

GEORGIA DOT RESEARCH PROJECT 20-16

Final Report

**DEVELOPMENT OF TRAINING MODULES
TO INCREASE USAGE AND
UNDERSTANDING OF AGENCY-WIDE
SOFTWARE PROGRAMS**



Office of Performance-based Management and Research
600 West Peachtree Street NW | Atlanta, GA 30308

November 2022

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.: FHWA-GA-22-2016	2. Government Accession No.: N/A	3. Recipient's Catalog No.: N/A	
4. Title and Subtitle: Development of Training Modules to Increase Usage and Understanding of Agency-Wide Software Programs		5. Report Date: November 2022	
		6. Performing Organization Code: N/A	
7. Author(s): Stephan A. Durham (PI), Ph.D., P.E., F.ASCE https://orcid.org/0000-0002-6177-3491 Mi Geum Chorzepa (coPI), Ph.D., P.E. https://orcid.org/0000-0001-7259-3165 ; S. Sonny Kim (coPI), Ph.D., P.E., F.ASCE https://orcid.org/0000-0002-3468-0230 Baabak Ashuri (coPI), Ph.D., P.E. https://orcid.org/0000-0002-4320-1035 Will Shirley (Graduate Research Assistant) Brianna Dier (Graduate Research Assistant) Jung Hyun Lee (Graduate Research Assistant)		8. Performing Organization Report No.: 20-16	
		9. Performing Organization Name and Address: University of Georgia College of Engineering Driftmier Engineering Center, Athens, GA 30602 Phone: (706) 542-9480 Email: sdurham@uga.edu	
11. Contract or Grant No.: PI# 0017434			
12. Sponsoring Agency Name and Address: Georgia Department of Transportation (SPR) Office of Performance-based Management and Research 600 West Peachtree St. NW Atlanta, GA 30308		13. Type of Report and Period Covered: Final Report (August 2020 – November 2022)	
		14. Sponsoring Agency Code: N/A	
15. Supplementary Notes: Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration.			
16. Abstract: The Georgia Department of Transportation (GDOT) e-construction initiatives utilize key software programs—ProjectWise, Bluebeam, and CATS—that currently lack adequate on-demand training. This study aims to develop innovative and engaging e-construction training programs to increase usage and understanding of ProjectWise, Bluebeam, and CATS across the department. e-Construction training practices at the national, state DOT, and commercial level were initially investigated. GDOT's current e-construction training practices were evaluated to understand existing training content and opportunities to improve Department training. A survey and subsequent meetings were conducted with GDOT Office of Construction personnel to fully understand the software challenges and training goals. ProjectWise, Bluebeam, and CATS training programs were developed consisting of PDF guides, instructional video demos, and interactive computer-based training (CBT) modules organized asynchronously into beginner and intermediate–advanced topics. Through a multifaceted approach, the training programs offer on-demand, engaging online materials that increase productivity in the programs, resulting in resource and time savings for the Department.			
17. Keywords: e-Construction, Software, Training Program, ProjectWise, Bluebeam, Video Module, Interactive Training		18. Distribution Statement: No restrictions.	
19. Security Classification (of this report): Unclassified	20. Security Classification (of this page): Unclassified	21. No. of Pages: 162	22. Price: Free

GDOT Research Project 20-16

Final Report

DEVELOPMENT OF TRAINING MODULES TO INCREASE USAGE AND
UNDERSTANDING OF AGENCY-WIDE SOFTWARE PROGRAMS

By

Stephan A. Durham, Ph.D., P.E., F.ASCE
Professor¹

Baabak Ashuri, Ph.D.
Professor²

Mi Geum Chorzepa, Ph.D., P.E.
Associate Professor¹

S. Sonny Kim, Ph.D., P.E., F.ASCE
Professor¹

Will Shirley, E.I.T.
Graduate Research Assistant¹

Brianne Dier, E.I.T.
Graduate Research Assistant¹

Jung Hyun Lee
Graduate Research Assistant¹

¹University of Georgia
School of Environmental, Civil, Agricultural, and Mechanical Engineering

²Georgia Institute of Technology
School of Building Construction and School of Civil and Environmental Engineering

Contract with
Georgia Department of Transportation

In cooperation with
U.S. Department of Transportation, Federal Highway Administration

November 2022

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Georgia Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yard	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
NOTE: volumes greater than 1000 L shall be shown in m ³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in ²	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km ²	square kilometers	0.386	square miles	mi ²
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m ³	cubic meters	35.314	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in ²

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION	3
OVERVIEW	3
FINAL REPORT STRUCTURE	4
CHAPTER 2. BACKGROUND	5
PAST GDOT E-CONSTRUCTION RESEARCH FINDINGS	5
CURRENT GDOT E-CONSTRUCTION TRAINING	8
ProjectWise Training Material	10
Bluebeam Training Material	13
CATS Training Material	13
CHAPTER 3. LITERATURE REVIEW	15
NATIONAL E-CONSTRUCTION IMPLEMENTATION	15
FHWA e-Construction Matrix	17
DOT e-Construction Benefits	17
NEED FOR E-CONSTRUCTION TRAINING	18
NATIONAL E-CONSTRUCTION TRAINING EFFORTS	19
FHWA Efforts and Resources	20
Non-FHWA Efforts	20
STATE DOT EFFORTS	21
Training Materials	22
e-Construction Training	27
Noteworthy Training Practices	34
COMMERCIAL TRAINING MATERIALS	35
Bluebeam Training	36
Bentley ProjectWise Training	38
LITERATURE REVIEW SUMMARY	41
CHAPTER 4. PROBLEM STATEMENT	43
RESEARCH OBJECTIVES	43
RESEARCH SIGNIFICANCE	44
CHAPTER 5. RESEARCH METHODOLOGY	45

PRELIMINARY REVIEW	46
GDOT DISTRICT CONSTRUCTION SURVEY	48
Overview	48
Survey Development and Distribution.....	48
GDOT MEETINGS	49
District 1 Construction Meeting	50
District 2 Construction Meeting	51
Construction Managers and Inspectors Meeting.....	51
MODULE DEVELOPMENT STRATEGY	52
LEARNING OUTCOME ASSESSMENT	55
RECOMMENDED ADDITIONS AND SUPPLEMENTAL PROCEDURAL GUIDANCE TO GDOT'S <i>CONSTRUCTION MANUAL</i>	60
CHAPTER 6. RESEARCH FINDINGS	64
PRELIMINARY REVIEW FINDINGS	64
SURVEY ANALYSIS	64
General Information.....	64
Training Information.....	70
ProjectWise, Bluebeam, and CATS Challenges.....	72
Survey Main Takeaways	76
GDOT MEETING TAKEAWAYS	76
District 1 Construction Meeting Takeaways	77
District 2 Construction Meeting Takeaways	79
Construction Managers and Inspectors Meeting Takeaways.....	81
TRAINING TOPIC DEVELOPMENT	82
TRAINING PROGRAM DEVELOPMENT.....	84
Training Topic List and Description.....	87
Sample Training Material.....	100
TRAINING PROGRAM PUBLISHING	106
QRG Document Updates	107
Video Updates.....	108
Interactive Module Updates.....	109
TRAINING PROGRAM PROMOTION	111
ENHANCEMENTS TO THE CURRENT GDOT <i>CONSTRUCTION MANUAL</i>	112
Electronic As-built Plans Process	112

<i>Construction Manual Workflow Models and Flowcharts</i>	114
CHAPTER 7. CONCLUSION/RECOMMENDATIONS	132
APPENDIX A. LIST OF STATE DOT AND TRANSPORTATION INSTITUTE WEBSITES REVIEWED	135
APPENDIX B. SURVEY QUESTIONNAIRE	141
ACKNOWLEDGEMENTS	150
REFERENCES	151

LIST OF FIGURES

Figure 1. Image. GDOT interactive mapping tool: ProjectWise	7
Figure 2. Image. GDOT mapping diagram of software usage.....	8
Figure 3. Image. GDOT ProjectWise training layout.	11
Figure 4. Image. GDOT ProjectWise current PDF training guides.....	11
Figure 5. Graph. GDOT distribution of ProjectWise training PDFs.	12
Figure 6. Chart. Training type distribution by state DOT.	24
Figure 7. Image. Publicly available ProjectWise training materials: Colorado DOT.	28
Figure 8. Image. FDOT Training YouTube channel.	29
Figure 9. Image. Florida DOT training module organization.....	30
Figure 10. Image. Michigan DOT ProjectWise Support page.....	30
Figure 11. Image. Missouri DOT CADD Services Support page layout.....	31
Figure 12. Image. Snapshot of PennDOT training calendar.....	33
Figure 13. Image. Utah DOT Training and Support videos.	34
Figure 14. Image. Bluebeam free online training videos.....	36
Figure 15. Image. Bentley ProjectWise on-demand training courses.....	39
Figure 16. Image. Bentley ProjectWise learning path: Deliverables Management.....	40
Figure 17. Flowchart. Video demo creation process.	53
Figure 18. Flowchart. PDF training document creation process.	54
Figure 19. Flowchart. Interactive module creation process.....	56
Figure 20. Image. e-learning Success Model.....	59
Figure 21. Flowchart. Process map included in the as-built process section in the Florida DOT construction manual.	62
Figure 22. Chart. ProjectWise, Bluebeam, and CATS software use.	65
Figure 23. Chart. ProjectWise use.	65
Figure 24. Chart. Bluebeam use.....	66
Figure 25. Chart. CATS use.....	66
Figure 26. Chart. ProjectWise confidence.	68
Figure 27. Chart. Bluebeam confidence.	69
Figure 28. Chart. CATS confidence.	69
Figure 29. Chart. Existing training frequency.	70
Figure 30. Chart. Type of existing training.....	71
Figure 31. Chart. New training priority.	72
Figure 32. Chart. Existing ProjectWise training effectiveness.	74
Figure 33. Image. Bluebeam General Markup Tools PDF guide: Screenshot 1.....	101
Figure 34. Image. Bluebeam General Markup Tools PDF guide: Screenshot 2.....	102
Figure 35. Image. Bluebeam General Markup Tools video demo: Screenshot 1.	103
Figure 36. Image. Bluebeam General Markup Tools video demo: Screenshot 2.	104
Figure 37. Image. Bluebeam General Markup Tools interactive module: Screenshot 1.	105
Figure 38. Image. Bluebeam General Markup Tools interactive module: Screenshot 2.	106
Figure 39. Images. GDOT PDF guides header and subheader samples.	107
Figure 40. Image. PDF guide with numbered step-by-step instructions.....	108

Figure 41. Image. Document Manipulation video demo goals and objectives slide.	109
Figure 42. Image. Interactive module workflow update.	110
Figure 43. Image. Documenting electronic as-built plans process in Bluebeam.	113
Figure 44. Image. Combining current plan sheets in Bluebeam.	113
Figure 45. Image. Editing documents – Completing elemental edits in Bluebeam.	115
Figure 46. Image. Editing documents – Redlining as-built sheets in Bluebeam.	116
Figure 47. Flowchart. <i>Notice to Proceed</i> topic.	117
Figure 48. Flowchart. <i>Time Extensions</i> item.	118
Figure 49. Flowchart. <i>Materials Certificate</i> item.	118
Figure 50. Flowchart. <i>Material Reconciliation Checklist Reporting & Finalizing</i> item.	120
Figure 51. Flowchart. <i>Contract Modifications</i> item.	121
Figure 52. Flowchart. <i>Change Orders</i> item in SiteManager.	121
Figure 53. Flowchart. <i>Field Inspection</i> item.	122
Figure 54. Flowchart. <i>Final Inspection</i> item.	123
Figure 55. Flowchart. <i>Final Acceptance</i> item.	124
Figure 56. Flowchart. <i>Projects Pending Final Payment Reports (PPFPR)</i> item.	125
Figure 57. Flowchart. <i>Contract Close Out</i> item.	126
Figure 58. Flowchart. <i>Final Audit</i> item.	126
Figure 59. Flowchart. <i>Accident Documentation</i> item.	127
Figure 60. Flowchart. <i>Traffic Interruption Reports</i> item.	127
Figure 61. Flowchart. <i>Daily Work Report</i> item.	128
Figure 62. Flowchart. <i>Contract Bidding</i> item.	129
Figure 63. Flowchart. <i>Audit</i> item.	129
Figure 64. Flowchart. <i>Contract Modifications</i> item.	130
Figure 65. Flowchart. <i>Progress Payments</i> item.	131

LIST OF TABLES

Table 1. Publicly available training method by state DOT.....	25
Table 2. GDOT meetings.....	50
Table 3. Comparison of content in construction manuals – Functions related to Bluebeam.	61
Table 4. Software confidence.	68
Table 5. Key challenges associated with ProjectWise, Bluebeam, and CATS.....	73
Table 6. Missing factors from existing ProjectWise training material.	75
Table 7. Proposed new training outline.	83
Table 8. Updated training outline.	85
Table 9. A summary of flowchart candidates.	116

EXECUTIVE SUMMARY

The Georgia Department of Transportation (GDOT) e-construction initiatives utilize key software programs—ProjectWise, Bluebeam, and CATS¹—that currently lack adequate on-demand training. This study aims to develop innovative and engaging e-construction training programs to increase usage and understanding of ProjectWise, Bluebeam, and CATS across the Department. The following methods were implemented to inform researchers on the available materials and additional needs:

- A review of e-Construction training practices at the national, state DOT, and commercial level were initially performed to gain a clearer understanding of industry software training practices and availability of resources.
- GDOT’s current e-construction training practices were evaluated to understand existing training content and opportunities to improve Department training.
- A survey and subsequent meetings were conducted with GDOT’s District field personnel to fully understand the software challenges and training goals.

Based on the results from those evaluations, ProjectWise, Bluebeam, and CATS training programs were developed consisting of Quick Reference Guides (QRG), instructional videos, and interactive computer-based training (CBT) modules organized asynchronously into beginner and intermediate–advanced topics. Ultimately, nine ProjectWise, thirteen Bluebeam, and four CATS training modules were developed as a part of this study. Through a multifaceted approach, the training programs offer on-demand, engaging online materials that increase productivity in the programs resulting in resource and time savings for the Department. A training workshop was

¹ Construction Authorization Tracking System.

delivered to the Office of Construction and District Construction that provided a review of the three software programs with the objective to provide an introduction and overview of the training, review the training modules and what can be expected from each, show selected video modules and work through several interactive modules, and promote the training program to encourage use and adoption.

Lastly, a review of GDOT's *Construction Manual* and its use identified a few opportunities for enhancement and resources. As a result, the study develops an electronic as-built plan process as well as *Construction Manual* workflow models and flowcharts. A total of twenty-two flowcharts were produced to model the workflow and participants throughout the construction administration process.

Ultimately, the new training content produced as a result of this study will deliver standardized and on-demand training to the current and future construction personnel across the state. Through the development of this multi-level training program delivered through a variety of materials, training in ProjectWise, Bluebeam, and CATS can impact a broader range of users and therefore have a more significant impact across GDOT.

CHAPTER 1. INTRODUCTION

OVERVIEW

e-Construction has become a vital component of the construction industry over the last 20 years. The Federal Highway Administration (FHWA) defines e-construction as the collection, review, approval, and distribution of highway construction contract documents in a paperless environment. Departments of transportation (DOTs) across the country have implemented countless e-construction programs and practices at various levels. The use of e-construction applications and processes by DOTs improves the efficiency and productivity of the construction management process. One of the most important features to implement along with new e-construction technologies is effective, relevant, and specific training to facilitate the transition to unfamiliar technologies and practices.

As the Georgia Department of Transportation (GDOT) shifts to a more paperless environment, the software programs ProjectWise, Bluebeam, and CATS² are vital to the construction management process and require more relevant and effective training. A thorough literature review of e-construction training material and techniques at the national, state, and GDOT levels was conducted in this project to comprehensively understand existing e-construction training. Following the literature review, a thorough investigation into GDOT uses and challenges of the three software programs was conducted. Through the extensive feedback of GDOT construction personnel, a robust and innovative set of training modules covering ProjectWise, Bluebeam, and CATS material was developed to increase agency-wide understanding of the three programs. Further, GDOT's *Construction Manual* ([GDOT 2020a](#)) was reviewed to determine

² Contract Authorization Tracking System.

opportunities for enhancement and inclusion of additional resources. As a result, the study created an electronic as-built plan process and *Construction Manual* workflow models and flowcharts. Recommendations coming from this study are found in chapter 7 of this report.

FINAL REPORT STRUCTURE

The structure of this report encompasses seven chapters that describe the process of developing new training modules for ProjectWise, Bluebeam, and CATS for use by GDOT personnel and consultants. Chapter 2 describes the results of a past research study that investigated an implementation plan for GDOT's e-construction program. Additionally, chapter 2 provides a review of existing GDOT training material available to employees with a specific focus on ProjectWise, Bluebeam, and CATS material. Chapter 3 provides an extensive literature review covering national and state DOT e-construction training material and methods, along with a review of existing commercial training material available for ProjectWise and Bluebeam. Chapter 4 reviews the research objectives and significance. Chapter 5 investigates the research methodology, which consisted of an in-depth survey; multiple meetings with various GDOT construction personnel; collaboration with the State Office of Construction and the Office of Information Technology (IT); and training module development, review, and publishing. Chapter 6 discusses the results of the survey and GDOT meetings, along with the development of the new training material. Finally, chapter 7 summarizes the research and offers multiple recommendations for future studies. The appendix and references are found at the end of this report.

CHAPTER 2. BACKGROUND

PAST GDOT E-CONSTRUCTION RESEARCH FINDINGS

Georgia DOT Research Project (RP) 17-13: Development of Implementation Plan for GDOT e-Construction Program was submitted in November 2018. Researchers in that project were tasked with identifying and understanding the limitations of GDOT's construction administration process, establish a framework for a more advanced e-construction program, and develop a proposal for the FHWA Accelerated Innovation Deployment (AID) Demonstration ([Durham, Ashuri, and Shannon 2018](#)). Over the course of November 2017 to May 2018, the research team met with GDOT representatives from 15 offices, including Construction, Roadway Design, Engineering Services, and IT Infrastructure, to understand more completely each office's software usage, communication needs, and challenges. Various challenges were identified relating to GDOT training and ProjectWise features.

The Office of Construction indicated that the disadvantage of implementing new software is the training required, and offices only involved with preconstruction, consultants, and contractors do not have direct access to ProjectWise. The Office of Engineering Services saw a lack of knowledge regarding functionality of ProjectWise. Although training was provided for ProjectWise, it was provided a year or more before it was implemented. The Office of Environmental Services indicated that because some new software programs are not implemented on all projects, they do not have adequate time to learn the application. The Office of IT noted the excessive number of folders within ProjectWise. The Office of Program Delivery indicated that program users are not always comfortable using a dashboard such as the one available in ProjectWise. Similar to the Office of Engineering, the Office of Right of Way indicated that ProjectWise training was provided 6 months before implementation. The Office of Roadway

Design also discussed the importance of being able to resolve problems in the field as quickly as possible. Finally, it was noted that the Program Control Office leads the Plan Development Process (PDP) training course and the Local Technical Assistance Program (LTAP) for GDOT.

Following the information gathered from the various GDOT offices, two software usage diagrams were created to depict software use across GDOT's offices. The first diagram created was a web-based, interactive mapping tool depicting GDOT's software usage related to office, project phase, and task. The tool allows users to scroll over any item and view the connections between each category. Observing ProjectWise through the mapping tool (see figure 1) shows a connection to every office interviewed, all phases of construction, and most depicted tasks. The second figure developed was a mapping diagram depicting GDOT's software usage in relation to office and task (see figure 2). It was determined that ProjectWise was being used by virtually every GDOT office during all phases of construction for document distribution, retrieval, storage, management; historical plans research; updating the PDP; sharing documents externally; and reporting. The internal software CATS was another very common program used for routing contracts and documents that require the commissioner's signature.

Many offices discussed a need for e-construction software training, especially for ProjectWise. ProjectWise training was determined to be a challenge in at least four GDOT offices: Engineering Services, Environmental Services, Program Delivery, and Right of Way. Another challenge for both the Offices of Construction and IT Application Support was the inability to query in ProjectWise. Heavy reliance on IT was expressed by the Office of Materials and Testing (OMAT). Finally, keeping up with advances in technology was addressed as a concern for IT Application Support. RP 17-13 indicated one of GDOT's primary goals was "developing a robust

training program for its employees and consultants for its newer software programs not currently being used to full advantage” ([Durham, Ashuri, and Shannon 2018](#)).

