA process should find this guide helpful.
Influence of Geotechnical Investigation and Subsurface Conditions on Claims, Change Orders, and Overruns (2016)	National Academies of Sciences, Engineering, and Medicine. 2016. Influence of Geotechnical Investigation and Subsurface Conditions on Claims, Change Orders, and Overruns. Washington, DC: The National Academies Press. https://doi.org/10.17226/21926.	Subsurface conditions are frequently considered to represent significant elements of technical and financial risk for infrastructure projects. The information in this Synthesis is derived from a literature review, a survey of transportation agencies, and case examples from state agencies with experience reducing claims, change orders, and cost overruns resulting from subsurface conditions. The Synthesis addresses:

Title	Reference	Summary
		• The scope of subsurface investigation required by transportation • agencies; • Causes of claims, change orders, and cost overruns attributed to subsurface conditions; • Ranges of costs and prevalence of claims, change orders, and • cost overruns attributed to subsurface conditions; and • Successful practices to reduce claims, change orders, and cost • overruns.
Innovation Programs and Practices of State Departments of Transportation (2024)	National Academies of Sciences, Engineering, and Medicine. 2024. Innovation Programs and Practices of State Departments of Transportation. Washington, DC: The National Academies Press. https://doi.org/10.17226/27829.	Synthesized state department of transportation (DOT) innovation programs and initiatives, areas of focus on the innovation spectrum, and associated activities. Common themes: • Obtaining leadership support • Developing an innovative culture • Engaging and empowering staff • Meeting in the middle (collaborative organizational structure) • Managing risk aversion • Establishing statewide pathways for innovation
Intersectoral Vulnerabilities: Assessing the Impact of External Shocks on the U.S. Construction Sector (2024)	American Society of Civil Engineers. Journal of Management in Engineering. DOI: 10.1061/JMENEA.MEENG-5774.	Industries and sectors are interdependent between themselves. This interdependence is necessary, as no sector can produce all the products that it needs to consume to produce its primary output. Likewise, the U.S. construction sector relies on other producing sectors in the economy for its own production. This reliance makes the construction sector vulnerable to any exogenous shocks originating in other sectors.
Know What You Are Trying to Accomplish: The Primacy of the Scope Baseline (2020)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Scope baseline has primacy among the baseline documents • (scope, schedule, and budget). • Lack of clarity of scope and goals is the number one project pitfall • for contract management. • Inadequate scope definition and management is the source of the Spearin Doctrine, which determines who bears the construction of design errors.

Title	Reference	Summary
		• Scope of work and basis of design must be tightly linked to the owner's project requirements. • Principle elements of scope of work are scope of facilities and • scope of services. • All items of scope must be quantifiable and measurable.
Liability of State Departments of Transportation for Design Errors (2017)	National Academies of Sciences, Engineering, and Medicine. 2017. Liability of State Departments of Transportation for Design Errors. Washington, DC: The National Academies Press. https://doi.org/10.17226/24681.	With respect to tort claims against transportation departments, the threshold, potentially dispositive question may be whether the State has waived the department's immunity for the precise claim being asserted against the department. Even if a State has waived its immunity for certain claims, however, a transportation department may still have immunity when a claim arises out of its exercise of discretion, such as in the planning or design of highways and other projects.
Managing Materials During Engineering — Civil/Structural (2024)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• This Executive Insight looks at the materials management during • the various engineering phases. • It describes an approach where the owner separately contracts • with a designer and a construction manager. • Responsibilities, activities, and workflow are described for the • civil/structural discipline. • Tracking, reporting, and reviewing forecast and actual engineered and bulk material quantities during the lifecycle of a project is a critical success factor for predicting and controlling project costs. • Early variance identification allows for corrective action. • Materials management activities are focused on large quantities, • primarily bulk items. • Material Take-Off (MTO) Allowance is the quantity for growth in • estimated quantities of the bulk material.

Title	Reference	Summary
Managing the Risk of Subsurface Conditions (2022)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Owners are best capable of assuming the risk of unknown • subsurface conditions. • Strong benefits occur to owners who use Differing Site • Conditions (DSC) clauses on their construction projects. • It is difficult for an owner to transfer differing site conditions risks • through exculpatory clauses. • Owners should make all information available regarding • subsurface conditions to bidders during procurement. • Owners should consider using project delivery methods such as • construction management at risk and progressive design-build, where subsurface risk can be assigned through negotiation before the final construction price is established.
Partnering and the Need for Speed (2018)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Benefits of partnering: speed, cost, quality, safety, and future work • Hallmarks of partnering: trust, cooperation, initiative, and project focus Partnering is a project approach that addresses human interactions. Companies do not build buildings; people build buildings. Larger projects often have complicated, frustrating problems. When these occur, it is important to remember to be hard on the problems and easy on the people. By taking care of the people on the project, the people will take care of the project. Partners can be very helpful. One cautionary note: while partnering has been and continues to be a successful approach to completing construction projects, not everyone will agree to partnering. Partnering can be offered, but cannot be contractually dictated.

Title	Reference	Summary
Performance-Based Construction Contractor Prequalification (2009)	National Academies of Sciences, Engineering, and Medicine. 2009. Performance-Based Construction Contractor Prequalification. Washington, DC: The National Academies Press. https://doi.org/10.17226/21991.	Performance-based contractor prequalification goes beyond the financial prequalification provided by the surety industry when it issues a bond in conjunction with a public transportation project and includes a contractor's performance record in the prequalification process. The synthesis' conclusions covered the gamut of contractor prequalification issues from the current administrative forms to post-project evaluation. • the transition from a system of administrative prequalification only to performance-based prequalification could be accomplished smoothly • bonding and financial factors are best restricted to general administrative prequalification and later as project-specific prequalification factors applied at the time of contract award • rigorous post-project contractor performance evaluation system can replace many of the commonly used minor performance-based prequalification factors • many of the current performance-based contractor prequalification programs result in an adjustment to a contractor's bidding capacity • performance based contractor prequalification essentially • consists of a three-tiered system • few actual barriers to implementing performance-based contractor prequalification.
Post-Construction Evaluation Practices for Highway Projects Delivered Using Alternative Contracting Methods (2024)	National Academies of Sciences, Engineering, and Medicine. 2024. Post-Construction Evaluation Practices for Highway Projects Delivered Using Alternative Contracting Methods. Washington, DC: The National Academies Press. https://doi.org/10.17226/27817.	Synthesized DOT practices for evaluating the outcomes of the ACM processes after project completion. Specifically, the synthesis (1) identifies the current state of practice for conducting post-construction evaluations of ACM projects at state DOTs; (2) documents the DOT policies, procedures, and guidelines used to evaluate ACM performance and processes after completion of construction; and (3) reports the benefits, challenges, and experiences of using post-construction evaluations of highway design and construction projects delivered using ACMs.

Title	Reference	Summary
		Additionally, the synthesis identifies the benefits and challenges of evaluating ACM projects after completion and the experiences of state DOTs in doing so.
Pricing Work for a Profit: Developing a Construction Estimate (2018)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	A contractor is a buyer who wishes to purchase the opportunity to build a project in a marketplace consisting of multiple owners offering a variety of projects. A project owner is a seller with a product that has no standard value. It is the contractor who defines the project's value based on its view of the marketplace. Key Points: 1. Evaluate bid opportunities. 2. Identify what factors effect project cost. 3. Recognize task production impactors. 4. Ascertain possible project risk.
Prime Contract Management (2020)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Contract disputes are a regular and costly activity on large • complex construction projects. • Adding a Prime Contract Manager (PCM) to the contractor's project team reduces the contractor's exposure and may help mitigate disputes. • The PCM supports the administration of the prime contract, with • principal duties in the area of change management. • The pivotal role the PCM can play in management of contract compliance often lends itself to some additional associated activities. • From the owner's perspective, the PCM role can be valuable in getting issues and potential claims on the table in order to reach timely resolutions.
Programmatic Implementation of Alternative Contracting Methods (2024)	National Academies of Sciences, Engineering, and Medicine. 2024. Programmatic Implementation of Alternative Contracting Methods.	Synthesizes document the practices and methods used by state DOTs to establish a programmatic approach for implementing ACM projects. • Identifies state DOTs that have implemented or

Title	Reference	Summary
	Washington, DC: The National Academies Press. https://doi.org/10.17226/27782.	considered implementing programmatic approaches to delivering ACM projects; • Documents state DOTs' organizational structure, policy and/or procedural changes for using programmatic approaches (including procurement and administration), ACM methods and procedures such as forms, tools, guidance, and specifications used from project initiation to construction completion, and changes to programmatic approaches over time; and • Identifies factors state DOTs consider for implementing programmatic approaches to ACMs, including legislative authority, selection processes, training of staff, performance measures, and risk identification and assignment. • Additionally, the synthesis identifies challenges and success factors and documents experiences and lessons learned, as noted by state DOTs in their efforts to establish a programmatic approach for implementing ACM projects.
Reducing Waste in Construction Projects (2021)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Construction waste reduction begins at project conception, not inception; the construction waste management plan should be developed at an early stage. • Construction waste can be viewed as consisting of solid, liquid, and gaseous wastes. • Effective scope control is an essential first step in construction waste minimization. • Construction waste minimization continues into the supply chain. • Waste minimization during the construction phase has as much to do with efficient productive construction execution as it does with control measures. • Poor quality construction in the first instance, out of

Title	Reference	Summary
		sequence construction, and poor scope control all result in higher rework levels and with it growth in construction waste streams. • Construction waste minimization requires the causes of added waste generation through poor management oversight and practices be addressed.
Resolving Construction Disputes: Review of State DOT Processes (2024)	National Academies of Sciences, Engineering, and Medicine. 2024. Resolving Construction Disputes: Review of State DOT Processes. Washington, DC: The National Academies Press. https://doi.org/10.17226/27891.	This digest examines: • State statutes and regulations that govern the resolution of disputes; • Processes state DOTs are using for the resolution of construction disputes; • Rules used for the different ADR processes (e.g., timing, makeup, administration of panels, enforcement of contract clauses)
Resolving Construction Disputes: Review of State DOT Processes (2024)	National Academies of Sciences, Engineering, and Medicine. 2024. Resolving Construction Disputes: Review of State DOT Processes. Washington, DC: The National Academies Press. https://doi.org/10.17226/27891.	This digest examines: • State statutes and regulations that govern the resolution of disputes; • Processes state DOTs are using for the resolution of construction disputes; • Rules used for the different ADR processes (e.g., timing, makeup, administration of panels, enforcement of contract clauses) and how the rules affect the outcome of disputes. Also, this digest provides an in-depth analysis of the use of arbitration among those DOTs that have used this binding dispute process. The analysis includes (1) contract provisions that arbitrators are regularly asked to enforce; (2) sample fact patterns; (3) levels of proof required to prove damages; and (4) differences in the levels of discovery conducted in arbitration versus proceedings in court.

Title	Reference	Summary
Risk Identification, Prioritization, and Mapping for Early Construction Cost Contingency in Transportation Infrastructure Projects (2024)	American Society of Civil Engineers. Journal of Management in Engineering. DOI: 10.1061/AJRUA6.RUENG-1315.	This study contributes to the body of knowledge by laying the initial foundation for a project-specific and risk driven approach for DOTs. Significant risks affecting construction cost contingencies were identified, prioritized, and then mapped with common project types by applying a hybrid research methodology of reviewing and analyzing DOT manuals, risk checklists, and risk registers and conducting and analyzing questionnaire surveys with DOT experts.
Risk-Based Construction Inspection: A Guide (2023)	National Academies of Sciences, Engineering, and Medicine. 2023. Risk-Based Construction Inspection: A Guide. Washington, DC: The National Academies Press. https://doi.org/10.17226/27099.	The goal of this document is to provide a flexible methodology for risk-based inspection that can be applied at the programmatic level to a standard construction inspection program or at the project level to prioritize highway construction inspection activities and optimize the resources applied to a given project. The anticipated benefits of these guidelines include: • Enhanced understanding of the cost and benefits of construction inspection, • More efficient allocation of inspection and testing resources, and • Better alignment of project inspection and materials risks with inspection resources to help agencies deliver a quality project for the lowest overall cost.
State DOT Product Evaluation Processes (2024)	National Academies of Sciences, Engineering, and Medicine. 2024. State DOT Product Evaluation Processes. Washington, DC: The National Academies Press. https://doi.org/10.17226/27809.	Synthesized the current practices, funding, policies, management techniques, tools, and workflows of state DOT Product Evaluation Processes (PEPs). The scope of the synthesis is confined to the state DOT PEPs and A/QPLs in use and the current state of practice associated with the product evaluation of construction and maintenance products and materials. Findings show that guidance is needed to develop consistent practices in product evaluations. The various methods in place for product evaluation at state DOTs do not allow for much sharing of information or approval of products that other states have already approved. Also, while NTPEP does provide vital information, it does not set the testing

Title	Reference	Summary
		limits or tolerances for acceptance.
Teaming in Construction (2025)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• This Executive Insight serves as a comprehensive guide for construction firms to enhance collaboration and teamwork. • Significance of forming strong partnerships and aligning goals among various stakeholders is emphasized. • Detailed checklist is provided to help teams assess their readiness for collaboration. • Best practices for fostering a collaborative culture are outlined. • Necessity of developing a comprehensive risk management plan to identify potential risks early and implement mitigation strategies throughout the project lifecycle is highlighted.
Trends for the Construction Industry: Innovation to be Accelerated (2022)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• The total number of people leaving their jobs each year is rising, the "Great Resignation" from the pandemic is adding to the number, and 10,000 baby boomers are retiring daily. • The construction industry currently has 750,000 open positions, and its leadership will need to further innovate their hiring, development, and retention processes. Labor shortages are affecting project outcomes now. • The hard trends for the construction industry include labor • shortages, safety mitigation, off-site modularization, and a focus on sustainability, resource-efficiency, and environmental responsibility. • Technology is a key to improvement in safety, efficiency, financial outcomes, and quality. • A focus on employees and employee needs will be critical to attract new talent to the industry.
Trust (2022)	National Academy of Construction. Executive Insights. Retrieved from https://www.naocon.org/insights/	• Trust is an essential ingredient in project leadership and success. • Trust is multi-directional—up, down, sideways, and uniquely in projects, inside out.

Title	Reference	Summary
		• Trust is defined, but one really knows it when it is personally experienced. • The special challenges of building trust in a project setting are described. • Strategies for building trust in a project setting are described. • Factors influencing trust in a project setting are outlined.
Understanding Construction Change Orders (2025)	U.S. Department of Transportation. Office of the Under Secretary of Transportation for Policy. 11DOT-VNTSC-OST-25-02	This report identifies common issues that result in change orders and cause project delays and overruns, organized into three main categories relating to the quality of technical project development work, influences of organizational culture, and uncertainty introduced by financial forces. It also describes best practices to minimize and mitigate change orders and highlights noteworthy project delivery practices currently used by project sponsors of various transportation modes. Enhancing understanding of construction change orders can help practitioners with limited experience in federally funded transportation projects, along with their partners, achieve better project delivery outcomes. Change orders can be attributed to technical, organizational, and financial and funding causes, and can result from a confluence of multiple causes ranging across categories. For example, technical causes may be driven by upstream organizational or financial forces. Strong organizational support is necessary to spend time and resources creating high-quality work products early in project development. Addressing change order causes before a project goes to construction requires solutions that consider the entire project ecosystem through the lens of the project agreement and may leverage a combination of best practice strategies. Establishing standardized processes, communicating frequently, and supporting a culture of quality, knowledge, and accountability are fundamental aspects of addressing change orders. Data, technology, alternative contracting methods, and risk management are additional tools that can be employed to achieve better project delivery outcomes.

Title	Reference	Summary
Unveiling and Evaluating the Collaboration in Engineering Projects through a Two-Layer Information Collaboration Network Model (2024)	American Society of Civil Engineers. Journal of Management in Engineering. DOI: 10.1061/JMENEA.MEENG-5871	This study focused on information collaboration (IC) in engineering projects. Devised an integrated framework with an information perspective and a network perspective. The framework comprises (1) a two-layer information collaboration network model, integrating information demands and flows; (2) network analysis across different project levels, detecting stakeholder roles in collaboration, revealing unevenly distributed collaboration configurations, and presenting overall collaboration patterns; and (3) a novel assessment method for collaboration performance considering the efficiency and resilience of IC.

Appendix B: Survey

Developing a Framework for Defining Quality and Constructability of Transportation

The purpose of this survey is to collect data on current issues affecting the quality and constructability of Transportation Projects in Vermont - with the goal of developing a framework to better engage collaborators and partners. The issues you identify will be further analyzed and prioritized for improvement opportunities and informing the framework. All responses are confidential.

* Indicates required question

VTrans

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

A. Name (optional, will only be used for follow-up or clarification purposes if necessary)

_____

B. Email (optional, will only be used for follow-up or clarification purposes if necessary)

_____

Survey questions

C. What type of organization do you represent?

- ☐ Contractor – Bridge
- ☐ Consultant – Designer
- ☐ Fabricator
- ☐ Consultant - Construction Inspection
- ☐ Supplier
- ☐ Contractor – Highway
- ☐ VTrans employee
- ☐ Other:

Perceived Quality Issues

1. Based on your experience working on bridge projects for VTrans, how do you rate the quality of the following documents:

a. Advertisement

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

b. Special provisions

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

c. Contract

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

d. Project Plans

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

e. Written Orders

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

f. Change Orders

g. Other, Please Specify

_____

2. Based on your experience working on bridge projects for VTrans, how do you rate the quality of the Agency review of the following contractor submittals?

    a. Application or Renewal of Prequalification

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    b. Fabrication drawings

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    c. Construction drawings

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    d. Requests for Information (RFI)

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    e. Value Engineering proposals

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    f. Pricing for Extra Work

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    g. Materials Mix Designs

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    h. Materials Approved Products List

3. Based on your experience working on bridge projects for VTrans, how do you rate the quality of communicating with the following Agency teams or positions:

    a. Contract Administration

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    b. Resident Engineer

	1	2	3	4	5	
Poor (needs improvement)	○	○	○	○	○	Excellent (do not make any changes)

    c. Structures Project Manager

	1	2	3	4	5	

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

d. Regional Construction Engineer

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

e. Construction Engineer

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

f. Materials Laboratory Personnel

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

g. Environmental Permitting Team

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

h. Construction Finals Team

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

i. Other, please specify

_____

4. Based on your experience working on bridge projects for VTrans, how do you rate the following:

a. Response time for general inquiries

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

b. Response time for Contractor Submittals

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

c. Response time for questions during advertisement

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

d. Completion Dates of projects.

1 2 3 4 5

Poor (needs improvement) ○ ○ ○ ○ ○ Excellent (do not make any changes)

Opportunities for Improvement

5. Which of the following topics does the Agency need to improve? Select all that apply

- ☐ a. Project Plans
- ☐ b. Bridge design details
- ☐ c. Project Special Provisions
- ☐ d. Project Completions Dates
- ☐ e. Constructability
- ☐ f. Maintenance of Traffic
- ☐ g. Agency response times
- ☐ h. Communication between Agency staff and contractor/suppliers
- ☐ i. Engagement with the bridge contractors
- ☐ j. Engagement with the material suppliers
- ☐ Other: _____

Prioritization of Solutions

6. Please identify from the list the five most important topics the Structures Program should focus on to improve the delivery of bridge projects (select only 5):

- ☐ a. Project Plans
- ☐ b. Bridge design details
- ☐ c. Project Special Provisions
- ☐ d. Project Completions Dates
- ☐ e. Constructability
- ☐ f. Maintenance of Traffic
- ☐ g. Agency response times
- ☐ h. Communication between Agency staff and contractor/suppliers
- ☐ i. Engagement with the bridge contractors
- ☐ j. Engagement with the material suppliers
- ☐ Other: _____

Other questions

7. What future trends do you think will most affect the design and/or construction of VTrans transportation projects?

_____

8. Please provide any additional feedback or comments you believe would be helpful in identifying improvement opportunities. (For example, on barriers with VTrans engagement, design related issues, or construction related issues.)

   _____

Thank you!

We appreciate your time and input to help identify improvement opportunities and assisting VTrans deliver their construction program!

Appendix C: Survey Data Analysis

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

Focus Groups

June 13, 2025

Via Teams

Developing a Framework for Defining Quality and Constructability of Transportation Projects

Dan D'Angelo P.E.
Principal Civil Engineer
Applied Research Associates
ddangelo@ara.com

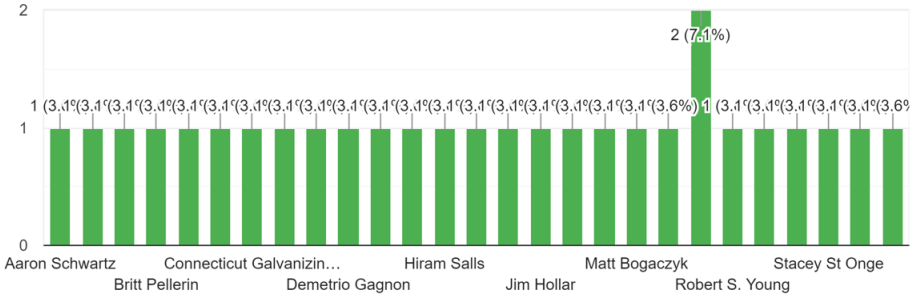
David Hoyne P.E.
VP | Director of Construction Services
GPI
dhoyne@gpinet.com

VERMONT
AGENCY OF TRANSPORTATION

72 responses

A. Name (optional, will only be used for follow-up or clarification purposes if necessary)

28 responses

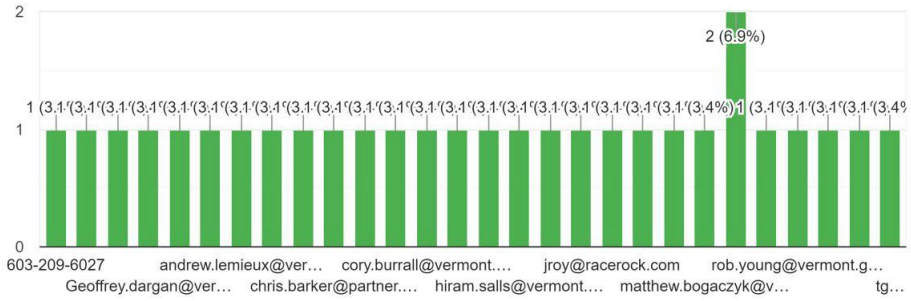


2

72 responses

B. Email (optional, will only be used for follow-up or clarification purposes if necessary)

29 responses

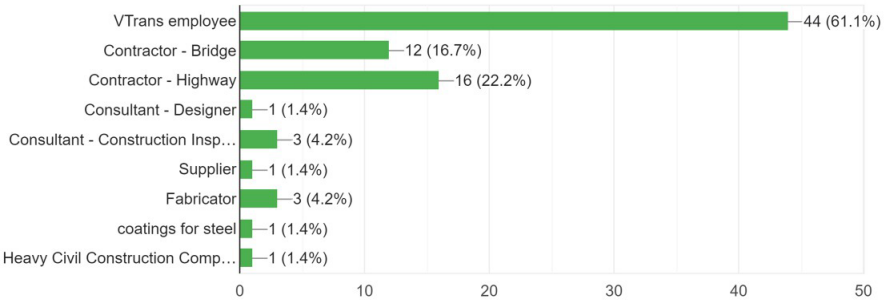


3

What type of organization do you represent?

C. What type of organization do you represent?

72 responses



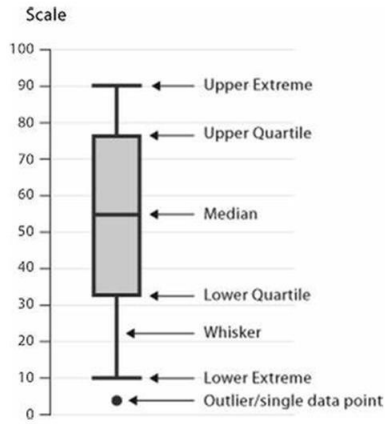
4

Key Findings - Analysis

- Reviewed overall scores
- Reviewed VTrans scores
- Reviewed non-VTrans scores
- Identified items with largest difference between VTrans and non-VTrans scores
- Reviewed written comments
- Plotted data by
  - Overall scores (bar graphs)
  - Comparison between VTrans and non-VTrans (bar graphs)
  - VTrans and non-VTrans ranges (Box & Whisker Plots)

5

Box & Whisker Plot



6

Key Findings - Perceived Quality Issues

- VTrans scores consistently higher (Score Range 1.00 - 5.00)
  - VTrans: 3.05-3.88
  - non-VTrans: 2.14-3.36
- Non-VTrans scores exhibited a wider range
- Top VTrans scores
  - Communication: Structures Project Manager (3.88)
  - Communications: Construction Engineer (3.84)
  - Communications: Resident Engineer (3.79)
- Top non-VTrans scores
  - Communications: Construction Finals Team (3.36)
  - Documents: Advertisement (3.25)
  - Communications: Environmental Permitting Team (3.07)
- Written feedback may be more valuable than scores

7

Key Findings - Perceived Quality Issues (continued)

- Lowest VTrans scores
  - **Contractor Submittals: Pricing for Extra Work** (3.05)
  - Contractor Submittals: Materials Mix Design (3.05)
  - Contractor Submittals: Application or Renewal of Prequalification (3.11)
  - **Completion Dates** (3.15)
  - **Contractor Submittals: Fabrication drawings** (3.20)
- Lowest non-VTrans scores
  - Response time for Contractor Submittals (2.14)
  - **Completion Dates** (2.36)
  - **Contractor Submittals: Fabrication drawings** (2.43)
  - **Contractor Submittals: Pricing for Extra Work** (2.43)
  - Contractor Submittals: Value Engineering proposals (2.46)

8

Key Findings - Perceived Quality Issues (continued)

- Top 5 Score Differences
  - Communications: Construction Engineer (1.12)
  - Contractor Submittals: RFIs (1.01)
  - Communications: Regional Construction Engineer (0.99)
  - Communications: Structures Project Manager (0.92)
  - Communications: Resident Engineer (0.90)
- Top 5 Closest Scores
  - Communications: Construction Finals Team (0.02)
  - Communications: Environmental Permitting Team (0.20)
  - Response time: Questions during advertisement (0.22)
  - Documents: Advertisement (0.23)
  - Communications: Materials Laboratory Personnel (0.41)

9

Which topics the Agency need to improve?