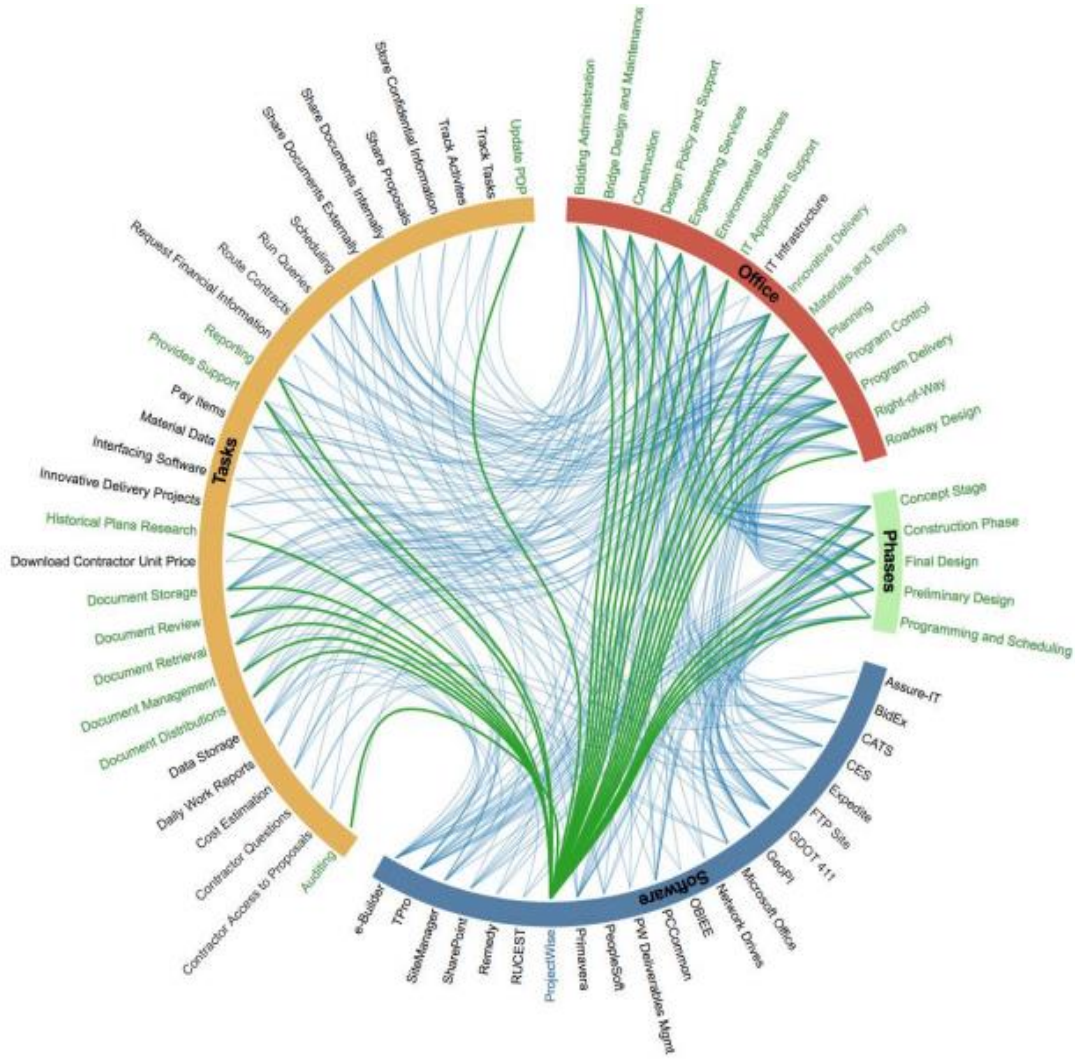


Figure 1. Image. GDOT interactive mapping tool: ProjectWise ([Durham, Ashuri, and Shannon 2018](#)).



Figure 2. Image. GDOT mapping diagram of software usage (Durham, Ashuri, and Shannon 2018).

CURRENT GDOT E-CONSTRUCTION TRAINING

GDOT provides a variety of training opportunities for prequalified engineers, public workers, and technicians that do business with the Department. Training is administered through the MYGDOT Employee Center, a Learning Management System (ELMS), the Local Technical Assistance

Program, and a Technician Certification Program (TCP). The training is managed by the GDOT Human Resources (HR) Training and Development Team.

The MYGDOT page contains access to the ELMS system, HR and IT training, various resources and courses, and tutorials for a wide range of GDOT applications. HR training classes are available for employees to enhance professional skills, while IT training classes provide employees learning opportunities to enhance their skills on GDOT program applications, software, and systems. The tutorials section contains extensive resources for AASHTOWare Project, ArcGIS, CATS, DocuSign, ProjectWise, Primavera, and others.

The Certifications & Training page of GDOT's website ([GDOT 2022a](#)) contains a wealth of training materials and course registration opportunities for the PDP, Construction Engineering Inspection Training (Engineering Skills Development), Flagger Certification, and Work Zone Safety & Mobility. In addition, the page contains extensive Stormwater (MS4) Training that offers scheduled training sessions via Microsoft Teams. Sessions require users to register through the Learning Management System (LMS). The LMS allows users to easily track training enrollment, progress, and certificates. Other training, including the GDOT Maintenance Service Contractor Training, is presented in the form of presentations. Managers/supervisors review content of applicable portions of training with their employees and record their participation and understanding. Software training materials are found under Design Software and includes materials covering Bentley Navigator, Bridge, CAiCE, Drainage, InRoads, MicroStation, OpenRoads, ProjectWise, and Traffic. The largest quantity of materials is provided for Bridge, InRoads, and ProjectWise. The material is delivered through various guidelines, videos, flowcharts, and other documents. While there is existing ProjectWise and CATS training material

available for construction personnel, there is currently no Bluebeam training section available on the GDOT website or internal MYGDOT page.

ProjectWise Training Material

Pertaining to ProjectWise, the GDOT website (see figure 3) currently contains workflows and training in the form of PDF documents, flowcharts, and YouTube videos. Further, the material is found on the internal MYGDOT Training page under the Tutorials section. Most of the material consists of PDF documents, guides, and workflows. The content delivered through the PDF training documents are categorized into six sections:

1. Access to ProjectWise.
2. Applications.
3. General.
4. Plotting.
5. ProjectWise Deliverables Management (DM).
6. ProjectWise Essentials.

The PDF guides in each section are listed in figure 4, and the distribution of material by section is shown in figure 5.

ProjectWise

Workflows		Training	
Training	Section	Flowchart	Video
External User Access Instructions	Access to ProjectWise		
Using ProjectWise Web Access	Access to ProjectWise		
ProjectWise Mobile Application	Access to ProjectWise		
Using MicroStation in ProjectWise	Applications		
Working with Office Applications and ProjectWise	Applications		
Using InRoads in ProjectWise	Applications		
Digitally Signing ProjectWise Documents using Bluebeam Revu	Applications		
Early Installation Help Document	General		
User Training Manual	General		
Why ProjectWise?	General		
Making Documents Available Externally (Public Access Flag)	General		

Figure 3. Image. GDOT ProjectWise training layout.

GDOT ProjectWise Current PDF Guides	
Access to ProjectWise	External User Access Instructions, Using ProjectWise Web Access, ProjectWise Mobile Application
Applications	Using MicroStation in ProjectWise, Working with Office Applications and ProjectWise, Using InRoads in ProjectWise, Digitally Signing ProjectWise Documents using Bluebeam Revu
General	Early Installation Help Document, User Training Manual, Why ProjectWise?, Making Documents Available Externally
Plotting	MicroStation v7 Plotting Instructions, GDOT Multi Print Utility Printing Instructions, Batch Plotting PDF Files in ProjectWise Using Bluebeam Revu
ProjectWise Deliverables Management	PWDM-GDOT Users and Partners Registering projects, External-Respond to Transmittals, GDOT-Respond to Submittals, External-Receive Responses, GDOT-Receive Responses, PWDM Workflow-External and GDOT Initiated, External-Create Submittals, GDOT-Create Transmittals, GDOT-Additional Internal Reviewers, GDOT-Bentley Account Creation Instructions, External Participants Bentley Account Creation/Accepting Invitations, GDOT-Additional External Reviewers, External Create Submittals for EDG QA Check, External EDG QA Check Submittal, GDOT-Resend New Version, External Resend New Version
ProjectWise Essentials	Working with Documents in ProjectWise, ProjectWise Explorer Fundamentals, Custom Views in ProjectWise, Using Local Document Organizer, Using ProjectWise Searches, Document Versions in ProjectWise, ProjectWise Document Sets

Figure 4. Image. GDOT ProjectWise current PDF training guides.

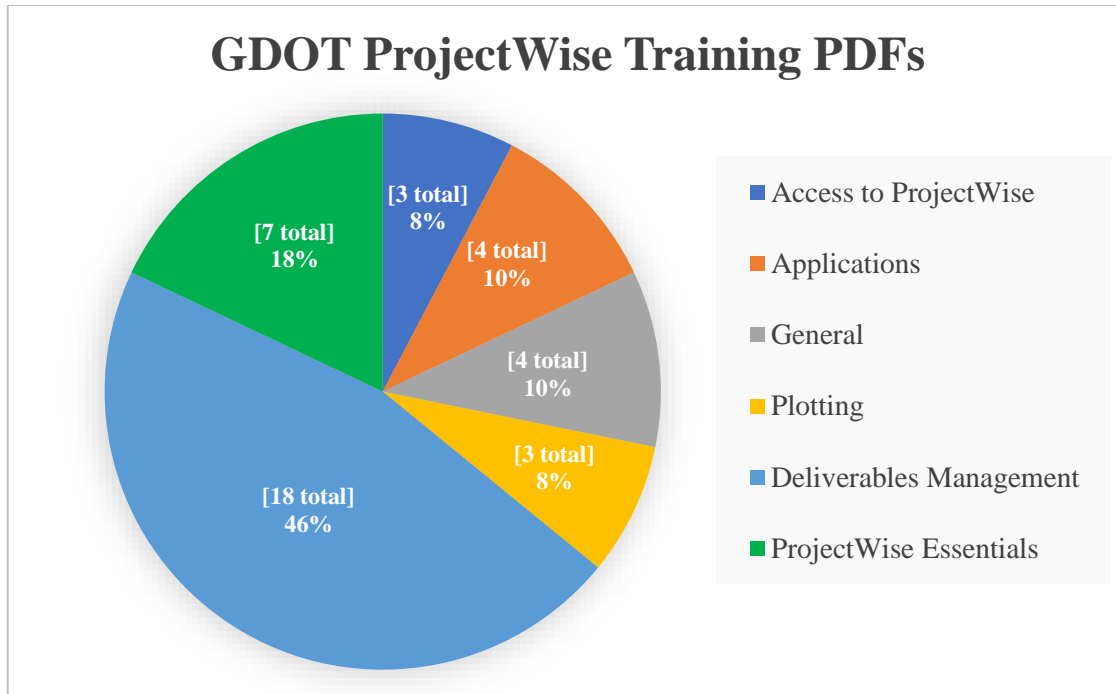


Figure 5. Graph. GDOT distribution of ProjectWise training PDFs.

As depicted in figure 5, a majority (64.00 percent) of the guides describe topics within ProjectWise Deliverables Management and ProjectWise Essentials. The documents provide detailed step-by-step instructions and guidelines for each topic with screenshots of the steps being carried out in ProjectWise. There are several PDF guides for ProjectWise workflows that are not organized in sections or chapters but are listed in alphabetical order from Award Process to Value Engineering (VE) Studies Process. The existing PDF guides offer a possible organizational structure for the new ProjectWise training modules, along with suggested video topics.

The only ProjectWise training videos available by GDOT include ProjectWise Deliverables Management topics and consist of External – Respond to Transmittals, GDOT – Receive Responses, External – Create Submittals, and GDOT – Create Transmittals. These four training videos are available via GDOT’s YouTube channel ([GDOT 2022b](#)) and are 4–6 minutes long. The videos focus on correspondence between external partners and GDOT concerning

package responses, transmittals, and submittals. There are currently no ProjectWise training modules/videos for other sections, including ProjectWise Essentials. Much of the training appears to focus on external user operations, rather than in-house ProjectWise functions.

Bluebeam Training Material

Currently, there is minimal existing Bluebeam training pertaining to GDOT. The following GDOT documents related to Bluebeam training are available:

- *Process for Digitally Signing Documents in Bluebeam Revu* ([GDOT 2020b](#)).
- *Batch Stamping in Bluebeam Revu* ([GDOT 2017](#)).
- *Batch Plotting Using Bluebeam Revu* ([GDOT 2016](#)).

The PDF documents depict step-by-step instructions with images of actions being completed in Bluebeam, similar to the ProjectWise guides. Unlike ProjectWise and CATS, Bluebeam does not contain a specified training section on the GDOT or MYGDOT website. While “Bluebeam was adopted to serve as a method for creating, editing, marking up, and sharing PDF design and construction documents” ([Durham, Ashuri, and Shannon 2018](#)), there is currently no available training for using Bluebeam’s markup tools. Although general training is offered by Bluebeam, the training is not GDOT-specific and only provides information on general features in Bluebeam through short video demonstrations. The Office of Construction would benefit from more workflow-specific and concise training.

CATS Training Material

Similar to Bluebeam, the publicly accessible GDOT website does not contain a section for CATS material or training. However, the internal page, MYGDOT, contains a CATS section with multiple training tutorials. A series of seven YouTube videos on the GDOT IT Training Group

channel ([GDOT 2022b](#)) covers the following topics: (1) electronic routing of agreements, (2) generating a contract ID, (3) quit-deed manual approval process, (4) quit-deed routing request, (5) ROW petition routing request, (6) supplemental agreement negotiation, and (7) vendor electronic signature. In addition, the site contains the CATS *User Guide*, which aims to provide an understanding of the new/revised functionality of the CATS application. The *User Guide* provides an extensive review of multiple functions in CATS and contains step-by-step examples of actions in the program, including creating a contract ID and creating a new supplemental agreement negotiation. Further, various classes are offered by IT through the ELMS system that demonstrate specific CATS processes. While CATS is only used by 4 of 15 GDOT offices, it is essential that Department employees are knowledgeable of the system such that sensitive contract documents are appropriately documented within the program. The current CATS training material does not appear to be widely used by the Office of Construction.

CHAPTER 3. LITERATURE REVIEW

e-Construction is a paperless construction administration process aimed to improve the quality and efficiency of the construction process. Different forms of e-construction practices have been implemented across national, state, and local departments of transportation during the last decade, with many DOTs, if not already doing so, planning to go completely paperless. One of the largest challenges with e-construction implementation is proper training of DOT staff and their constituents. Constituents include contractors and consultants that work closely with DOT staff. While some software companies, such as Bentley and Bluebeam, offer general online software training, it is not tailored specifically to GDOT needs. Transportation agencies across the country have investigated various training methods for e-construction software. The goal of this literature review is to understand current e-construction training practices for national and state transportation agencies, outline commercially available training materials (concerning ProjectWise and Bluebeam), and investigate optimum training materials/methods to exceed GDOT's training goals to implement an innovative and engaging training program to increase agency-wide usage and understanding of ProjectWise, Bluebeam, and CATS.

NATIONAL E-CONSTRUCTION IMPLEMENTATION

e-Construction is being implemented at some level by virtually every DOT in the country. State leaders, such as Michigan, Pennsylvania, Florida, and Georgia, have led the way with e-construction implementation and innovation. The implementation of e-construction practices occurs over various phases, including developing, demonstrating, assessing, and institutionalizing/adopting. The Federal Highway Administration has been a large proponent in the advancement of e-construction efforts.

The FHWA webpage, “e-Construction” ([FHWA 2021](#)), contains a wealth of information pertaining to e-construction technologies. Resources include case studies, technical briefs, how-to guides, technical reports and resources, and resources from the Every Day Counts (EDC) initiative. The case studies investigate various collaborative efforts with DOTs, including Minnesota, Iowa, Indiana, and Ohio. The technical briefs and how-to guides include peer exchanges and e-construction guides that are discussed later in this chapter. The FHWA created the EDC initiative to promote innovation and advancements in the transportation engineering industry. The fourth round of the EDC initiative (i.e., EDC 4) contained a series of webinars (FHWA 2018), which includes “Creating a Roadmap to Implement e-Construction Practices and Strategies for Assessing and Procuring Technology” ([Mitchell 2018](#)). Alaska DOT presented on the topic and discussed the following roadmap to e-construction implementation:

1. Identify DOT needs.
2. Assess legacy systems.
3. Identify challenges (such as budget restrictions, reorganization, resistance to change, lack of personnel, etc.).
4. Create a plan and choose a system.
5. Create a phased implementation.
6. Identify technology and personnel resources.
7. Understand cost effectiveness: one-time implementation costs and annual licensing fees.
8. Identify gaps and find solutions.

The webinar discussed the importance of identifying current technology resources, picking the right team, and coordinating with IT staff when implementing e-construction technologies.

FHWA e-Construction Matrix

As part of the FHWA’s EDC 4 program ([FHWA 2021](#)), innovation matrices were developed that display a summary of products being evaluated, piloted, and used by state DOTs organized both by product and state. The matrices are housed on the same “e-Construction” website previously mentioned ([FHWA 2021](#)). Information in the table was acquired from publicly available sources, including internet searches, state DOT websites, and conference presentations, and is not all-inclusive.³ Using information gathered from the product matrix, ProjectWise is currently being implemented by 30 state DOTs as their document management system (DMS), with GDOT and Michigan DOT also using it as Project References and a Collaboration Portal. Other DMSs being implemented include custom applications, Doc Express, Falcon DMS, OnBase, and SharePoint. Bluebeam is currently being implemented by 11 state DOTs as a Collaboration Portal and 3 states as Electronic As-Builts. Other Collaboration Portals being investigated and implemented include Autodesk BIM 360 Docs, Bentley OpenRoads Navigator, custom applications, e-Builder, and SharePoint. The matrices are valuable resources to view other state DOTs’ current e-construction practices and are available on the FHWA website ([FHWA 2021](#)).

DOT e-Construction Benefits

While the initial development of e-construction requires extensive time and resources, the long-term benefits, including improved document distribution and workflow, real-time document access, and reduction/elimination of paper, are substantial ([Weisner, Cawley, and Sindlinger 2017](#)). Additional benefits include time savings, higher productivity, and increased document security.

³ Correspondence from Kathryn Weisner, “Re: State DOT Training Implementation for e-Construction Software,” received by Will Shirley, July 10, 2020.

The Florida Department of Transportation (FDOT), after much planning, effort, and investment, was one of the early implementers of e-construction. The initial cost of implementing e-construction technologies for FDOT was \$1.5 million. Annual operating costs were estimated to be \$1 million. Despite these initial operating costs, as of 2015, FDOT's projected annual savings are expected to reach \$22 million (*e-Construction How-To Guide*; [FDOT 2015](#)).

Michigan DOT estimates an annual savings of \$12 million and 6 million pieces of paper from their e-construction efforts (*The Age of e-Construction*; [Weisner, Cawley, and Sindlinger 2017](#)). Change order processing time was also estimated to reduce by 27 days. Michigan DOT has noted less time spent on paperwork and an increase in employee and constituent engagement, enthusiasm, and efficiency.

NEED FOR E-CONSTRUCTION TRAINING

Although there are many advantages, e-construction implementation is met with various challenges, including a scarcity of relevant and effective training. To fully adopt e-construction material, all personnel involved in the implementation must be adequately trained in the system operation, tools, and processes. With the proper training, e-construction technologies are more successfully integrated. Proper training also helps with office pushback resulting from new and unfamiliar technologies.

There are various common pitfalls when developing online training materials. One of the more common is the existence of limitations beyond employee control. This could stem from a lack of communication between the training implementation team, inadequate training supervision, or impractical training expectations ([Mansell 2014](#)). Another common pitfall is excessive or minimal training materials. The amount of training should fall in the middle ground:

too much can cause impatience or be overly burdensome, and too little can cause confusion and lack of engagement.

NATIONAL E-CONSTRUCTION TRAINING EFFORTS

One of the how-to guides created by the FHWA, titled *Guide For e-Construction & Partnering: Training the 21st Century e-Construction Workforce* (FHWA 2019), describes the four main components of a successful adult training program:

1. Self-Directed.
2. Relevant.
3. Task-Oriented.
4. Clear Benefit.

Training is recommended to follow a blended e-learning environment containing mentoring, documentation, and innovative technology. Mentoring options are implemented in various ways. For example, the FHWA discussed the Virginia DOT's (VDOT) use of retired construction staff as mentors for employee training. Online training should be structured asynchronously, so the user can complete at his/her own speed and need. A form of accountability in the training is critical to track progress and competency level. Accountability is in the form of assessments, certificates, or similar tools and is often implemented through an LMS or other e-learning system. Kathryn Weisner, a Construction & Contract Administration Engineer who is heavily involved in FHWA e-construction efforts, helped develop the guide and stressed the importance of task-oriented, on-demand, and easily accessible/navigated training resources. Specific training and efforts already underway by the FHWA and other sources are detailed in the subsections below.

FHWA Efforts and Resources

The FHWA's Local Technical Assistance Program provides web-based training videos, documents, and other materials to each state DOT. The GDOT LTAP program, led by the Program Control Office, provides training for DOT staff through scheduled classes. All workshops are available to GDOT employees, local and state agencies, contractors, and consultants. Users sign up for classes through the GDOT Learning Management System.

Along with the innovation matrices, the FHWA EDC 4 program (FHWA 2018) conducted a series of peer exchanges from mid-2018 to early 2019. The focus of the peer exchanges was DOT e-construction technology and innovation. FHWA worked with state DOTs to develop a scope and agenda for the peer exchanges and provided speakers for the event. The venue location and attendee list were the responsibility of the state DOT host. Upon review of the peer exchanges, multiple takeaways concerning e-construction training were concluded:

- On-demand training is the most effective for online e-construction learning.
- The importance of implementing dedicated e-construction engineer/team/tech-savvy employees to lead e-construction efforts was heavily discussed.
- Educate IT staff on field personnel needs and work with field personnel to understand training needs.

Non-FHWA Efforts

The American Association of State Highway and Transportation Officials (AASHTO) Transportation Coordination Council (TC3) provides online training modules covering topics that include construction, maintenance, and materials. Redundancy is avoided by sharing training nationally across various DOTs. The TC3 offers an "e-Construction Introduction" course for 2 PDHs that outlines what e-construction is, how it impacts the construction process, key

considerations related to e-construction implementation, steps to implementation, and examples of successful state DOT e-construction implementation.

The International Highway Engineering Exchange Program (IHEEP) hosts a conference once a year devoted to sharing ideas across DOTs currently implementing construction technology. The 2018 conference contained various e-construction–related technical sessions, including the following:

- “e-Construction Confessions from the Field” ([Elmedorp and Ridgell 2018](#)).
- “Michigan DOT Partnering with Industry for a Digital Tomorrow” ([Cassar and Wilkerson 2018](#)).

“e-Construction Confessions from the Field” was presented by the Virginia DOT and discussed benefits of e-construction, challenges, a project example, and e-construction solutions. VDOT recommended to not “assume experience levels or comfort with software solutions” and to “foster a collaborative team approach to facilitate making each user a trainer” ([Elmedorp and Ridgell 2018](#)). Further, VDOT recommended the importance of starting with the end user and working up from there.

Michigan DOT’s presentation was concerned with digital delivery in construction and level of development (LOD) that helps improve digital data processes and data consistency. Michigan DOT highlighted the importance of setting up an early training program and engaging all stakeholders ([Cassar and Wilkerson 2018](#)).

STATE DOT EFFORTS

Multiple states have led the way in e-construction efforts and innovation, including Michigan, Pennsylvania, and Florida. Michigan DOT began using e-construction technologies in 2012 and

has led the way with FHWA peer exchanges, having hosted one in 2016 with the California DOT (Caltrans). The Pennsylvania DOT (PennDOT) developed and released eight mobile construction apps through their mobile development team. The Pennsylvania State Transportation Innovation Council (STIC) supports and facilitates the implementation of the FHWA EDC initiatives. Finally, Florida DOT was one of the early implementers of e-construction technology and currently is operating through a paperless environment. FDOT has also developed support through an extensive computer aided design and drafting (CADD) YouTube channel, where training videos for a wide variety of e-construction technologies are available. Appendix A provides a list of the state DOT websites that were reviewed as a part of this study.

Training Materials

With e-construction technology being implemented at some level in nearly every state DOT, a wide variety of training materials has been investigated and applied. As part of the literature review in the current study, online public training resources were investigated for each state DOT. Training materials across departments included PDF documents, training videos/modules, YouTube channels, classes/webinars, PowerPoint presentations, LMS/e-learning systems, extensive support teams, and national resources. A summary of the training methods available is depicted in Figure 6 and table 1. Figure 6 illustrates the general breakdown of training types used by state DOTs. The percentage data labels indicate the percentage of states using the specific training method. Table 1 shows the distribution by individual state DOT.

State DOTs generally provide online sources containing detailed and extensive contacts for e-construction assistance. Some states did not provide substantial in-house resources, but rather primarily used national resources, as indicated in the National e-Construction Training Efforts section. Although not all-inclusive, the goal of Figure 6 and table 1 is to provide a broad overview

of existing DOT training practices and recognize general trends and commonalities between state DOTs across the country. Individual state DOT efforts in Alaska, Iowa, Oregon, Texas, and Washington stood out with unique and innovative training materials, as discussed in the following subsections.

Alaska DOT

The Alaska DOT provides a variety of materials, including various environmental procedures, training modules, FHWA webinars, PDF documents, PowerPoint presentations, and in-person class training ([Alaska DOT 2020](#)). The training modules review Alaska DOT environmental procedures and contain 10 well-organized module videos, each one requiring roughly 25 minutes to complete. To receive credit for the training, the user must complete a short multiple-choice quiz at the end of each module.

Iowa DOT

The Iowa DOT offers web-based training and a Technical Training and Certification Program (TTCP) ([IDOT 2020](#)). The web-based training requires users to register for courses that are then completed at the pace set by the individual user. Doc Express is used by Iowa DOT for digital signatures and as a document management system. A list of 10 Doc Express training videos is posted on the Iowa DOT YouTube channel, with each video after the overview being under 9.5 minutes. In addition to the training videos, Iowa DOT provides a 28-page Doc Express *User's Guide*.

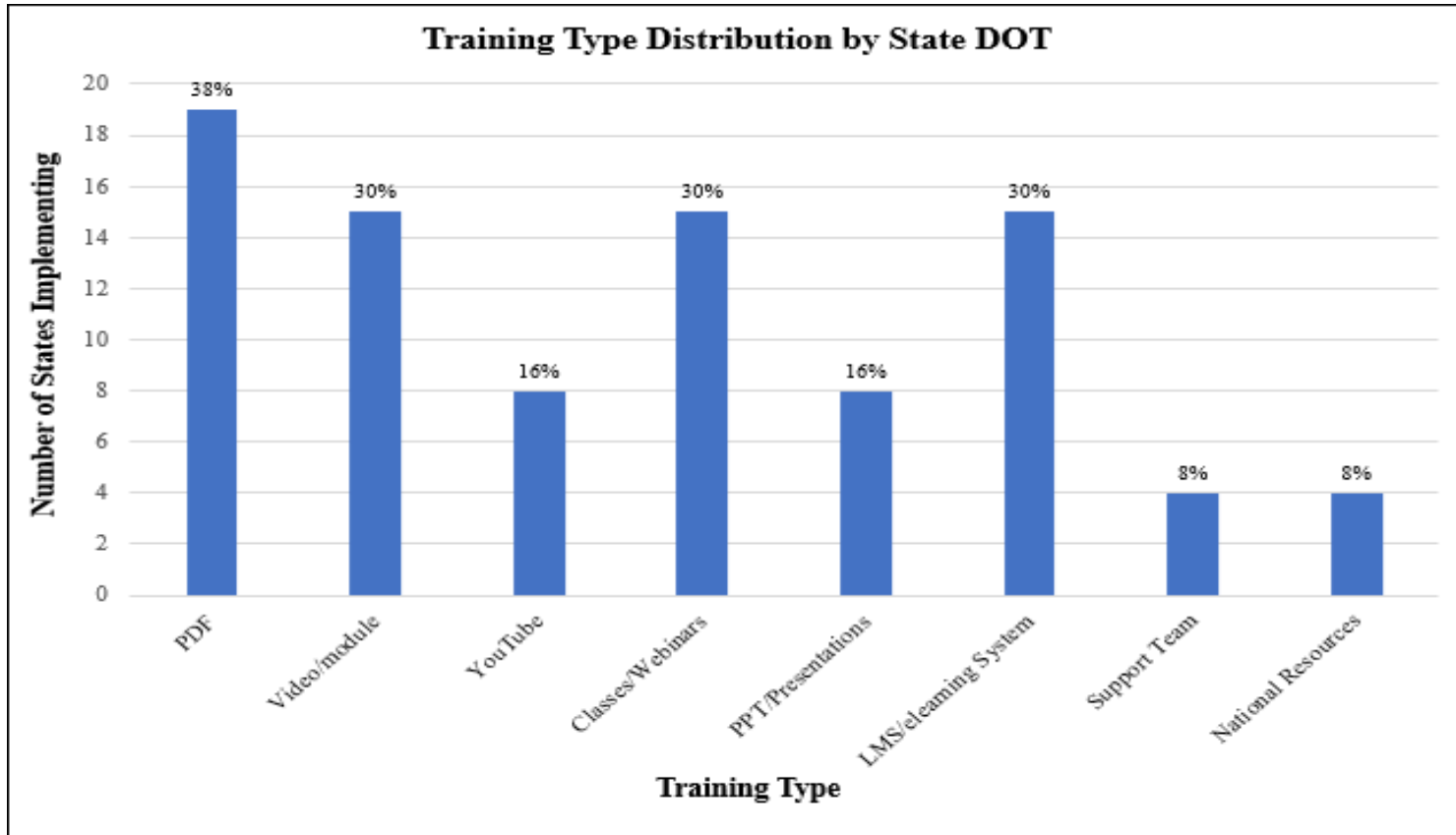


Figure 6. Chart. Training type distribution by state DOT.

Table 1. Publicly available training method by state DOT.

Training Method								
	PDF	Video (website)/Modules	Youtube	Classes/Webinars	PPT/Presentations	LMS/elearning system	Support Team	National Resources
State Use	ADOT & PF	ADOT & PF	*FDOT	ALDOT	ADOT & PF	*CDOT	*FDOT	ALDOT
	ArDOT	Caltrans	GDOT	ADOT & PF	DelDOT	*FDOT	*MDOT (MI)	ADOT & PF
	*CDOT	*CDOT	IowaDOT	ADOT	MaineDOT	GDOT	*MoDOT	RIDOT
	ConnDOT	ConnDOT	KDOT	GDOT	*MoDOT	IDOT	*PennDOT	TDOT
	*FDOT	*FDOT	NDOT	*FDOT	MDOT (MS)	IowaDOT		
	GDOT	GDOT	NDDOT	LaDOTD	MDT	*MoDOT		
	LaDOTD	INDOT	ODOT	NDOT	NCDOT	NCDOT		
	*MDOT (MI)	*MoDOT	TxDOT	NCDOT	*UDOT	ODOT		
	*MoDOT	MDT		ODOT		ODOT		
	MDT	NDDOT		ODOT		*PennDOT		
	NHDOT	ODOT		*PennDOT		TxDOT		
	ODOT (OR)	TxDOT		SDDOT		*UDOT		
	TDOT	*UDOT		TDOT		VDOT		
	TxDOT	Vtrans		TxDOT		WSDOT		
	*UDOT	WVDOT		VDOT		WisDOT		
	VTrans							
	WSDOT							
WVDOT								
WisDOT								

Note: ADOT & PF - Alaska Department of Transportation and Public Facilities, ALDOT – Alabama Department of Transportation, ArDOT – Arkansas Department of Transportation, Caltrans – California Department of Transportation, CDOT – Colorado Department of Transportation, ConnDOT – Connecticut Department of Transportation, FDOT – Florida Department of Transportation, GDOT – Georgia Department of Transportation, LaDOTD – Louisiana Department Transportation and Development, IDOT – Illinois Department of Transportation, INDOT – Indiana Department of Transportation, IowaDOT – Iowa Department of Transportation, KDOT – Kansas Department of Transportation, MaineDOT – Maine Department of Transportation, MDOT – Michigan Department of Transportation, MoDOT – Missouri Department of Transportation, MDT - Montana Department of Transportation, NCDOT – North Carolina Department of Transportation, NDOT – Nebraska Department of Transportation, NDDOT – North Dakota Department of Transportation, NHDOT – New Hampshire Department of Transportation, ODOT - Oregon Department of Transportation, PennDOT – Pennsylvania Department of Transportation, RIDOT – Rhode Island Department of Transportation, SDDOT – South Dakota Department of Transportation, TDOT – Tennessee Department of Transportation, TxDOT – Texas Department of Transportation, UDOT – Utah Department of Transportation, VDOT – Virginia Department of Transportation, VTrans - Vermont Agency of Transportation, WSDOT - Washington State Department of Transportation, WVDOT – West Virginia Department of Transportation, and WisDOT – Wisconsin Department of Transportation.

Oregon DOT

Along with many DOTs, Oregon uses ProjectWise as their document management system. They launched ProjectWise in October 2016 as part of the Statewide Transportation Improvement Program. The Oregon DOT website contains information on requesting access and resetting account password for ProjectWise use, along with user resources containing 15 PDF quick guides and manuals ([ODOT 2020](#)). Online training videos and webinars are implemented for MicroStation use. At the time of this review, online training was conducted via their training website: iLearnOregon⁴.

Texas DOT

The primary Texas DOT (TxDOT) training resources are through its Connect system ([TxDOT 2020](#)). The TxDOT Connect system contains a large variety of training videos, reference material PDFs, interactive modules, and virtual coaching sessions that are also accessible to external partners. Online short course presentations are available that discuss TxDOT ProjectWise implementation. The TxDOT Inspector Development Program (IDP) contains classroom training, online courses, and YouTube training videos that are well-organized into 18 modules, beginning with general requirements and ending with specific technical details.

Washington State DOT

The Washington State DOT (WSDOT) website contains continuously evolving Design Project Development Training classes for employees ([WSDOT 2020](#)). Part of this training is a Project Management e-learning section consisting of Negotiation Essentials, Risk Management, and Cost Management using Primavera Scheduler YouTube videos ranging in length from 6 minutes to

⁴ Subsequent to this review, the iLearnOregon site was retired. Additional information available online: <https://www.oregon.gov/das/HR/Pages/wd-training-overview.aspx>

29 minutes. Online training modules are available for local agencies, covering a variety of Construction Activity topics. Washington originally implemented ProjectWise in 2005 within the state mega-projects and currently uses the platform in more minor projects and offices. Ten ProjectWise Training Documents, including Creating Engineering Files, Creating Custom Views, and Advanced ProjectWise File Commands, are publicly available on the DOT website, along with four ProjectWise Tech Note documents. For ProjectWise support, most projects have a local ProjectWise administrator who helps facilitate issues.

e-Construction Training

The states of Colorado, Florida, Michigan, Missouri, Pennsylvania, and Utah offer exceptional public e-construction training resources, which are expanded upon in the following subsections.

Colorado DOT

The Colorado Department of Transportation (CDOT) contains a set of publicly available ProjectWise training videos and documents on their website ([CDOT 2021](#)). The asynchronous ProjectWise videos incorporate various topics of the program, including viewing and opening documents, checking in and checking out documents, and editing title block attributes. Training materials specifically tailored to CDOT employees are accessed via the ProjectWise intranet website. The Business Center also contains PDF guides and training videos for other programs, including MicroStation and InRoads. A list of publicly available CDOT ProjectWise videos is shown in Figure 7.

ProjectWise User Training Materials

Training Videos (these videos do not have to be viewed in sequential order), and a link to the ProjectWise Intranet website for CDOT employees only.

[ProjectWise Intranet Website for CDOT Employees Only](#)

Includes the ProjectWise Reference Manual and ProjectWise End User Online Training.

- [Document Properties](#)
- [Viewing and Opening Documents](#)
- [Create, Copy, and Delete Documents](#)
- [Checking In and Checking Out Documents](#)
- [Finding Documents Quickly](#)
- [Local Document Organizer Tool](#)
- [ProjectWise and Outlook](#)
- [Creating a New MicroStation File](#)
- [Editing Title Block Attributes in ProjectWise](#)
- [Attaching Reference Files](#)
- [Opening, Saving, and Sharing InRoads Files](#)
- [Setting Up Project Defaults](#)
- [Plan and Profile Generator](#)
- [Changing Attributes for Multiple Files](#)
- [Archived ProjectWise Training Materials](#)

ProjectWise V8i SS2 and XM User's Guide Manuals

Contact Us

[303.757.9858](tel:303.757.9858)

[Email CADD
or ProjectWise
staff](mailto:cdot@projectwise.com)

Write to us at:
CDOT CADD
Manager
CDOT Headquarters
2829 W. Howard Pl.
Denver, CO 80204

Figure 7. Image. Publicly available ProjectWise training materials: Colorado DOT.

Florida DOT

The Florida Department of Transportation was one of the early implementers of e-construction, after realizing its considerable benefits. The FDOT website contains an extensive CADD Training page that employs various training courses for programs including MicroStation, Civil 3D, OpenRoads, and other resources ([FDOT 2020](#)). The training courses include detailed PDF guides and well-organized module training videos. As illustrated in Figure 8, the video modules are organized by chapters on FDOT's YouTube channel. Each set of modules is accompanied by a PDF manual. The module organization is shown in Figure 9. While the support site is extremely

organized, the videos are generally longer than 20 minutes, with some exceeding an hour long.⁵ An FDOT CADD support team is also available to answer any employee questions, comments, or concerns.

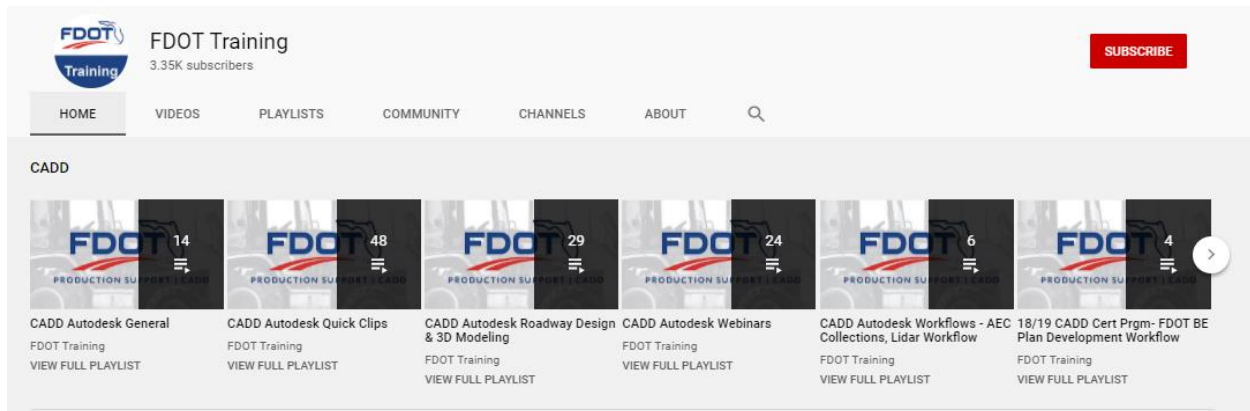


Figure 8. Image. FDOT Training YouTube channel.

Michigan DOT

Along with Florida DOT, the Michigan Department of Transportation was one of the early adopters of e-construction technology. Michigan DOT utilizes both ProjectWise and Bluebeam in their construction and engineering workflows. The Support Services page is laid out in categories that include CADD Basics, Bridge Modeling, and GIS Surveying. A specific ProjectWise Support page ([Michigan DOT 2020](#)) contains extensive contacts for help and PDF documents organized by Construction, Development, External Installation, and Local Agency, as shown in Figure 10. Michigan participated in two peer exchanges in the FHWA EDC 4 program where project collaborations for software like ProjectWise were discussed. Michigan DOT also stresses the importance of employee involvement in e-construction ideas, implementation, and innovations.

⁵ When developing GDOT video modules, it will be beneficial to keep videos to a shorter length and each to a specific topic.

Documentation	
File	Updated Date
Training Guide	09/26/2018
Dataset	09/26/2018

Videos	
Title	Updated Date
Module 1 of 15: Chapter 1 - Introduction and Design Files	04/26/2019
Module 2 of 15: Chapter 2 - Design Environment	04/26/2019
Module 3 of 15: Chapter 3 - Viewing and Zooming	04/26/2019
Module 4 of 15: Chapter 4 - Models	04/26/2019
Module 5 of 15: Chapter 5 - Levels	04/26/2019
Module 6 of 15: Chapter 6 - Basics Drawing Tools	04/26/2019
Module 7 of 15: Chapter 7 - Drawing with Precision	04/26/2019
Module 8 of 15: Chapter 8 - Changing Elements	04/26/2019
Module 9 of 15: Chapter 9 Selecting & Grouping	04/26/2019
Module 10 of 15: Chapter 10 - Drawing Annotation	04/26/2019
Module 11 of 15: Chapter 11 - Cells & Points	04/26/2019
Module 12 of 15: Chapter 12 - Patterning & Hatching	04/26/2019
Module 13 of 15: Chapter 13 - Dimensions	04/26/2019
Module 14 of 15: Chapter 14 - Information & Measuring Tools	04/26/2019
Module 15 of 15: Chapter 15 - Reference Files	04/26/2019

Figure 9. Image. Florida DOT training module organization.

ProjectWise Support

ProjectWise is MDOT's electronic document tool used by both internal MDOT staff and external partners for managing documentation for design/construction projects as well as many other non-project related MDOT processes. The use of ProjectWise for doing business with MDOT requires software installation and username/password login credentials.

The drop-down menu selections below include ProjectWise user documentation, installation files and training information for both external partners and MDOT staff.

If you need assistance or have questions, please contact one of the following resources:

- ProjectWise Construction related issues contact: MDOT-ProjectWiseConst@michigan.gov
- ProjectWise Consultant related issues contact: MDOT-ProjectWiseConsultant@michigan.gov
- ProjectWise Local Agency related issues contact: MDOT-ProjectWiseLocalAgency@michigan.gov
- MDOT Development Guide: http://mdotwiki.state.mi.us/design/index.php/Main_Page
- MDOT Construction Manual: http://mdotwiki.state.mi.us/construction/index.php/Main_Page
- MDOT DocuSign: [e-Signature Information](#) Contact: MDOT-eSign@michigan.gov

Figure 10. Image. Michigan DOT ProjectWise Support page.

Missouri DOT

The Missouri Department of Transportation (MoDOT) contains a well-presented CADD Support page, shown in figure 11, for ProjectWise, GEOPAK, Microstation, and ArcGIS training ([MoDOT](#)

2020). The Support site uses a variety of training materials such as videos, PDF files, PowerPoint presentations, and web pages. The ProjectWise training material contains a ProjectWise manual, Contract Plans Information, Miscellaneous Information, and Signing and Sealing. The three categories contain primarily PDF manuals and two webpages for “File Naming Convention for Contract Plan Drawings” and “File Naming Convention for Addendums or Revision Sheets.”



Figure 11. Image. Missouri DOT CADD Services Support page layout.

Pennsylvania DOT

The Pennsylvania Department of Transportation has been a leader in e-construction development. The Pennsylvania State Transportation Innovation Council is a large proponent of the FHWA EDC initiative and facilitates the implementation of new technologies at PennDOT. The STIC conducted a study to investigate the level of preparedness for e-construction implementation where a majority of respondents identified online training and statewide guidance and standards as the most desired support tools (Kirkpatrick 2020). PennDOT maintains an Online Services page where most resources require a business partner or employee login. A technical training calendar for

business partners and employees is also used, as shown in Figure 12 for the month of November 2020. The training calendar contains instructor-led courses on an extensive variety of topics, including Construction Management, Highway Design, Information Technology, and Project Management. Employees have “training coordinators” that help employees track training progress and goals.