- Top 5 VTrans
  - **Engagement with the bridge contractors (20)**
  - **Communication between Agency staff and contractor/suppliers (19)**
  - Project Plans (18)
  - **Engagement with the material suppliers (18)**
  - **Constructability (16)**
- Top 5 non-VTrans
  - **Constructability (17)**
  - Project Completions Dates (15)
  - **Communication between Agency staff and contractor/suppliers (15)**
  - **Engagement with the bridge contractors (15)**
  - **Engagement with the material suppliers (15)**

10

Prioritization of Solutions

- Top 5 VTrans
  - **Constructability (29)**
  - **Project Plans (26)**
  - **Engagement with the bridge contractors (23)**
  - **Communication between Agency staff and contractor/suppliers (22)**
  - Project Special Provisions (18)

- Top 5 non-VTrans
  - **Communication between Agency staff and contractor/suppliers (19)**
  - **Constructability (17)**
  - Agency response times(14)
  - **Engagement with the bridge contractors (12)**
  - **Project Plans (10)**

Note: Top 5 overall included "Engagement with the material suppliers" [VTrans (17), non-VTrans (9)]

11

Summary of written responses

Quality of Documents & Communication	Future Threats & Opportunities	Additional Feedback
Process	Workforce Development	Partnering
Time	Model Based Design	Quality of Plans
Workforce Development	Partnering	Submittals
Culture	Funding	Workforce Development
	Rising Costs	Process
	Barrier to Entry	Question During Procurement
	Submittals	Burdensome Requirements
	Innovative Materials	Completion Dates
	Specifications	
	Environmental Regulations	
	Miscellaneous	

12

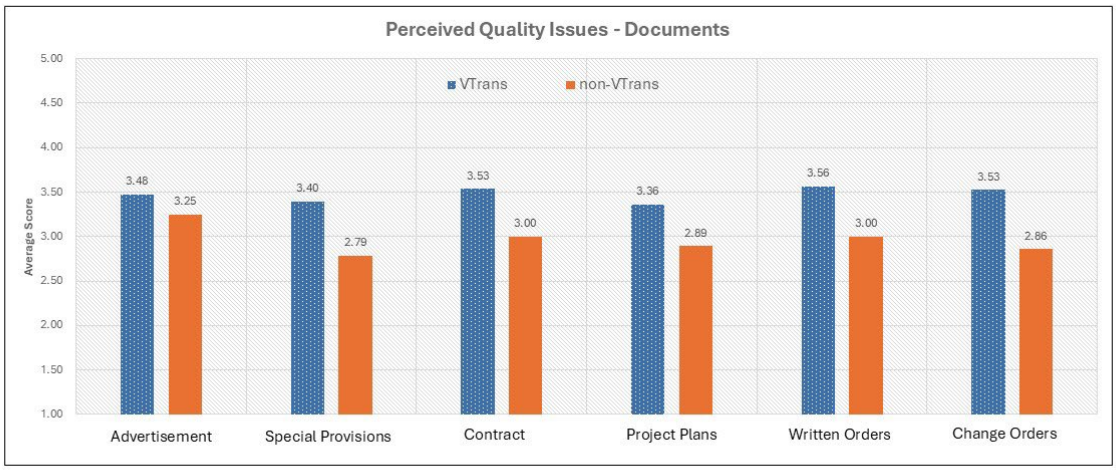
Themes

Most Important Themes
Workforce Development
Partnering/Culture
Submittals
Process
Quality of Plans
Time

Secondary Themes
Barrier to Entry
Funding
Rising Costs
Innovative Materials
Specifications
Environmental Regulations
Burdensome Requirements

13

Perceived Quality Issues - Documents

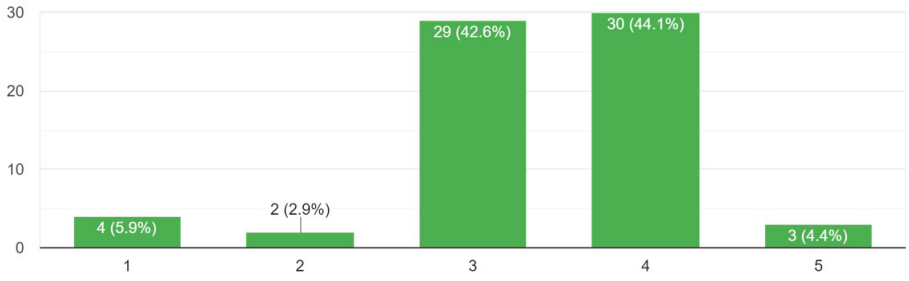


14

Perceived Quality Issues - Documents

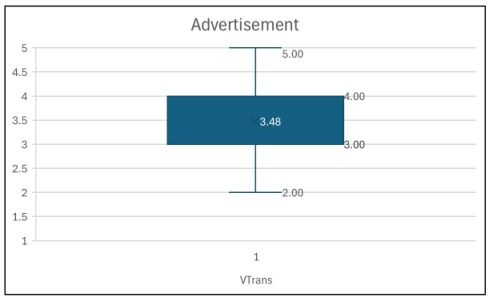
a. Advertisement

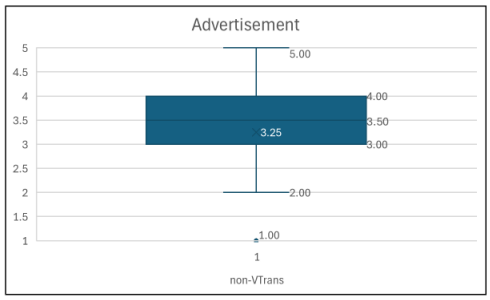
68 responses

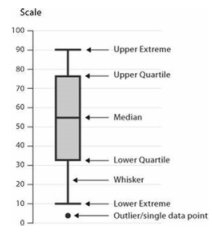


15

Perceived Quality Issues - Documents





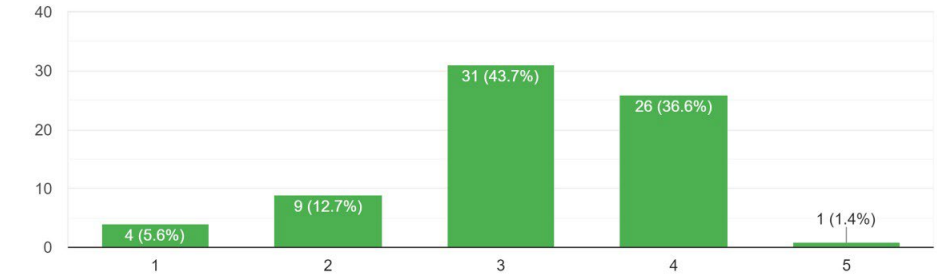


16

Perceived Quality Issues - Documents

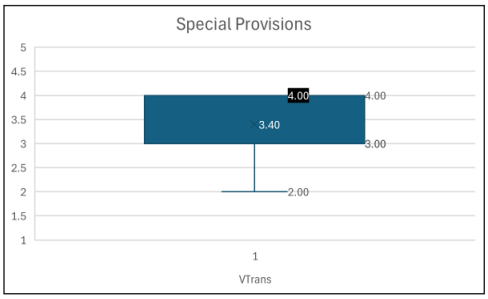
b. Special provisions

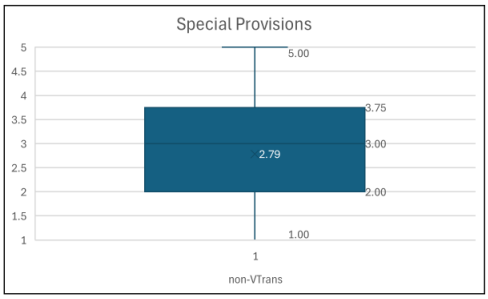
71 responses

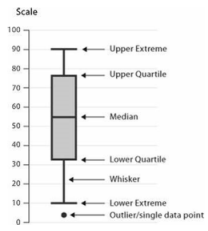


17

Perceived Quality Issues - Documents

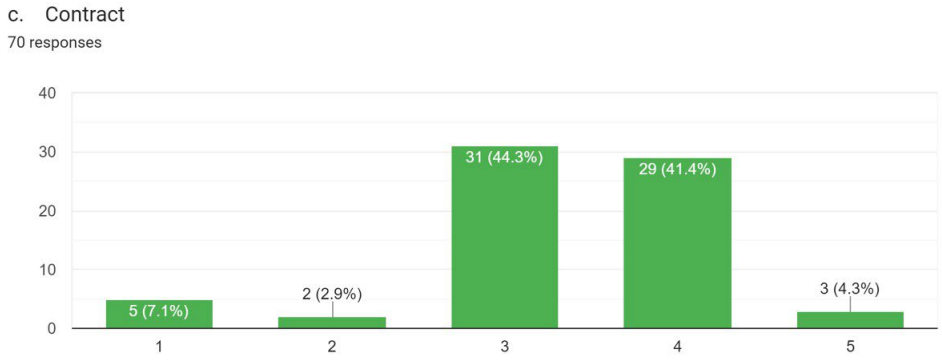






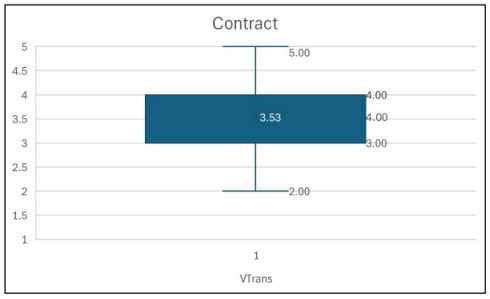
18

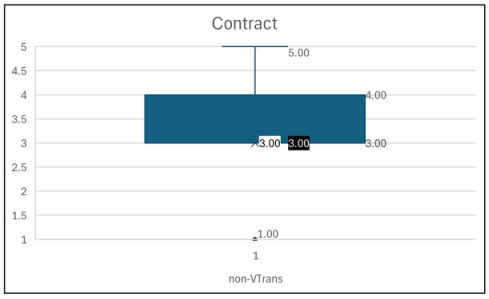
Perceived Quality Issues - Documents

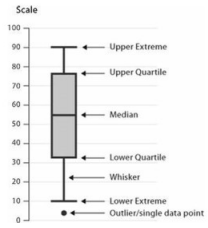


19

Perceived Quality Issues - Documents

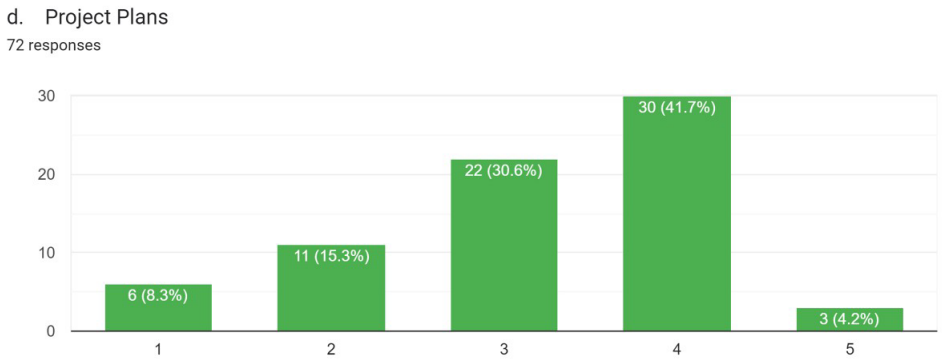






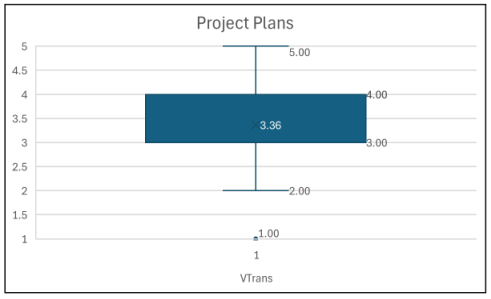
20

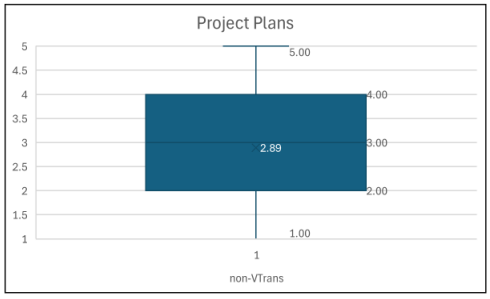
Perceived Quality Issues - Documents

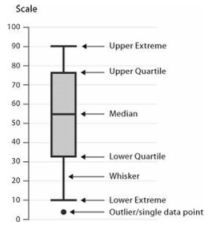


21

Perceived Quality Issues - Documents





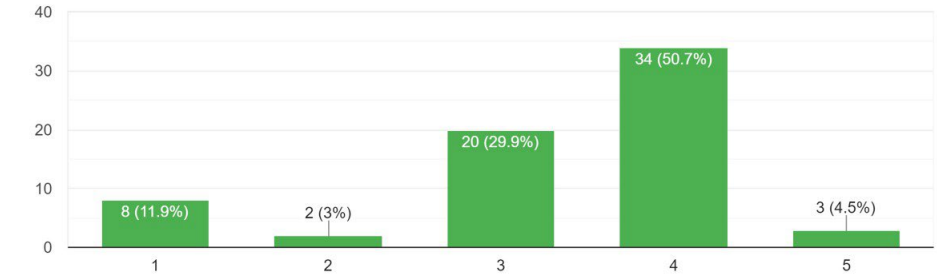


22

Perceived Quality Issues - Documents

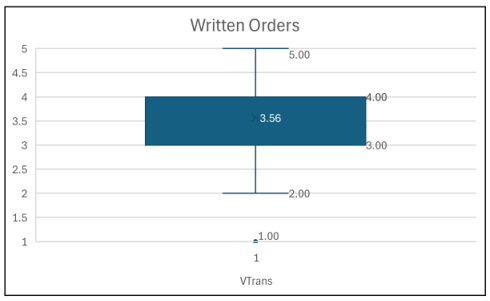
e. Written Orders

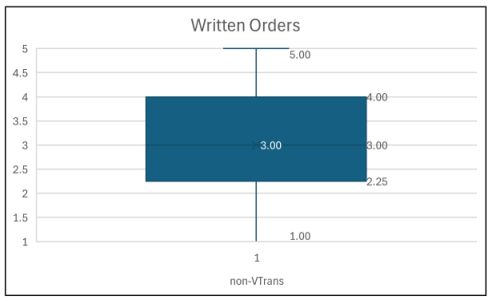
67 responses

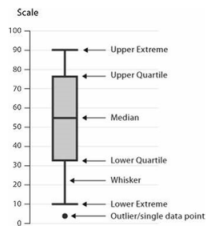


23

Perceived Quality Issues - Documents





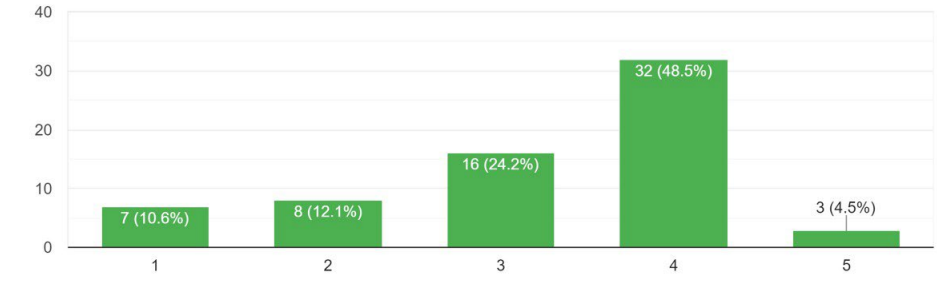


24

Perceived Quality Issues - Documents

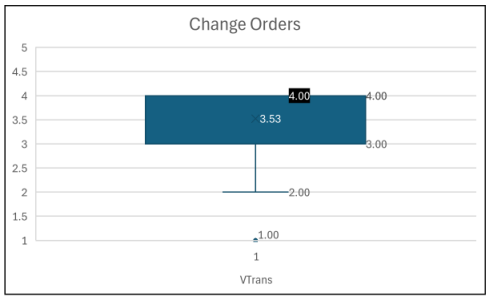
f. Change Orders

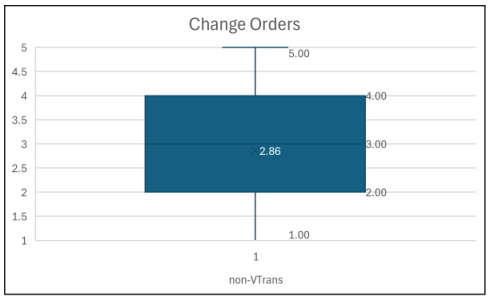
66 responses

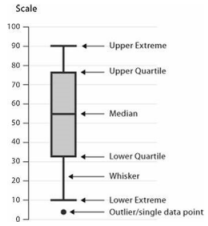


25

Perceived Quality Issues - Documents





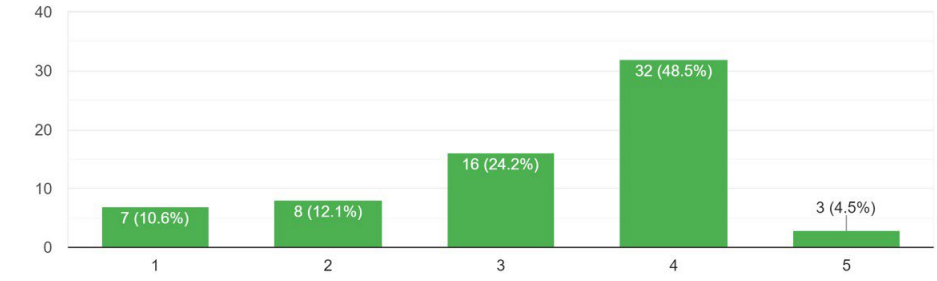


26

Perceived Quality Issues - Documents

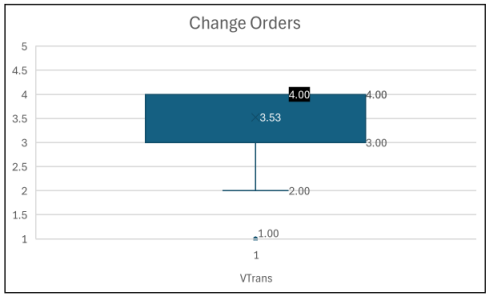
f. Change Orders

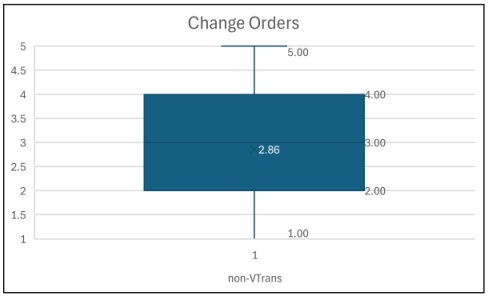
66 responses

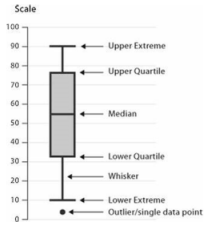


25

Perceived Quality Issues - Documents

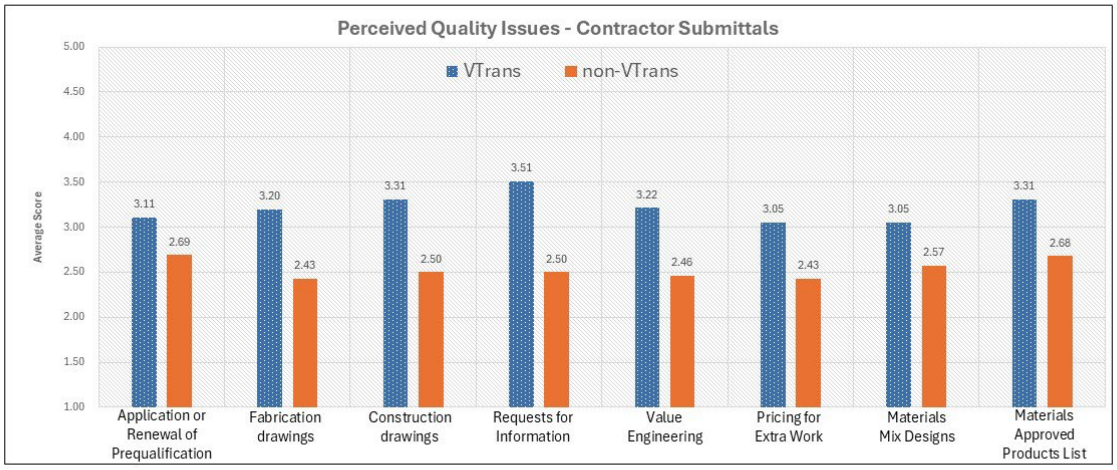






26

Perceived Quality Issues – Contractor Submittals

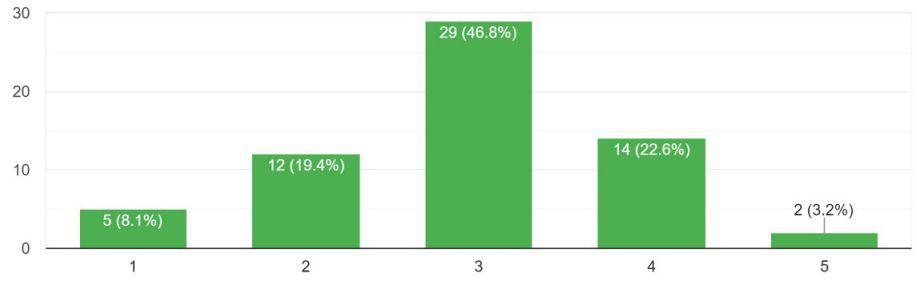


27

Perceived Quality Issues – Contractor Submittals

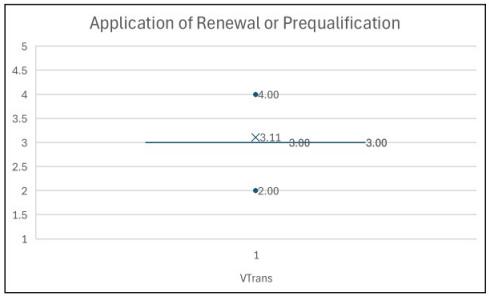
a. Application or Renewal of Prequalification

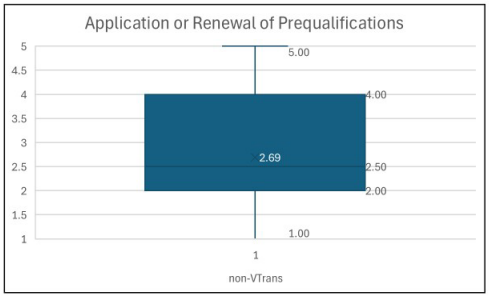
62 responses

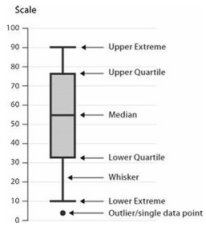


28

Perceived Quality Issues – Contractor Submittals





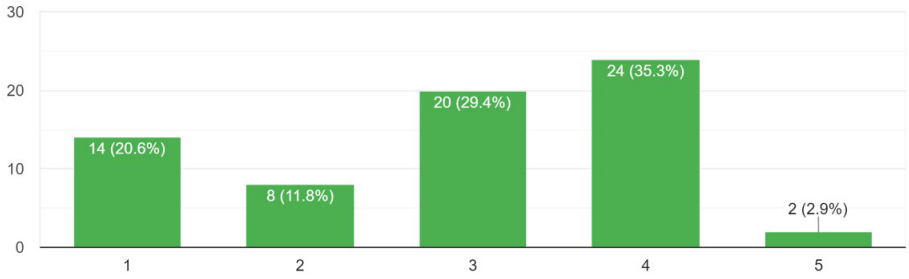


29

Perceived Quality Issues – Contractor Submittals

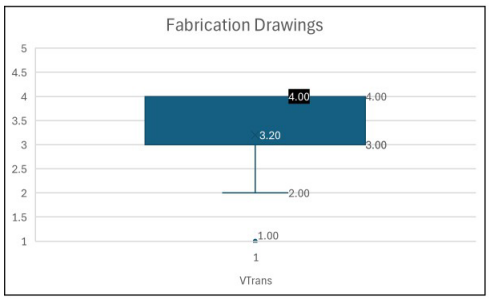
b. Fabrication drawings

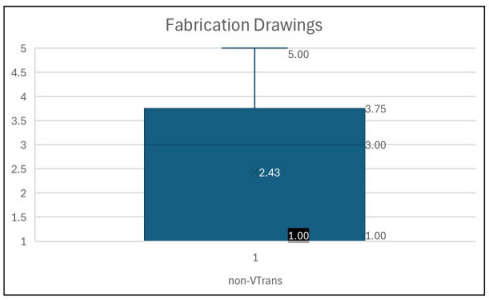
68 responses

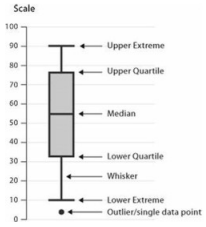


30

Perceived Quality Issues – Contractor Submittals





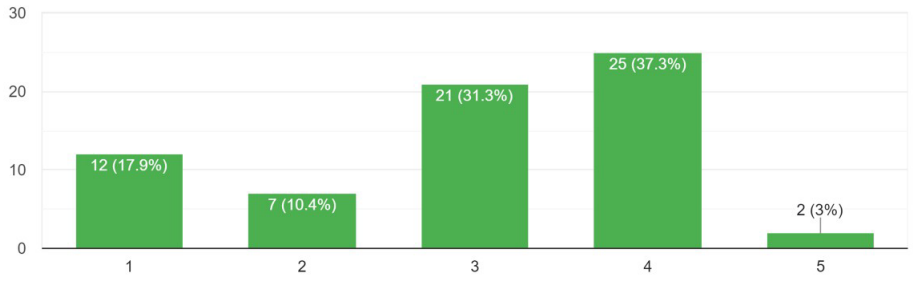


31

Perceived Quality Issues – Contractor Submittals

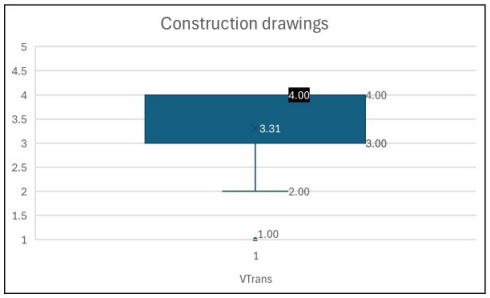
c. Construction drawings

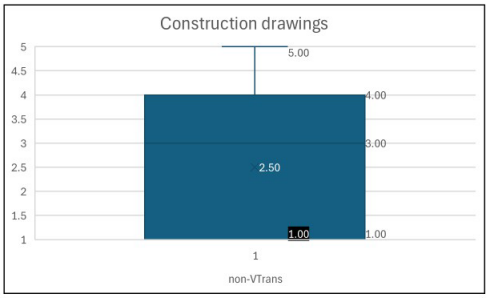
67 responses

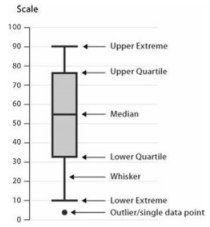


32

Perceived Quality Issues – Contractor Submittals





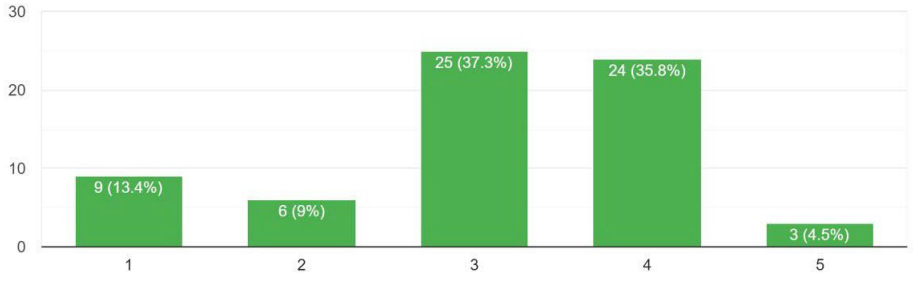


33

Perceived Quality Issues – Contractor Submittals

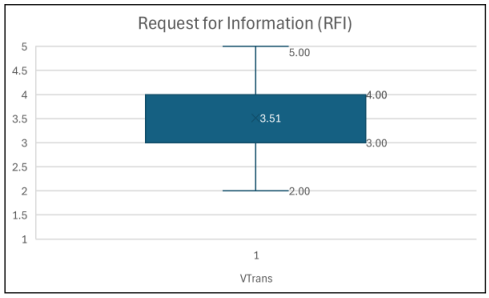
d. Requests for Information (RFI)

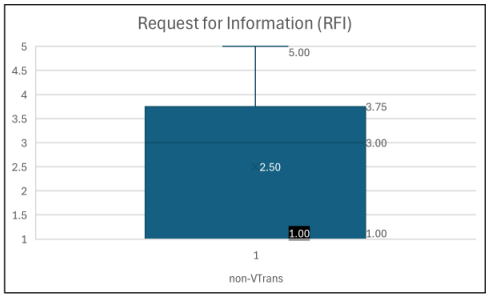
67 responses

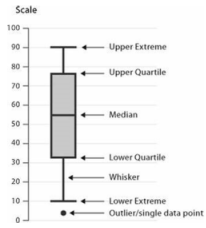


34

Perceived Quality Issues – Contractor Submittals





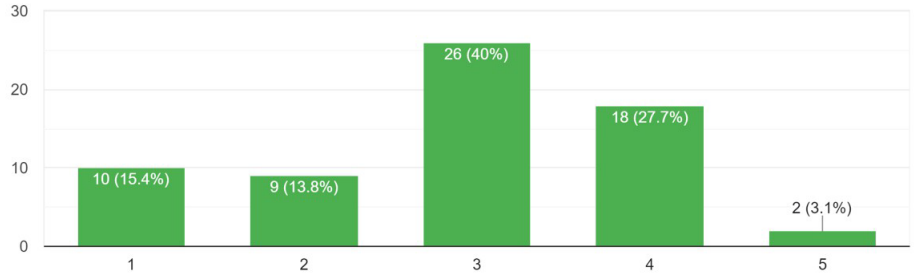


35

Perceived Quality Issues – Contractor Submittals

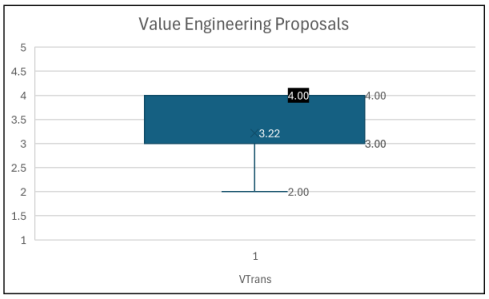
e. Value Engineering proposals

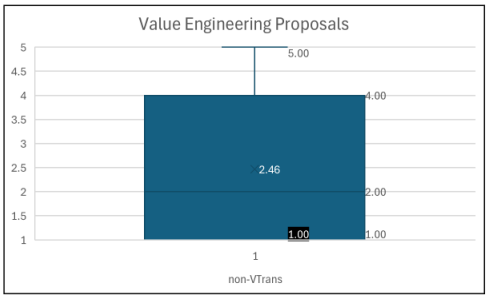
65 responses

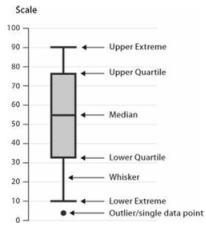


36

Perceived Quality Issues – Contractor Submittals





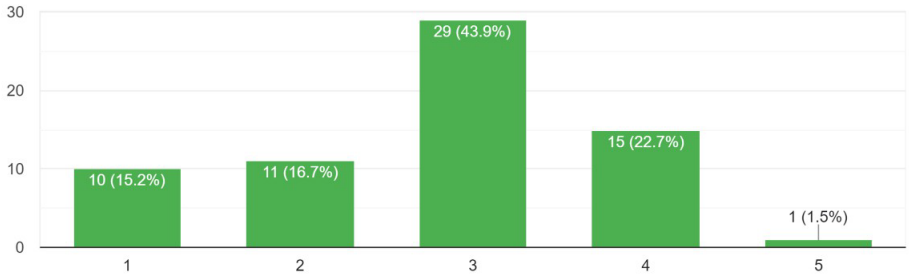


37

Perceived Quality Issues – Contractor Submittals

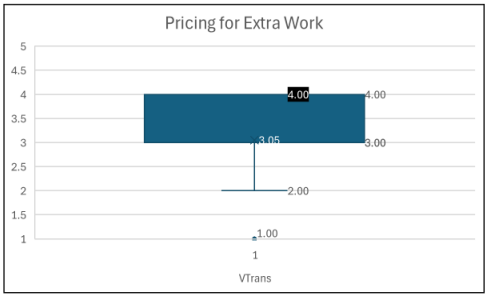
f. Pricing for Extra Work

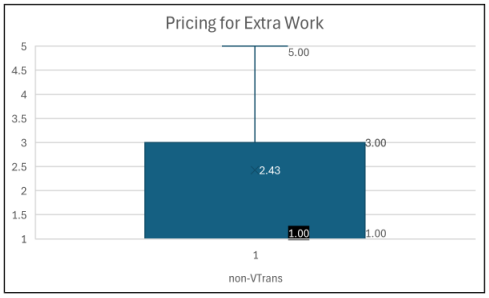
66 responses

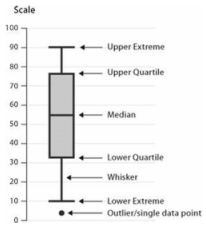


38

Perceived Quality Issues – Contractor Submittals





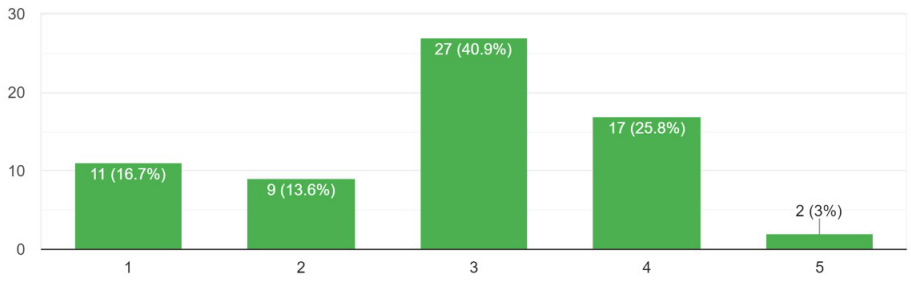


39

Perceived Quality Issues – Contractor Submittals

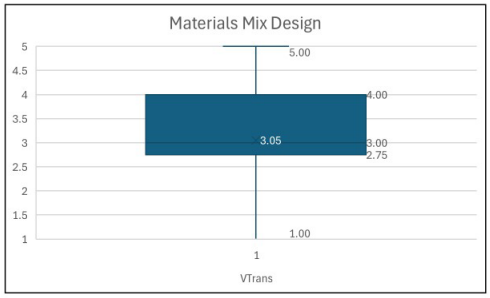
g. Materials Mix Designs

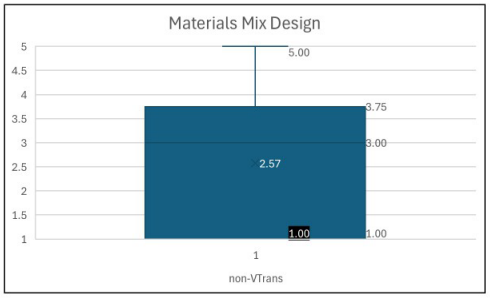
66 responses

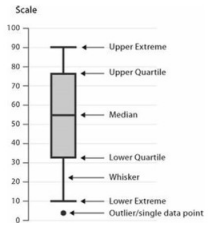


40

Perceived Quality Issues – Contractor Submittals





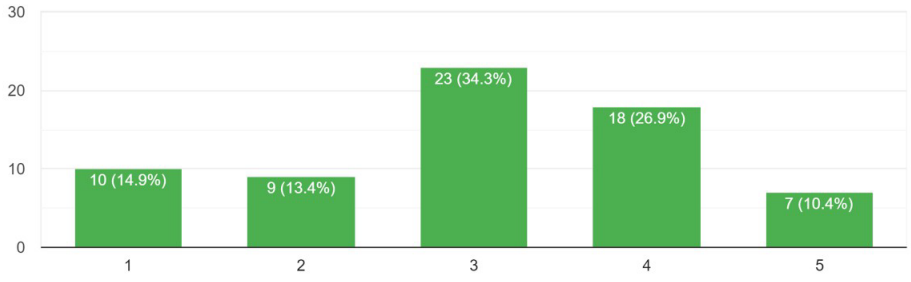


41

Perceived Quality Issues – Contractor Submittals

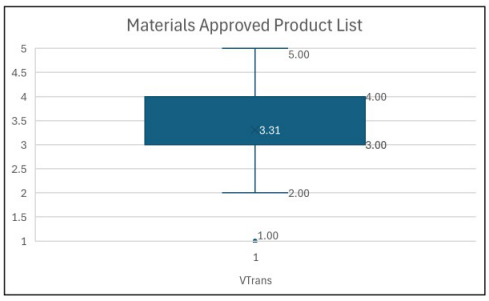
h. Materials Approved Products List

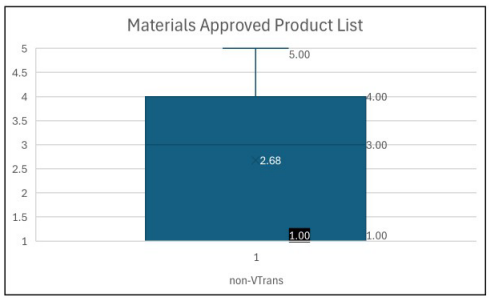
67 responses

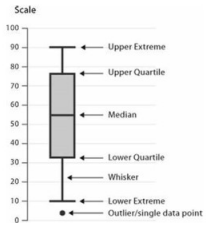


42

Perceived Quality Issues – Contractor Submittals

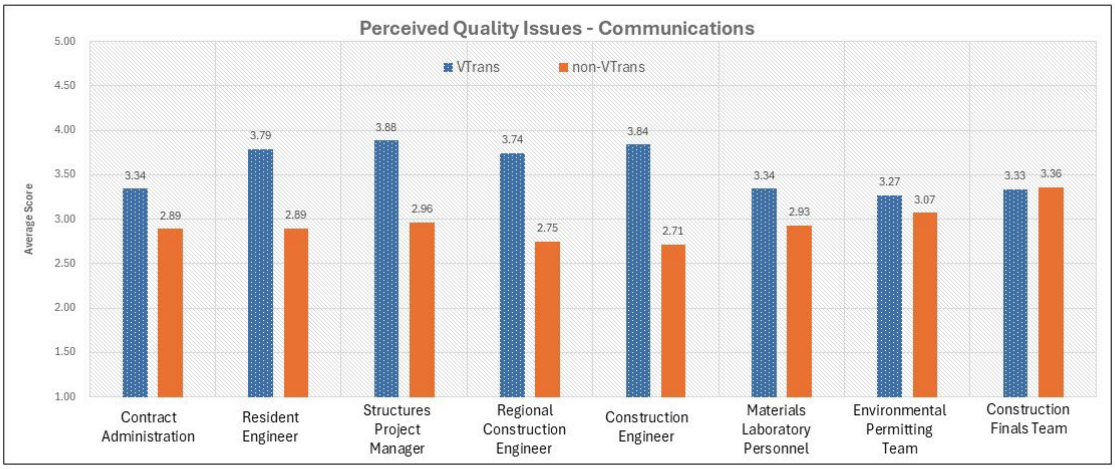






43

Perceived Quality Issues – Communications

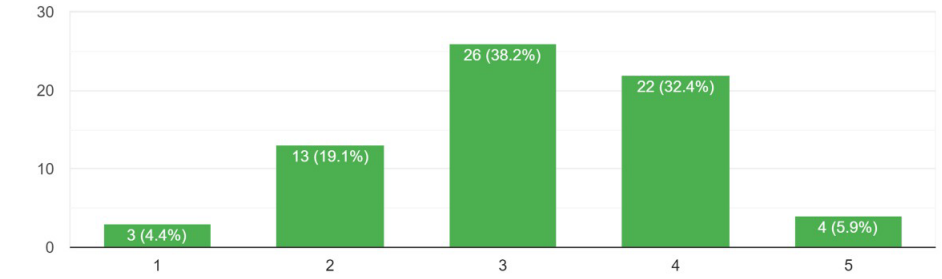


44

Perceived Quality Issues – Communications

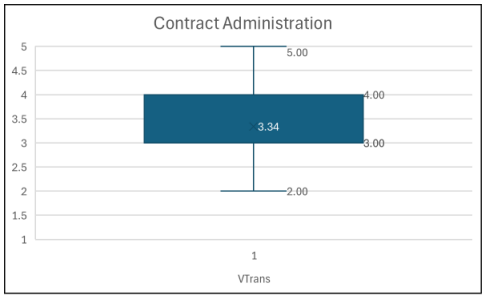
a. Contract Administration

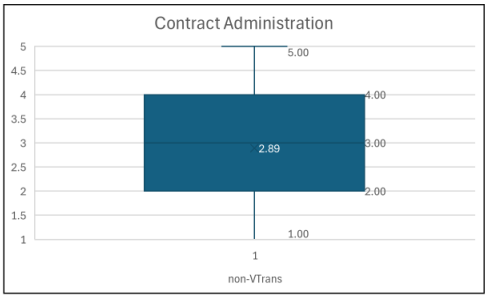
68 responses

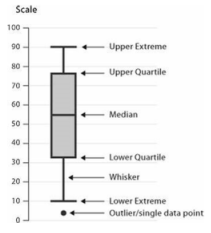


45

Perceived Quality Issues – Communications





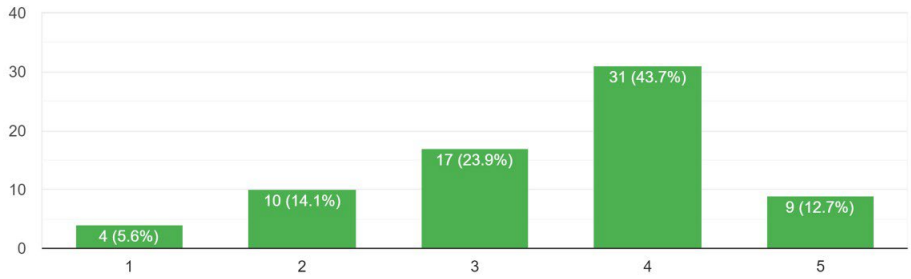


46

Perceived Quality Issues – Communications

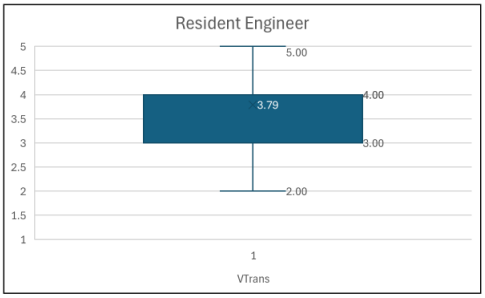
b. Resident Engineer

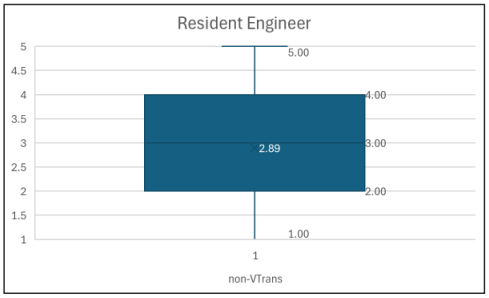
71 responses

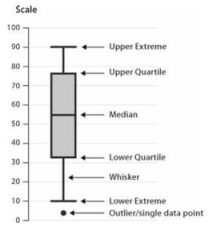


47

Perceived Quality Issues – Communications





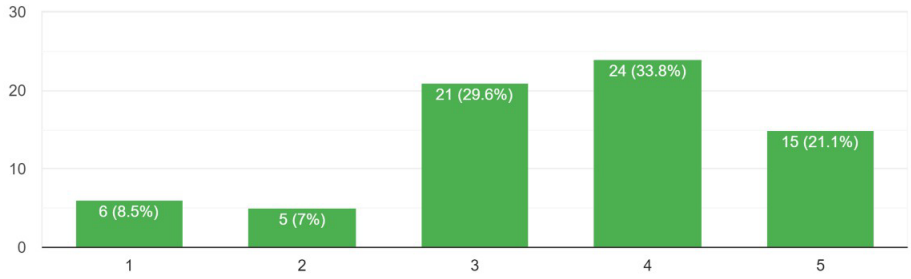


48

Perceived Quality Issues – Communications

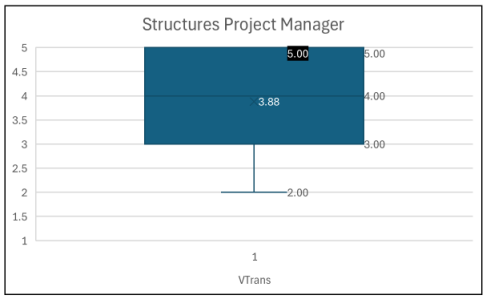
c. Structures Project Manager

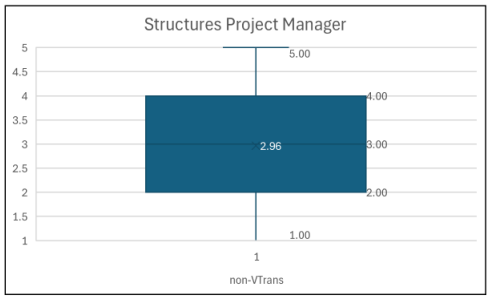
71 responses

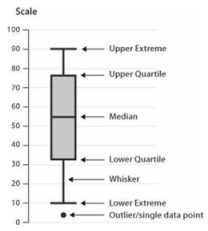


49

Perceived Quality Issues – Communications





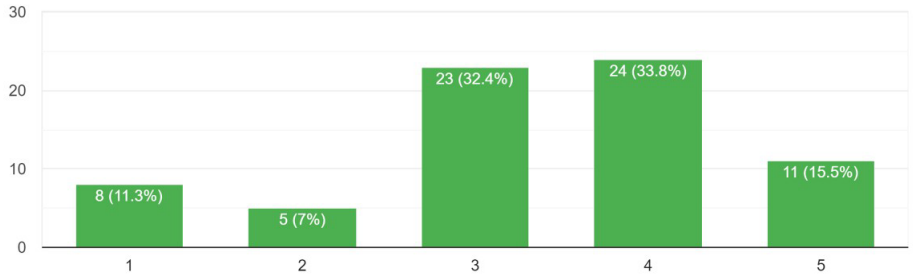


50

Perceived Quality Issues – Communications

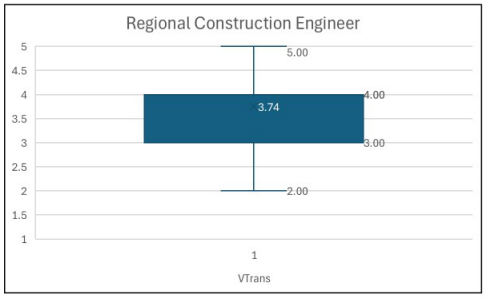
d. Regional Construction Engineer

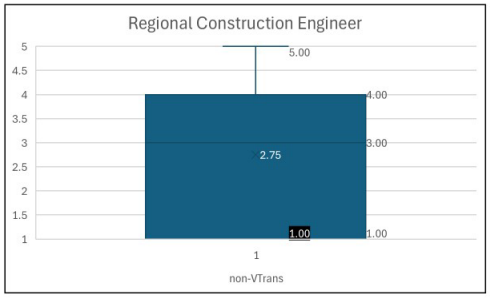
71 responses

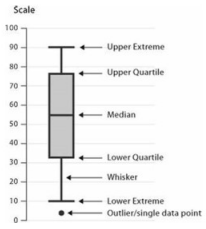


51

Perceived Quality Issues – Communications





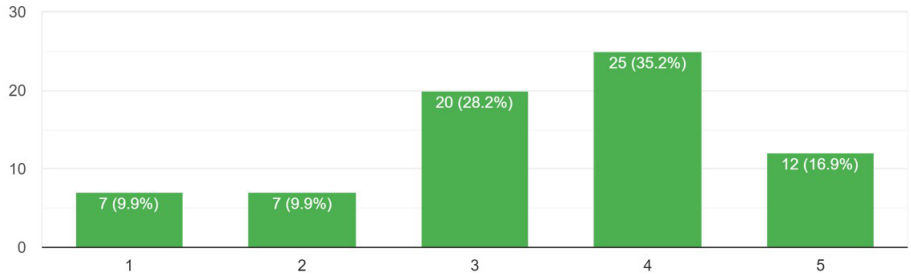


52

Perceived Quality Issues – Communications

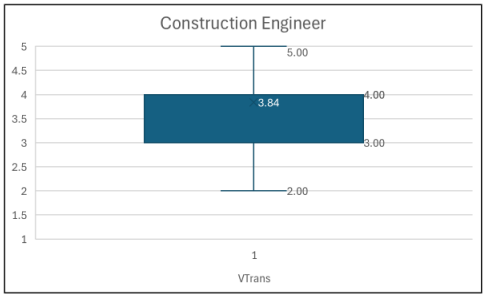
e. Construction Engineer

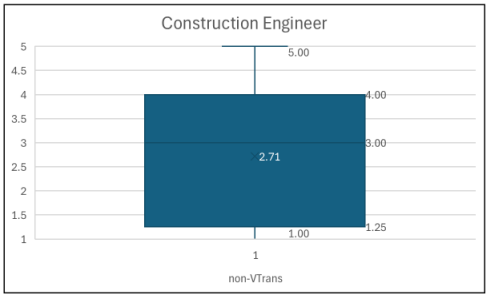
71 responses

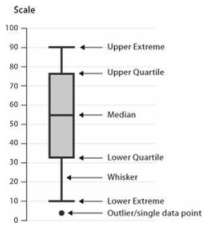


53

Perceived Quality Issues – Communications





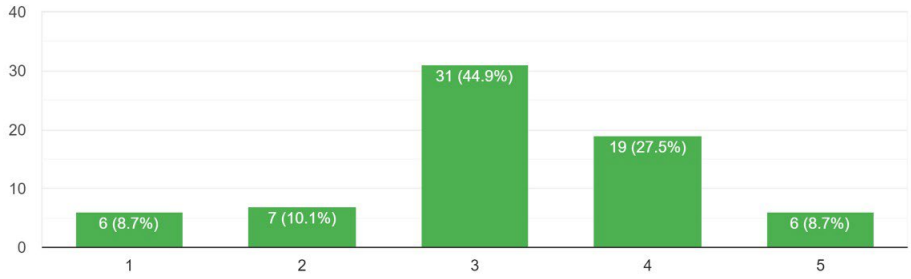


54

Perceived Quality Issues – Communications

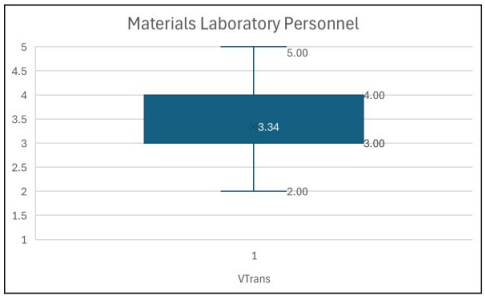
f. Materials Laboratory Personnel

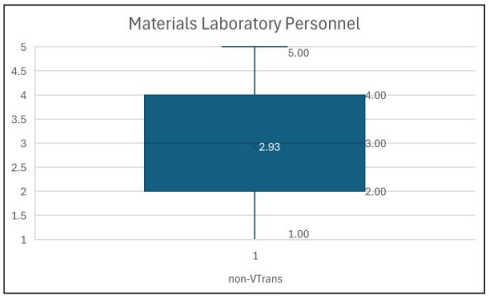
69 responses

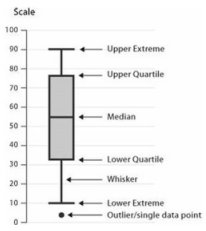


55

Perceived Quality Issues – Communications





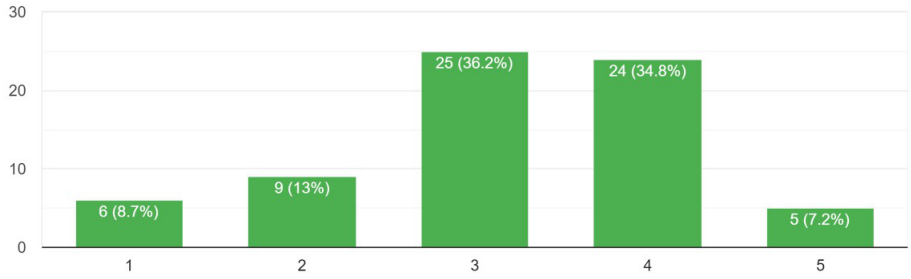


56

Perceived Quality Issues – Communications

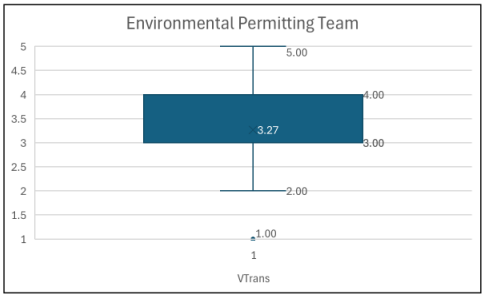
g. Environmental Permitting Team

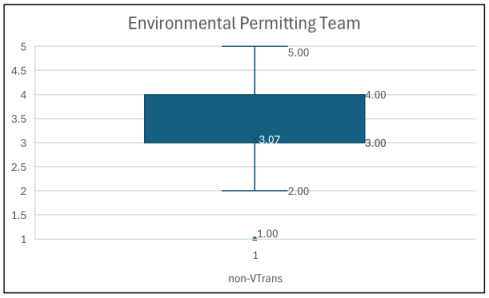
69 responses

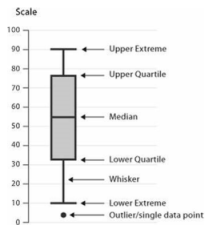


57

Perceived Quality Issues – Communications

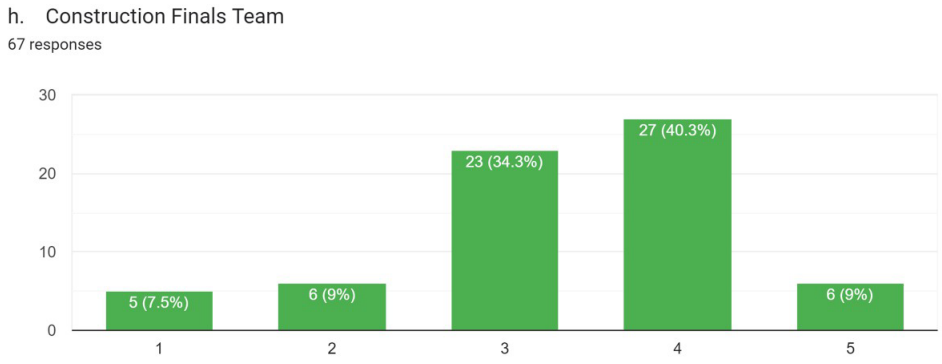






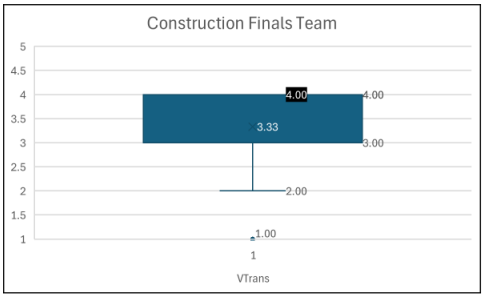
58

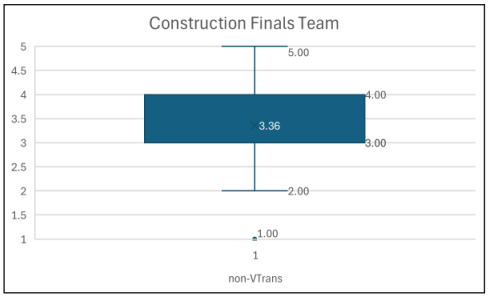
Perceived Quality Issues – Communications

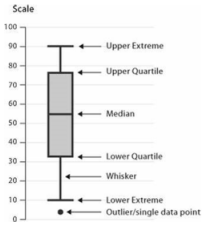


59

Perceived Quality Issues – Communications

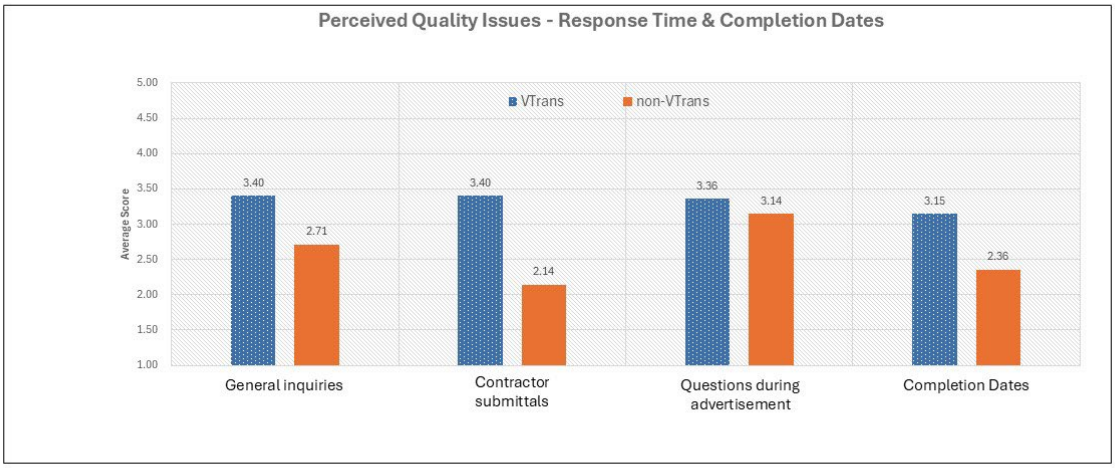






60

Perceived Quality Issues – Response Time & Completion Dates

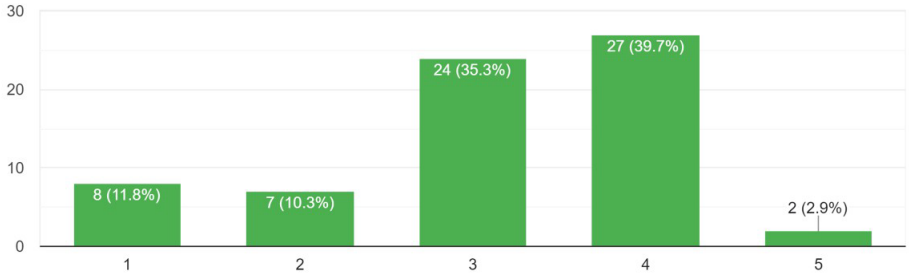


61

Perceived Quality Issues – Response Time

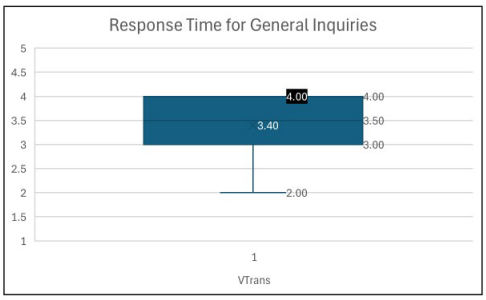
a. Response time for general inquiries

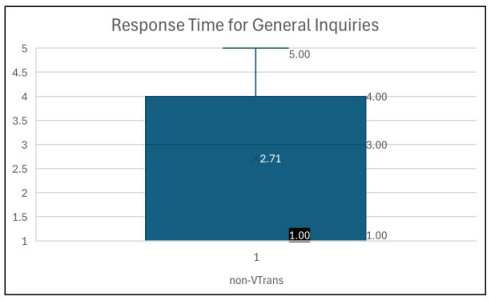
68 responses

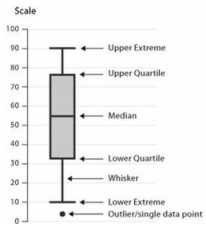


62

Perceived Quality Issues – Response Time





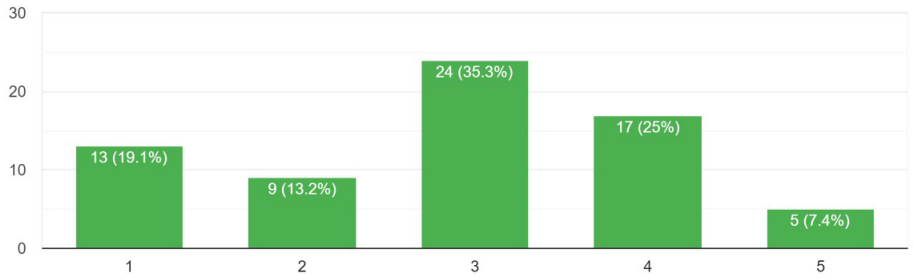


63

Perceived Quality Issues – Response Time

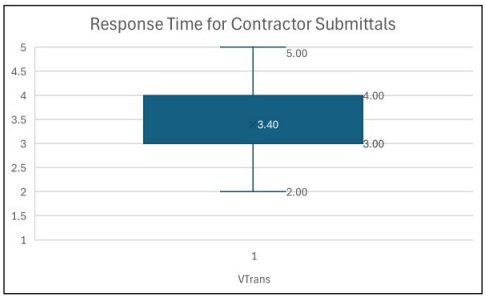
b. Response time for Contractor Submittals

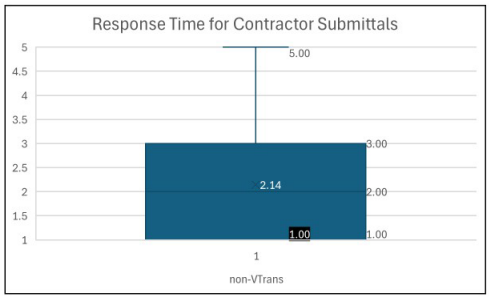
68 responses

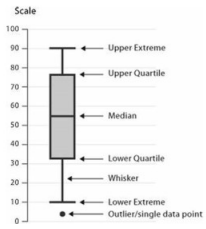


64

Perceived Quality Issues – Response Time





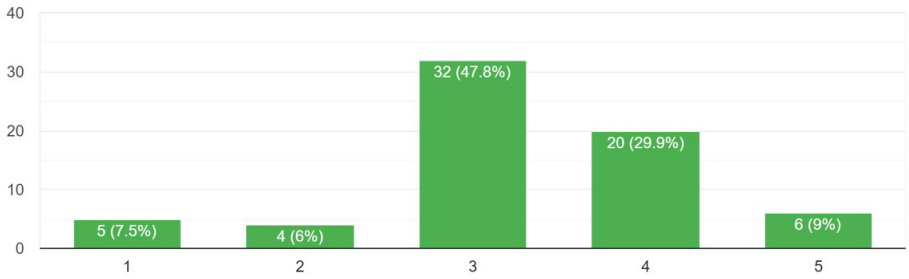


65

Perceived Quality Issues – Response Time

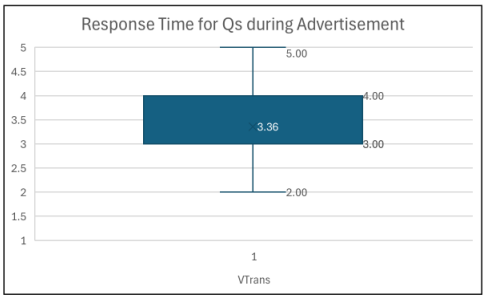
c. Response time for questions during advertisement

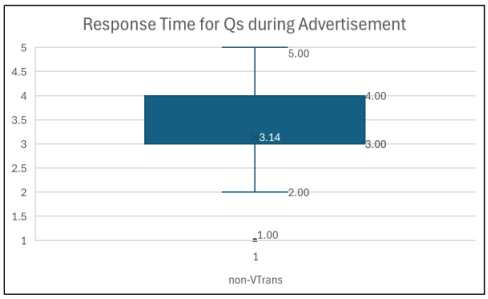
67 responses

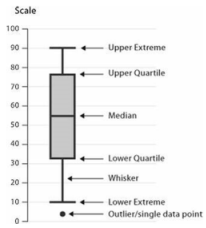


66

Perceived Quality Issues – Response Time





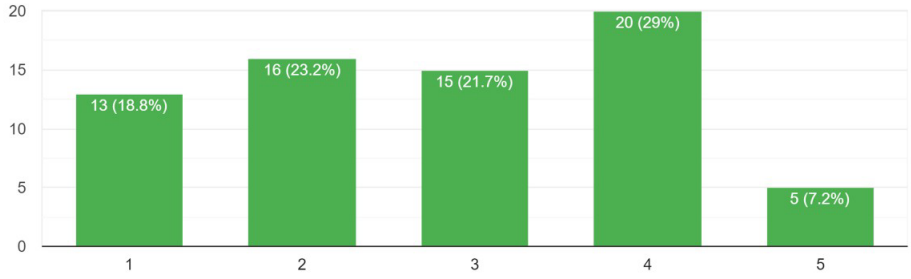


67

Perceived Quality Issues – Completion Dates

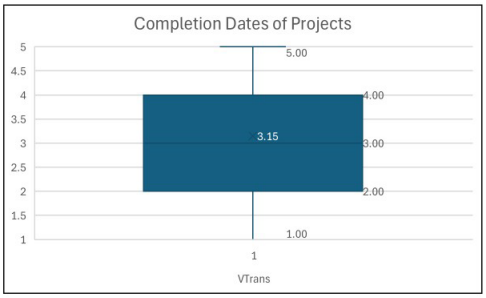
d. Completion Dates of projects.

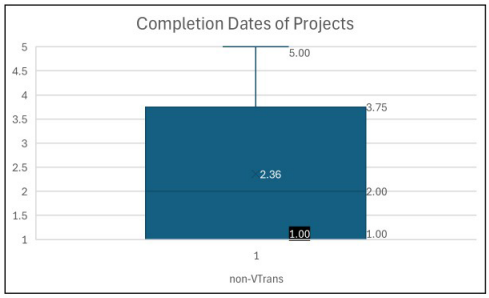
69 responses

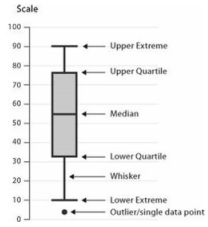


68

Perceived Quality Issues – Completion Dates







69

Perceived Quality Issues Documents & Communication (written feedback summary)

70

Process

1. Include the geotechnical reports as part of the information provided during bidding.
2. Provide one location contractors can search for RFP's.
3. Project bundling
   a. Concerns with quality
   b. Inconsistencies created when different entities prepare the documents (design firms, agency)
4. Managing Consultants
   a. Consultants need to be held to quality standards
   b. Inconsistencies in deliverables is problematic
5. Permit Restrictions negatively impact the buildability of projects
6. The number of special provisions is cumbersome
7. The certification process has gotten much better

71

Culture

1. The RE's are not willing to partner with the contractor
2. The Regional Construction Engineers (RCE) are not engaged in the site work
3. Difficult to collaborate with the Steel Fabrication Inspector
4. Communication with VTrans has become very poor
5. Who is in charge? "Everyone seems to do what they want"
6. There is a breakdown in communication between the contractor and designer

72

Time

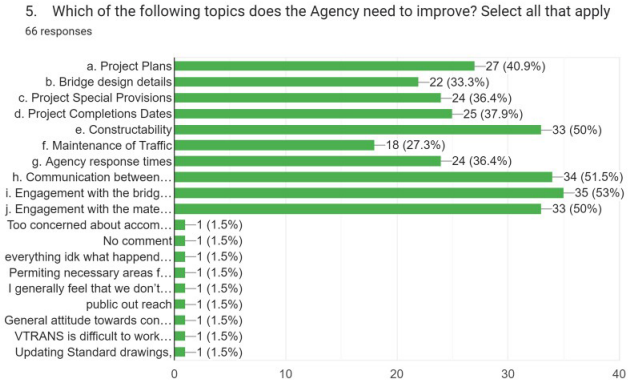
1. Request for Information (RFI) are ignored, or answers are delayed
2. The review by date, or time allotted for a review are changed or extended
3. Change Orders are not processed timely.
4. Design Changes are not processed timely.
5. Project Managers are not responding timely.

Workforce Development

1. The knowledge, skills, and abilities of the Resident Engineers (RE) is questioned.

73

Opportunities for Improvement



h. Communication between Agency staff and contractor/suppliers
i. Engagement with bridge contractors
j. Engagement with material suppliers

74

Opportunities for Improvement

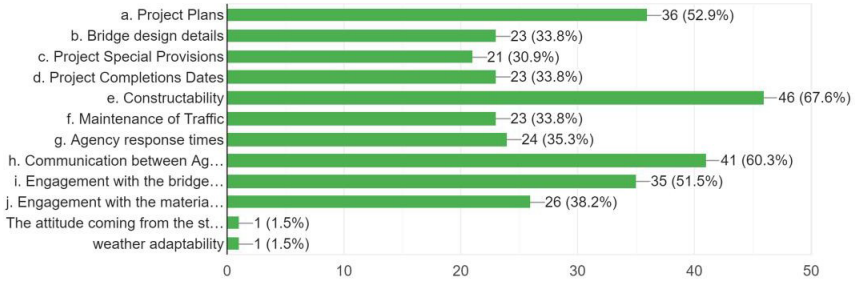
Which of the following topics does the Agency need to improve?	VTrans	non-VTrans	Total
a. Project Plans	18	9	27
b. Bridge design details	13	9	22
c. Project Special Provisions	15	9	24
d. Project Completions Dates	10	15	25
e. Constructability	16	17	33
f. Maintenance of Traffic	8	10	18
g. Agency response times	12	12	24
h. Communication between Agency staff and contractor/suppliers	19	15	34
i. Engagement with the bridge contractors	20	15	35
j. Engagement with the material suppliers	18	15	33
Other...Permiting necessary areas for construction	1		1
Other...Updating standard drawings	1		1
Other...Public out reach	1		1
Other...Communication with contractors and suppliers	1		1
Other...Too concerned about accommodating the public during construction		1	1
Other...Teamwork		1	1
Other...Decisions are all made by committee		1	1
Other...Too many people retire and no ones in charge anymore		1	1
Other...General attitude towards contractors		1	1

75

Prioritization of Solutions

6. Please identify from the list the five most important topics the Structures Program should focus on to improve the delivery of bridge projects (select only 5):

68 responses



h. Communication between Agency staff and contractor/suppliers
i. Engagement with bridge contractors
j. Engagement with material suppliers

76

Prioritization of Solutions

Prioritization of Solutions	VTrans	non-VTrans	Total
a. Project Plans	26	10	36
b. Bridge design details	16	7	23
c. Project Special Provisions	18	3	21
d. Project Completions Dates	12	11	23
e. Constructability	29	17	46
f. Maintenance of Traffic	16	7	23
g. Agency response times	10	14	24
h. Communication between Agency staff and contractor/suppliers	22	19	41
i. Engagement with the bridge contractors	23	12	35
j. Engagement with the material suppliers	17	9	26
Other…Weather adaptability	1		1
Other…Steel review		1	1

77

Future Trends Affecting Design/Construction (written feedback summary)

78

Workforce Development

1. Limited number of workers, limited skills of workforce, for VTrans and contractors
2. Decrease in experience for VTrans and Contractors
3. A shortage of labor exacerbated by public policy
4. Aging workforce who are not technologically savvy
5. Increase Davis-Bacon wage rates to help contractors offer more incentives to employees
6. Contractors are more knowledgeable about contracts than construction staff assigned to the project.
7. The lack of on-site real-world experience; the trades are becoming a lost art.
8. Inadequate contractor skills to construct more complex projects
9. Too many layers of project managers, specialists, and consultants

79

Model Based Design & Construction

1. The results need to be superior to 2D paper plans or what is the value?
2. RFID underground utility marking
3. Automated machine guidance
4. The model as a legal document will have a significant impact on bidding and building
5. VTrans can't move faster than the contractors can with digital delivery
6. Presents challenges and opportunities
7. Digital delivery is going to make it difficult for small contractors to compete

80

Partnering

1. Lack of partnering is driving up costs
2. The ability of VTrans to work with fabricators and suppliers
3. VTrans treatment of contractors is driving them away to work in other states
4. VTrans is arrogant
5. VTrans should realize that the contractor and AOT are working for the same goal