Utah DOT

The Utah Department of Transportation (UDOT) website contains a wealth of video resources pertaining to Digital Delivery, Workspace Modification, Display Rules, and Miscellaneous topics, as shown in Figure 13. The videos are organized into “Parts” where the first part contains basics and terminologies followed by more in-depth discussions. The UDOT website also contains Project Management Training that provides tools, resources, and training for UDOT project teams. A portion of the training was created on Issuu Inc., an electronic publishing platform that enables creators of publications to digitally share materials. UDOT currently has webpages under construction with digital delivery information on roadway, structures, and drainage and utility design (UDOT 2020).

November 2020						
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
26	27	28	29	30	31	1
	Advanced Highway Des... Day 3 of 4 Bridge Inspection Re... Day 1 of 3 Open Roads Designer ... Day 2 of 2 Open Roads Designer ... Day 2 of 5 PennDOTs Bridge Safe... Day 10 of 14 Reinforced Concrete ... Day 1 of 1 Reinforced Concrete ... Day 1 of 1 Ultrasonic Testing -... Day 2 of 5	Advanced Highway Des... Day 4 of 4 Asbestos Building In... Day 1 of 1 Bridge Inspection Re... Day 2 of 3 Open Roads Designer ... Day 3 of 5 Ultrasonic Testing -... Day 3 of 5	Bridge Inspection Re... Day 3 of 3 Open Roads Designer ... Day 4 of 5 PennDOT Assistant Hi... Day 5 of 5 PennDOT Bridge Inspe... Day 1 of 4 PennDOTs Bridge Safe... Day 11 of 14 Ultrasonic Testing -... Day 4 of 5	PennDOT Bridge Inspe... Day 2 of 4 PennDOTs Bridge Safe... Day 12 of 14 Ultrasonic Testing -... Day 5 of 5		
2	3	4	5	6	7	8
Open Roads Designer ... Day 1 of 2 PennDOT Bridge Inspe... Day 3 of 4 PennDOTs Bridge Safe... Day 13 of 14 Proprietary Traffic ... Day 1 of 4	Bridge Inspection Re... Day 1 of 3 Open Roads Designer ... Day 2 of 2 PennDOT Bridge Inspe... Day 4 of 4 PennDOTs Bridge Safe... Day 14 of 14 Proprietary Traffic ... Day 2 of 4	Bridge Inspection Re... Day 2 of 3 HAZMAT General Aware... Day 1 of 1 Proprietary Traffic ... Day 3 of 4	Bridge Inspection Re... Day 3 of 3 HAZMAT General Aware... Day 1 of 1 Open Roads Designer ... Day 5 of 5 Proprietary Traffic ... Day 4 of 4			
9	10	11	12	13	14	15
Open Roads Designer ... Day 1 of 5	Open Roads Designer ... Day 2 of 5		Constructability and... Day 1 of 3 Open Roads Designer ... Day 3 of 5	Open Roads Designer ... Day 4 of 5		

Figure 12. Image. Snapshot of PennDOT training calendar.



Figure 13. Image. Utah DOT Training and Support videos.

Noteworthy Training Practices

The most important training practice discussed by various DOTs was the dedication of an e-construction support team that assists employees with the implementation and development of e-construction technologies and training materials. Alabama DOT created an e-construction engineer position within its Construction Bureau to accelerate the advancement of digital solutions and oversee all e-construction initiatives. The Ohio Facilities Construction Commission (OFCC) dedicated five to seven full-time equivalents that provide end-user support and training for Primavera Unifier. Colorado DOT created a group called “The Core 5” consisting of four volunteers and one full-time employee specifically hired to lead e-construction efforts. Michigan DOT, a leader in e-construction development, created a mobile computing development team that develops applications to enhance user experience. Virginia DOT established a small team to oversee e-construction initiatives. Regardless of training material type, a dedicated e-construction support team helps facilitate the implementation of e-construction technologies.

The most common publicly available training materials for state DOTs are PDF manuals or guides. Other training techniques included module or chapter videos created on various platforms, PowerPoint presentations, classes or webinars, and a combination of two or more

methods. While general training was offered, many state DOTs' resources pertained to their specific workflows/systems. The following optimum online training practices were examined when developing GDOT training materials for ProjectWise, Bluebeam, and CATS:

- Short (<10 min) and relevant videos with a specific topic focus.
- Adobe Captivate, SCORM 1.2 compliant.
- Topics well-organized into chapters/parts and easily accessible and navigated (on-demand).
- Accompanying manual/PDF that outlines video discussions.
- Implementation and support of an e-construction support team/staff with the highest knowledge of software and e-construction practices to facilitate training/implementation.⁶
- Some form of accountability with the training i.e., certifications/assessments.
- Training progress easily tracked.
- The need to hear from field staff when generating material and to understand user-specific needs.

With an understanding of national and state DOT training methods established, the following section of the literature review aimed to investigate commercial training material offered by Bentley and Bluebeam.

COMMERCIAL TRAINING MATERIALS

The second task of the literature review was to investigate commercially available training materials. Because CATS was developed in-house by GDOT, the review focused on Bluebeam and Bentley ProjectWise materials.

⁶ This involved close collaboration with the GDOT project advisory group and the Office of IT.

Bluebeam Training

The Bluebeam website offers self-guided training courses (sign-up required; Bluebeam 2022b), instructor-led training courses for a team, scheduled webinars, and a series of free training videos covering the topics shown in figure 14. The training videos outline key Bluebeam features; are generally 2–5 minutes in length; and apply to Revu 20, Revu 2019, and Revu 2018 ([Bluebeam 2020](#)). Each video depicts a clear picture of a Bluebeam screen with varying voiceovers describing step-by-step actions and processes of the video topic. The training videos follow a slow to moderate pace and are easily understood. Bluebeam training videos that relate to existing GDOT Bluebeam training PDFs include Digital Signatures/Certifications, Markup Tools, and Flattening Tools. The free training videos offered by Bluebeam provide a valuable reference for basic Bluebeam features and capabilities.

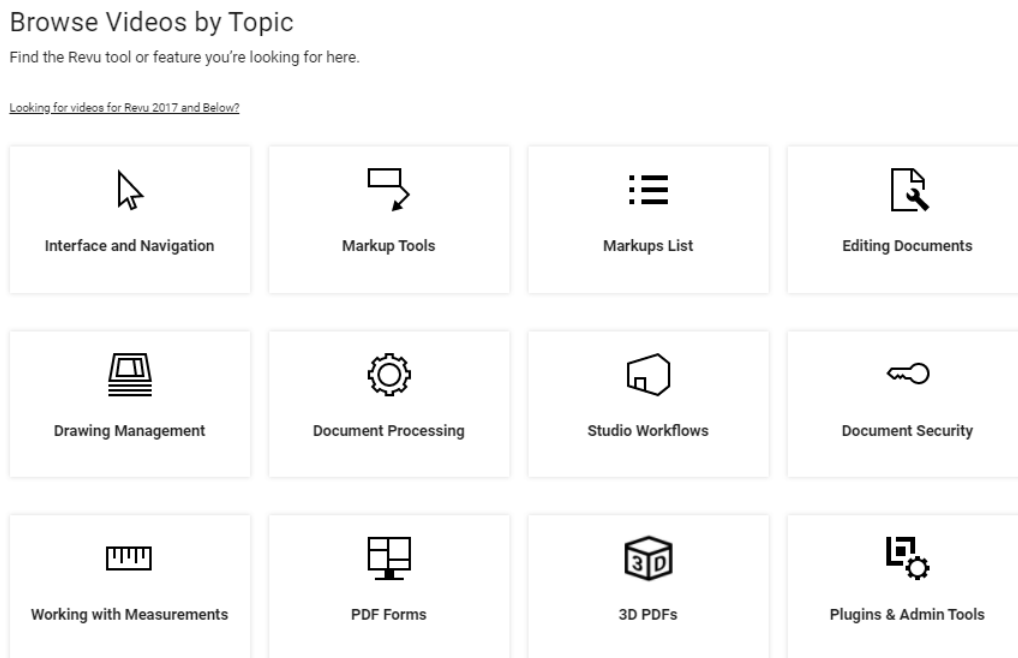


Figure 14. Image. Bluebeam free online training videos.

While the free training videos offer simple demonstrations for many Bluebeam features, more-involved self-guided training courses are available through the Bluebeam University. The Bluebeam University is a self-paced Revu training program available in various formats. The coursework contains step-by-step videos, interactive exercises, quick quizzes, and a certificate of completion after the course has been mastered. While all the coursework contained in Bluebeam University is completed through a web-based interface, there are numerous downloadable exercises that are completed using Bluebeam. To receive a completion certificate, the user must click through each lesson in the course and pass the final test at the end. Once the test is passed, a certificate is awarded. The “BBU Power Pack” is a comprehensive package that covers tools and features in Revu 2018, Revu 2019, and Revu 20. An alternative pack available covers just Revu basics and is available for yearly access. Additional courses include Drawing Management, Field Issues, Measurements Takeoffs and Estimation, and Building Project Dashboards. These courses are incorporated in the BBU Power Pack. Once payment is processed (\$249 for a year of access), the user logs in and begins the coursework ([Bluebeam 2020](#)).

Instructor-led training is also available for essential Revu features and workflows by utilizing the knowledge of Bluebeam trainers. The Revu Fundamentals Bundle identifies key features and workflows, including Revu and Studio Essentials, Quality Takeoff, and Drawing Management, taught over two days. An online option and an in-person option are available. Individual courses are also available and include Revu Essentials (online or in-person), Studio Essentials (online only), and Revu for iPad (in-person only).

Finally, Bluebeam Certified Instructor Training is offered to accelerate company-wide software implementation by providing ready-to-deliver Bluebeam Certified Training (BCT) courses. The training is specifically for Bluebeam Certified Instructors (BCIs). Individuals that

should attend include corporate trainers leading Bluebeam training within their organizations; trainers responsible for training project teams, subcontractors, or employees; and trainers providing Revu training to members of the industry or similar associations. The curriculum is given over three days. Day one is Bluebeam Trainer Basics, day two is Training Bluebeam Revu (Part 1), and day three is Training Bluebeam Revu (Part 2).

Bentley ProjectWise Training

The Bentley Institute provides a wide variety of learning and training programs for all types of schedules and budgets ([Bentley Systems 2020](#)). Training options available include virtual classrooms, local classrooms, on-demand courses, Bentley Institute User Group Program, webinars, Bentley Institute Press Books, and Bentley Communities. PDHs are awarded by the Bentley Institute for each completed course. Team learning reports and individual transcripts are reported to help track training progress and calculate return on investment.

With a Bentley login, users are able to access Bentley Institute's LEARNserver that provides on-demand training courses presented in "learning paths" for a wide variety of software types. The ProjectWise training is organized by edition (i.e., Connect or V8i) and level of training (i.e., fundamental, intermediate, and advanced). The training consists of 18 fundamental learning paths, 11 intermediate learning paths, and 6 advanced learning paths, all shown in figure 15.

Bentley LEARNserver ProjectWise Learning Paths

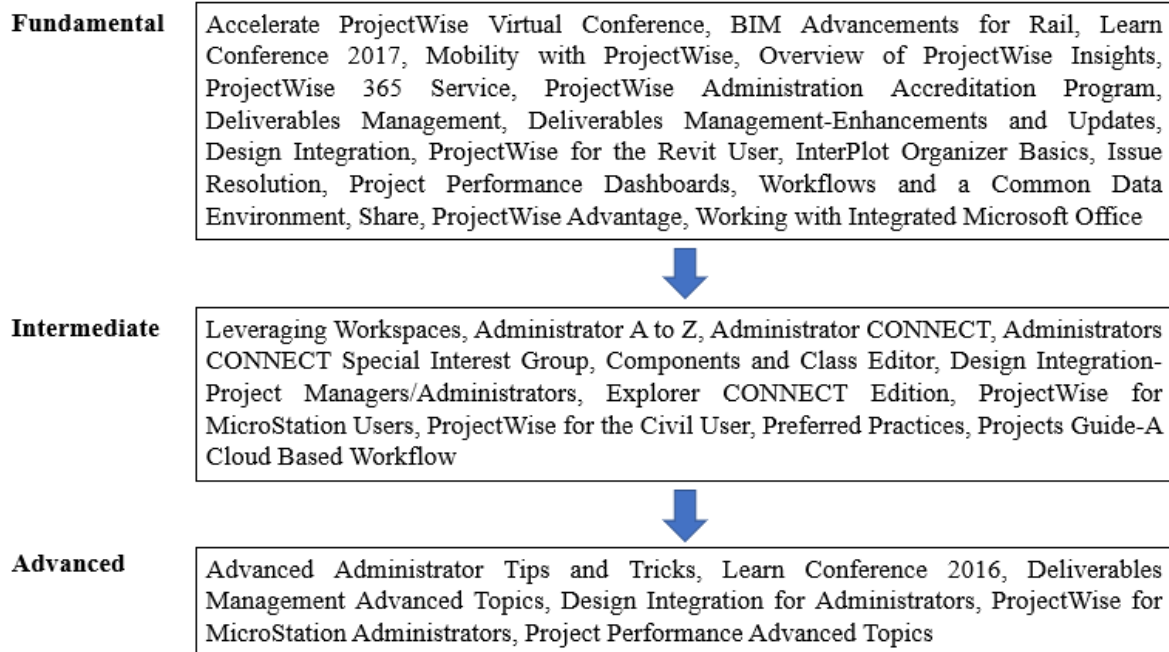


Figure 15. Image. Bentley ProjectWise on-demand training courses.

Each learning path contains lecture videos of varying lengths that cover specific topics of the path, some more extensive than others. For example, the “ProjectWise Deliverables Management” fundamental learning path is shown in figure 16.

	Title	Language	Generation	Release Detail	Type	Duration	Status	Launch
▼	1 An Overview and Getting Started	English	CONNECT Edition					
	What is ProjectWise Deliverables Management?				Lecture	1m	🔒	Launch
	How Do I Get Started with ProjectWise Deliverables Management?				Lecture	1m	🔒	Launch
▼	2 How Do I Use It?	English	CONNECT Edition					
	Working Through ProjectWise Explorer				Lecture	2m	🔒	Launch
	Working Through the Cloud				Lecture	2m	🔒	Launch
	Creating & Sending a Transmittal				Lecture	2m	🔒	Launch
	Adding Team Members				Lecture	1m	🔒	Launch
	Adding External Participants				Lecture	1m	🔒	Launch
	Working with RFIs				Lecture	1m	🔒	Launch
	Receiving & Responding to a Submittal				Lecture	2m	🔒	Launch
	Viewing Package Responses				Lecture	1m	🔒	Launch
	Rejecting Deliverables				Lecture	3m	🔒	Launch
	Creating & Responding to General Correspondence				Lecture	3m	🔒	Launch
	2D and 3D Design Review				Lecture	49m	🔒	Launch
▼	3 How Do I Set It Up?	English	CONNECT Edition					
	Registering a CONNECTED Project				Lecture	1m	🔒	Launch
	Enabling Deliverables Management for Your Project				Lecture	27s	🔒	Launch
	How to Set Up Deliverables Management Settings				Lecture	12m	🔒	Launch
	Configuring Your Project in ProjectWise				Lecture	1m	🔒	Launch
▼	4 Where Can I Apply a Document Distribution Matrix?	English	CONNECT Edition					
	Document Distribution Functionality				Lecture	4m	🔒	Launch
	Ensuring a Valid Matrix				Lecture	3m	🔒	Launch
	Populating the Template				Lecture	6m	🔒	Launch
	Applying a Matrix				Lecture	6m	🔒	Launch
	Upload and Validation				Lecture	3m	🔒	Launch
	See a Package with a Matrix Applied				Lecture	4m	🔒	Launch
▼	5 How do I get insight into my Project Deliverables?	English	CONNECT Edition					
	Deliverables Management Dashboard				Lecture	1h 1m	🔒	Launch
	ProjectWise Project Insights Update1 Release Overview				Lecture	21m	🔒	Launch

Figure 16. Image. Bentley ProjectWise learning path: Deliverables Management.

Each lecture video contains a walkthrough of the topic focus with a clear and easy-to-follow video voiceover, similar to the Bluebeam videos. The lecture videos are accompanied by a course details section where “skills taught” are listed out in bullet-point form, along with any course prerequisites needed for the video. The bullet-point list offers a quick overview of the topics outlined in the video. Other learning paths such as the fundamental “ProjectWise Virtual Bentley Institute Learn Conference” contain recorded PowerPoint presentations that cover more broad topics, such as an introduction to “ProjectWise Connection Services” and “Supporting the Transition to a Hosted ProjectWise Environment.” While many of these courses have an

underwhelming number of views, indicating the resources may not be well-known by DOTs or other user groups, they offer a valuable resource for users of various experience levels.

Bentley Communities offer an opportunity to connect with industry peers and Bentley software experts to assist with various software questions. The ProjectWise community offers tips, product support, best practices, advice, and an easy way to query for a variety of ProjectWise topics. The community is split into smaller subcommunities—Content Management, Content Publishing, Project Review, and ProjectWise Deliverables Management—to provide more specific help. On some occasions, DOT agencies will partner with Bentley and/or Bluebeam to create training programs, while others will contract with external partners to produce training that is workflow-specific. The latter is generally more effective for DOT employees.⁷ After investigating Bluebeam and Bentley materials, additional optimum training methods were added to the list previously discussed:

- Bluebeam quick quizzes and/or certificates of completion for courses.
- Bluebeam video topics.
- Bentley level of training (i.e., fundamental, intermediate, advanced).
- Bentley learning path organizational structure.
- Bentley videos accompanied with bullet-point list of topics and video prerequisites.

LITERATURE REVIEW SUMMARY

This literature review investigated national e-construction efforts and training resources with a focus on the FHWA, individual state DOT methods concerning e-construction and e-construction training, and commercially available training resources pertaining to ProjectWise and Bluebeam.

⁷ Correspondence from Francesca Maier, “Re: State DOT Training Implementation for e-Construction Software,” received by Will Shirley, July 11, 2020.

The FHWA contains a wealth of resources, such as the Every Day Counts initiative, for state DOTs when tackling the challenge of implementing e-construction technologies. Additional national organizations, including AASHTO and the TC3, offer state DOTs e-construction training guidelines and resources. When developing new training, it is important for the material to be self-directed, relevant, task-oriented, and contain a clear benefit. State DOTs across the country have implemented a wide variety of e-construction technologies and training practices. Various states, including Florida, Colorado, Pennsylvania, Utah, Missouri, and Michigan, have paved the way for e-construction advancement and maintain a wealth of e-construction software-related training resources. The most noteworthy training practices included short and relevant video modules with a specific topic focus, well-organized training topics that are easily accessible/navigated, accompanying manual/PDF with video training, and training that is workflow-specific to DOT needs. Finally, Bluebeam and Bentley provide users with a wide variety of training material that offers a general overview of software functions and tools but does not pertain specifically to DOT workflows and functions. However, Bentley and Bluebeam both contain effective training methods that include short, specific video modules; tiered learning for multiple experience levels; and learning path organization methods. Following the literature review, the goals for the new training program were specifically outlined to better understand the impact of the new training on the Office of Construction.

CHAPTER 4. PROBLEM STATEMENT

RESEARCH OBJECTIVES

This research aimed to develop a robust training program to assist GDOT staff in learning and fully implementing agency-wide software programs. The training programs were modeled after a successful GDOT project (RP 17-18; [Kim, Durham, and Chorzepa 2020](#)) to develop online learning modules for pavement design AASHTOWare PavementME software. Specifically, the research objective was to create online training modules for ProjectWise, Bluebeam, and CATS. Along with being SCORM 1.2-compliant, the module development used Adobe Captivate to create the eLearning video training material. The modules are expected to enhance the usage and understanding of the three programs within the GDOT Construction Office.

The research provided a summary of e-construction training methods at the national and state DOT levels, commercially available training programs for ProjectWise and Bluebeam, and an overview of GDOT's existing training methods and capabilities. To more completely understand GDOT's needs, a survey was conducted to provide different GDOT construction perspectives of the three programs. Secondly, meetings with various GDOT construction personnel were held to understand the use, implementation, and challenges with ProjectWise, Bluebeam, and CATS that were then addressed when creating the training modules. Following the survey and meeting period, a working list of training material was developed from the combined feedback. Once the final list of training topics was confirmed, the training material for Bluebeam, ProjectWise, and CATS was created, which included a blend of video demonstrations, interactive software simulations, and PDF go-by documents. The objective of the new material was to create more engaging, interactive, and relevant material that GDOT construction employees and consultants could reference, regardless of experience level.

Additionally, the research critically examines the content of GDOT's *Construction Manual* as related to e-construction tools and technologies. GDOT's *Construction Manual* was reviewed with respect to capabilities offered in e-construction software tools, specifically, ProjectWise, Bluebeam, and CATS. Knowledge mapping was conducted to establish links between various phases and processes in GDOT's *Construction Manual*, and capabilities and functionalities were ultimately mapped via workflow models and flowcharts.

RESEARCH SIGNIFICANCE

With the benefits of increased efficiency, cost savings, and time savings, one of the largest challenges in successfully implementing an e-construction program is the training required for new software. While a large amount of national and commercial training material is available for e-construction software, it is not tailored specifically to GDOT needs. Several e-construction challenges were identified in RP 17-13 pertaining to ProjectWise, Bluebeam, and CATS. Lack of training, inadequate knowledge, and inability to use the software to its full capacity were three of the main challenges GDOT employees face. The training programs created fill GDOT's training void and increase employee knowledge and understanding of the programs to maximize their capabilities. The programs provide on-demand training for GDOT employees of varying experience levels that they can access and reference at their own pace. Additionally, the training programs provide several types of material for the user to interact with, including PDF reference guides, video demonstrations, and interactive software simulations that allow the user to actively engage with the material. Increased understanding of the programs will result in higher efficiency and resource, time, and cost savings for the Department.

CHAPTER 5. RESEARCH METHODOLOGY

A complete e-construction training program involves on-demand, innovative, and well-organized training material that is specific to DOT workflows and practices. Following the extensive background and literature review, the research methodology was clearly defined through five main components:

1. A survey questionnaire distributed to Construction Office personnel.
2. Subsequent GDOT meetings with construction personnel.
3. Training topic development.
4. Module development, review, and confirmation.
5. Collaboration with IT.

A preliminary review involved meeting with the Office of Construction project advisory group on January 7, 2021. The project advisory group includes GDOT State Construction Engineer John Hancock, Assistant State Construction Engineer Beau Quarles, and Research Engineer Brennan Roney. The goal of the meeting was to discuss ProjectWise, Bluebeam, and CATS uses and training challenges, along with determining the need for subsequent meetings with GDOT offices and districts. A survey was developed to obtain feedback from a wide variety of GDOT construction offices and districts concerning the program's existing processes and challenges, along with various challenges associated with the GDOT *Construction Manual*. The primary focus of the research study was the development of training material for ProjectWise, Bluebeam, and CATS, while a separate but parallel study focused on updating the GDOT *Construction Manual*. Following a highly successful response rate to the survey, subsequent meetings with GDOT construction personnel were conducted to elaborate on the survey results and understand more

completely the ultimate goal for the new training. Finally, a meeting was held with the GDOT IT department to understand training branding and guidelines. Following the meeting, communication continued with IT to format and post the training material to locations specified by the project advisory group. After the meetings and survey analysis, a working list of training material for ProjectWise, Bluebeam, and CATS was developed. The complete list of findings from the research methodology is found in chapter 6.

PRELIMINARY REVIEW

In order to understand fully the goal and purpose of implementing new training for ProjectWise, Bluebeam, and CATS, an initial meeting was held with the project advisory group. Although background information acquired from RP 17-13 discussed the use and challenges of the three programs across GDOT, existing uses, process, and challenges associated with the three programs needed further investigation. The remainder of this section provides an overview of the meeting minutes.

Except for a few select old projects, ProjectWise and Bluebeam are currently used for all GDOT projects, with ProjectWise being pushed as a requirement. Use of Bluebeam and ProjectWise directly coincides across offices. A project advisory group member mentioned an in-house survey conducted about a year ago with the GDOT districts that found an approximate 80.00 percent usage rate for ProjectWise. Additionally, the project advisory group discussed how offices are becoming more comfortable with ProjectWise as they use it more and adjust accordingly. Even with an increase in use of the programs, minimal regular training occurs in the office. Instead, training is primarily performed as needed and by a construction manager. All ProjectWise training is managed through the Design Policy and Support Office, which conducted initial training for ProjectWise; unless the office receives a request, no training is conducted.

Currently, there is no formal training for Bluebeam and ProjectWise. Concerning CATS, the project advisory group discussed that the state construction team conducts training for the in-house software every quarter or half year and when a need rises.

The goal of the new training modules is to provide more formalized, detailed, and on-demand training for the three programs in question. The new training will aim to contain more details that are specific to the activities/actions that individuals complete on a regular basis. Another goal of the new training is to add more interactive elements. A majority of the current training (i.e., for ProjectWise) is simple PDFs with step-by-step instructions. By producing new training that is more interactive, users will more completely digest the content, which will result in more efficient use of the software. The focus of the new training should contain content supporting construction and district engineers, but the project advisory group indicated that obtaining perspectives from other offices would prove beneficial. Furthermore, the current ProjectWise training material was discussed. The current material required review and evaluation for updates. The following questions concerning the ProjectWise material were discussed in the meeting:

- What topic only needs a PDF outline/description/step-by-step instruction?
- What topic calls for a video tutorial?
- What topic needs both a PDF outline and video tutorial?

While some software topics/features are simple and do not require a video tutorial, other more extensive features may require both. Finally, the project advisory group mentioned a certificate/assessment is not important for the new training modules. Alternatively, it is important for the new training to be on-demand and readily available for construction staff across the state, depending on individual needs and learning preferences.

GDOT DISTRICT CONSTRUCTION SURVEY

Overview

A survey was conducted to obtain a variety of GDOT personnel perspectives on the processes and challenges with ProjectWise, Bluebeam, CATS, and the *Construction Manual*. The survey was conducted among GDOT's District construction personnel. The goal of the survey was to provide GDOT personnel a chance to voice their concerns with the three programs and the *Construction Manual* without having to conduct a formal meeting. Combined with additional feedback, the survey results were used to develop training material that more completely addressed GDOT challenges.

Survey Development and Distribution

The content of the survey questionnaire is presented in the appendix. The web-based application Qualtrics was used to develop the survey and document and analyze responses. The survey was divided into five blocks of questions, with a total of 17 questions. The blocks of questions were categorized as follows:

1. **General Information.** This block collected contact information plus three questions covering general use of the three software programs and the confidence level of the respondent with using the programs.
2. **Training Information.** The second block also included three questions to gauge what type of training occurs in the respondent's office, how often training occurs, and which of the three software programs the respondent feels is in most need of new training.
3. **ProjectWise, Bluebeam, and CATS Challenges.** The third block provided the most important feedback of the questionnaire and consisted of five questions aiming to

understand more completely the challenges facing GDOT concerning the three programs, along with what they are looking for in the new training material.

4. ***Construction Manual Use.*** The remainder of the survey focused on the GDOT *Construction Manual*. This block consisted of only one question, intended to weed out respondents who do not use the manual prior to the questions in block 5. If “never” was selected as the answer, the survey ended.
5. ***Construction Manual Challenges.*** The final block in the survey consisted of five questions that focused on missing elements in the *Construction Manual* and how it can be improved, which is the main focus of the separate study mentioned previously.

On January 25, 2021, the survey link was provided to the project advisory group, who proceeded to distribute the survey to GDOT district construction managers (CMs). In order to obtain additional survey responses, the CMs sent the survey to their respective staff. The results of the survey are presented in chapter 6, specifically in Survey Main Takeaways.

GDOT MEETINGS

A meeting was held on February 26, 2021, with the Office of Construction to discuss the survey results and the next steps. Following the presentation of the survey results and main takeaways, the project advisory group was asked to compile a list of GDOT construction personnel, focusing on District 1, whom they felt would be beneficial to meet with and discuss software and *Construction Manual* challenges more extensively. Additionally, it was requested that the survey results presentation be shared with district engineers and managers so they could reach out with any additional feedback and/or questions. The project advisory group provided a list of five individuals to speak with: three managers from District 1 and two managers from District 2.

Table 2 provides a complete list of the GDOT meetings. Chapter 6 provides the key takeaways from the meetings.

Table 2. GDOT meetings.

GDOT Meetings	
Office/District	Date
State Construction	2/26/2021
D1 Construction	3/18/2021
D2 Construction	3/25/2021
D1 and D2 CMs and Inspectors	4/14-15/2021
State Construction	5/5/2021
IT	5/13/2021

District 1 Construction Meeting

A meeting was held with District 1 personnel on March 18, 2021, to discuss in more detail ProjectWise, Bluebeam, and CATS challenges, along with specific goals for the new training modules. Before discussing new training material, the critical software challenges ascertained from the survey were presented and discussed with District 1 personnel in order to gain their unique perspective on the challenges. Specifically concerning ProjectWise, the file naming system and file navigation were discussed in detail. Regarding Bluebeam, the primary challenge discussed was becoming accustomed to the Bluebeam interface, along with learning the most efficient tools to edit or markup documents. Finally, the primary challenge discussed concerning CATS was the software not allowing users to go back/send back documents or processes once they are started.

The second half of the meeting focused on the goals of the new training and *Construction Manual* updates. Keeping in mind the general objective to develop more interactive, organized, and formal training with a blend of both general and construction-specific information, the research team’s goal of meeting with District 1 personnel was to understand more specifically their expectations with the new training and how to effectively build the material around their needs.

Additionally, a sample video demo was presented to the District 1 personnel to obtain their feedback and suggestions with the format of the demo.

District 2 Construction Meeting

Following the District 1 meeting, a meeting was held with District 2 personnel on March 25, 2021, to discuss in more detail ProjectWise, Bluebeam, and CATS challenges, along with specific goals for the new training program. The meeting followed a similar format to the meeting with District 1 personnel. Critical challenges for District 2 personnel concerning the three programs were first discussed, including the ProjectWise naming system and Deliverables Management, the experience-level gap with Bluebeam users, and accessing project information in CATS.

The second portion of the meeting focused on new training and *Construction Manual* update goals. Similar to the District 1 meeting, the goal of meeting with District 2 personnel was to understand more specifically their expectations with the new training and how to effectively build the material around their needs. Additionally, a sample interactive module (building from the video demo presented to District 1) was shared with the District 2 personnel to collect their feedback and suggestions with the format of the module.

Construction Managers and Inspectors Meeting

Following the meetings with district and area managers, additional meetings were held to gain the perspective of construction managers and inspectors concerning software challenges and potential new training topics, along with *Construction Manual* updates. Two meetings were conducted with two consultants and three construction managers on April 14 and 15, 2021. Similar to the District 1 and 2 manager meetings, specific challenges with the three programs were discussed first. Following the discussion of software challenges, the specific topic areas and goals for new training

were further discussed. Results of these meetings are discussed in Construction Managers and Inspectors Meeting Takeaways in chapter 6.

MODULE DEVELOPMENT STRATEGY

This section clearly outlines the module development, review, and confirmation process. The training program development process began with a video outline where the learning outcomes and goals were clearly defined. Next, the video script was outlined and recorded. The video script was then used to record the video demo in Adobe Captivate, with special attention given to the recording time and pace. Following the completion of the video demo, the audio was uploaded into Adobe Captivate where it was edited through a noise reduction process. Additionally, animations were added to the video demo through Adobe Captivate features in the form of text, shape, and object callouts that aimed to enhance the user's engagement with the material. The process for the video demo development is shown in Figure 17.

If a PDF go-by document was required for the topic, it was developed following the completion of the video demo. The PDF go-by documents follow along with the video demos and contain descriptions and screenshots directly from the demo. Screenshots from the video demo were added to show the locations of tools, action box items, and additional software features discussed in the video demos. Various callouts, numbered step-by-step instructions, and additional information were added to the screenshots to complete the PDF documents. After being developed and edited in Microsoft Word, the guides were saved as PDF documents. The process for the PDF training guide development is shown in Figure 18.

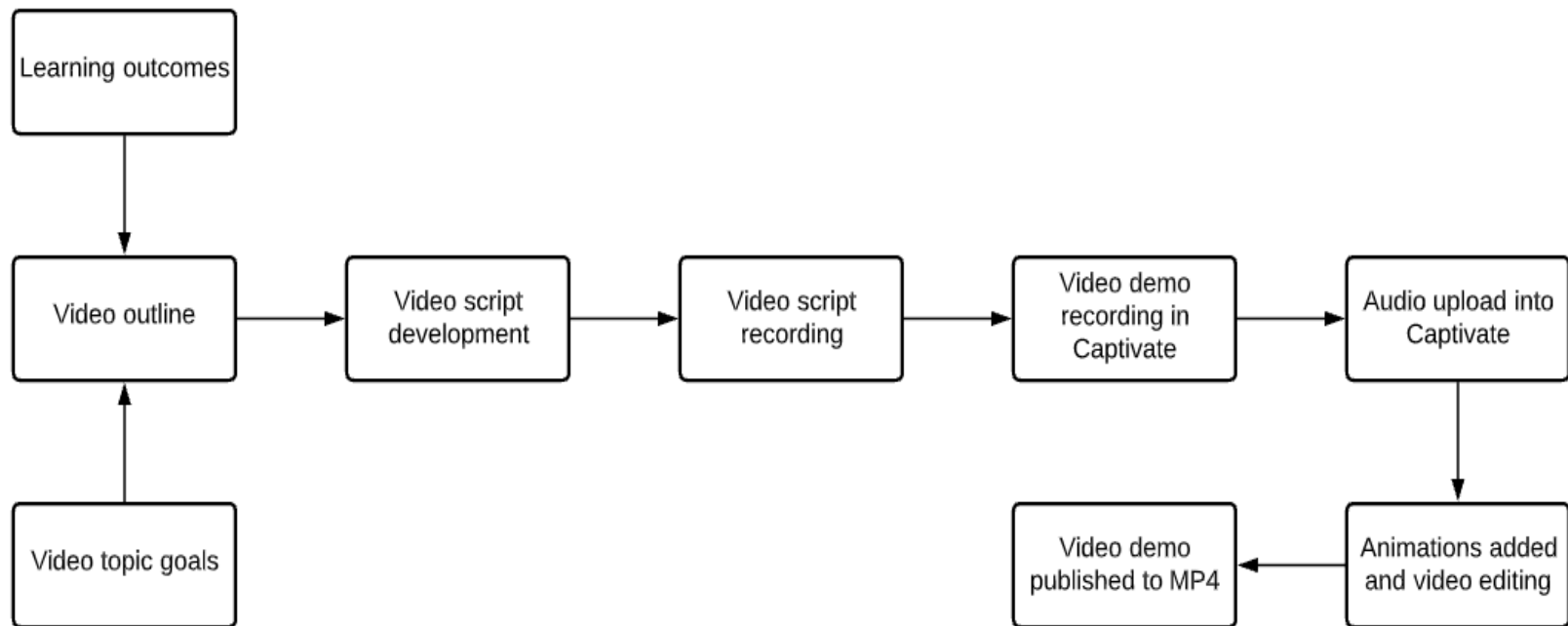


Figure 17. Flowchart. Video demo creation process.

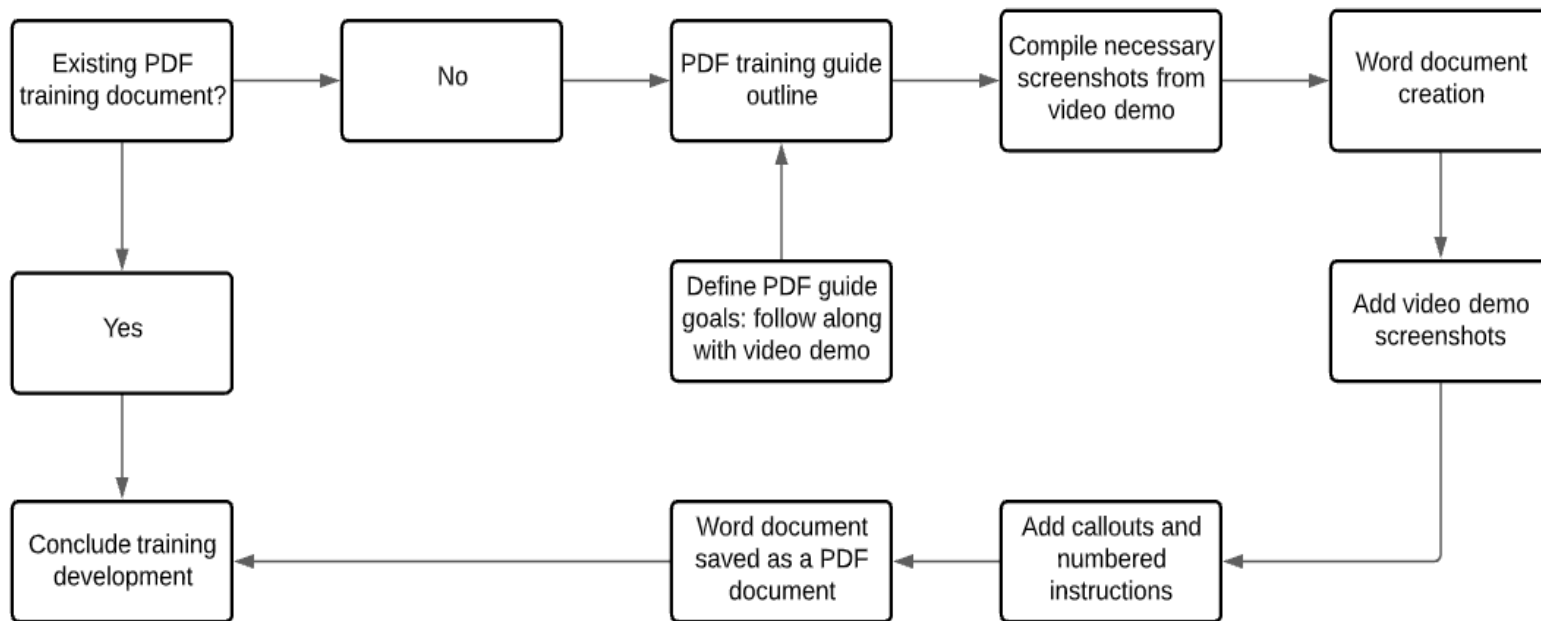


Figure 18. Flowchart. PDF training document creation process.

Finally, if an interactive module was required for the topic, a software simulation was recorded in Adobe Captivate. The software simulation follows similar, slightly simplified software actions outlined in the video demo. Similar to the video demo, the software simulation was edited in Adobe Captivate, where audio was added along with various on-screen prompts that direct the user through the training. The process for the interactive module development is shown in Figure 19.

Following the completion of the module development, the material was sent to the project advisory group for review. Upon receiving feedback, the material was updated accordingly and sent to the Office of IT for an additional review and format check. Collaboration with IT personnel was critical in the confirmation and posting of the training material.

LEARNING OUTCOME ASSESSMENT

As part of the e-learning training program development, learning outcome assessment options and recommendations were investigated. The goal of this investigation was to clearly understand how the training programs enhance user understanding or achievement in their profession, along with how to assess this achievement/improvement. As noted later in this section, multiple articles published in the *Journal of Engineering Education* (JEE) by the American Society for Engineering Education (ASEE) were reviewed to understand how to measure the success of the ProjectWise, Bluebeam, and CATS e-learning training programs. The features outlined in this investigation were incorporated into the training programs throughout the development process.

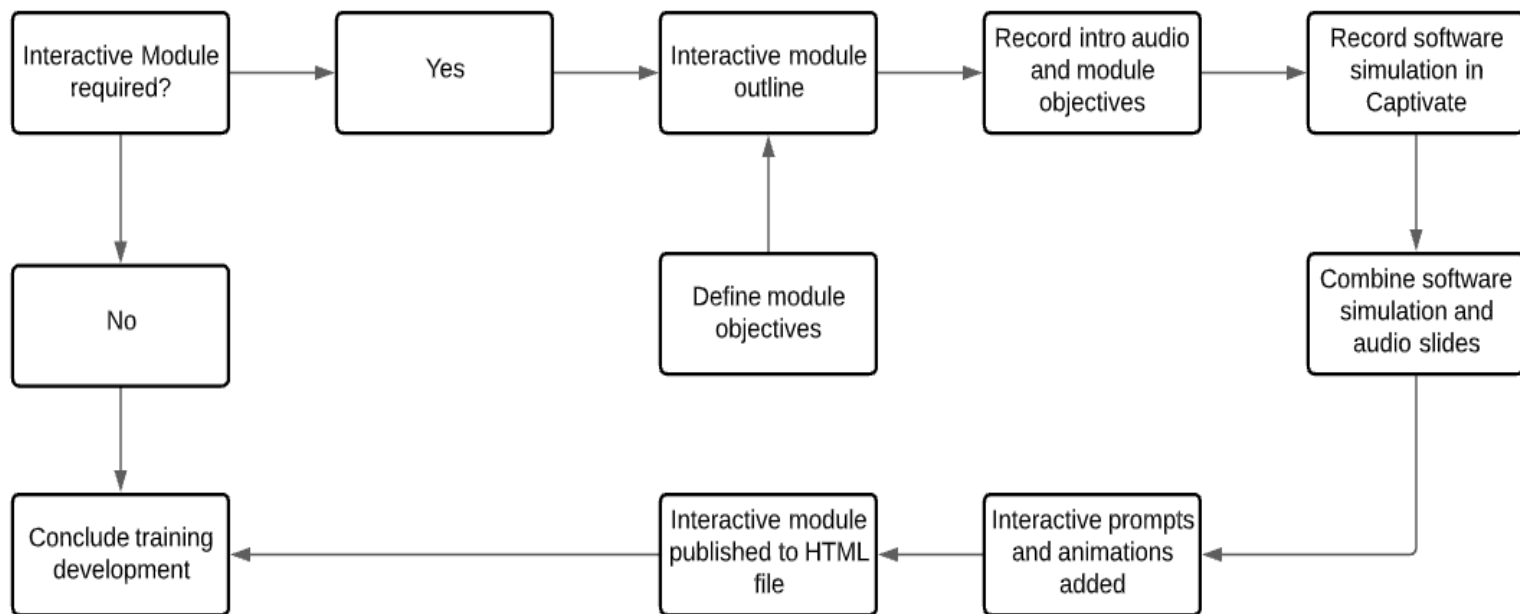


Figure 19. Flowchart. Interactive module creation process.

The training program development followed a competency-based learning (CBL) approach. CBL is defined as a “pedagogical approach that focuses on the mastery of measurable student outcomes” ([Henri, Johnson, and Nepal 2017](#)) which allows students or learners to progress through material at their own pace, making it ideal for an online environment. The training programs follow this approach through beginner and advanced topics that allow users to master basic topics before moving on to more advanced software features. While the training is designed to be asynchronous, various advanced topics require existing knowledge of the software outlined in the beginner topics. In addition to setting the learner’s own pace, the CBL strategy aims to accommodate differences in learning style and encourages learners to take an active role in their continuing education ([Henri, Johnson, and Nepal 2017](#)). By providing multiple training materials through PDF documents, video demos, and interactive software simulations, users are able to choose the material best suited for their training needs.