6. The need for Agency-Consultant-Contractor collaboration
7. Provide more flexibility with contractors and material suppliers

81

Funding

1. Lack of funding in the budget

Rising Costs

Barrier to Entry

1. Material Procurement
2. The submittal processes
3. Complicated specifications
4. VTrans could offer a graduated prequalification process to increase the number of competitive bidders by allowing contractors to start small and grow.

82

Submittal Process & Timelines

1. Endless submittals, resubmittals, and paperwork
2. Whatever happened to “approve as noted”
3. Turning around submittals should be priority #1
4. It shouldn’t take 21 days to review a submittal.
5. Difficulty and timing of approvals for steel fabrication

83

Innovative Materials

Specifications

1. Supplier’s unwillingness to comply with VTrans material specifications
2. VTrans has a lot of requirements other states do not have.
3. Changes to concrete content and manufacturing

Environmental Regulations

1. Tight project footprints make projects more difficult
2. Waste, borrow and staging areas are becoming more challenging to find and permit

84

Miscellaneous

1. Driverless cars
2. The need for charging stations for EV's
3. Floods
4. Increased deterioration to the infrastructure
5. Artificial Intelligence
6. Less delays for the traveling public
7. The need to rehabilitate and repair steel bridges
8. The ability to deliver projects quickly, from concept to construction
9. Consistency and standardization

85

Additional Feedback or Comments to Identify Improvement Opportunities (written feedback summary)

86

Partnering

1. Understanding the challenges facing the contractors could help VTrans design in a way that minimizes those challenges
2. Fabricators alienated may not quote work for VTrans
3. Contractor engagement during design would provide better constructability
4. The majority of the time VTrans makes the change order process adversarial and isn't fairly considering the pricing
5. VTrans needs to be more open, and easy to work with contractors and suppliers
6. Subcontractors and suppliers threatening to not quote VTrans work is driving up pricing
7. Be reasonable with the administration and application of specifications required in the completion of work
8. The state needs to play by the rules they require the contractors to follow
9. Creating a space where designer and contractors can collaborate without creating issues with the procurement process could be a tremendous advantage
10. VTrans has a culture that the contractor is the enemy and whatever the contractor might say or do is an effort to increase their bottom line

87

Partnering

11. Contractors are experts too, and in a lot of circumstances have more experience than VTrans staff
12. There is no sense that the VTrans staff is working with the contractors to get the projects done on time, and in most situations, it seems like just the opposite
13. VTrans puts up arbitrary roadblocks to draw things out longer
14. Work with the contractors to improve plan details and development
15. As a designer, I feel that open access to contractors and suppliers should be encouraged and facilitated
16. VTrans should rely less on "that is the contractor's means and methods" as it limits their understanding of what it takes and costs to perform the work
17. Resident Engineers are increasingly unapproachable, argumentative, and unreasonable with contractors throughout the state
18. VTrans is turning away more contractors due to their overall blatant disrespect and disregard for the contractor's input
19. There are very few Resident Engineers that will even allow for a discussion on constructability concerns and value engineering alternatives
20. Resident Engineers should not be disparaging or openly disrespecting contractors

88

Partnering

21. VTrans has zero self-awareness and zero accountability
22. VTrans refuses to change and refuses to work with the contractors so contractors do not want to work for them
23. VTrans needs to have a serious conversation with contractor on how to lower costs
24. The general culture at VTrans needs to be realigned to a team effort, not VTrans VS. Contractor
25. Communication and engagement at all levels is important for understanding and training
26. Knowing how to identify and address the issues is key; experience and working together to solve challenges is important
27. VTrans has become extremely arrogant and has cemented themselves in such a rigid position that is now very difficult to dig themselves out
28. The attitude and culture need to change, starting at the top all the way to the bottom
29. Take out the pride and start acting like you really want to work with others
30. Contractors are far from perfect either, there are certainly bad actors on both sides, but two wrongs don't make a right

89

Quality of Plans

1. Improve the quality of the designs
2. Check plan sets before advertising for bid doc conflicts in addition to constructability reviews
3. Need consistent details, consistent notes, consistent plan organization across the design groups
4. Improve quality control
5. Estimating and estimates need to be improved
6. Rehabilitation projects could be improved and require more attention from qualified personnel during design and construction
7. Improvements need to be made using the Open Roads software for project plan development
8. Include material requirements in the special provisions in the same format as all specifications
9. Improve the online-shared-review (OLSR) process so more people are engaged, major comments addressed, and final plans need to be final
10. Having a vetted 3D model will address risks in bidding and construction

90

Submittal Review

1. Submittal reviews should never be put on hold due to someone being on vacation/leave
2. It appears that communication and timeliness of reviews happens faster with VTrans run project vs their partners
3. VTrans is not turning around submittals in a timely fashion
4. Submittals that could be “approved as noted” are returned as revise and resubmit
5. Those responsible for reviewing the submittal should be capable of preparing the submittal
6. The approval process for shop drawings, working drawings, traffic control plans etc. is arduous at best
7. It has become common occurrence that RFI’s do not get addressed or responded to
8. The review process for submittals has become extremely burdensome on the contractor
9. Consistency from VTrans’ response on all projects

91

Workforce Development

1. To retain qualified people, we need to offer 12 months of employment; no one wants seasonal employment
2. The state could be more flexible on winter work
3. VTrans inability to hire new young designers and limited number of qualified design consultants
4. Embracing technology could encourage an interest in the profession
5. Stop putting unqualified people in positions just because they have a PE
6. Stop hiring consultant inspectors who know nothing
7. Hold consultants responsible
8. Install real leadership (need to hire outside of VTrans for management roles as the only way to fix things)
9. Poor leadership allows employees to run unchecked; unprofessional behavior directed at contractors

92

Process

1. Make applying and reapplying for prequalification and finding RFPs' easier
2. Changing the narrative of construction impacts to environmental improvement should expedite project delivery and lower PE costs
3. Better engagement with abutting landowners
4. VTrans needs to collaborate with DEC to develop a management plan for urban soils including defining waste areas statewide
5. In-person meetings
6. VTrans should think outside the box on procurement of projects and progressive design-build seems promising

93

Questions During Procurement

1. I hate to ask questions during the bidding process because VTrans does not like addendums and the response is most likely going to be bid it as you see it.
2. Bidders get different information because questions and answers are not shared with everyone
3. VTrans needs to share all questions and responses during the bidding process with all bidders

94

Burdensome Requirements

1. Unreasonable submittal reviews and QA testing driving suppliers away and cost up
2. Too many materials certification requirements
3. It is getting harder to work on VTrans projects due to the hoops that you need to jump through

Completion Dates

1. Extend completion dates through May. There are not enough subcontractors for tail end work items (plug joints, paving, markings) to complete the late season work when days are short and conditions difficult
2. Accelerated schedules

95

Summary of written responses

Quality of Documents & Communication	Future Threats & Opportunities	Additional Feedback
Process	Workforce Development	Partnering
Time	Model Based Design	Quality of Plans
Workforce Development	Partnering	Submittals
Culture	Funding	Workforce Development
	Rising Costs	Process
	Barrier to Entry	Question During Procurement
	Submittals	Burdensome Requirements
	Innovative Materials	Completion Dates
	Specifications	
	Environmental Regulations	
	Miscellaneous	

96

Themes

Most Important Themes
Workforce Development
Partnering/Culture
Submittals
Process
Quality of Plans
Time

Secondary Themes
Barrier to Entry
Funding
Rising Costs
Innovative Materials
Specifications
Environmental Regulations
Burdensome Requirements

97

Appendix D: Survey Written Responses

Perceived Quality Issues – Documents

(Advertisement, Special Provisions, Contract, Project Plans, Written Orders, Change Orders)

g. Other, please specify

1. Another important bid document is the geotechnical report.
2. The state of Vermont needs one data base that contractors can search RFPs in.
3. Permit restrictions negatively affect the buildability of the project. the number of special is cumbersome.
4. communication from the state has become very poor
5. Certifications process has gotten much better .
6. In recent experience with projects, combining multiple jobs from different designers, it is being found that there are inconsistencies between projects and how items are getting paid for or different design for the same item. The same designer should be used under multiple projects advertised under the same contract.
7. need to separate these question between consultant and aot
8. Cooperation with VTrans - Ryan Foster - 0
9. Need to hold consultants to a standard. Poor management of consultants and inconsistencies with designs are rampant.