A study presented at the 2021 ASEE Annual Conference titled “Creating ACTIVE Learning in an Online Environment” investigated a method for evaluating video platforms for development of active videos for Generation-Z ([Basinger, Lahijanlian, and Ortega 2021](#)). Although the target audience is different, their study contained clear parallels with the proposed ProjectWise, Bluebeam, and CATS training programs. While online video learning is extremely popular both in the academic and professional engineering industry, stand-alone videos may not be enough to establish meaningful learning ([Basinger, Lahijanlian, and Ortega 2021](#)). Because ProjectWise, Bluebeam, and CATS are key components in GDOT’s construction management process, it is vital that construction staff actively learn the software through interacting with the training content. Active learning is developed by supplementing passive videos with activities that require users to learn the information based on completing a task ([Basinger, Lahijanlian, and Ortega 2021](#)). The

interactive modules provide this active learning task by requiring users to carry out various software actions presented in the video demos in a simulated software environment. Additionally, construction staff indicated the usefulness of PDF go-by documents not only for training, but for reference as well. The PDF guides developed offer additional supplemental material to ensure meaningful learning.

Online training is often accompanied by assessments, tests, and/or certificates that track user progression through the material. Although the software training programs do not contain standard assessments or quizzes, the programs still allow users to actively work through training topics with the interactive modules. Generally, training assessments are split between two categories: knowledge tests and task/skill-based tests or performance assessments ([Dalto 2015](#)). The interactive modules act as self-guided performance assessments to be completed once the user has reviewed the video demo and/or the PDF reference guide for the specific topic. Following the review of the PDF guide, video demo, and completion of the interactive module for a specific software topic, it is recommended the user perform the action directly in the software, returning to the material for reference.

The measure of e-learning success is based on several factors. A study conducted by [Holsapple and Lee-Post \(2006\)](#) introduced the e-Learning Success Model that defined the overall success of an e-learning initiative through an information systems perspective. The model defined three stages of e-learning systems development: system design, system delivery, and system outcome (see Figure 20).

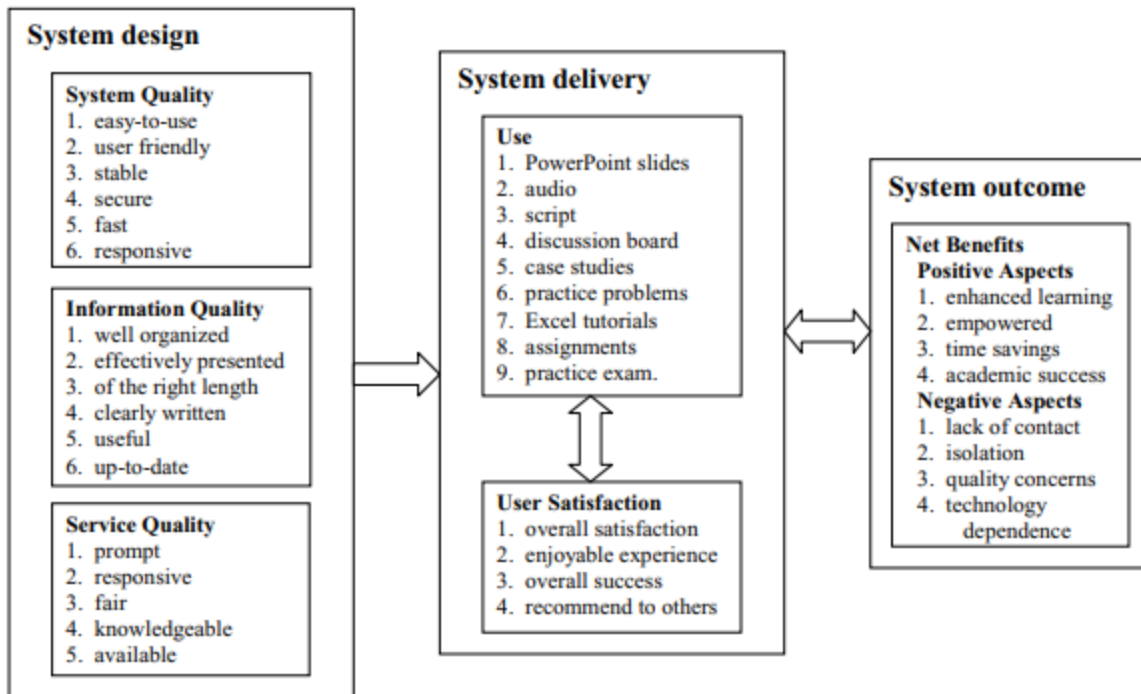


Figure 20. Image. e-learning Success Model(Holsapple and Lee-Post 2006).

While the model was investigated and evaluated in an undergraduate student setting, the three stages of e-learning success contain clear parallels to the ProjectWise, Bluebeam, and CATS training programs. Success of the design stage is evaluated through system quality, information quality, and service quality (Holsapple and Lee-Post 2006). Similar success metrics seen in Figure 20 were evaluated for the Bluebeam and ProjectWise training programs with focus on the following:

- **System Quality:** user-friendly, easily accessible, on-demand, engaging.
- **Information Quality:** well-organized; asynchronous; short/specific, relevant topic focused; useful for construction operations; up-to-date.
- **Service Quality:** responsive and knowledgeable, dependent on IT personnel and software-savvy construction personnel.

The system delivery consists of the following success metrics:

- **Use:** PDF documents, video demos, interactive software simulation modules.
- **User Satisfaction:** construction staff satisfaction with the programs, ability to learn from the material and apply the knowledge to day-to-day construction operations.

Finally, the system outcome is evaluated based on positive and negative aspects of the training programs. Positive aspects include enhanced learning and use of the software programs, and time and resource savings for the Department. Negative aspects include lack of accessibility or use of the training. Concerning the above success metrics at the system design, delivery, and outcome levels, collaboration with the project advisory group was critical during training program delivery, review, and publishing to ensure the success of the e-learning software training programs.

RECOMMENDED ADDITIONS AND SUPPLEMENTAL PROCEDURAL GUIDANCE TO GDOT'S *CONSTRUCTION MANUAL*

Construction manuals and similar documents from GDOT, five other state DOTs,⁸ and FHWA were evaluated for reference to Bluebeam software. In general, most of the reviewed manuals focus on high-level e-construction goals rather than hands-on instructions for specific software, such as Bluebeam. Among the five reviewed state DOTs, other than Georgia, only Connecticut explicitly mentions the name of the software, Bluebeam. As shown in table 3, the two suggested uses of Bluebeam, i.e., collaboration portal and electronic as-built, are not adopted by all reviewed transportation agencies. Georgia only uses it for electronic as-built but not as a collaboration portal. Table 3 summarizes the content in construction manuals related to the functions of Bluebeam.

⁸ Florida, Virginia, Michigan, Connecticut, and Texas.

Table 3. Comparison of content in construction manuals – Functions related to Bluebeam.

Comparison item	Reviewed Transportation Agencies						
	GA	FL	VA	MI	CT	TX	FHWA
Use as collaboration portal	No	Yes	Yes	Yes	No	No	N/A
Use for electronic as-built	Yes	No	No	No	Yes	No	N/A
Separate section on as-built plans	Yes	Yes	No	Yes	Yes	Yes	Yes

Based on GDOT feedback and the review of the construction manuals, the as-built process emerged as a principal topic of interest. For instance, Florida, as one of the recognized leaders in e-construction ([Durham, Ashuri, and Shannon 2018](#)), has an extensive section in their construction manual dedicated to the as-built process (see figure 21). In the as-built section, process maps are included as supporting references. However, the process maps, as shown in figure 21, do not mention how to realize the process using the Bluebeam software. Even Connecticut, the only state that explicitly mentions the name of Bluebeam in their construction manual, does not provide any supporting references guiding the use of Bluebeam.

Using a flowchart to illustrate the process flow, process maps are recognized as being capable of helping businesses improve their understanding of high-level, organizational objectives, as well as administration efficiency ([Damelio 2016](#)). With confirmation from GDOT personnel, involvement of process maps guiding the use of Bluebeam was identified as an avenue of enhancement to GDOT’s *Construction Manual*, and a recommended enhancement to GDOT’s *Construction Manual* is a documented process for electronic as-built plans.

Attachment 5.12-1A FINAL AS-BUILT PLANS PROCESS Resident Office

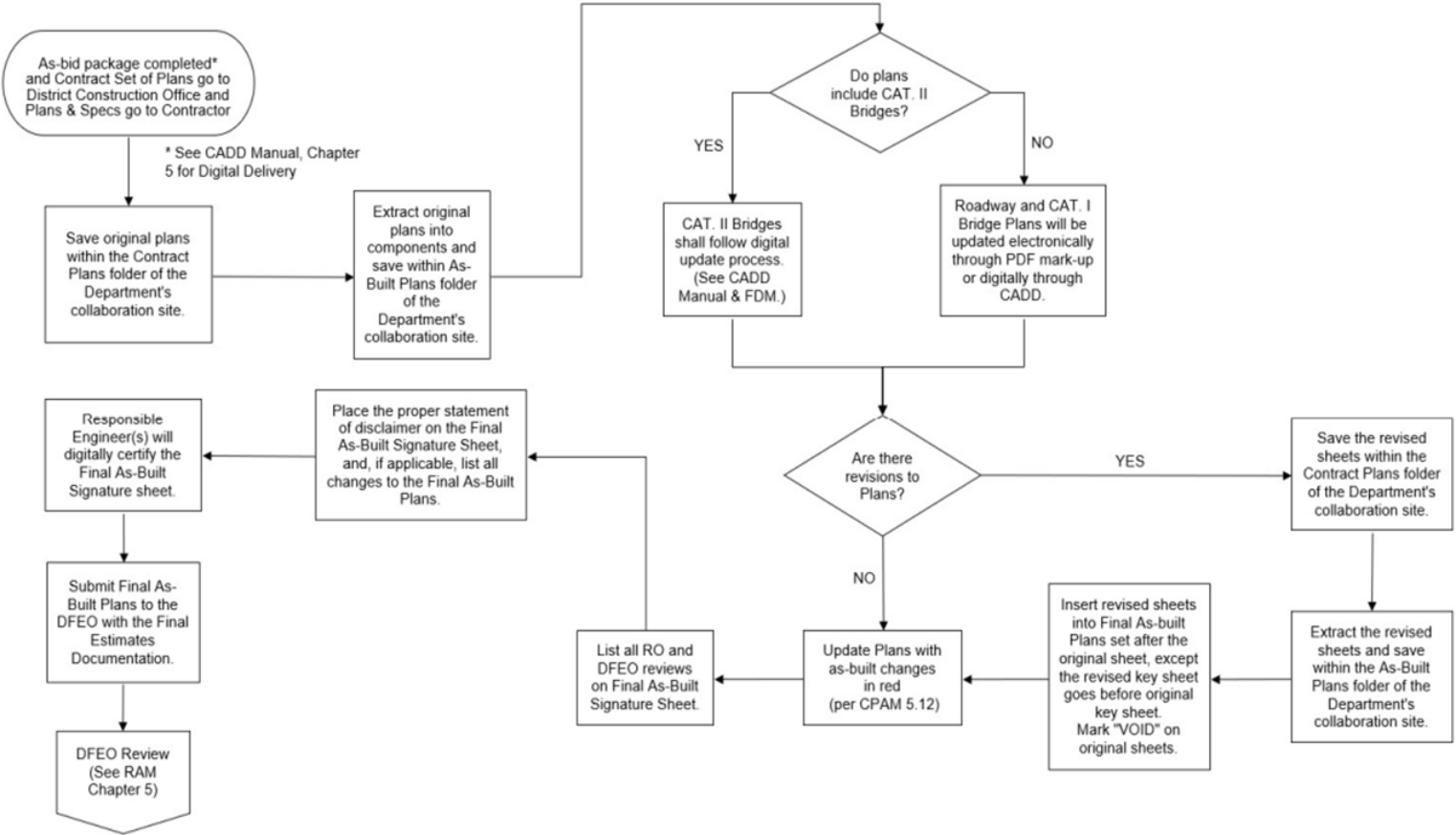


Figure 21. Flowchart. Process map included in the as-built process section in the Florida DOT construction manual.

The GDOT *Construction Manual* establishes “procedural guidance for the administration of Department construction contracts” ([GDOT 2020a](#)). It is important that the *Construction Manual* should be a form of communication implementing unified data governance. One challenge in using the *Construction Manual* in the Office of Construction is the textual information that may often miss some parties involved in the process. Thus, this study retrieves the textual information and knowledge from the GDOT *Construction Manual* and organizes it in systematic workflow models with visual representations. The purpose of developing workflow models is to describe steps involved in specific construction administration tasks (e.g., material management, time management, and quality assurance/quality control [QA/QC]) in a standard format.

CHAPTER 6. RESEARCH FINDINGS

PRELIMINARY REVIEW FINDINGS

The preliminary review consisted of a meeting conducted with the project advisory group on January 7, 2021, as outlined in chapter 5. The meeting provided initial high-level goals for the new training programs, including building from existing training material to develop more engaging, interactive training, and developing construction-specific training topics. These goals were further expanded on through the survey and subsequent meetings, which are discussed in the following two sections.

SURVEY ANALYSIS

Survey responses were collected over a one-week-and-two-day period from January 26, 2021, to February 4, 2021. A total of 209 responses were collected primarily from district construction personnel, along with approximately five KCI Technology⁹ respondents and three Kennedy Engineering & Associates Group (KEA) respondents. The survey analysis was organized into the first three blocks of questions: general information; training information; and ProjectWise, Bluebeam, and CATS challenges. The questions were analyzed both quantitatively and qualitatively, depending on the specific question. Following the closure of the survey, the full survey report was extracted to a PDF document and an Excel spreadsheet to analyze the data.

General Information

The first section of the analysis pertained to how the respondents of the survey use ProjectWise, Bluebeam, and CATS, along with their confidence level with the three programs. Results of

⁹ GDOT consultant.

software use are presented in figure 22, and that information is broken down by software type in figure 23, figure 24, and figure 25.

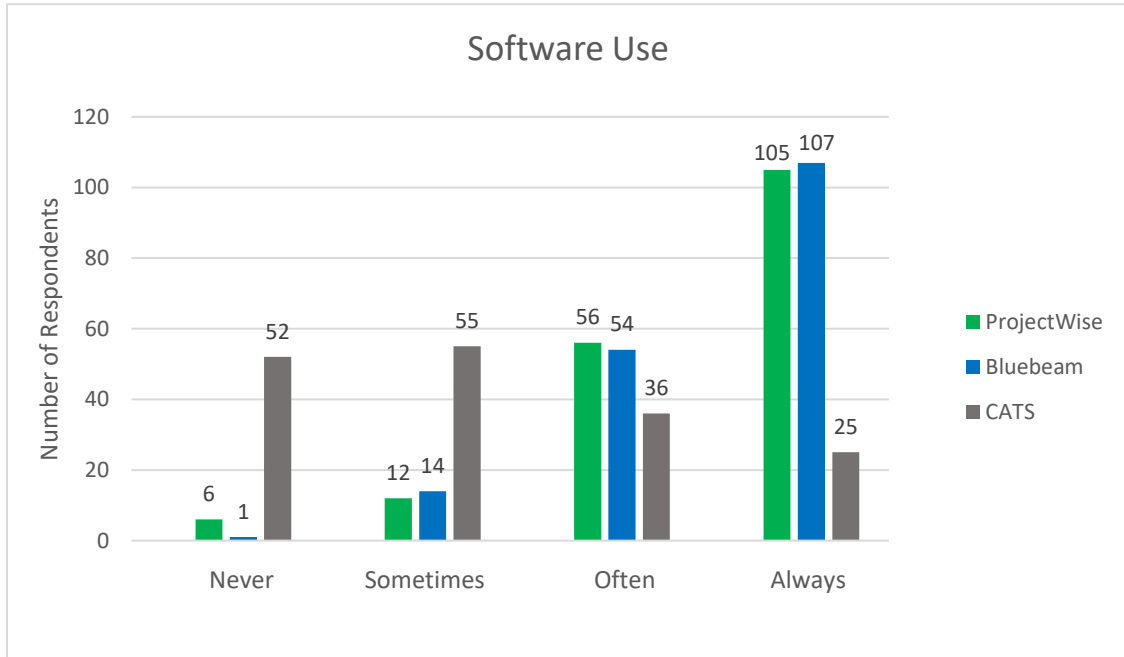


Figure 22. Chart. ProjectWise, Bluebeam, and CATS software use.

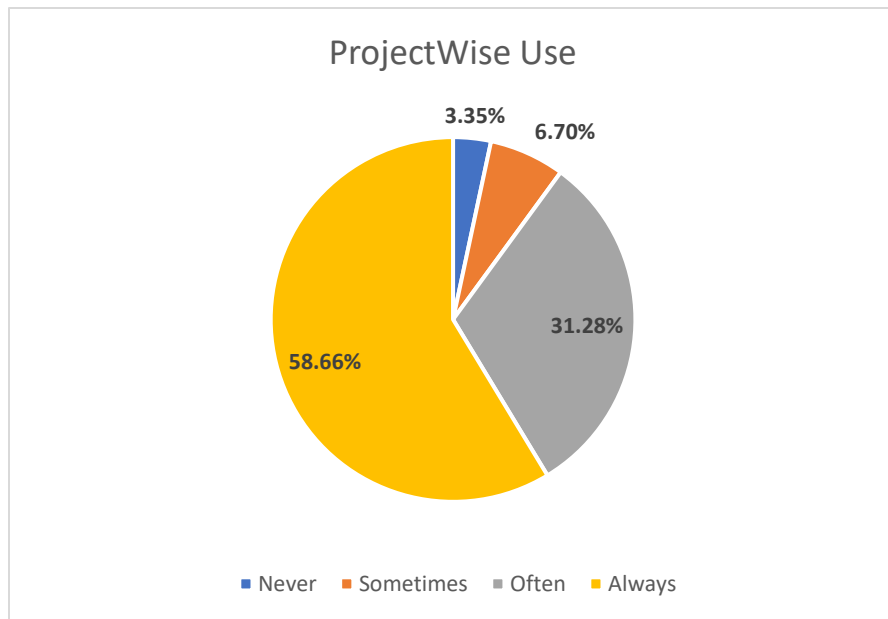


Figure 23. Chart. ProjectWise use.

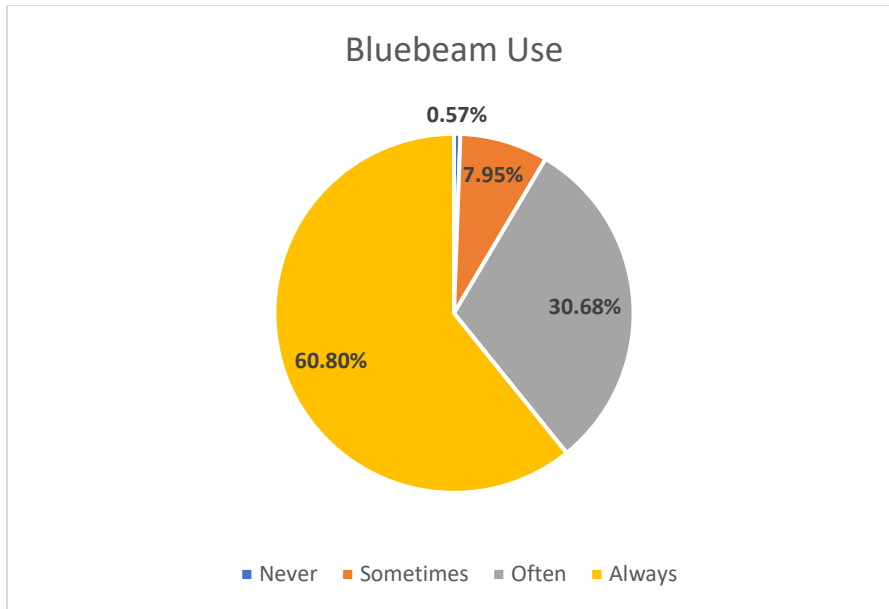


Figure 24. Chart. Bluebeam use.

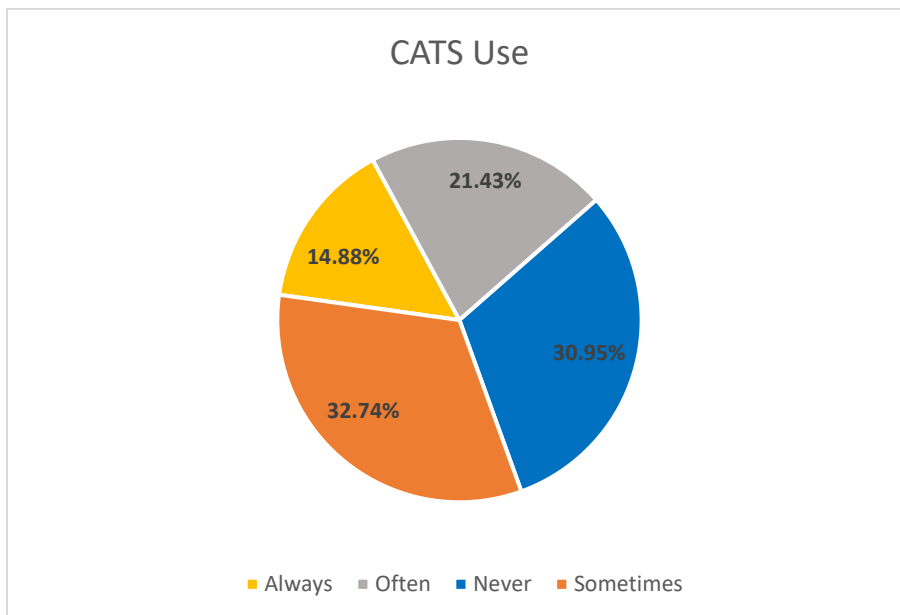


Figure 25. Chart. CATS use.

ProjectWise and Bluebeam use closely coincides, with 90.00 percent of respondents indicating they often or always use ProjectWise and 91.00 percent indicating they often or always use Bluebeam. CATS is not used nearly as frequently, with only 36.00 percent of respondents

indicating they often or always use the program, and nearly one-third, 31.00 percent, indicating they never use the program. Along with frequency of use, respondents were asked to provide a brief description of how their office currently uses the three programs.

ProjectWise is used primarily as a file storage system and a way to organize and centralize all project information. Project documents are placed in, updated, and extracted through ProjectWise. The software is used as a form of communication and file sharing wherein information can be uploaded and reviewed by different offices, documents are sent and received, files are relayed from the field to the office for review and approval, and correspondence is carried out with GDOT contractors. Bluebeam is used primarily as a PDF editor for signing, marking up, redlining, highlighting, and manipulating documents (e.g., inserting, deleting, combining, or extracting pages). A large majority of project documents are created, opened, and edited in Bluebeam. Plans are reviewed, measured, scaled, and printed from Bluebeam. Other uses of Bluebeam include time sheets, letters and correspondence, and converting Word and Excel documents to PDF. Finally, CATS is used for creating and processing contract documents, negotiations, and amendments. The in-house software is a means to implement supplemental agreements (SAs), change orders, time extensions, allotment requests, and force accounts. CATS' primary use is related to the Office of Construction's SAs.

In order to develop relevant training material, the existing confidence of GDOT construction personnel when using ProjectWise, Bluebeam, and CATS must be well understood. The confidence level of respondents with the three programs was recorded on a scale of 0–100. The mean confidence level, median confidence level, standard deviation, and count (i.e., number of responses) are presented in table 4, along with each respective program's percentage histogram presented in figure 26, figure 27, and Figure 28.

Table 4. Software confidence.

	Mean	Median	Standard Deviation	Count
ProjectWise	69.21	75.0	23.48	171
Bluebeam	67.48	74.5	22.34	176
CATS	47.45	50.0	31.42	133

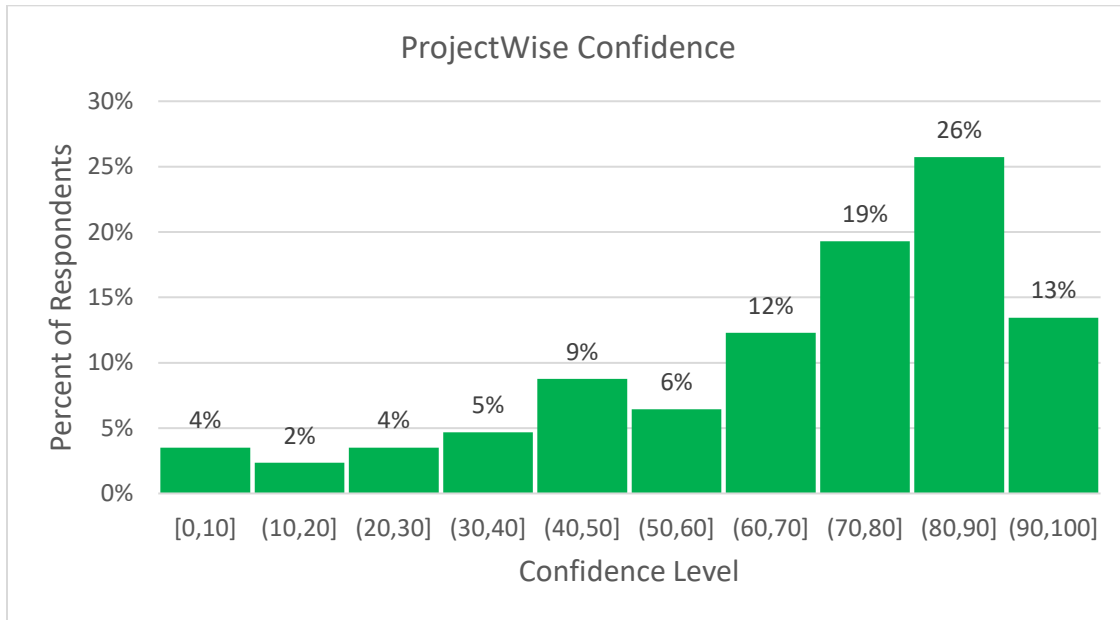


Figure 26. Chart. ProjectWise confidence.

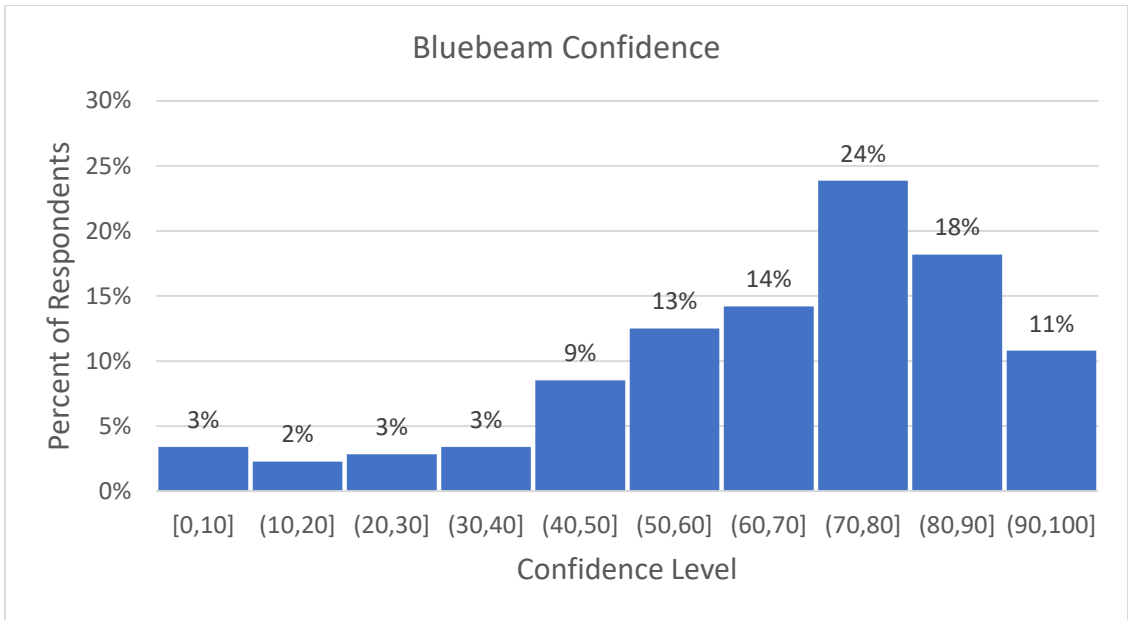


Figure 27. Chart. Bluebeam confidence.

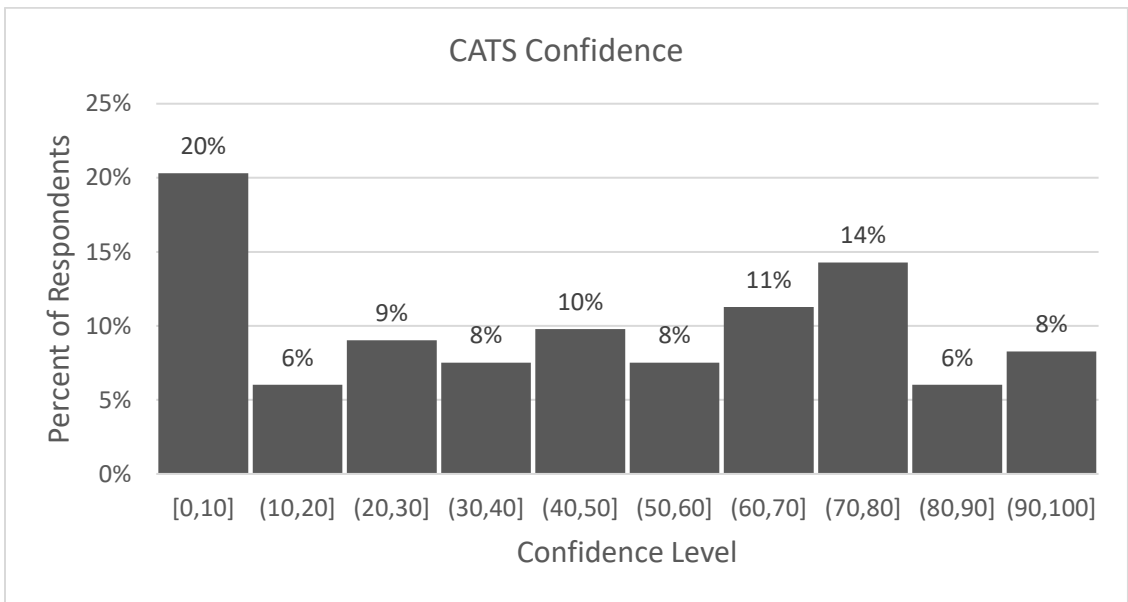


Figure 28. Chart. CATS confidence.

ProjectWise and Bluebeam displayed similar results with confidence level, with a mean confidence level of 69.21 and 67.48, respectively. Similarly, both data sets are skewed left, indicating a higher percentage of respondents who are generally more confident with the software

than are not. Of respondents, 58.00 and 53.00 percent indicated having a confidence level of at least 70.00 with ProjectWise and Bluebeam, respectively. The CATS confidence level was much more dispersed, indicated by a higher standard deviation. The key takeaway from the CATS data is that 53.00 percent of respondents indicated a confidence level of 50.00 or below. While a portion of this lack of confidence is due to lack of use of the software, new training is a necessity to increase the confidence level of users with the program.

Training Information

The subsequent block of questions investigated existing GDOT training material and the level of priority for new training. In order to completely understand GDOT’s existing training practices, respondents were asked how often training occurs and how it is implemented. The results of training frequency and training type are displayed in figure 29 and Figure 30.

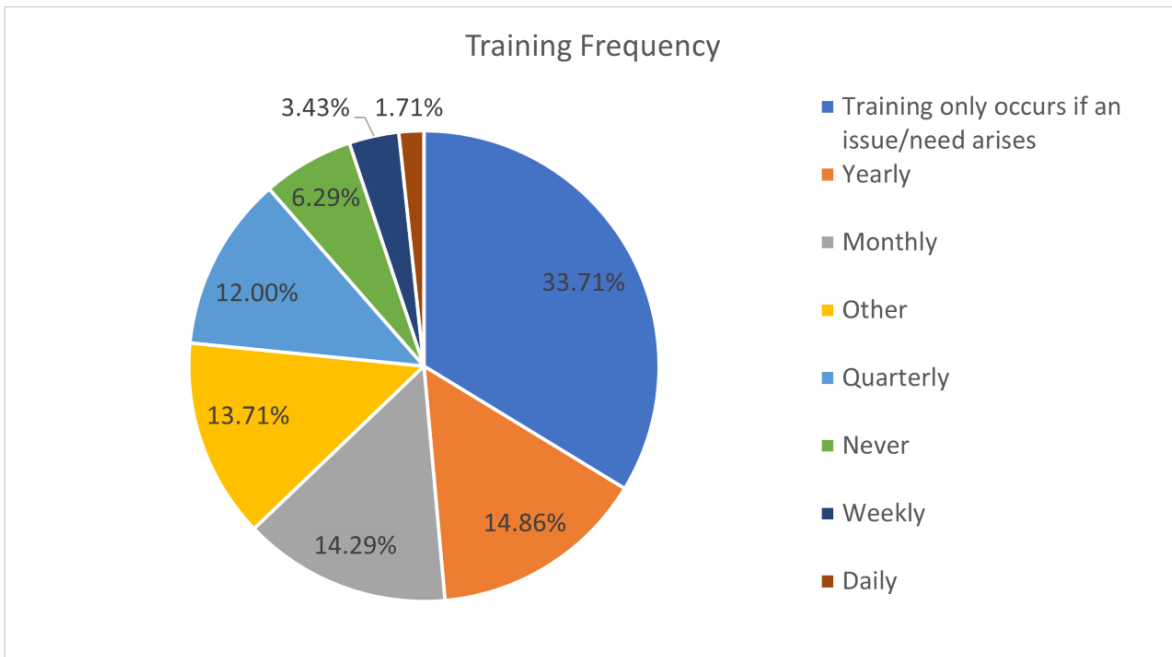


Figure 29. Chart. Existing training frequency.

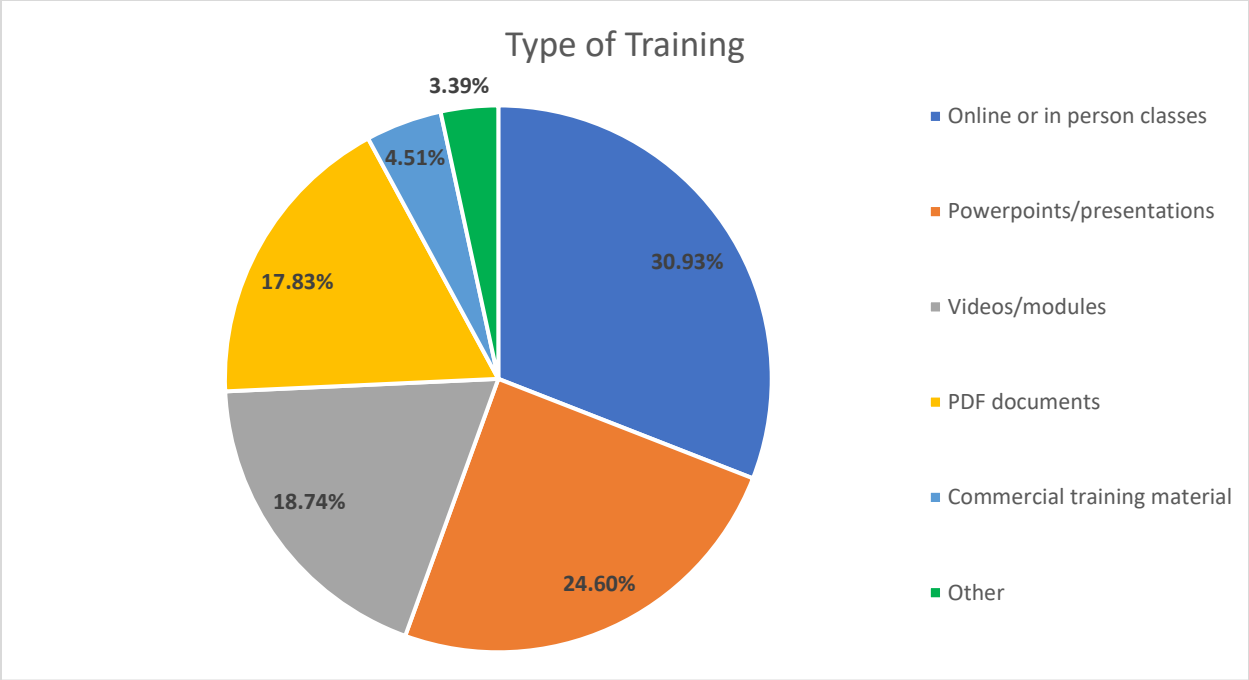


Figure 30. Chart. Type of existing training.

Observing figure 29, roughly one-third of respondents indicated that training occurs only if a software challenge arises in the district, suggesting that a majority of district construction offices do not currently implement any formal, reoccurring training. In other words, training only occurs if construction personnel indicate the need for software training. Additional responses indicating yearly, quarterly, and monthly training also suggest no formal training occurs across construction offices. With training that does occur, online or in-person classes followed by PowerPoints/presentations were the most popular methods for implementation, indicating that these methods are most familiar to construction personnel.

Before moving into software and training challenges, respondents were asked to give their perspective on the priority for new training. The results are shown in figure 31. As expected, the highest priority for new training was ProjectWise, receiving 56.00 percent of the number one

votes. The priority was followed by Bluebeam and CATS, which obtained nearly 80.00 percent of the least priority votes.

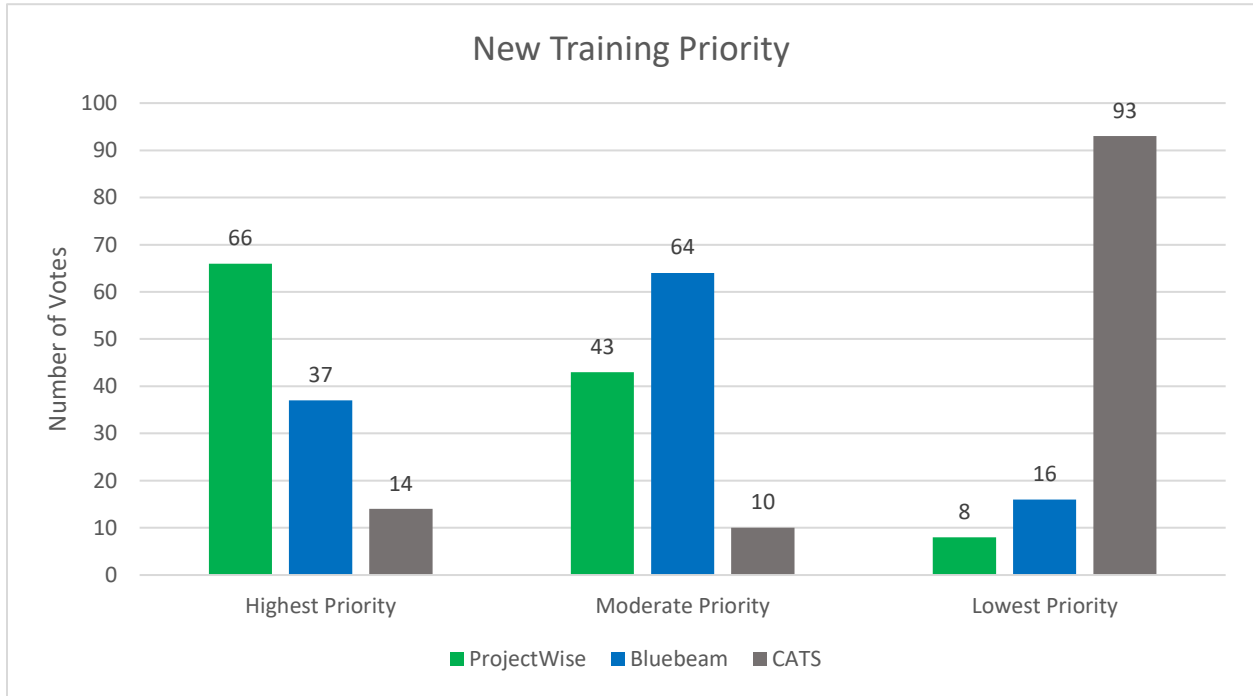


Figure 31. Chart. New training priority.

ProjectWise, Bluebeam, and CATS Challenges

The final block of questions before the *Construction Manual* section concerned software challenges. Respondents to the survey were asked to describe specific challenges with the three programs. Table 5 expresses the main challenges discussed by the respondents and the associated frequency of the specific challenge mentioned.

Table 5. Key challenges associated with ProjectWise, Bluebeam, and CATS.

ProjectWise	Frequency	Bluebeam	Frequency	CATS	Frequency
Slow server/connectivity	18	General features, tools, and functions when editing	26	Lack of use, knowledge, and familiarity	6
Navigation, searching, and finding documents/projects	8	Training	7	Finding and filling out SA's	5
Labeling/naming documents	8	Info lost or corrupted when combining files or attaching to email	2	Training	4
Deliverables Management	7	Printing	2	Navigation, search, and find projects	3
Uploading files, lock, read only	7	Change/make a spreadsheet	1	Not user friendly, errors discovered down approval chain	3
Training	6	Apply digital signatures correctly	1	Not notified of updates	2
Deleting folders	5	Lock files, add permissions, edit after locked	1	Reference to contract ID's instead of PI's	2
Correspondence between GDOT and contractor	4	Measuring tool	1	Revising change orders	1

A common challenge indicated for all three programs included training. More specifically, respondents indicated the challenge with the programs was a lack of training, not adequate initial training for new hires, and ineffective training. Concerning ProjectWise, the top issue discussed was a slow server and slow connectivity. Because this is an external issue, focus remained on the other challenges listed, including labeling/naming documents, Deliverables Management, and uploading and manipulating files. The primary challenge discussed by respondents for Bluebeam was understanding general tools, features, and functions of Bluebeam when editing documents. Many respondents indicated a lack of efficiency when redlining or marking up plans and felt that Bluebeam was not being used to its full capacity. Finally, with CATS, the primary challenge

indicated was a general lack of knowledge and familiarity with the program. The second most common challenge involved finding and filling out SAs. The common challenges listed provided multiple focus areas when developing the new training modules.

The next two questions in the survey inquired about the existing GDOT training material, focusing on ProjectWise. The GDOT website currently contains ProjectWise training material, as discussed in chapter 2. In order to investigate the possibility of updating the current material, respondents were asked about their perception of the effectiveness of the current material. Nearly 70.00 percent of respondents indicated that the existing material is very effective, effective, or somewhat effective, as indicated in figure 32.