Perceived Quality Issues – Contractor Submittals

(Application or Renewal of Prequalification, Fabrication Drawings, Construction Drawings, Requests for Information, Value Engineering, Pricing for Extra Work, Materials Mix Designs, Materials Approved Product List)

None provided.

Perceived Quality Issues – Communications

(Contract Administration, Resident Engineer, Structures Project Manager, Regional Construction Engineer, Construction Engineer, Materials Laboratory Personnel, Environmental Permitting Team, Construction Finals Team)

i. Other, please specify (7 responses)

1. significant difference in the resident engineer between projects. Many younger RE are not knowledgeable willing to partner with the contractor for the best project outcome.
2. who is in charge everyone seems to do what they want in the state
3. Never see Regionals ("working" from Florida))
4. Scores of ‘3’ indicate that I have no experience communicating with this team.
5. RFIs are often ignored. Answers are delayed. Dates for review are often changed or
6. extended for no given reason. Change orders and design changes are not processed in a

7. timely manner to suit the needs of the construction completion date. There is a breakdown in communication between the contractor and the designer.
8. project managers do not respond in a timely manor. Most regional play very little role during the project
9. [redacted] Project Delivery Bureau, Structures Section - 0 - Impossible to work with.

7. What future trends do you think will most affect the design and/or construction of VTrans transportation projects? (53 responses)

1. BIM, but it needs to be done in a way that the results are superior to 2D paper plans. If not then go back to 2D paper plans.
2. Rising cost and suppliers' unwillingness to comply with VTrans material specs.
3. Digital Construction (BIM, model based construction, etc.)
4. Limited numbers and skills of workforce for both VTrans & Contractors
5. Decrease in experience for both VTrans and the contractor combine with the lack of partnering is driving up cost.
6. Money
7. Lack of Labor. The State needs to stop paying people to stay home and not work. We are a small company that normally as 35-40 people on payroll and the last couple of years we are lucky to have 25. So, this limits the amount of project we can take on. So, then the bigger contractors get the projects for a lot more money.
8. The ability of VTrans to work with fabricators and suppliers
9. Driverless cars. Electric vehicles needing charging stations.
10. Workforce, sustainability, subject matter expertise
11. no ones is going to want to work the state the way the cowboys from the state treat contractors
12. Floods and lack of money in the budget.
13. Technologies such as machine guided equipment - RFID underground utility marking - model based deliveries.
14. Arrogance - VTrans has too much of it.
15. Contactors leaving the state to find work in NY, MA, NH
16. Digital Delivery
17. Funding
18. Lack of Help #1. We use to build with supers and residents. #2 Now we must have layers of project managers on both sides with endless submittals and re submittals. Way too many VTrans specialists in the way to get and keep a project going, then add in consultants who only make money by billing more hours = more submittals. Whatever happened to approved as noted? NH doesn't take 21 days to turn stuff. The job is underway, turning shops/submittals should be priority #1!!!
19. Innovative materials, increased deterioration of our infrastructure
20. Digital delivery
21. Model as the legal document will have a significant impact on bidding and building assets.
22. increasing costs

23. Labor availability, digital delivery
24. Environmental regulations
25. Low experienced workers in design and in the field
26. AI, new materials
27. 3D modeling as long as VTrans doesn't move faster than our contractors can.
28. Digital delivery is going to create a lot of challenges, but some opportunities as well. A shortage of employees is likely to continue to be an issue for the foreseeable future.
29. In addition to an aging workforce that may not be technologically savvy, complicated specifications, construction submittal processes, risk of material procurement, etc. can be a deterrent for many small contractors. (Barrier to entry may be too high)
30. How can we assist small contractors get into infrastructure work to increase the number of competitive bidders? In coordination with the prequalification process, perhaps develop a program / strategy / plan so small contractors may understand how to grow their business by performing work on certain projects, building competency, and becoming eligible for larger scale more complicated projects.
31. Less delays to the traveling public
32. Tighter project foot prints make it harder for contractors to construct project and need space for traffic control, especially for high volume roads.
33. Waste, staging and access areas are getting increasing more challenging to find and permit. There are more factors to consider regarding the material itself and the location it will be stockpiled or waste. It is typically a very time consuming process.
34. Changes to concrete content and manufacturing
35. We are entering a time where our workforce is aging out and the level of experience of the new people coming in is limited. The number of contractors bidding on projects has been less and more projects are coming out for re-advertisement or canceled because only one bid was received. Projects are going to get more expensive and fewer projects are going to be getting it done. The Davis bacon wages need to be substantially increased to allow the contractor to offer more incentive.
36. the VTrans employees and designers they hire need a lot of work
37. The state has a lot of requires that other states do not have and the workforce is getting older and smaller.
38. Moving toward digital delivery will have a learning curve but should be beneficial. Shortage in workforce is an ongoing problem in all steps of the process.
39. Electronic 3D plan sets are going to make it difficult for small contractors and require extra resources for large contractors.
40. Contractors are more knowledgeable about many aspects of the contract than the Construction staff assigned to the project.
41. VTrans needs to realize that the contractor and AOT are working for the same goal
42. The need for rehab/repairs of structural steel bridges. Development of consistent (to extent possible) will be very beneficial for this.
43. Lack of a competent workforce for design, construction, and inspection.
44. Difficulty working with / receiving approvals in any timely fashion from Ryan Foster directly affect my companies' ability to work with VTrans and our future plans to quote work for VTrans.

45. Lack of on site experience. Virtual versus hands on exposure to real life scenarios. Young people aren't entering the work force knowing how to run equipment or fix mechanical or electrical devices. No concept of safety issues or how things work. The trades are becoming a lost art.
46. Consistency and standardization
47. Agency-Consultant-Contractor collaboration
48. Collaboration through design and construction. We could use feedback from contractors through design and its also important for designers to see lessons learned through the construction of the project. VTrans has great guidance to get many of our conventional projects through design and constructed with ease. But material and labor costs are only increasing, if we work on a project for 3 to 5 years in design then send it to construction with the greatest intent and the contractor can think of a way to reduce costs, I see that as money that could have been better used in design. Then there are few options for contractors to make changes in construction, through change orders of VEs which needs to be reviewed, taking more time and money. I could see how design build on a simpler level could work well for some of our smaller projects. I also think clarity with the public about our process could improve contractor interest.
49. We have lots of issues in this state. Lack of manpower, funding, and resources being all big ones. Having more flexibility with your contractors and suppliers will generate a lot better working relationship with them.
50. Lack of qualified contractors to construct the projects being programmed.
51. Ability to deliver a set of contract plans more quickly from concept to advertising.
52. The amount of paperwork required of the contractors to do projects. Some projects are really small, but require a massive amount of paperwork, which makes it harder to bid these projects.
53. Improved materials

8. Please provide any additional feedback or comments you believe would be helpful in identifying improvement opportunities. (For example, on barriers with VTrans engagement, design related issues, or construction related issues.) (44 responses)

    1. Understanding the challenges the contractors face could help VTrans design in a way that minimizes those challenges.
    2. Make applying easier, make reapplying easier, make finding RFPs easier!
    3. Having redundancy on the fabrication drawing review team. Contractor submittals that can impact project schedules should never be put on hold due to someone being on vacation/leave.
    4. There should have been a few questions about the differences between Consultant vs In-

House VTrans Developed contracts. Many of the questions would have been answered
differently. It appears communication and timeliness of reviews happen faster with VTrans run projects vs their partners.

5. Several fabricators wont work on jobs with the Structural Steel Fabrication Engineer
6. Unreasonable submittal review and quality assurance testing is driving suppliers away and costs up. Contractor engagement during design would provide better constructability.
7. VTrans needs to be more open and easier to work with. With both Contractors, Subs and suppliers. We have people that will not quote us on project because they have had bad
experiences with the State and do not want to work with VTrans. So, this limits who we are getting pricing from so then the cost is more because they know we need it, and they are the only ones to supply it. So, in the long run this is only hurting the State because they are paying more for the finished project.
8. Being reasonable with the administration and application of specifications required in the completion of work.
9. make the state follow the rules like they make the contractors follow. find new designers they are horrible lately.
10. I believe creating an opportunity/space where designers and contractors can collaborate
without creating issues with competitive procurement would be a tremendous advantage to the State. In a perfect world it would allow for contractors to learn about WHY some of the design considerations are in the plans AND allow designers to see which details or other construction issues are most frustrating for Contractors.
11. VTrans has a culture that the contractor is the enemy and that whatever the contractor might say or do, is an effort to increase the bottom line. Contractors are experts too, and in a lot of circumstances have more experience that the VTrans staff.
12. VTrans does not deal with change order situations very well, and a majority of the time, it creates an adversarial atmosphere surrounding them. Then VTrans looks to compare pricing that is presented for the change order to a 5 year average bid price where there might have been completely different circumstances associated with the pricing in those bids.
13. VTrans is not good about turning around submittals in s timely fashion, and quite often what could be approved as noted, comes back as revise and resubmit. This costs valuable time.
14. There is no sense that the VTrans staff is working with the contractor to get the project done on time, and in most situations, it seems like just the opposite, that they are putting up
arbitrary road blocks to draw things out longer.
15. I almost hate to ask questions during the bid process, because I know

VTrans does not like doing addendums, and the response is most likely going to be bid it as you see it. It also
results in various bidders getting different information in the preparation of their bids, because questions and answers are not shared with everyone

16. Working with contractors to improve plan details/development
17. Need to extend completions thru May for jobs. There are only single subs for the tail end
work items (plug joints, striping, paving top) during the shortest, coldest days of the season. One day in August = 4 days in November.
18. To retain qualified people, we need to offer 12 months of employment. Seasonal work no one wants. State could be much more flexible on winter work, that would be a great help.
19. Changing the narrative of construction impacts to environmental improvements should expedite project delivery and lower PE costs. Having a vetted 3d Model will address risks in bidding and construction. Embracing the technology could also encourage new workforce interest.
20. As a designer, I feel that open access to contractors and suppliers (such as precasters) should be encouraged and facilitated.
21. Better engagement with abutting landowners
22. Check plan sets before advertising for bid doc conflicts in addition to constructability reviews
23. Special Provisions should have a 'Materials' section at the top just like the subsections in the spec book does. Otherwise, it's hard to know what materials are involved with the special provisions and hence what certifications are needed. It's unfair to the RE and Contractor to continually add certification requirements during the course of the project simple because the special provisions didn't specify what was included and what needed to be certified.
24. The OLSR process needs to be improved (more people should be involved at conceptual plans so that major comments can be addressed early, consistent distribution lists are needed, final plans need to be FINAL). The different design groups need consistent details, consistent notes, and consistent plan organization. There is a lot of unnecessary variation between HSD, Structures, and RAB in all of those elements, and between various consultants. Quality control needs to be improved. Estimating and estimate quality needs to be improved.
25. In collaboration with DEC, VTrans HWY, and Operations, develop a Statewide plan on the management of urban soils and defining designated waste areas across the state.
26. I think there needs to be less reliance on the "that's contractor means and methods" mentality. It is often true and accurate, but I think it limits VTrans' understanding of what it takes, and costs, to do the work. I think more emphasis could be put the designed method of construction. Ideally, those responsible for reviewing a submittal would be capable of preparing the submittal.
27. The approval process for shop drawings, working drawings, traffic control plans, etc. is arduous at best. Reviews take the full two weeks allowed almost every time. Drawings are updated based on the review and then rejected again with

new comments that could have been addressed the first time because there was a different reviewer. This may appear to be nit picking, however there is a very limited time window to complete work in Vermont and
the approval process can add weeks to the project schedule.

28. As stated before, it has become common occurrence that RFI is do not get addressed or
responded to. The review process on the submittals has become extremely burdensome on the contractor. While the process is thorough for the state, there are often inconsistencies in the notes of the returned submittals.
29. in person meetings
30. VTrans preaches the motto of the State working with the contractors. Meanwhile, the Resident Engineers on projects are increasingly unapproachable, argumentative and unreasonable with contractors throughout the state. VTrans is their own worst enemy and is turning away more contractors every year due to their overall blatant disrespect & disregard for the contractor's input. There are very few REs that will even allow for a discussion on constructability concerns and VE alternatives that would save the State both time and money. We cannot even count the number of times an RE has shown up onto one of our projects and has openly bad-mouth another contractor, claiming they are inept. If VTrans is going to preach about working with the contractor, then they should not be openly disrespecting the people that are bidding on their projects.
31. Another major concern is the complete lack of transparency throughout the entire process. VTrans is the only entity that does not share ALL questions posed in the bid process to ALL of the bidders, which is ridiculous. If VTrans wants to start adding more competition to their contractor pool, start from the beginning and be transparent and allow every bidder to have access to all of the questions posed by everyone in the Q&A window, not just the questions that each individual contractor asked on their own. By not allowing all bidders to have all information, VTrans is hoping that the bidders make oversights when putting together their bids, in hopes that they will get a project awarded for cheap. In reality, all this does is force contractors to add contingency costs into each bid, thus driving up the price of each project. For every single other project that is formally bid in Vermont for municipalities and even private development, the engineer compiles a list of every question asked in the Q&A period and sends it out to every registered bidder. When you lose the transparency and trust of the contractors, your bidder pool is going to suffer as a result.
32. Overall, VTrans has absolutely zero self awareness and zero accountability. VTrans refuses to change and refuses to work with the contractors, and as a result, contractors do not want to work for them and have built stronger relationships with municipalities and private engineering firms who are open to constructability & VE discussions, and realize that not everything put on a piece of paper is practical.
33. I feel a few areas that could be looked at are accelerated schedules, requiring all of these material specifications. Vermont has a lot of requirements compared to other states.
Currently most bridge construction companies have between 8 and 25 people with a number of their workers being over 60. I think the state needs to have a

serious talk with the constructions companies to see what the state can do to help lower costs.

34. Having consistency in VTrans response on all projects.
35. Hold consultants responsible, install real leadership(need to hire outside of VTrans for management roles, only way you will fix things) and the general culture at VTrans needs to be re aligned to a team effort not aot vs contractor. You need to stop putting un qualified people into positions just because they have a pe. Some of the smartest people in VTrans don't have a PE and most positions that require a PE don't do any real engineering. VTrans is aware of issues for example Ryan Foster but that lack of leadership does nothing about it and they continue to pay inflated prices on steel, that is not fiscal responsibility. These fancy surveys are not needed all of the answers are staring you in the face. The contractor community has voiced their frustrations on def ears. You should ask the questions why do contractors do a single project in Vermont and never come back? The other issue is stop hiring consultant inspectors who know nothing and just stand on the job all day and add nothing to the job at all. The contractors see these guys making $50-$60 an hour to sit in their trucks and watch. They have no clue what they are looking at. I had a project with 2 inspectors who did nothing on a job that was 1000' long and most of the work was on a 200' bridge.
36. Just to point out VTRANS let people like Daryl Basset and Scott Wheatly run unchecked for years and did nothing about it another example of pour leadership. If I spoke to a VTrans employees the way those two have spoken to me I would be thrown off the job and would have had civil rights showing up at my door. The VTrans philosophy or culture failed many years ago and nothing has been done to fix it.
37. Rehab projects could use improvement. They are difficult and complicated to begin with, and spending more time with the right personal (in house and/or consultant) during plan development as well as during construction inspections, will make big improvements.
38. I cannot stress enough that the difficulty working with / receiving approvals in any timely fashion from Ryan Foster directly affect my companies' ability to work with VTrans and our future plans to quote work for VTrans.
39. Communication and engagement at all levels is important for understanding and training.
    Its okay to have a good set of plans versus a perfect set, but knowing how to identify the issues and address them is key. Experience and working together to solve challenges is important.

40. VTrans should think of out-of-the-box solutions for procuring projects. Although there will be a learning curve, Progressive Design Build seems promising, and the construction
    industry seems interested. Constructability and risk management will be easier and fairer to deal with under this approach. Sharpening the ICE

capabilities internally and externally is critical to justify the construction price with this the single source procurement.

41. VTrans has become extremely arrogant and has cemented themselves in such a rigid position that it is now very difficult to dig themselves out. I'd never say this and attach my name to it, since there is an extremely valid fear of some negative repercussion by VTrans towards myself or my company. The attitude and the culture at VTrans needs to change. Starting at the top and working all the way to the bottom. Every new employee learns from their supervisor and the culture continues to snow ball in the wrong direction. Take out the pride, and start acting like you really want to work with others, instead of merely saying that you do. Contractors are far from perfect either, there are certainly bad actors on both sides. But two wrongs do not make a right.

42. VTrans inability to hire new young designers and limited number of qualified design consultants.
43. Improvements need to be made using the Open Roads software for project plan development.
44. It is getting harder and harder to work on VTrans projects due to the sheer number of engineers, state agencies, and hoops that you need to jump through in order to even do the project. Projects that are typically on the smaller side have an added $20,000+ due to the amount of aggravation and paperwork required to do the small job. Asking for obscure material/grass seed mixes makes it even harder to do the project, as not everyone has a great supplier for everything VTrans. We have reached out to our local VTrans before for a type of grass seed and where they get it from and, even though they were within the district we were working, they had never heard of that type of grass seed mix required for the job or used it.

Appendix E: Focus Group Invitations, Agenda, and Presentation

Internal Focus Group invitation email to VTrans staff

Hello,
Would you like to see improvements to the quality and constructability of VTrans Projects?

Do you have ideas on how VTrans can create a framework to engage with the contracting and consultant community to foster collaboration?

Please consider participating in a focus group meeting. It will only take 90 minutes of your time, and you can help shape the future!

The VTrans Structures Program initiated a research project to develop a framework for defining quality and constructability of transportation projects that will create an avenue for collaboration with all stakeholders who support the design, procurement, and construction of VTrans projects. As part of this research, we sent you a survey to get feedback on quality and constructability, and to help the Agency identify areas of improvement. This information is being used to develop a framework that can foster dialogue among stakeholders to enhance the quality and constructability of transportation projects in Vermont.

The next phase of the research is to convene small focus groups (5-8 participants) to further explore the framework and again, we need your help. We are looking for volunteers willing to participate in the focus groups to help us better understand the challenges and explore the opportunities. The focus groups will meet virtually in May and June, be facilitated by the research team, and last approximately 90 minutes. **Please consider engaging in this important work and helping to shape the future of project delivery at VTrans!**

Attached is the fact sheet describing the project in greater detail. If you have any questions or would like more information, feel free to contact the research team directly (contact information in the attached), or Agency representatives Carolyn Cota and Jim Lacroix.

If you would like to participate, please respond to Dan D'Angelo (ddangelo@ara.com) and David Hoyne (dhoyne@gpinet.com), copied on this note, no later than May 16th with the remarks, Yes, I would like to participate. The research team will then provide you with information about the dates and time of the focus groups, and the agenda.

Thank you very much.

External Focus Group invitation email to Contractors, Suppliers, Engineers, and Fabricators

Hello,
Are you a Contractor, Supplier, Engineer, or Fabricator providing services to VTrans?

Would you like to see improvements to the quality and constructability of VTrans Projects?

Do you have ideas on how VTrans can create a framework to engage with the contracting and consultant community to foster collaboration?

Please consider participating in a focus group meeting. It will only take 90 minutes of your time, and you can help shape the future!

The VTrans Structures Program initiated a research project to develop a framework for defining quality and constructability of transportation projects that will create an avenue for collaboration with all stakeholders who support the design, procurement, and construction of VTrans projects. As part of this research, we sent you a survey to get feedback on quality and constructability, and to help the Agency identify areas of improvement. This information is being used to develop a framework that can foster dialogue among stakeholders to enhance the quality and constructability of transportation projects in Vermont.

The next phase of the research is to convene small focus groups (5-8 participants) to further explore the framework and again, we need your help. We are looking for volunteers willing to participate in the focus groups to help us better understand the challenges and explore the opportunities. The focus groups will meet virtually in May and June, be facilitated by the research team, and last approximately 90 minutes. **Please consider engaging in this important work and helping to shape the future of project delivery at VTrans!**

Attached is the fact sheet describing the project in greater detail. If you have any questions or would like more information, feel free to contact the research team directly (contact information in the attached), or Agency representatives Carolyn Cota and Jim Lacroix.

If you would like to participate, please respond to Dan D'Angelo (ddangelo@ara.com) and David Hoyne (dhoyne@gpinet.com), copied on this note, no later than May 16th with the remarks, Yes, I would like to participate. The research team will then provide you with information about the dates and time of the focus groups, and the agenda.

Thank you very much.

David and Dan

Focus Group Agenda

VERMONT
AGENCY OF TRANSPORTATION

Developing a Framework for Defining Quality and Constructability of Transportation Projects

Grant Agreement #GR1881
Technical Advisory Committee Agenda
June 13, 17, 19, 25, and 27, 2025

1. **Research Team Introductions**
   - VTrans opening remarks
   - Co-principle investigators: Daniel D'Angelo P.E., ARA & David Hoyne P.E., GPI

2. **Overview of the Project**

   Project Objectives:
   - ✓ Define quality, risk, and constructability of transportation projects.
   - ✓ Develop a feedback framework with which VTrans can engage the contracting community and key collaborators and partners.
   - ✓ Develop Technology Transfer and Guidelines for Implementation.

3. **Self-Introduction of Participants:** name, affiliation, and interest in this project

4. **Structured Discussion using the Amplifying Questions:**
   - What do quality project documents, process, and communication look like, and mean to a contractor/fabricator/supplier?
   - How can the Agency develop constructability skills in-house, and leverage the contractor's
   - expertise to ensure that the constructability of projects is practical and achievable?
   - How do we promote partnering and effective communication?
   - Where do we begin, for example, how do we jumpstart a new framework of communication and cooperation?
   - How can my organization participate, contribute, and do better?
   - How will the agency know it is being successful?

5. **Summary and Wrap up**

Focus Group Presentation

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

Focus Groups

June 13, 17, 19, 25, and 27, 2025

Via Teams

Developing a Framework for Defining Quality and Constructability of Transportation Projects

Dan D'Angelo P.E.
Principal Civil Engineer
Applied Research Associates
ddangelo@ara.com

David Hoyne P.E.
VP | Director of Construction Services
GPI
dhoyne@gpinet.com

VERMONT
AGENCY OF TRANSPORTATION

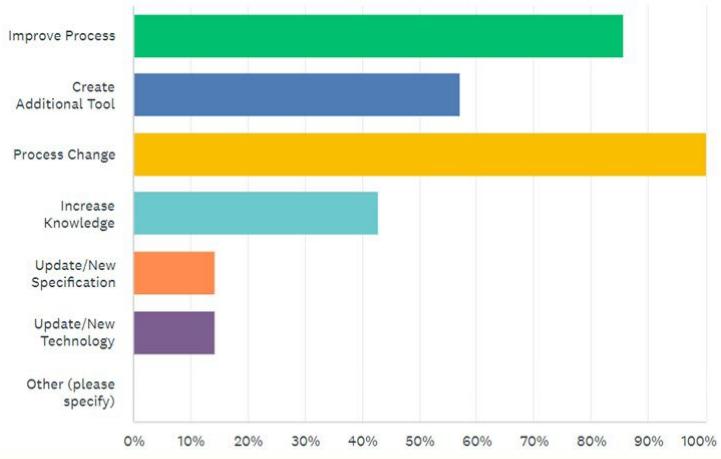
Objective

To develop a framework for VTrans to implement to engage the contracting community to improve partnering and for feedback to VTrans to better define risk, quality, and constructability.

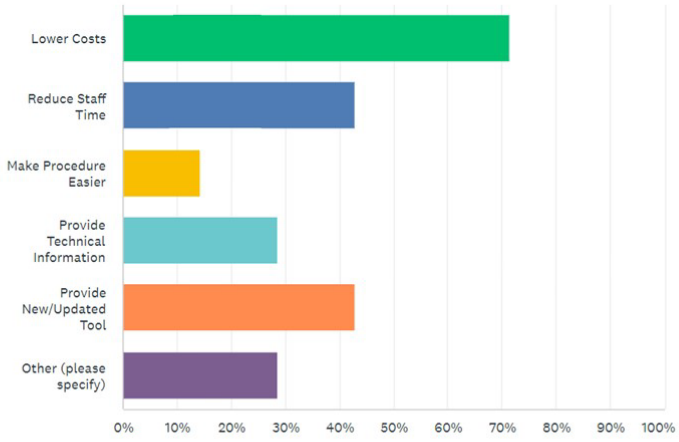
Methodology

1. Collect Data (Literature Search, Survey, Focus Groups)
2. Analyze Data: Errors & Omissions, Contract Change Orders, Claims
3. Review Current State-of-Practice
4. Perform Risk Assessment
5. Prepare Interim Report
6. Propose Engagement Framework
7. Test and Finalize Framework
8. Prepare Final Report

What type of improvement will this project accomplish?



How will this research make things easier?



Improved collaboration, risk allocation, and quality.

Improve quality of work

What do you think the benefits will be?

We want better contract documents so that the bidding and construction process will be smoother and ultimately more fair to all and less expensive for the Agency.

Providing a biddable and buildable set of plans. Plans that limit the number of change orders and errors/omissions.

Improve construction contracts to make them more biddable and buildable

Improved internal and external engagement with contracting community leading to improved construction quality and constructability.

Improved quality of deliverables that can lead to better pricing of work, reduce the changes and overruns, and develop meaningful professional relationships with effective communication channels.

Help understand how to make projects more efficient and understand how to save money in construction

Schedule

Task/Deliverable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25
Task 1 Data Collection																		
Task 2 Data Analysis																		
Task 3 State of Practice																		
Task 4 Risk Assessment																		
Task 5 Interim Report																		
Task 6 Engagement Framework																		
Task 7 Test Proposed Framework																		
Task 8 Final Report																		

Contact Info

Daniel D'Angelo, P.E., Applied Research Associates (ARA)
ddangelo@ara.com

David Hoyne, P.E., Greenman-Pedersen, Inc. (GPI)
dhoyne@gpinet.com

June 13, 2025 DEVELOPING A FRAMEWORK FOR DEFINING QUALITY AND CONSTRUCTABILITY OF TRANSPORTATION PROJECTS VERMONT AGENCY OF TRANSPORTATION

Appendix F: Focus Group Comments

#	Focus Group #	Issue Theme	Comment
1	1	Risk Sharing	1. The source of funding (FHWA, FRA, FTA) impacts risk assessment, bidding, and schedules of projects. The funding sources create challenges as there are strings attached.
2	1	Constructability	2. Contractor's will surprise you. Need to think like a contractor.
3	1	Collaboration	3. While not every project will be CMGC, collaboration between contractors and designers is still necessary.
4	1	Collaboration	4. VTrans needs to improve their collaboration with contractors, without compromising the quality.
5	1	Collaboration	5. Make VTrans easier to work with, without compromising quality.
6	1	Quality	6. Include all the information in the contracts to reduce the likelihood of change orders.
7	1	Process	7. We (VTrans employee) don't know how to officially communicate with contractors; "I have always wondered how I can communicate with the contractors." Need formal guidance/training on when and how to communicate.
8	1	Culture	8. We (VTrans employees) need to listen to contractors. (Contractors have good ideas)
9	1	Process	9. The way VTrans defines the limits of projects and permits the projects to avoid impacts can be problematic. This approach limits space for constructability.
10	1	Collaboration	10. The relationship with (VTrans and) contractors could be significantly improved; too much risk is transferred.
11	1	Barrier to Entry	11. The Agency transfers risk to a (smaller) contractor that is not prepared to manage the risk.
12	1	Barrier to Entry	12. Smaller contractors cannot handle all the requirements contained in the contracts.
13	1	Communication	13. Communication is about asking the right question and making the discussion more conversational and not a "do as I say" approach.
14	1	Workforce Development	14a. The attitude of the Project Managers and Resident Engineers makes a difference. The example cited is the review of fabrication drawings. The role of the PM/RE is to step in and facilitate communication (take initiative, set the tone early) to get the process on track and complete.
15	1	Culture	14b. It's important to set the (positive) tone from the beginning.
16	1	Workforce Development	15. There should be training for PM/RE on leadership, culture, and how to foster collaboration (some are set in their ways, not easy to change).

#	Focus Group #	Issue Theme	Comment
17	1	Quality	16. The current quality of the plans are akin to “choose your own adventure." There should be a focus on quality and consistency, follow-up on plan review comments, and include all the information the agency has in the contract.
18	1	Quality	Plan sheet notes can get hidden; hindering communication between VTrans (intent) and contractor - need to highlight important notes.
19	1	Quality	17. The location of the borings, and the associated boring logs lead to changes in the contract.
20	1	Workforce Development	18. The designers need more knowledge of the specifications.
21	1	Workforce Development	19. The agency works in silos, especially with the review of submittals. Rejected submittals cause friction. The RE’s need to be informed of the (submittal review) process as they are the means of communication with the contractor.
22	1	Workforce Development	20. Knowing what is important with the submittals.
23	1	Constructability	21. Constructability: Designers need to know basic construction knowledge and how the contractor will build the project. The example provided was using the toe of the footing as support for shoring a slab bridge.
24	1	Quality	22. VTrans has a constructability review process, so what in the process isn’t working? It is difficult for construction staff to conduct a thorough review due to capacity issues.
25	1	Quality	23. There is too much reliance on construction to find the problems. Preliminary plans are where the discussion should take place and not enough time is spent on preliminary plans. Then when problems are identified at final plans it is decided to be too late in the process (to correct or change).
26	1	Risk Sharing	24. There is too much shifting of risk ("they will figure it out in the field") when stating the contractor will figure it out.
27	1	Quality	25. When VTrans conveys a conceptual sequence of the construction, it needs to be viable.
28	1	Quality	26. The consultants providing services to VTrans need to be on the same page as VTrans.
29	1	Process	27. The environmental section review of plans is limited in scope, and could be more integrated and valuable.

#	Focus Group #	Issue Theme	Comment
30	1	Process	28. How to access contractors for constructability reviews.
31	1	Quality	29. Designers need to use the correct pay items.
32	1	Workforce Development	30. We (VTrans designers) don't know the pricing and other pressures the contractors face.
33	1	Risk Sharing	31. Rehabilitation projects have a lot of unknowns, leading to hard discussions and change orders.
34	1	Collaboration	32. The scope of projects (out of scope work) can lead to challenges with subcontractors and schedules.
35	1	Communication	33. Communication is a low hanging fruit.
36	1	Culture	34. Stakeholders (property owners in the ROW process, and concrete suppliers) don't want to work with the agency.
37	1	Process	35. Covid and emergency declarations streamline the processes, but we don't leverage that going forward to improve our work.
38	1	Communicati on	Balancing Act with available funding, change orders, future projects.
39	1	Process	Planning & programming review may help, e.g., bundling of similar work types.
40	1	Barrier to Entry	Those outside of VTrans do not want to work with VTrans, e.g., property owners and suppliers do not like our restrictive specifications.
41	1	Collaboration	1. At the end of the year conduct a postmortem, how did the season go, break out into teams, have all stakeholders participate.
42	1	Collaboration	Get contractor feedback on design.
43	1	Collaboration	2. The paving industry has a forum (TECH PAVE) that does this. Why not the contractor community.
44	1	Process	3. There could be an evaluation process for contractors to evaluate the agency.

#	Focus Group #	Issue Theme	Comment
45	1	Process	4. After action reviews to determine what is missing from designs.
46	1	Process	5. Add steps to the Project Development Process to make constructability and quality reviews more managed and followed.
47	1	Risk Sharing	6. Identify what items of work transfer too much risk.
48	2	Culture	1. Contractors expressed a reluctance to speak out, or speak up, for fear of retribution. Subtle or not so subtle retribution.
49	2	Collaboration	2. "Both sides" have common goals. Need to be identified and communicated.
50	2	Quality	3. The plans produced by consultants are of inferior quality to VTrans' produced plans and the contractors and VTrans staff see it too.
51	2	Workforce Development	4. The contractors speculated that with the experienced staff moving on (retiring) that the quality suffers, and this is true for both VTrans and the contractors.
52	2	Workforce Development	5. One representative suggested that inexperience (designer and construction staff) is 50-60% of the problem.
53	2	Workforce Development	6. Inexperienced staff refer to the specifications and become guarded in their decision making, which can lead to bad feelings.
54	2	Process	Need an improved quality checking process (designs, plans)
55	2	Process	Need to track RFI's on bids - use the data to drive improvements.
56	2	Workforce Development	7. A contractor noted 4 inspectors on one project with 2 of those being interns.
57	2	Process	8. A contractor questioned why the Contract Administration group doesn't provide responses to questions asked during the bid stage to all plan holders. The current practice is to share addendums with the plan holders.
58	2	Workforce Development	9. There appears to be inexperienced staff in responsible positions as they cross over from one part of the agency to another. At some levels, the lack of experience with the new subject becomes problematic.

#	Focus Group #	Issue Theme	Comment
59	2	Risk Sharing	10. Contractors noted seeing more work items incorporated in the project that require the contractor to engineer & design the feature.
60	2	Risk Sharing	11. VTrans should retain more of the risk as it will result in cost savings as this will be cheaper than asking the contractor to carry the risk.
61	2	Collaboration	12. Contractors expressed the difficulty in getting vendors to price VTrans' work. The submittal review times, and review process are not worth the hassle when considering the volume (lack of) work in the project.
62	2	Collaboration	13. A contractor noted that his approach with submittals is to initiate a call with VTrans and the vendors to hammer out the differences, which saves the back and forth. He noted that most VTrans staff are amenable to this approach. Also noted is the contractor seems to have to initiate this as they need the information.
63	2	Collaboration	14. In general, RE's don't want to hold up the contractor.
64	2	Process	15. Doc Express has been great. It has the dates, times and to-do list that are very helpful. The downside seems to be that now "everyone" at VTrans gets involved, which slows the process down.
65	2	Collaboration	16. There is very little give and take from VTrans. There is no ability to appeal, so as a result bids are higher.
66	2	Quality	17. The Waterbury Montpelier Interstate paving project was referenced as an example of a design issue that should have been addressed prior to construction and have a real impact on the contractor.
67	2	Communication	18. The middle ground is found through communication, and we need to stop hiding behind screens and get back out front.
68	2	Communication	Change order process takes too long; need decisions in 48-hours - office staff do not recognize field urgency.
69	2	Process	19. VTrans needs to embrace accelerated decision-making as it is in the best interest of the projects.
70	2	Workforce Development	20. Empower the field staff to make decisions.

#	Focus Group #	Issue Theme	Comment
71	2	Process	21. Add a 5% contingency to the low bid amount for the contract to help reduce the number of change orders.
72	2	Collaboration	22. We need to establish the culture of which we are all working towards the same goals.
73	2	Process	23. VTrans operates based on the bad taste from previous experiences and ensuring that will never happen again. This can add burdensome requirements and process when it's not necessary.
74	2	Collaboration	24. It is not us versus them. Tone down the heat and open honest communication.
75	2	Culture	25. There is no partnering, community, or harmony on the job sites.
76	2	Culture	26. There should be a better atmosphere for sharing and understanding each other's needs.
77	2	Risk Sharing	27. The concrete industry wants a shot at PCC pavements.
78	2	Risk Sharing	28. Industry believes there is an unwillingness to try treatments like PCC pavements, cold-in-place recycling.
79	2	Specifications	29. The specifications are too burdensome as evidenced by the new spec book, which is now two volumes.
80	3	Process	1. The agency should strive to reduce the back-end costs of closing out projects with claims and change orders.
81	3	Barrier to Entry	2. Vermont is a small state with smaller type projects. There are not a lot of contractors or larger contractors.
82	3	Process	3. How can VTrans optimize paving contracts?
83	3	Risk Sharing	4. VTrans is paying more for risk than other states. How can we address this issue so we are getting market value for projects.
84	3	Workforce Development	5. Make improvements to the Construction Section so they can handle more themselves, less reliance on others. It would help to expedite reviews and decisions. Submittal review process is extensive.

#	Focus Group #	Issue Theme	Comment
85	3	Collaboration	6. The TECH PAVE committee is functioning much better than in the past.
86	3	Process	7. VTrans is piloting contractor involvement in digital delivery, and this may lead to a reduction in risk, or better risk allocation.
87	3	Quality	8. VTrans struggles to get consultant firms to adopt and use VTrans details in their plans. The consultants tend to use their own that they have developed or used in other states and this leads to a lack of standardization in plan sets, and can result in delays or problems in construction.
88	3	Constructability	9. VTrans should strive to use more common materials and products. For example, bridge expansion joints that can require submittals, which can lead to delays.
89	3	Constructability	10. VTrans could do more to develop and adopt standards to help simplify plans and construction.
90	3	Quality	11. There are way too many details for the same topic, spread across different standards, plan details creating confusion on how to handle a situation. Simplify and consolidate (driveway and culvert details offered as examples).
91	3	Quality	12. Get the design teams on the same page with standard details.
92	3	Constructability	13. Migrate details to standard details sheets (as a tool to simplify and control).
93	3	Quality	14. The standard details need to be kept current with the specification book.
94	3	Constructability	15. The notes for traffic control should be standardized and not changed on a project basis.
95	3	Quality	16. The same defects show up in plan sets after plan sets and don't get corrected and carried through. Need better tracking of comments and resolution - and incorporation into practice to avoid repeating.
96	3	Communication	17. The bidders don't have time, nor should they be expected to note all the minor differences made to notes and details during the bid phase.
97	3	Collaboration	18. After action meetings with the designers, contractors and construction staff could be very useful.

#	Focus Group #	Issue Theme	Comment
98	3	Constructability	19. Early contractor input to the design plans and contract would be a positive.
99	3	Process	20. Alternative contracting like CMGC offers promise.
100	3	Collaboration	21. Partnering with ACEC and AGC; determine what levels of staff should be engaged to be most effective.
101	3	Collaboration	22. A joint meeting between ACEC, AGC and VTrans would be beneficial.
102	3	Process	23. VTrans is working on an Alternative Contracting Manual.
103	3	Process	24. During the winter months the construction staff should meet with the structures staff to review the previous season/projects, like an after-action meeting. Identify the good and bad, identify improvement opportunities.
104	3	Process	25. VTrans should engage contractors after bids are open to better understand what contractors are seeing and why the pricing for items is higher than expected.
105	3	Process	26. VTrans should be conducting site visits to the project site closer to the final plans to confirm site conditions and to address any changes noted.
106	3	Quality	27. Legacy projects are problematic in terms of quality and standardization.
107	3	Planning	28. The timing and scheduling of projects is important.
108	3	Workforce Development	29. The project managers/designers should visit projects to hear from contractors and construction about the quality of the plan sets.
109	3	Constructability	30. The contractors are skilled and can assist the design teams with advice during the design phase.
110	3	Workforce Development	31. With less experienced staff a rotation program that encourages designers to spend time in the field during construction would be valuable.
111	3	Collaboration	32. TECH PAVE is focused on the technical issues of materials and laydown, and does not get hampered by non-technical matters.

#	Focus Group #	Issue Theme	Comment
112	3	Communication	33. VTrans has tried to replicate the TECH PAVE for concrete but without much success.
113	3	Collaboration	34. VTrans can do better when it comes to cooperation. Submittal review periods of 21 days, and then one rejection, becomes a lengthy process.
114	3	Process	35. Do updated contractor QC plans have to be submitted for a full review, or some other expedited process?
115	3	Collaboration	36. AGC is a paid membership and does not represent all contractors.
116	3	Planning	37. VTrans should strive to advertise projects in the fall and early winter for better pricing.
117	3	Process	38. Project bundling offers economies and increased competition.
118	3	Workforce Development	39. The contractors want quicker decisions made in the field. The contractors then cherry pick from the answers. VTrans needs to make answers consistent.
119	3	Workforce Development	40. The current staff is less experienced and may be more risk adverse. Making good and timely decisions is important.
120	3	Process	41. VTrans should have dedicated support for organization and management of standards rather than as additional duties or side jobs for staff.
121	3	Workforce Development	42. Design staff should be empowered to achieve standardization.
122	3	Quality	43. For quality control, what is the minimum standard to meet? What is appropriate?
123	3	Quality	44. The design teams are dedicated to quality.
124	3	Quality	45. Final plans do not appear to be final (lacking ROW details, final design elements, etc.)
125	3	Quality	46. Quality standards for in-house designs seem to be lacking.
126	3	Quality	47. There is pressure to move fast and deliver, and that causes errors. Design teams need space and time to collaborate.

#	Focus Group #	Issue Theme	Comment
127	3	Collaboration	48. The design teams should have common goals and priorities.
128	3	Quality	49. The OLSR distribution list has grown, yet ' only the same 6 to 8 people performing reviews.
129	3	Process	50. The best plan reviews are from retired resident engineers with the time to dig in and do a thorough review.
130	3	Process	51. The RE's don't have the time to do a quality review.
131	3	Quality	52. The reviews from the Construction staff are missing.
132	3	Culture	53. The agency needs to support updating documents like manuals, engineering instructions etc.
133	4	Barrier to Entry	1. Smaller contractors need opportunities to gain knowledge working for VTrans.
134	4	Process	2. The changes with iCX (web-based bidding) should lead to a smoother process.
135	4	Collaboration	3. The TECH PAVE is a good forum to discuss valuable information and foster good working relationships with contractors.
136	4	Culture	4. Sometimes it can feel like the contractors are being "force-fed" changes to the specifications.
137	4	Barrier to Entry	5. The barrier to entry into work on VTrans projects is very high.
138	4	Specifications	Consider a multi-state tech/specification committee to standardize more.
139	4	Process	6. The TECHS & SPECS provide more of a heads up than they used to.
140	4	Quality	7. E-ticketing is a big improvement. It is quick, provides easy access to information and all-around better communication.

#	Focus Group #	Issue Theme	Comment
141	4	Collaboration	8. MASSDOT holds one large meeting for agency, contractors, suppliers, fabricators and there is a good turnout.
142	4	Barrier to Entry	9. A Contractor gives praise to the ID/IQ program. It allows smaller contractors the ability to prime on these contracts and gain more experience working for VTrans. These contracts are more attainable for small contractors. Smaller contractors like ID/IQ.
143	4	Barrier to Entry	10. Job-order contracting is also a great way for smaller contractors to participate.
144	4	Process	11. A suggestion is to share project information during the design phase so experts can weigh in on the projects.
145	4	Culture	12. Too often contractors hear "bid it as you see it" in response to questions posed during advertisement.
146	4	Constructability	13. For some project components, it becomes clear that the agency hasn't requested feedback from the industry.
147	4	Planning	14. The anticipated ad-list gets chopped and moved around too much. More accurate and stable is important for contractors to plan.
148	4	Planning	15. The fall is a better time to advertise and award projects. The timing is important to allow contractors to plan.
149	4	Planning	16. The Statewide project bid openings have come later into the spring. For pavement markings, this makes labor and material sourcing very difficult to manage.
150	4	Planning	17. Bidding multiple large projects on the same day is very challenging for prime and subs.
151	4	Planning	18. The FPAVE projects achieve more mileage, with limited specifications, less inherent risk, and fewer barriers to entry. Maine has a "LCP" (low-cost pavement) program considered a success.
152	4	Planning	19. The rack liquids can offer a lot of value. It is understood that it is desired to achieve more life out of premium liquids but are we really achieving the service life from these, so are they worth the extra cost?
153	4	Process	20. The engineering and construction inspection costs are out of hand for a resurfacing project with a lifespan of seven years. Simplify these projects.

#	Focus Group #	Issue Theme	Comment
154	4	Planning	21. Throughout New England there are 26 different performance grade liquids. Simplify.
155	4	Planning	22. The base rate for liquid asphalt is $600 per ton. This is a major cost of paving projects.
156	4	Quality	23. The consultant engineering firms follow the VTrans process and details for municipal projects and this has unintended consequences as the documents have erroneous requirements.
157	4	Planning	24. What is the return on investment for VTrans resurfacing projects?
158	4	Collaboration	25. VTrans used to have committee meetings. With the movement of staff, the contractors have lost relationships with key people and haven't been able to develop relationships with the new people. There was no transition. It seems like there have been no meetings in the last 18 months, and there isn't the interest in having the meetings.
159	4	Workforce Development	26. There may be a generational gap between young VTrans staff and the older contractor staff.
160	4	Culture	27. VTrans needs to have key positions available, in person, to develop relationships with the contracting community.
161	4	Collaboration	28. The TEAMS platform does offer some efficiencies, but it is a barrier when trying to develop new relationships.
162	4	Collaboration	29. Contractors have unique perspectives and VTrans could benefit from this perspective.
163	4	Planning	30. The states in New England could coordinate to simplify and develop consistent specifications. The easier it is to bid work will drive more competition which will lower prices.
164	4	Communication	31. VTrans states they are trying to do the right thing, but that opinion is not validated by the responses contractors receive to questions. More discussion with contractors would be beneficial.
165	4	Communication	32. A contractor questioned if VTrans is really listening.
166	4	Communication	33. At TECH PAV sometimes the response given is that FHWA is the reason why some action isn't taken, and contractors find that response frustrating.

#	Focus Group #	Issue Theme	Comment
167	4	Collaboration	34. Contractors acknowledge that the weather is a challenge, and they need more flexibility with the number of days allowed to perform the work.
168	4	Planning	35. Late lettings equate to late starts. Fall advertising is preferred.
169	4	Planning	36. Contractors need more notice when the project will require them to rent specialized equipment. There may be limited supply.
170	4	Planning	37. Project bundling at the state and town level can offer efficiencies by reducing overhead costs. Low-cost paving projects as an example. MASSDOT and CTDOT are bundling thin lift treatment projects. Noted bundling with local agencies is difficult due to perceived higher state cost.
171	4	Workforce Development	38. There could be more partnering for workforce development between contracting community, trades, and VTrans. State could assist.
172	4	Risk Sharing	39. The unemployment laws in Vermont force employees to look for work during the winter shutdown and this is a burden to staff and a risk that companies will lose staff.
173	4	Risk Sharing	40. The unemployment laws also describe full-time work based on yearly hours and not weekly hours.
174	4	Risk Sharing	41. VTrans should consider accepting contractor test results, other states are doing so to reduce the overhead cost of projects.
175	5	Constructability	1. A contractor gave the example of 3 cy of concrete added by addendum, specified as the performance mix, that no supplier would quote as it is a nominal quantity at a difficult location. The contractor needs to submit a very high price to cover the prospect of having to use the mix and/or try to get the spec changed.
176	5	Specifications	2. The performance-based concrete mixes are a huge challenge as suppliers are not interested in supplying the material.
177	5	Quality	3. The submittal process at VTrans is a huge challenge.
178	5	Specifications	4. There is no competition for concrete and no options for suppliers. Suppliers are quoting $600/cy for materials alone. The suppliers do not want to supply the State of Vermont.
179	5	Risk Sharing	5. Contractors need options. This is stacking risk of the suppliers and contractors.

#	Focus Group #	Issue Theme	Comment
180	5	Planning	6. Quotes from steel suppliers are also challenging. There are competing schedules for limited fabrication schedules. The time and availability of materials also needs consideration. There is limited capacity, and VTrans should understand industry's capacity to deliver materials.
181	5	Risk Sharing	7. Contractors are bidding items knowing that they will have to give credit back for failing test results.
182	5	Barrier to Entry	8. Vermont concrete suppliers are territorial and there is no competition.
183	5	Risk Sharing	9. The testing process for materials puts the risk on the contractors in situations where the risk can't be passed on to the supplier.
184	5	Specifications	10. The penalties associated with the performance concrete specifications are getting built into the risk factor for the work.
185	5	Risk Sharing	11. The percentage of concrete supplied to VTrans is such a small part of the market, the suppliers are stating that the problems are worth the added volume of work.
186	5	Constructability	12. VTrans should consider the lay down and yard space requirements for a project. It is getting more difficult to locate space for off-site activities. Contractors need room to work.
187	5	Process	13. The pivot to precast elements has been positive as it helps to avoid the supply problems.
188	5	Quality	14. The steel fabrication approval process is a major issue.
189	5	Barrier to Entry	15. The process to become qualified as a supplier is so , . suppliers of small plates and members. Barrier to entry.
190	5	Planning	16. VTrans needs to do market research ahead of time to understand supply challenges.
191	5	Specifications	17. The VTrans requirements for heat straightening work are preventing competent contractors from performing the work and driving up prices because only a few firms are qualified.
192	5	Quality	18. The plans sometimes omit design elements, or require the contractor to submit design elements, and this work is not clear, and subject to interpretation, thereby driving up the pricing to cover the risk. What will be acceptable is not well defined.

#	Focus Group #	Issue Theme	Comment
193	5	Quality	19. VTrans is adding risk to bidding projects by the number of bids rejected, re-advertised, or determined to be over budget. Bidding costs money and contractors need to recover these costs.
194	5	Quality	20. VTrans should look at the data from the last two years; it is telling as to the issues with the plans, estimates and risk passed on to the contractor.
195	5	Constructability	21. The temporary disturbances are not well accounted for in the permits, and sometimes access to the site is missing, the location of the crane is not considered, and the ROW or permits need to be adjusted. Permits based on permanent features, not constructability.
196	5	Constructability	22. Permitting and trucking cranes that require special permits is expensive. Consider capacity of over the road cranes currently available in Vermont.
197	5	Quality	23. The lack of parody in bids is in part due to the contractor's view of the risk involved and what will be allowed. A contractor may be risk adverse, but providing clearer direction as to what will be acceptable will lead to more competitive bids.
198	5	Constructability	24. VTrans should consider providing more slopes that can be laid back rather than supportive excavations or cofferdams.
199	5	Process	25. Vermont now requires permits to go through the engineering department which takes 2 weeks to review.
200	5	Process	26. A contractor offered two examples of good processes: contractor input during the design process like CMGC and the 3D modeling project in Chester. These help to vet the design prior to advertisement.
201	5	Constructability	27. Look at crane access for girder erection. If girders are too large, you must hire a subcontractor, or build a trestle, at great expense.
202	5	Quality	28. VTrans needs to assume responsibility for the design addendum decisions. Decisions seem to be made in a vacuum and not considering the project in its entirety.
203	5	Risk Sharing	29. VTrans rarely uses "approved as noted" anymore for submittal reviews. Everything now is rejected.
204	5	Collaboration	30. VTrans' oversight is centralized, which is good and bad. The positive is we know who we are dealing with, but the drawback is the lack of flexibility or accommodation.
205	5	Quality	31. There doesn't appear to be ownership of the quality of the plans and submittal reviews.

#	Focus Group #	Issue Theme	Comment
206	5	Quality	32. Contractors are frustrated by new comments made during a subsequent round of a submittal review. Contractors question the value of the reviews, and whether the reviews are adding value.
207	5	Specifications	33. VTrans only accepts MS project schedule submittals, and contractors prefer Primavera P6. Allow options, time to upgrade technical abilities.
208	5	Collaboration	34. VTrans should hold partnering sessions between the decision makers to help understand each other. May need a 3rd party to facilitate.
209	5	Workforce Development	35. VTrans needs to get out and see the projects, meet the people and communicate, develop relationships.
210	5	Collaboration	36. VTrans could participate and attend the AGC outreach efforts.
211	5	Workforce Development	37. Less experienced designers should have more field experience, constructability review training, and doing constructability reviews.
212	5	Workforce Development	During the off-season hold lessons learned meetings; discuss & train on constructability topics.
213	5	Workforce Development	Staff should visit other projects, similar work, learn from what/how designed.

Appendix G: State of Practice state-by-state summary

Information in this Appendix was assembled in Month, Year. Agency websites were searched for A, B, C, D and related information is summarized below.

1. Alabama DOT
    a. Alabama Road Builders Association
        i. Exclusive representation of industry
        ii. Includes consultant community
        iii. Works with ALDOT, legislature, congress and FHWA
        iv. Contact is Skip Powe for more information

2. Alaska DOT and Public Facilities
    a. Has a Roads and Highways Advisory Board
        i. Provide recommendations to the governor and commissioner on public policy matters, powers and duties.
        ii. Areas include highway construction

3. Arizona DOT
    a. DOT has an Office of Partnering
        i. Teach classes on partnering
        ii. Partnering is required for all construction projects
        iii. There is a public partnership geared toward other public stakeholders
        iv. Offer meeting facilitation, tools and forms

4. Arkansas DOT
    a. Nothing identified from the website

5. California CalTrans
    a. Caltrans engagement portal
        i. How to get information, find out about meetings and events
        ii. Has plans and projects
    b. Contractor's Corner
        i. A dedicated web page geared toward keeping the contracting community informed of announcements etc.
    c. Bridge Contractors/Caltrans Liaison Committee
        i. To foster productive discourse between bridge design and contracting community
        ii. Focuses on structural matters
        iii. Meets twice a year, with agenda, presentations, minutes

d. California Bridge Falsework Forum
e.
    i. A partnership between Caltrans and bridge industry
    ii. Topic specific
f. Caltrans uses Dispute Resolution
g. Caltrans has formal partnering program with resources, manuals, forms, contacts and awards.

6. Colorado DOT
    a. Nothing identified from the website

7. Connecticut DOT
    a. Nothing identified from the website

8. Delaware DOT
    a. Nothing identified from the website

9. Florida DOT
    a. Public involvement in developing the five-year work plan
    b. Formal Partnering Program

10. Georgia DOT
    a. Has a constructability guidance tool for project development

11. Hawaii DOT
    a. Nothing identified from the website

12. Idaho DOT
    a. Has a Construction Partnering Guide
    b. Has Dispute Resolution Board

13. Illinois DOT
    a. Nothing identified from the website

14. Indiana DOT
    a. Robust public involvement process outline on webpage
    b. Has a partnering handbook for INDOT projects
    c. Has a constructability review guide as part of the project delivery process

15. Iowa DOT
    a. Has workforce development boards
    b. Nothing identified from the website

16. Kansas DOT
    a. Project level partnering tools and resources
    b. Has the Kansas Contractors Association (KCA)
    c. KDOT created a task force to improve relationships between KDOT and contractor personnel. Annual workshops held.
    d. Established a Charter Mission, Common Values, Partnering Goals, Resources and Awards.

17. Kentucky KYTC
    a. Nothing identified from the website

18. Louisiana LADOTD
    a. Has a Plan Quality Unit, to optimize constructability and performance while mitigating costs.

19. Maine DOT
    a. Public involvement at the project level

20. Maryland DOT/SHA
    a. Nothing identified from the website

21. Massachusetts DOT
    a. Public involvement at the project level

22. Michigan DOT
    a. Public involvement at the organization level using public comments forms
    b. Guide to Virtual Public Involvement
    c. Guide to Stakeholder engagement
    d. Post upcoming public meetings on website
    e. MDOT has a Risk Management Workbook
    f. Has a small business program (reduce barrier to entry)
    g. Design Process Flowchart has preliminary and final constructability reviews embedded in the process
    h. CR steps are contained in the Design Manual with specific action items.

23. Minnesota DOT
    a. Public involvement in projects, plans and studies
    b. Posts public and stakeholder engagement opportunities
    c. Has Dispute Resolution list of certified providers
    d. Has an Industry Constructability Review Guidelines document under Innovative Contracting
    e. Has a Partnering Guidelines document
    f. Has a Quality Management Process for DBB Final Plan Development (address quality reviews, independent reviews and CR, and checklists)

24. Mississippi DOT
    a. Nothing identified on the website

25. Missouri DOT
    a. Has public engagement process for all meetings on website
    b. Has employee outreach and engagement process
    c. Has a partnership development webpage, for cost sharing
    d. Meetings with AGC by specialty area, bituminous, bridge, concrete paving, grading, safety and specialty
    e. Meetings with ACPA, MAPA and MLPA
    f. Centralized contractor facing webpage

26. Montana DOT
    a. Public involvement on webpage
    b. Centralized contractor webpage
    c. Has a partnering program, with different levels, field guide, handbook

27. Nebraska DOT
    a. Nothing identified from the website

28. Nevada DOT
    a. Has a Guide to Partnering on NDOT projects, list of partnering facilitators, and partnering conference toolbox
    b. Also has a Dispute Resolution Program
    c. Has a Construction Industry and NDOT Liaison Committee, and subcommittees for specialty topics
    d. Public involvement and Information for projects
    e. Has a position dedicated as the Constructability Manager

29. New Hampshire DOT

a. Has a public involvement process for projects

30. New Jersey DOT
    a. Posts public meetings on the website
    b. Has a constructability review manual, with concepts to consider, checklists and implementation plans
    c. Has a guidance document on how to review plans from a constructability perspective
    d. Has process maps for constructability during the project development cycle
    e. It has a well-documented customizable Capital Project Development
    f. Process overing all project phases (problem screening through construction).

31. New Mexico DOT
    a. Has a public involvement portal and tool available on the website
    b. Nothing else available from the website

32. New York DOT
    a. NYSDOT works with AGC, General Contractors Association (GCA), Long
    b. Island Contractors Association (LICA) and Construction Industry Council of Westchester and Hudson Counties
    c. NYSDOT offers training on Designing Bridges for Constructability
    d. Has Engineering Instruction EI 99-013 regarding the departments policy for conducting constructability reviews

33. North Carolina DOT
    a. Holds an AGC-DOT Joint Bridge Meeting

34. North Dakota DOT
    a. Nothing noted from the website

35. Ohio DOT
    a. Has Partnering and Dispute resolution guidance documents and resources
    b. Hosts regional roundtable meetings for primes, DBE and consultants
    c. Uses Notice to Industry to share important information

36. Oklahoma DOT

    a. Has a public meeting portal on the website with all meetings listed
    b. Nothing else noted from the website

37. Oregon DOT
    a. Jointly hosts annual meetings between ODOT and AGC
    b. ODOT participates in a small business initiative to improve the capability and capacity of contractors
    c. Hold virtual constructability review meetings and one-on-one meetings for projects with contractors
    d. Has a Project Delivery Quality Program Manual

38. Pennsylvania DOT
    a. Not able to identify anything from the website

39. Rhode Island DOT
    a. Nothing identified from the website

40. South Carolina DOT
    a. Has a public involvement portal for meetings and engagement, plans and resources
    b. Has resources for small businesses
    c. There is a joint annual meeting between AGC and SCDOT

41. South Dakota DOT
    a. Has a public meetings portal on the website
    b. Hosts an annual webinar between AGC and SDDOT
    c. Conducted a customer satisfaction survey in 2021
    d. Hosts an annual AGC & DOT Summit

42. Tennessee DOT
    a. Has a public meeting and hearing portal and public involvement plan
    b. Has a small business development program
    c. Has a constructability review procedures manual
    d. Contractor can request to participate in constructability reviews; CR reviews and projects are posted to the website
    e. Has a Quality Manual and a Project QMP

43. Texas DOT
    a. Has a public involvement policy
    b. Has many advisory committees
    c. Holds a Joint Committee meeting for AGC and TXDOT
    d. Co-hosted District workshops for accelerated bridge construction

44. Utah DOT
    a. Has public meeting posted on the website
    b. Uses partnering and offers partnering training
    c. Hosts a Utah Transportation Conference

45. Vermont Agency of Transportation

    Do we have anything on our website?

46. Virginia DOT
    a. Has public meetings and hearings webpage
    b. Collects public information from surveys posted to websites
    c. VDOT engagement hub
    d. Has a small business enterprise program
    e. Has a Field Guide to Partnering

47. Washington DOT
    a. Hosts on-line Open House meetings
    b. Has a partnering field guide
    c. Uses Dispute Resolution Board
    d. Has a Manual for Instruction for the Implementation of the Constructability Review Process
    e. Holds a joint meeting annually with AGC

48. West Virginia DOT
    a. Nothing identified from the website

49. Wisconsin DOT
    a. Has Technical Committee meetings with industry representation for project development, structures, tech services, traffic operations
    b. Embraces partnering and has a collaboration with ACEC
    c. Has a Construction Quality Management toolkit

50. Wyoming DOT
    a. Has a Construction Collaboration Program Guide; Our Commitment to Collaboration (with contractors)
    b. Has a Public Involvement Handbook

Appendix H: Draft Interim Report Meeting Agenda

VERMONT
AGENCY OF TRANSPORTATION

Developing a Framework for Defining Quality and Constructability of Transportation Projects

Grant Agreement #GR1881
Technical Advisory Committee Agenda
August 20, 2025

1. **Introductions**
   - VTrans Research – opening remarks (Emily and Ashlie)
   - VTrans TAC members
   - Co-principle investigators (Daniel D'Angelo P.E., ARA & David Hoyne P.E., GPI)

2. **Interim Report Overview**
   - Task 1 - Data Collection Summary
   - Task 2 - Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims
   - Task 3 – State of Practice
   - Task 4 – Risk Assessment.

3. **Phase II**
   - Task 6: Develop a Proposed Engagement Framework
   - Task 7: Testing Proposed Framework
   - Task 8: Develop Final Report and Technology Transfer

4. **Q&A**

Appendix I: Draft Interim Report Presentation

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

GR1881

Task 5 – Interim Report
TAC Meeting

August 20, 2025

Developing a Framework for Defining Quality and Constructability of Transportation Projects

Daniel D'Angelo, P.E.
Principal Civil Engineer
Applied Research Associates
ddangelo@ara.com

David Hoyne, P.E.
VP | Director of Construction Services
GPI
dhoyne@gpinet.com

VERMONT
AGENCY OF TRANSPORTATION

Agenda

- Introductions
- Interim Report Overview
  - Task 1 - Data Collection Summary
  - Task 2 - Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims
  - Task 3 – State of Practice
  - Task 4 – Risk Assessment
- Phase II
- Q&A

2

Task 1 – Data Collection Summary

- Task 1A: Literature Search – 57 documents identified
- Task 1B: Survey – 72 responses
- Task 1C: Focus Groups – 5 Groups, 37 participants

3

Task 1A: Literature Search - 57 documents

- Themes
  - Change Orders
  - Constructability
  - Culture
  - Design
  - Disputes/Claims
  - Innovation
  - Partnering
  - Pricing
  - Procurement
  - Quality Control
  - Risk
  - Trends
  - Trust
  - Workforce Development

4

Task 1B: Survey – 72 responses

- Themes
  - Barrier to Entry
  - Burdensome Requirements
  - Environmental Regulations
  - Funding
  - Innovative Materials
  - Partnering/Culture
  - Process
  - Quality of Plans
  - Rising Costs
  - Specifications
  - Submittals
  - Time
  - Workforce Development

5

Key Findings - Perceived Quality Issues

- VTrans scores consistently higher (Score Range 1.00 - 5.00)
  - VTrans: 3.05-3.88
  - non-VTrans: 2.14-3.36
- Non-VTrans scores exhibited a wider range
- Top VTrans scores
  - Communication: Structures Project Manager (3.88)
  - Communications: Construction Engineer (3.84)
  - Communications: Resident Engineer (3.79)
- Top non-VTrans scores
  - Communications: Construction Finals Team (3.36)
  - Documents: Advertisement (3.25)
  - Communications: Environmental Permitting Team (3.07)
- Written feedback may be more valuable than scores

6

Key Findings - Perceived Quality Issues (continued)

- Lowest VTrans scores
  - **Contractor Submittals: Pricing for Extra Work** (3.05)
  - Contractor Submittals: Materials Mix Design (3.05)
  - Contractor Submittals: Application or Renewal of Prequalification (3.11)
  - **Completion Dates** (3.15)
  - **Contractor Submittals: Fabrication drawings** (3.20)
- Lowest non-VTrans scores
  - Response time for Contractor Submittals (2.14)
  - **Completion Dates** (2.36)
  - **Contractor Submittals: Fabrication drawings** (2.43)
  - **Contractor Submittals: Pricing for Extra Work** (2.43)
  - Contractor Submittals: Value Engineering proposals (2.46)

7

Key Findings - Perceived Quality Issues (continued)

- Top 5 Score Differences
  - Communications: Construction Engineer (1.12)
  - Contractor Submittals: RFIs (1.01)
  - Communications: Regional Construction Engineer (0.99)
  - Communications: Structures Project Manager (0.92)
  - Communications: Resident Engineer (0.90)
- Top 5 Closest Scores
  - Communications: Construction Finals Team (0.02)
  - Communications: Environmental Permitting Team (0.20)
  - Response time: Questions during advertisement (0.22)
  - Documents: Advertisement (0.23)
  - Communications: Materials Laboratory Personnel (0.41)

8

Which topics the Agency need to improve?

- Top 5 VTrans
  - **Engagement with the bridge contractors (20)**
  - **Communication between Agency staff and contractor/suppliers (19)**
  - Project Plans (18)
  - **Engagement with the material suppliers (18)**
  - **Constructability (16)**
- Top 5 non-VTrans
  - **Constructability (17)**
  - Project Completions Dates (15)
  - **Communication between Agency staff and contractor/suppliers (15)**
  - **Engagement with the bridge contractors (15)**
  - **Engagement with the material suppliers (15)**

9

Prioritization of Solutions

- Top 5 VTrans
  - **Constructability (29)**
  - **Project Plans (26)**
  - **Engagement with the bridge contractors (23)**
  - **Communication between Agency staff and contractor/suppliers (22)**
  - Project Special Provisions (18)
- Top 5 non-VTrans
  - **Communication between Agency staff and contractor/suppliers (19)**
  - **Constructability (17)**
  - Agency response times(14)
  - **Engagement with the bridge contractors (12)**
  - **Project Plans (10)**

Note: Top 5 overall included "Engagement with the material suppliers" [VTrans (17), non-VTrans (9)]

10

Task 1C: Focus Groups – 37 participants

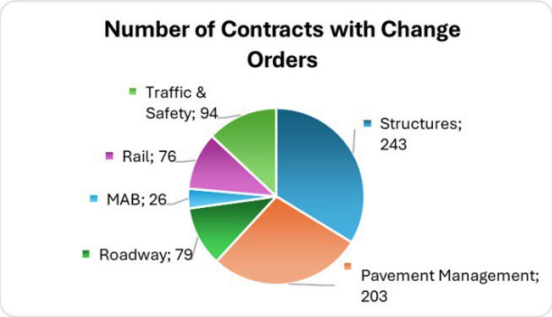
- Themes
  - Barrier to Entry
  - Collaboration
  - Communication
  - Constructability
  - Culture
  - Planning
  - Process
  - Quality
  - Risk Sharing
  - Specifications
  - Workforce Development

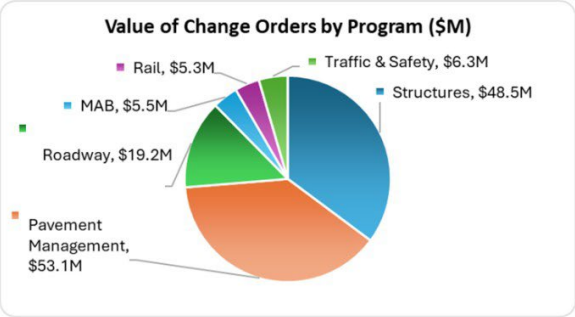
11

Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims

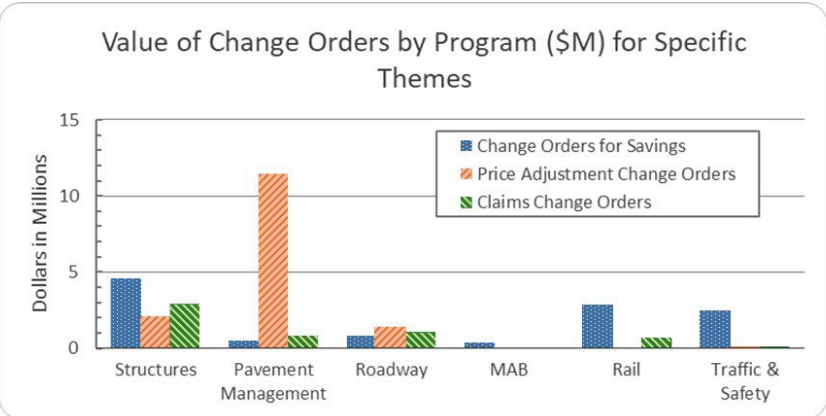
- Themes
  - Claims Settlement
  - Material Substitution
  - Price Adjustments
  - Scope Change
  - Time Extensions
  - Value Engineering

12


Number of Contracts with Change Orders
Traffic & Safety; 94
Structures; 243
Rail; 76
MAB; 26
Roadway; 79
Pavement Management; 203


Value of Change Orders by Program ($M)
Rail, $5.3M
Traffic & Safety, $6.3M
Structures, $48.5M
MAB, $5.5M
Roadway, $19.2M
Pavement Management, $53.1M

13


Value of Change Orders by Program ($M) for Specific Themes
Dollars in Millions
15
10
5
0
Change Orders for Savings
Price Adjustment Change Orders
Claims Change Orders
Structures
Pavement Management
Roadway
MAB
Rail
Traffic & Safety

14

Task 3 – State of Practice

- Themes
  - Constructability
  - Contractor Engagement
  - Dispute Resolution
  - Partnering
  - Quality

15

Task 4 – Risk Assessment

1. Themes (risks) identified by task
2. 49 themes organized into the following 23 overall risks
3. 23 risks were evaluated qualitatively
4. Each scored and ranked

16

Highest Ranked

1. Workforce Development
2. Risk Sharing
3. Contractor Engagement
4. Funding
5. Process
6. Trends

17

Phase II

- Task 6: Develop a Proposed Engagement Framework
- Task 7: Testing Proposed Framework
- Task 8: Develop Final Report and Technology Transfer

18

Q&A

- Next TAC Meeting – September 30th @ 10:30 AM

19

Schedule



GR1881 - Developing a Framework for Defining Quality and Constructability of Transportation Projects - Schedule

Aug-25	FFY24 Q4				FFY25 Q1				FFY25 Q2				FFY25 Q3				FFY25 Q4			FFY26 Q1		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Task/Deliverable	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25
Kick-off Meeting																			
Develop Work Plan																			
Task 1 Data Collection																			
Task 1A: Literature Review																			
Task 1B: Survey																			
Task 1C: Focus Groups																			
Task 2 Data Analysis																			
TAC Meeting 1																			
Task 3 State of Practice																			
Task 4 Risk Assessment																			
Task 5 Interim Report																			
VTrans Interim Report Review																			
TAC Meeting 2																			
Task 6 Engagement Framework																			
TAC Meeting 3																			
Task 7 Test Proposed Framework																			
Task 8 Final Report																			
VTrans Final Report Review																			
TAC Meeting 4																			
Final Deliverables submitted																			
Quarterly Reports																			
FFY24 Q3 (April-June)																			
FFY24 Q4 (July-September)																			
FFY25 Q1 (October-December)																			
FFY25 Q2 (January-March)																			
FFY25 Q3 (April-June)																			
FFY25 Q4 (July-September)																			
Vermont Agency of Transportation Research and Innovation Symposium																			
2024 Symposium Registration																			
2024 Symposium Preparation																			
2024 Research & Innovation Symposium																			
2025 Symposium Registration																			
2025 Symposium Preparation																			
2025 Research & Innovation Symposium																			

20

Appendix J: Draft Interim Report comments and responses

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
Project Description	3	Consider expanding on these points with a separate section called something along the lines of "Discussion of Agency Operating Environment". Consider referencing Vermont general public demographic reports, along with state government demographic reports. Please see my snip and commentary on the bottom of page 5.	The comment references the opening paragraph of the Project Description and seeks expansion of the discussion on demographics at the State and Agency levels, the aging workforce, and the declining experience levels in the industry. The researchers consider this important information for the Agency, but collecting and analyzing the data is beyond the scope of work of this project.
Modernize and Improve Government Efficiency through Customer Service	5	Full disclosure: I pulled this data from ChatGPT with a prompt to compare demographics between NH and VT. This data will definitely need a check and fleshing out if included in the report. AI cited its sources as official census information. I don't think that this information is surprising, however. VT has aging demographics. Working aged people are a smaller portion of the population than other NE states. I think that this kind of data should be considered for inclusion as it informs us of our operating decisions at VAOT. As far as healthy competition goes, we are fighting against the grain in VT. We need to work that much harder to stimulate competition through contractor-friendly policies, constructible plans, and culture shifts.	The demographics data may help inform the strategies the Agency chooses as it moves forward, and recognizing the efforts to stimulate competition and improve quality may be hindered by a lack of a skilled workforce. The State of Vermont Department of Human Resources publishes a Workforce Report covering the State workforce. There are similar reports available for the contracting industry.
Task 1B Survey	9	Does a higher score indicate the issue was assessed as more problematic?	No. The scale is 1 for Poor and 5 for Excellent. The higher the score means the topic is less of a concern.

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
Task 1B Survey	9	I feel that this notable and worth exploring. What are the specifics of these quality issues? I suspect that what is behind this gap is pay item and estimating issues. Dealing with these kinds of issues creates a tremendous amount of work and frustration for VTrans Construction staff but has (fairly) limited impact on contractors since Construction staff generally sees to it to make sure that the contractor is paid adequately. There is potential here to make the change order process for small issues less arduous for VTrans Construction staff. Field changes are common. This is not always the result of issues in design, especially when viewed in the context of design resources (seemingly) are continuously reduced. In a world where design resources are slim, designers have learned to prioritize tasks. Designers generally give more attention to structural calculations (high risk, potentially life-threatening) and plan generation (the overall deliverable), and less attention to pay items and quantities. In this environment, it makes sense to empower residents to make change orders quickly.	Agreed. As part of the strategies for improving quality, a closer look at why the external stakeholders rated the level of quality lower than VTrans staff could be informative. The solution mentioned in the comment, which is to simplify the change order process for small issues is a good example of small improvements that can have an impact. Empowering the RE is also a good example. Note: As a reminder, the scope of this project is to develop a framework to improve quality and constructability, and not to solve each of the topics raised. The researchers used the topics to help inform the type of framework most suited to address the state of practice.
		Identifying specifics here would be very valuable. What items/work is often being realized as Extra Work? Perhaps a specialized interview with VTrans Construction staff and/or more accessible/available contractors could be arranged to focus in on this issue.	Agreed. As part of the strategies for improving quality, a closer look at why the contractor's submittals, pricing for extra work, scored the lowest by the Agency would be informative.
Task 1B Survey	10	Notable in an environment where VTrans is transferring risks that independent contractors are not well positioned to bear and/or	This comment is in relation to the Agency scoring for Completion Dates, and this topic is in the group with

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
		manage.	the lowest scores. It is unclear from the comment what is behind the comment. Completion dates can be a source of friction.
Task 1B Survey	10	I have witnessed this process go disastrously badly and exceptionally well. When the process goes well, it is usually the result of the Project Manager fostering collaboration of the stakeholders responsible for the submittal (prime, subs, design staff) with one or two virtual,1-hr (or less) meetings.	Thank you for the observation.
Summary of Focus Groups: Barrier to Entry	13	Notably, these contractors generally receive much less construction oversight.	This comment refers to contractors performing ID/IQ work and that they receive less oversight for task orders.
Summary of Focus Groups: Collaboration	1	I am surprised that no one mentioned leveraging technology (virtual meetings) with contractor staff wasn't mentioned. I have worked closer with contractor staff since virtual meetings became more commonplace. I have heard that feedback from others in VTrans Structures as well. I experienced eight years of projects, both as a member of the Construction staff and Structures staff, before virtual meetings were commonplace. Before virtual meetings, projects went "over the wall (outside of the design office)" and all communication happened through email directly to the PM (if at all). Now, REs are able to video call designers and/or PMs using Microsoft Teams on their state-provided phone. We are able to stand "over the hole" virtually, together, to work solutions in real	Great observation and thank you for the examples. The virtual meeting environment can foster collaboration and improve communication. As pointed out, having the contractor, Resident Engineer, Project Manager and designers embrace collaboration is key.

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
		time all while staring directly at the same problem. I recall (as a lead designer) spending a recent afternoon virtually with an RE while our contractor excavated through a particularly difficult, utility-laden trench. We were able to discuss problems, ideas, and thoughts that came up on site in real time. This is groundbreaking capability that is made possible through technology and a culture shift at VTrans where everyone is dialed into Teams at all times. This culture was non-existent to me prior to COVID. On the same project several weeks later, I was able to sit in on a meeting that took place in the contractor's job trailer with all of the contractor's personnel to discuss unexpected site conditions with the entire project team. Lastly, I was able to sit in on resident engineer/contractor weekly meetings and discuss project issues that arose in real-time with cameras on. We were able to brainstorm solutions and discuss "grey area" issues, opportunities, and challenges that the contractor was experiencing freely. This created an incredibly collaborative environment where the resident, tasked with a very tough project, felt more like the entire project team, including "the office staff" (a loaded term for people that have spent time in the Construction Section), were fully on the same page at all times. All of this was made possible by communication technology and our forward-thinking resident who	

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
		facilitated open communication. I was able to develop a close working relationship with the contractor's Project Manager.	
Summary of Focus Groups: Culture	15	This is a fair ask and I understand where contractors are coming from when they ask for this. However, "key people" often have extraordinarily busy schedules and are often unavailable. I often felt this way working in direct proximity every day in-office with my colleagues prior to COVID. Key people were often unavailable; attending to in-person office meetings or even traveling for in-person meetings. I have found key people to be more accessible than ever virtually. Contractors and Construction staff can leverage this digital availability. We can use modern communication technology to facilitate better communications. That's what it's created to do! There are real opportunities here that can be realized by culture shifts in field personnel. Communication between field staff and office staff has always been challenging. Modern technologies are in common use now that can close that gap more than ever.	Thank you for the comment and the support for leveraging technology to improve communication.
Summary of Focus Group: Planning		This is totally fair and not unexpected. What's very interesting to me is that, with limited competition, projects need more than one round of advertisement more often to be awarded. This creates a self-reinforcing feedback loop that feeds this negative cycle.	Thank you for the comment and observation.
Summary of Focus Groups: Process	1	I absolutely share this concern and bump my head into it constantly as a designer. The internal culture at VTrans on this issue has eased	The framework will offer tools to communicate with contractors while maintaining the integrity of

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
		somewhat, but not long ago it was considered very faut-pas to communicate with contractors in design for fear of providing someone with a competitive advantage.	the procurement process.
Summary of Focus Groups: Process	1	This is an excellent, vital idea and has been done in the past. The process lacks formality and needs reform badly.	A formalized process for after action reviews of contract documents is a strategy for improving quality.
Summary of Focus Groups: Process	1	The opportunities to improve based on communication at this part of the process are endless. We are often hampered by concerns of providing competitive advantage. I would argue that the risks are worth the boundless rewards in this area.	Thank you for the comment.
Summary of Focus Groups: Process	1	We can find a way to leverage that RFI data and potentially use AI to summarize it. There are two, potential sources of data to examine that are in-line with this suggestion: 1. Bidding inquires (contractor questions prior to bidding) 2. RFIs during construction I am looking into that with the CMS team (and others) now.	The examples offered illustrate how using objective data can help inform the Agency and guide solutions moving forward.
Summary of Focus Groups: Process	1	I think I generally understand the concerns behind this paragraph, but it's interesting that accelerated (I'm reading this as accelerated construction-like decision making mindset) is specified here as a solution. Approaching a project from an accelerated mindset often means shrinking project limits to as small a footprint as possible. This often creates problems for contractors, but we find that they are better able to negotiate with land owners than we are.	Great observations regarding who is better positioned to assume the risk for accelerated projects. The shrinking of projects and working with property owners are important components of projects.

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
Summary of Focus Groups: Process	1	From Wendy Ducey Contact Admin Chief: Contractors have expressed concerns that they prefer their responses to remain confidential. This question was posed to contractors around 201 /2019 when the Construction Management Software (CMS) upgrade project was kicked off.	Thank you for sharing the background. To reiterate, the information in the report is not intended as action items, but to reflect sentiments expressed by stakeholders that may be informative going forward with the framework.
Summary of Focus Groups: Quality	17	Are there any specifics of what information we might have that the plans are often missing?	That level of detail was not part of the discussion. The comment is on target in terms of structuring solutions moving forward: "what needs fixing"
Summary of Focus Groups: Quality	17	This is a critical issue that I hope isn't glossed over. Taking time to do deep plan reviews takes both time and experience. These two quantities are in short supply as resources have generally been cut down to the bare-minimum. I snipped this question to my supervisor and he felt similarly. Perhaps older, experienced construction staff that now serve as consultants could be brought in for this kind of vital work?	Agreed, quality reviews take time and experience, and the process needs to account for the task.
Summary of Focus Groups: Risk Sharing	1	Critical	This comment is in support of the discussion on risk sharing.
Summary of Focus Groups: Risk Sharing		Notably in this department, it's my understanding that in-plant concrete inspectors were eliminated. This essentially eliminated our chance of catching quality-related issues at the plant prior to the prime contractor realizing quality issues on-site and financially.	Thank you for sharing that example.
Summary of Focus Groups: Specifications	19	Consider fleshing out industry dynamics and past experience with key material suppliers in "Operating Environment" section.	The detail of this dynamic is beyond the scope of this project and is a topic that the framework should help to work through.

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
Summary of Focus Groups: Specifications	19	This is the kind of very specific information that is vital for us to examine our practices and make improvements.	Noted.
Summary of Focus Groups: Workforce Development	20	I agree with this statement. I have witnessed present-day Construction personnel carrying around an albatross of administration on their shoulders. The new environment of "do more with less" calls for empowering REs to be more nimble and agile. When I was a Construction staff member ten years ago, I witnessed experienced REs using a great deal of discernment to avoid flagging minor issues that could create administrative overhead. New residents want to do the "right thing" to include others into minor discussions which creates a great deal of administrative overhead and headaches for themselves. A common understanding I witnessed in the field is that administrative staff and even office staff generally create more problems than they solve. Asking residents to fly under the radar more often to avoid administrative headaches and keep the wheels greased on-site to get the job done suggests that some things are broken in the process. The million-dollar question is what, specific, parts of the administration system need to be addressed for the best results.	Thank you for sharing the sentiment.
Summary of Change Order Data	27	The marginal value of change orders as a percentage of the contract suggests more to me that perhaps the CO process itself is creating too much overhead for the overall financial impacts that COs have on the program.	Thank you for your observation. The overhead and disruption to the project may be of more consequence than the value of the change order.

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
Summary of Change Order Data	27	Why is a process that is creating marginal impact to construction program's overall spending creating outsize impacts to staff time and contractor-staff relationships? Could allowing RE's more freedom in managing changes with less administrative oversight be a more realistic solution?	These are important questions. Is the process of change more impactful than the change itself?
Summary of Change Order Data	2	Again, this data suggests to me that change orders are common but not overall financially costly or particularly impactful to the program. I am concerned that, due to the way this paragraph is worded, that the administrative process behind triggering and completing change orders is above reproach. It seems that this data is suggesting that projects are, by and large, fairly free of modifications that require significantly impactful changes. Instead, it seems to be that the CO process itself is creating undue headache in administration and is not calibrated appropriately for the amount of risk that we are seeing realized in the field. I would go further to say that this may be another example at how VTrans over manages risk at the expense of other, less visible issues that its risk management practices create. When viewed from the perspective that the vast majority of change orders are either no-cost or change orders for savings, this point seems even more applicable. What is driving the way that the CO process works?	Not exactly. While the data for the analysis period shows that the total value of change orders is within the normal contingency range, the data also shows many high, and very high dollar value change orders. See the graph on page 2 . Change orders of these magnitudes should give pause to better understand what is occurring and why. An average of 5 change orders per contract also seems like a lot. There is the administrative and cost component to consider and there should be a feedback loop from the change order data to the design groups. We will revise the wording of the paragraph to more clearly convey the impacts.
Task 3 State of Practice	30	Stakeholders who are responsible for our webpages that serve contractors need to be identified. A working group could be formed	Thank you for the suggestion.

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
		to model our website after best practices.	
Phase II Remaining Tasks	37	What are the key findings?	The findings from Phase 1 are everything contained in this report, like the survey results, focus group summaries, the literature search, the state of practice, and risk assessment. These will be used to develop the framework. We will introduce the framework and capture the "key findings" as part of phase 2.
Strategic Alignment	5	The rest of the report seems to apply to AOT sections generically. The text here is VERY Structures oriented. I prefer generic for this section and throughout the report/project.	We will delete the words "bridges" and "structures" and replace with the more generic project, or construction terms.
Task 1B: Survey	9	I was confused by what is meant by "common" responses, but I think it's responses shared by AOT staff and non-AOT staff. We should be explicit with this.	Correct. We will clarify by adding "between VTrans and non-VTrans responses" after "…common response"
Summary of Focus Group Comments	1	Highlighted text	We will bold or italicize this text to further emphasize the highlighted text.
Summary of Focus Group Comments	1	Highlighted text	ditto
Summary of Focus Group Comments	15	Highlighted text (2 locations)	ditto
Summary of Focus Group Comments	1	Highlighted text (3 locations)	ditto
Summary of Focus Group Comments	17	Interesting that the PERCEPTION is that the addendum does not include ALL of the questions asked.	Agree!

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
Summary of Focus Group Comments	17	Highlighted text (locations)	We will bold or italicize this text to further emphasize the highlighted text.
Summary of Focus Group Comments	1	Highlighted text (locations)	ditto
Summary of Focus Group Comments	1	parity?	Good catch, we will correct this typo.
Summary of Focus Group Comments	19	Highlighted text (locations)	We will bold or italicize this text to further emphasize the highlighted text.
Summary of Focus Group Comments	20	Highlighted text	ditto
Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims.	23	I'm interested in more columns-- like change order value compared to value of construction contracts (each row).	We will add a column showing the percentage of change order values to the total contract value for each row. Structures 5.5% Pavement . % Roadway 9.0% MAB 1 . % Rail 5. % T&S 5.3% Total 5. % We also note there was a typo in the Totals row value for Change Orders, should be 137, 75, 795.
Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims.	2	Maybe what we want is an analysis of the less common change orders?	Further insight on Pavement change orders may be beneficial. We can look further into the data we have, but any insight form the program area can also be incorporated into the report.
Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims.	2	Value of the non-negative change orders does not mean much to us.	Noted.
Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims.	27	So what we really want is an analysis of these outlier change orders?	Further insight on Pavement change orders may be beneficial. We can

Filename: VTrans Research_GR1881_Task 5-Interim Report_GFD_Comments.pdf			
Section of Report	**Page**	**Comment**	**Response**
			look further into the data we have, but any insight form the program area can also be incorporated into the report.
Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims.	27	This figure I'm interested in. I was intrigued by this with the table in Figure .	Noted.
Task 2 – Analysis of Errors & Omissions (E&O), Contract Change Orders, and Claims.	27	Where is Fig 13? Interested in this since Fig also.	We will label each figure and table to avoid confusion. Figure 13 will be added.
Task 3 – State of Practice, Construction & Quality	31	I'm much more interested in this section than other sections of the "desktop review". So--of these 12 examples, are there 1-2 manuals that we like the best and should emulate? Should we show Constructability Review on a flow chart and have that prominently on a website like Michigan DOT?	This will be considered in the framework as a strategy or tactic for implementation.
Task 3 – State of Practice, Construction & Quality	32	Strikethrough text.	Another good catch, this typo will be corrected.

Appendix K: Draft Framework presentation

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

Developing a Framework for Defining Quality and Constructability of Transportation Projects

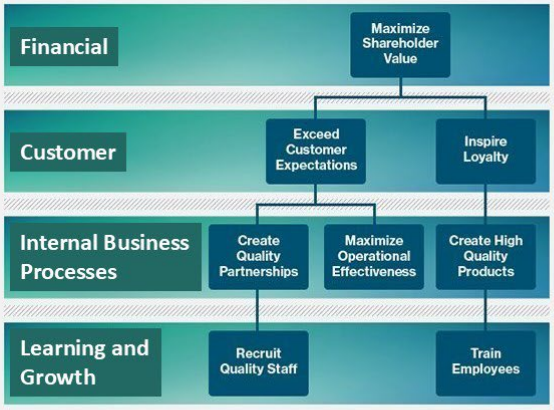
Daniel D'Angelo, P.E., F.ASCE
Principal Civil Engineer
Applied Research Associates (ARA)

David Hoyne, P.E.
VP | Director of Construction Services
Greenman-Pedersen, Inc. (GPI)

September 24, 2025

ARA
GPI

Balanced Scorecard – Strategy Map



Quality

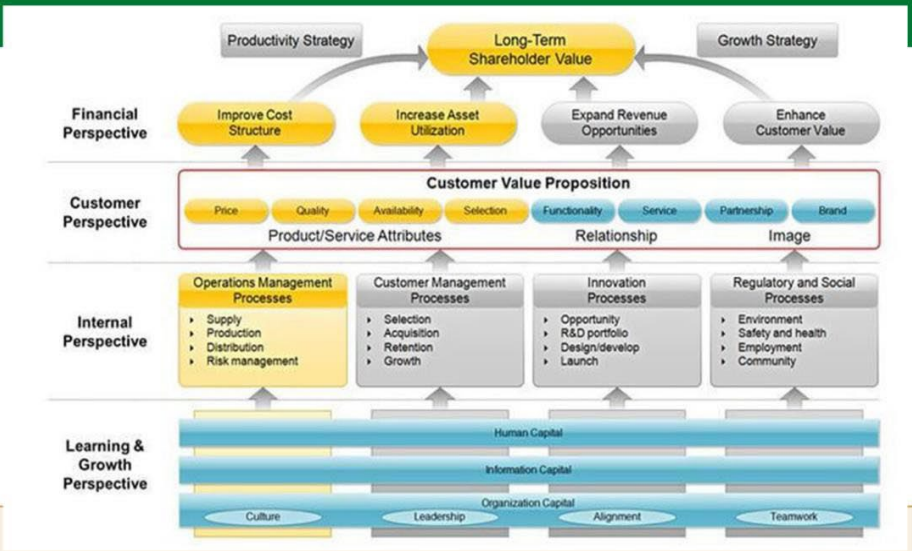
Outreach

Deliverables

Resources

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

Strategy Map – more detail



VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Quality and Constructability

- Quality of what?
- Are quality and constructability separate or interrelated?
- What are we trying to accomplish?
- How to roll this up into a framework?

VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Review the Themes

Themes (risks)				
Task 1			Task 2	Task 3
Literature Review	Survey	Focus Groups	E&O, CO & Claims	State of Practice
	Barrier to Entry	Barrier to Entry		
	Burdensome Requirements			
Change Orders			Scope Change	
Disputes/Claims			Claims Settlement	Dispute Resolution
		Collaboration		Contractor Engagement
		Communication		
Constructability		Constructability		Constructability
Culture		Culture		
Design				
	Environmental Regulations			
	Funding			
Innovation	Innovative Materials		Material Substitution	
Partnering	Partnering			Partnering
		Planning		
Pricing			Price Adjustments	
	Process	Process		
Procurement				
	Rising Costs	Risk Sharing		
Quality Control	Quality of Plans	Quality		Quality
Risk				
	Submittals			
	Specifications	Specifications		
	Time		Time Extensions	
Trends				
Trust				
			Value Engineering	
Workforce Development	Workforce Development	Workforce Development		

VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Program Management

Outreach
1. Contracting Community
2. Legislature, Executive Branch, Sister Agencies
3. Local Government, Property Owners, Businesses
4. FHWA, USACE, FEMA, Utilities



Resources
1. People
2. Funding
3. Equipment

Deliverables
1. Work Products
2. Work Processes

VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Strategies-Resources

- People
  - Core Competencies
  - Training
  - Career Ladders
  - Professional Development
- Funding
  - Forecasting tools
  - Sound Estimates & Scopes
  - Fiscally Constrained Programs
  - Tracking Expenditures
- Equipment
  - Inventory
  - Maintenance Schedules
  - Replacement Schedules
  - Budget Tracking



VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Strategies-Deliverables

- Work Products
  - Guidance Documents & Quality Standards
  - Checklists & Process Controls
  - Track Key Metrics to Measure Performance
- Work Processes
  - Develop and Document Workflows & Instructions
  - Provide Training
  - Deploy Business Improvement Strategies
  - Track Key Metrics to Measure Performance



VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Strategies-Outreach

- Existing Campaigns
  - ACEC
  - AGC-VT
  - Specifications Committee
  - Standards Committee
  - TECH PAVE
  - Contractor's Workshop
  - STIP/TIP
  - Local Concerns Meeting
  - Concrete Producers Committee
  - Legislative Testimony



VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Strategies-Outreach-Gaps

- Program Level Outreach
  - Industry Representation
    - Consultants
    - Material Suppliers
    - Fabricators
    - Subcontractors
    - Contractors

VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Outreach Stewardship

- Independent skilled facilitator
- Participants empowered to make decisions
- A professional code of conduct
- Committee governance
- Meeting agendas & minutes
- Oversight & support from Chief Engineer's Office

VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Themes Revisited

RESOURCES	DELIVERABLES	OUTREACH
	Scope Change	Barrier to Entry
	Change Orders	Burdensome Requirements
Collaboration	Disputes	Dispute Resolution Collaboration
Contractor Engagement		Contractor Engagement
Communication Culture	Constructability	Communication
	Design	
Funding Innovation Partnering		Funding Innovation Partnering
		Pricing
	Process	
	Procurement	Risk Sharing
	Quality	
	Submittals	
	Specifications Time	Specifications Time
		Trust
Workforce Development	Value Engineering	

VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Framework for Quality & Constructability

Strategies



VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Comments and Discussion

VERMONT AGENCY OF TRANSPORTATION RESEARCH PROGRAM

Appendix L: Fact Sheet

VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

Developing a Framework for Defining Quality and Constructability of Transportation Projects

STUDY TIMELINE
June 2024–January 2026

INVESTIGATORS
Daniel D'Angelo, P.E., Applied Research Associates (ARA), ddangelo@ara.com

David Hoyne, P.E., Greenman-Pedersen, Inc. (GPI), dhoyne@gpinet.com

AOT CONTACTS
Carolyn W. Cota, P.E., Structures Program Manager, Carolyn.Cota@Vermont.gov

KEYWORDS
Collaboration, Contractor, Constructability, Project Delivery, Quality, Risk

FUNDING
$140,200

Introduction (or Problem Statement)

The Vermont Agency of Transportation (VTrans) is experiencing declining competition for bridge and other infrastructure projects and rising construction costs. At the same time, demographic shifts are reducing workforce experience within both the Agency and the contracting community. Project plan content and quality processes have not evolved significantly since the Interstate era, despite major changes in construction materials, equipment, and technology.

Currently, VTrans does not have a formal mechanism for obtaining feedback from the contracting community regarding project plans, risk allocation, and constructability. This research developed a framework to improve engagement with industry partners and enhance the quality and constructability of transportation projects.

Project Methodology

The research included:

- Literature review of transportation project delivery practices
- Survey of VTrans staff and industry partners
- Focus groups with contractors, suppliers, and agency staff
- Analysis of change orders, claims, errors & omissions data
- Review of practices at other state DOTs
- Risk assessment and development of an engagement framework

Conclusions/Next Steps

Table 1 provides a summary of identified themes). Table 2 provides a summary of the Framework. Tables 3-5 summarize detailed strategies developed for Resources/People: Establish Core Competencies, Deliverables/Work Products: Develop Process Controls, and Outreach/Contracting Community: Host Facilitated Meetings. Figure 1 displays a Framework implementation approach.

More information about the Agency of Transportation Research Program, including additional Fact Sheets, can be found at: https://vtrans.vermont.gov/planning/research

Impacts and Benefits

The research gained from this project will assist VTrans with improving efficiency and provide staff with tools to deliver better quality and more easily constructed projects expeditiously at lower costs and increased competition. The administration, construction and maintenance costs of projects will be reduced due to improved quality and constructability of project plans.

Implementation of the quality and constructability framework can:
- Improve the quality and constructability of project plans
- Reduce change orders and construction claims
- Increase competition for transportation projects
- Improve communication between VTrans and industry partners
- Reduce administrative and construction costs
- Strengthen long-term relationships with contractors and suppliers

The long-term project benefit may be a relationship that is built on trust, where all collaborators and partners are committed to advancing the state of practice, where voices are heard, challenges are overcome, and the process is respectful, transparent, and effective. Through this framework, the Agency, contractors, suppliers, and consultants will be more efficient because they have been engaged in a development process where the outcomes and results are well defined and understood. Table 1 summarizes the themes and top risks identified through the project data collection tasks. The top ranked risks are shown in bold text and are highlighted in red. Collaboration

Table 1. Data analysis themes and highlighted top risks

Themes (risks)				
Task 1			**Task 2**	**Task 3**
Literature Review	**Survey**	**Focus Groups**	**E&O, CO & Claims**	**State of Practice**
Change Orders	Barrier to Entry	Barrier to Entry	Claims Settlement	Constructability
Constructability	Burdensome Requirements	Collaboration	Material Substitution	Contractor Engagement
Culture	Environmental Regulations	Communication	Price Adjustments	Dispute Resolution
Design	Funding	Constructability	Scope Change	Partnering
Disputes/Claims	Innovative Materials	Culture	Time Extensions	Quality
Innovation	Partnering/Culture	Planning	Value Engineering	
Partnering	Process	Process		
Pricing	Quality of Plans	Quality		
Procurement	Rising Costs	Risk Sharing		
Quality Control	Specifications	Specifications		
Risk	Submittals	Workforce Development		
Trends	Time			
Trust	Workforce Development			
Workforce Development				

Table 2 summarizes the proposed engagement framework and strategies. The first strategies identified for implementation are in bold text and are highlighted in green.

Table 2. Proposed engagement framework and strategies

Summary of Framework Strategies		
Resources	**Deliverables**	**Outreach**
People:	Work Products:	Contracting Community:
• **Establish core competencies**	• Develop guidance documents	• **Host facilitated meetings**
• Develop training program • Establish career ladders • Provide professional development opportunities	• **Develop process controls** • Develop key performance indicators	• Participation by key decision makers • Oversight from Chief Engineer's Office
Funding:	Work Processes:	Legislature & State Government:
• Develop asset management tools • Develop scoping and estimating tools • Develop fiscally constrained programs • Track expenditures	• Document workflows and instructions • Provide training • Apply process improvement techniques • Develop metrics to track performance	• Deliver presentations to Committees • Engage with members of committees, Representatives, and Senators • Prepare responses to inquiries
Equipment:		Project Stakeholders:
• Develop inventory of equipment • Develop maintenance schedules • Develop replacement schedules • Develop and track equipment budget		• Ensure effective engagement with elected officials • Ensure business owners are engaged and informed • Ensure property owners are informed and treated fairly • Ensure public engagement process is followed
		Regulators:
		• Engage regulators at the program and project level • Work with the FHWA Division Office • Engage utilities at the program and project level

Tables 3-5 summarize the three strategies that were selected first for implementation. Specific actions for each of these strategies are detailed in the final report.

Table 3. Establish core competencies strategy

Goal:	To improve the professional development of staff by providing training and opportunities based on the core competencies of their role in the organization.
Urgency:	Professional development that leads to career advancement is an important employee retention strategy. Establishing core competencies is the cornerstone of training programs and promotional opportunities. Increasing staff skills and experience should directly lead to better products and external interactions.
Timeline:	This effort should take 6 months to complete. Regular updates are needed when roles change or new positions are created and new technologies and processes are utilized.

Table 4. Develop process controls strategy

Goal:	To improve the quality and constructability of bridge projects through the development and implementation of process controls.
Urgency:	The quality and constructability of some bridge projects have resulted in higher bid prices, increased change orders, and in some instances claims.
Timeline:	The initial development of the process controls should be within 6 months, and full deployment and application of the controls in 12 months. Monitoring will be ongoing.

Table 5. Host facilitated meetings strategy

Goal:	To improve bridge projects through stronger collaboration with industry partners.
Urgency:	There is an immediate need to address prices, competition, and risk allocation.
Timeline:	This effort is required to be ongoing and continuous.

Framework Implementation

It is recommended that an oversight team be established to guide the implementation of the Framework. The Oversight Team would,

- determine the implementation priority of each strategy,
- identify the lead(s) of a Working Group for each strategy,
- identify the initial program areas to be involved,
- establish a schedule, provide guidance, and monitor progress.

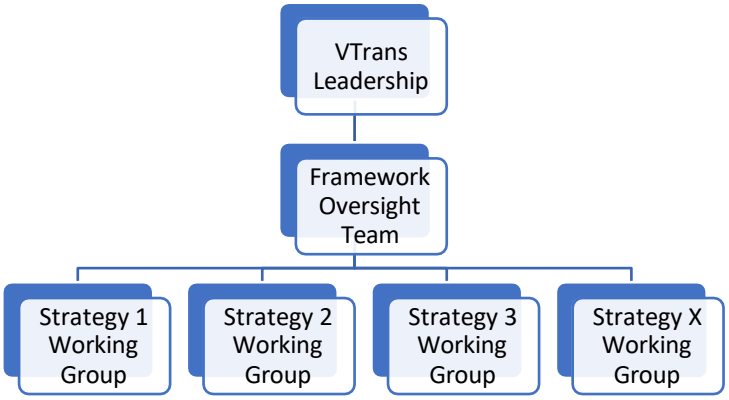


Figure 1. Framework Implementation