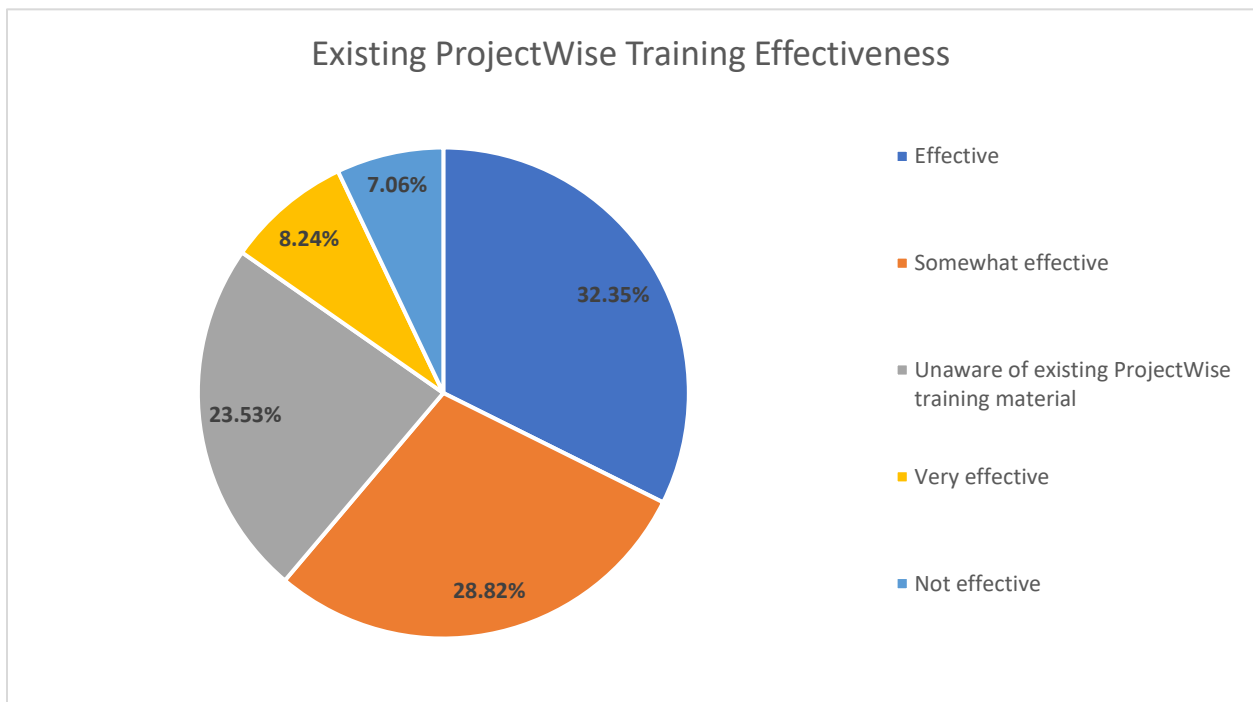


Figure 32. Chart. Existing ProjectWise training effectiveness.

However, nearly a quarter, 23.53 percent, of respondents indicated they were unaware of existing ProjectWise training material. With the high percentage of positive responses to the

existing material, the goal of the new training was to update and enhance the material, while also making it more accessible.

Along with the effectiveness of the existing material, respondents were asked to describe what was missing from the material. The common responses are presented in table 6. Many respondents indicated the missing factor from the ProjectWise material was more relevant demonstrations and examples related to construction. Additionally, a common response was more in-depth/engaging training, along with updated training.

Table 6. Missing factors from existing ProjectWise training material.

Missing Factors	Frequency
Step-by-step training material with specific examples, real world applications related to construction, simplicity	11
In-depth hands-on training, updates to training from changes to PW	10
Setting up, naming, and labeling documents	3
Difficult to navigate all PDF's, combine with index for easy reference?	3
Advertise training	3
Tools and multiple ways to achieve certain functions	1
Uploading files, locking, read only, etc.	1
Deliverables management	1

The final two questions of the survey inquired about desired features for general and interactive training. 93.00 percent of respondents indicated the desire for more interactive training. Interactive features of Adobe Captivate were investigated in order to make the new training more engaging. Along with training specific to GDOT work and processes, 74.00 percent of respondents indicated general training is also needed for ProjectWise and Bluebeam. General training will offer

a broader overview of features and tools of the programs that will be especially beneficial for new hires.

Survey Main Takeaways

Following the survey analysis, multiple key takeaways were identified. ProjectWise was the top priority for the new training, closely followed by Bluebeam, while the lowest priority for new training was CATS. ProjectWise and Bluebeam are used very often across construction offices, and their use frequently coincides. The primary goal with the new training was to create more interactive, organized, and formal training that contained a blend of general and specific topics related to construction. The main focus with ProjectWise was navigation, document labeling and document manipulation (uploading and extracting files), and Deliverables Management, along with building from the existing ProjectWise training documents. The main focus with Bluebeam included general document manipulation features (inserting, deleting, combining, and extracting pages from a document) and tools to edit and mark up PDF documents. Finally, the main focus with CATS was to increase general knowledge and familiarity with the program, along with working with SAs.

GDOT MEETING TAKEAWAYS

Following the survey period, meetings were conducted with GDOT District 1 and 2 construction personnel to more completely understand training needs concerning ProjectWise, Bluebeam, and CATS. Along with the survey results, the meetings provided key takeaways that resulted in a ProjectWise, Bluebeam, and CATS training program specifically tailored to the Office of Construction needs. Because construction personnel had little knowledge or were unaware of

existing ProjectWise and CATS training material, the goal of the new training program was to focus on promoting the material and ensure its accessibility to construction staff.

District 1 Construction Meeting Takeaways

District 1 personnel indicated multiple software challenges and suggestions to develop the most effective training material. Concerning ProjectWise, the file naming system and file navigation were described as serious challenges. The constant upgrades of the software cause issues, along with the system speed. Only being able to open/check out one file at a time proved to be a challenge for employees, especially for a large set of plans. Finally, general ProjectWise basics, such as navigating the interface, were discussed as being a challenge for new employees.

Concerning Bluebeam, the primary challenge consisted of becoming accustomed to the Bluebeam interface, along with learning the most efficient tools to edit/mark up documents. The use of Bluebeam in the field was discussed extensively. One of the key updates to the *Construction Manual* described for Bluebeam was proper as-built management, which is closely related to redlining plans. Construction personnel desire to have the quickest and most efficient way to update or mark up plans. The goal of field personnel is to redline plans in real time on a mobile device. It was discussed that while contractors use iPads or Getacs (not very user-friendly) to review plans, the majority of employees will redline hard copies of plans, scan them in, upload them, etc. This process is very time consuming; thus, the goal is to transition into a more electronic streamlined process. One of the main focus areas for the new Bluebeam training should deal with correctly and efficiently redlining plans, especially for those in the field.

Finally, the primary challenge concerning CATS was the software not allowing users to go back/send back documents or processes once they are started. Once an error is found, the user must

start over. Although this challenge was not in the scope of the project, it brought up a crucial issue in the operations of the software.

The second objective of the meeting focused on the goals of the new training and *Construction Manual* updates. Along with the main goal of the training to provide more interactive, organized, and formal training with a blend of both general and construction-specific information, District 1 personnel discussed the idea of having multiple levels of training (i.e., beginner, intermediate, and advanced). The different levels of training allow users to pick and choose the material they want to view, whether this is basic training for new hires/users, or more advanced topics, for the most effective use of the software. Specifically, with ProjectWise, the new training aimed to produce more engaging material and create more applicable material for construction personnel. Much of the current material is step-by-step PDF documents outlining a certain task or action in ProjectWise; this material does not appear to be well-known or widely used across construction personnel. District 1 personnel indicated the importance of repetition for training, especially for new hires. While training for software may have occurred in the past, it was a one-time class/course that may no longer be relevant. Short, specific, and engaging module videos allow training to be on-demand and viewed as frequently as the user requires.

Concerning Bluebeam, multiple features were discussed as important topics for new training, including converting PDF documents to Word documents, use of the “flatten” tool to prevent editing of documents, adding text comments and leader lines, highlighting, markup clouds, etc., how to extract/combine/delete certain pages from a document, and effectively redlining plans and the tools involved. The idea was discussed to structure the Bluebeam training in levels or tiers covering software basics followed by more advanced topics. Following viewing of the “rough draft” training video covering digital signature implementation in Bluebeam, the interactive

features of the new training were discussed. District 1 personnel indicated the video was a simple and good place to start. More interactive features were investigated following the meeting in order to further enhance the video's engaging properties.

District 2 Construction Meeting Takeaways

District 2 personnel discussed similar challenges with the software programs and added their unique perspective to the development of the new training material. Similar to District 1, two of the main challenges discussed with ProjectWise were: (1) locating documents, and (2) not having a naming system/guideline. Each area within District 2 may name files differently than other areas. Along with area differences, there are key differences across GDOT departments when it comes to naming files. An additional challenge discussed was implementing Deliverables Management, a feature in ProjectWise that is currently not being used. Because it is optional for contractors, many prefer to send documents through email. With Deliverables Management offering an easy way to track and file documents, its implementation would greatly increase productivity in the office. Deliverables Management is an area that contractors need more training on than GDOT personnel.

One of the primary challenges with Bluebeam discussed at this meeting was the large gap in experience level between many users in the office. While some users do not understand the basics of Bluebeam, others have been able to fully implement the basics and would benefit from more training on advanced features of the program. In order to assist district employees with Bluebeam, a redline guide was created for employees to follow. The guide offers step-by-step instructions with screenshots from Bluebeam on how to correctly mark up plans. Also, similar to District 1, field use of Bluebeam was discussed as a challenge primarily because the tablets currently in the field are rarely used and do not work effectively. A hard copy of the plans is

normally redlined in the field, brought back to the office, and transferred electronically into Bluebeam. Finally, with CATS, the only challenge mentioned was retrieving and searching for project information.

The second portion of the meeting focused on new training and *Construction Manual* update goals. Along with providing more interactive, organized, and formal training, District 2 personnel discussed the idea of having multiple levels of training, covering basics and more advanced topics, especially for Bluebeam. Similar to District 1 personnel, District 2 personnel indicated a general lack of knowledge of the existing ProjectWise training. While the training may have been initially mentioned, it does not appear to be used as relevant training material. The reason for the lack of use is that many people would do better with a video or in-person/peer training. Concerning Bluebeam, it is important to offer basic and advanced training. District 2 personnel discussed how basic training will be useful for new users and those not familiar with the program, while advanced training will provide a more detailed review of specialty functions and tools in Bluebeam. Training topics discussed included redlining, converting PDF documents to Word documents, and editing and locking documents/markups. Robert Rowland, District 2 Area 5 manager, provided a Redline Guide he and his team developed to assist District 2 employees with redlining plans. The guide contains step-by-step instructions on how to redline and explores different features of Bluebeam. The guide offered relevant topic ideas for the new Bluebeam training.

Prior to the meeting, an interactive video was developed to accompany the digital signature video demo shown in the District 1 construction meeting. The two were combined to form one complete video containing a demo in the first half and an interactive software simulation in the second half. The software simulation allows users to physically click and input information as they

would in the actual program. Following the preview of the video, the interactive features of the new training were discussed. District 2 personnel indicated that it may be more beneficial to separate the two videos to create two distinct files: a passive video demo and a more engaging interactive video. Following the meetings with district and area managers, additional meetings were conducted with construction managers and inspectors to gain their perspective on new training and *Construction Manual* updates.

Construction Managers and Inspectors Meeting Takeaways

After gaining the perspective of district and area managers, meetings were conducted to gain the input of construction managers and inspectors concerning the software challenges and goals for the new training, along with the *Construction Manual* updates. It was discussed that CMs and inspectors face similar challenges to district and area managers with the three programs, including the labeling/naming system and working with Deliverables Management in ProjectWise, lack of understanding of new and existing tools in Bluebeam, and a challenge working with contract documents in CATS. Specifically, with ProjectWise, while there is a District 1 go-by for file naming, there is no training on the naming system. Training that describes this go-by document and goes through it would be very beneficial. The difficulty in not having a standard naming system was also discussed as a challenge; different areas within a district might even have different naming systems, which is why District 1 created the go-by. While a statewide standard would be ideal, it may be hard to implement with districts and areas across the state that currently use conflicting methods. Concerning Bluebeam, it was discussed that new training is needed because of the recent update to the software that is new to many employees. While Bluebeam training did occur over Microsoft Teams in the past, it would be more helpful to have new training material to reference. CATS is also in need of new training, with a focus on navigating the program.

Following the discussion of software challenges, the specific topic areas for new training were further discussed. The most important topics to CMs and inspectors for new ProjectWise training were document labeling and Deliverables Management. Both the CMs and inspectors were unaware of the existing ProjectWise training and indicated that something more engaging and interactive to go along with the PDF go-by documents would be beneficial. Additional training regarding ProjectWise Deliverables Management and what is expected when using Deliverables Management was also discussed as an important topic for new training.

TRAINING TOPIC DEVELOPMENT

Following the survey analysis and construction meetings, the research team developed a working outline for the new training. The outline focuses on software challenges and uses discussed in the survey and in the subsequent meetings with a variety of construction personnel. Table 7 shows the proposed training outline. The outline is structured around a tiered approach with beginner and intermediate–advanced topics that will provide relevant training for users of various experience levels. A total of 20 initial modules were proposed: six ProjectWise topics, nine Bluebeam topics, and five CATS topics.

In order to fully accommodate different user preferences, three forms of new training were investigated, including a video demonstration, an interactive software simulation, and a PDF “go-by” document. A meeting with the project advisory group was conducted on May 5, 2021, to further discuss this proposed outline and the format options. The proposed outline was well-received, and feedback was provided for the topics.

Table 7. Proposed new training outline.

Software	Level	Module	Justification
ProjectWise	Beginner	Interface and Navigation	Provide a basic understanding and introduction to the software
		Navigating, Searching, and Finding Documents	One of the key challenges discussed, learn how to efficiently search
		Uploading and Extracting Files	Understand how to work with files in the system
		Document Setup, Labeling, and Organization	Naming and setup is confusing, no standard to follow
	Intermediate/Advanced	Using Deliverables Management Effectively	Another key challenge discussed, help contractors use the feature
		Best Practices and Construction Examples	Specific examples that Construction employees will often work with
Bluebeam	Beginner	Interface and Navigation	Provide a basic understanding and introduction to the software
		General Markup Tools	Primary function and use of Bluebeam by Construction personnel
		Converting File Types	Important feature discussed that many people struggle with
		Document Manipulation	Understand how to combine, separate, extract, and delete pages
		Digital ID and Signing Documents	Inform users how to correctly incorporate signatures on documents
		Use of the Flatten Tool	Frequently used tool discussed in construction meetings
	Intermediate-Advanced	Viewing Multiple Drawing Sheets at a Time	Beneficial to view different sections of plans at once using split screen, comparing and overlaying documents
		Effectively Redlining Plans and More Advanced Markup Tools	Most important and used feature in Bluebeam, users would benefit from additional training in advanced tools
		Interface Customization	Learn how to edit Bluebeam interface to maximize user productivity
CATS	Beginner	Introduction to CATS	Provide a basic understanding and introduction to the software
		Navigating, Searching, and Finding Projects	One of the key challenges discussed, learn how to efficiently navigate the software
	Intermediate/Advanced	Working with Contract Documents	Overview of CATS features, generating contract ID
		Supplemental Agreements	Primary use of CATS, step-by-step setting up and filling out SA
		Best Practices and Construction Examples	Specific examples that Construction employees will experience

The following topics were suggested to be included in the Bluebeam training material in addition to the proposed topics:

- The measure and scale tool, how to check the scale on a drawing, and how to calibrate the scale.
- Using layers and how to track markups.
- The as-built and shop drawing process (adding markups to as-builts and uploading to ProjectWise). The project advisory group provided a PowerPoint presentation covering the as-built tools and processes that they would like to have included in the intermediate–advanced Bluebeam training.

Subsequent meetings with the Office of Construction and Office of Design Policy and Support provided valuable insight into modifications to the ProjectWise and CATS module content. As a result, the training outline was updated to the version shown in Table 8. Ultimately, the training program consisted of a total of 26 modules: 9 ProjectWise topics, 13 Bluebeam topics, and 4 CATS topics.

TRAINING PROGRAM DEVELOPMENT

Following the approval of the training topics, the Bluebeam training development began. After meeting with GDOT IT personnel, resources were provided to create more standard material that aligned with GDOT’s IT branding guidelines. The guidelines included information on the style of text, graphics, callouts, and shapes, along with proper language, grammar, naming conventions, and syntax. Additionally, one more topic was added to the Bluebeam training outline: a review of Bluebeam Studio. Bluebeam Studio was discussed as a new feature currently being investigated by the Department.

Table 8. Updated training outline.

Software	Level	Module	Justification	Interactive	PDF
ProjectWise	Beginner	Interface and Navigation	Provide a basic understanding and introduction to the software	No	Existing
		Navigating, Searching, and Finding Documents	One of the key challenges discussed, learn how to efficiently search	Yes	Existing
		Uploading and Extracting Files	Understand how to work with files in the system	Yes	Existing
		Document Setup, Labeling, and Organization	Naming and setup is confusing, no standard to follow	Yes	Existing
	Intermediate-Advanced	Deliverables Management (DM) Introduction	Another key challenge discussed, help contractors use the feature	No	Existing
		DM: Using ProjectWise Explorer	Understand how to use PW effectively in finding projects, etc.	Yes	Existing
		DM: Sending and Receiving Transmittals	GDOT discussed having discrepancies in this aspect of DM	Yes	Existing
		DM: Receiving and Responding to Submittals	GDOT discussed having discrepancies in this aspect of DM	Yes	Existing
		DM: Working with RFIs	There is a need to establish best practices for working with RFIs	Yes	No
Bluebeam	Beginner	Interface and Navigation	Provide a basic understanding and introduction to the software	No	Yes
		General Markup Tools	Primary function and use of Bluebeam by Construction personnel	Yes	Yes
		Converting File Types	Important feature discussed that many people struggle with	Yes	Yes
		Document Manipulation	Understand how to combine, separate, extract, and delete pages	Yes	Yes
		Digital ID and Signing Documents	Inform users how to correctly incorporate signatures on documents	Yes	Existing
		Use of the Flatten Tool	Frequently used tool discussed in construction meetings	Yes	Yes
		Scale and Measurement Tools	Check the scale on a document, calibrate the scale, measuring tool	Yes	Yes
	Intermediate-Advanced	Viewing Multiple Drawing Sheets at a Time	Beneficial to view different sections of plans at once using split screen, comparing and overlaying documents	Yes	Yes
		Advanced Markup Tools: Stamps and Hyperlinks	Most important and used feature in Bluebeam, users would benefit from additional training in advanced tools	Yes	Yes
		Advanced Markup Tools: Layers	Discuss Bluebeam layers and tracking markups	Yes	Yes
		As-Built Plan Process	Follow along with PPT as-built process, link to PW	Yes	Existing
		Interface Customization	Learn how to edit Bluebeam interface to maximize user productivity	Yes	Yes
		Bluebeam Studio	Using BB Studio, see studio documents	No	Existing
CATS	Beginner	Introduction to CATS	Provide a basic understanding and introduction to the software	No	Existing
		Navigating, Searching, and Finding Projects	One of the key challenges discussed, learn how to efficiently navigate the software	Yes	Existing
	Intermediate-Advanced	Working with Contract Documents	Overview of CATS features, generating contract ID	Yes	Existing
		Supplemental Agreements	Primary use of CATS, step-by-step setting up and filling out SA	Yes	Existing

While the focus of the training program was the video demos, additional materials were created to provide users with multiple viewing options, depending on personal preferences and training necessity. The training program involved the development of the following materials:

- **Video:** Provide the user with an engaging but non-interactive step-by-step video of actions being carried out in the software.
- **Interactive Software Simulation:** The “do it yourself” version of the video demo. A number of the video demos are accompanied by an interactive element that requires users to physically click through a number of prompts to complete the specified action in the software. This material was targeted at new users needing more hands-on training.
- **Quick Reference Guide :** If a Quick Reference Guide (QRG) document did not already exist for the training topic, one was developed that walked through and described the same actions displayed in the video in the form of a visual PDF document. This material was targeted at more confident users who may just need a refresher or quick reference on a specific topic.

The first topics approved by the research advisory group covered the following Bluebeam topics: use of the flatten tool, document manipulation basics, and scale and measurement tools. The video, QRG, and interactive modules were provided to the research advisory group for review and approval. Following the approval, development of the beginner Bluebeam topics continued and proceeded to the intermediate–advanced topics.

In order to develop the ProjectWise training material, access to the applications was essential. Additionally, specific Bluebeam training topics, Bluebeam Studio, and the As-Built Plan Process, were linked to ProjectWise and thus required access to the application. After working with the GDOT project advisory group and GDOT IT personnel, a spare laptop was acquired for

training material development purposes. ProjectWise was installed on the laptop, along with the most recent version of Cisco, which was used as a virtual private network (VPN) to connect to the GDOT network. The same process was used to access the software program CATS. Because the screen capturing software Adobe Captivate was installed on a desktop located at the University of Georgia's (UGA) STRuctural ENGINEERING Testing Hub (STRENGTH) lab, the GDOT laptop was accessed via a remote desktop connection. The connection allowed for both ProjectWise or CATS and Adobe Captivate access to successfully record the training material. Following the Bluebeam training development, the ProjectWise content was developed, followed by the CATS content.

Training Topic List and Description

The following subsections provide a review of the modules developed as part of this research, the material produced for each topic, and a description of the topics covered in each module.

Beginner ProjectWise

The beginner ProjectWise training material comprises four modules that walk through basic actions and tools in ProjectWise. The training modules build off of and follow similar topics outlined in the existing GDOT ProjectWise training guides, as discussed in chapter 2. Because existing QRG documents are available, the ProjectWise topics focused specifically on video and interactive module development.

Interface and Navigation (Video)

This module introduces ProjectWise Explorer and provides a tour of the different panel and menu bar sections in the interface. First, the module begins with opening ProjectWise Explorer from a GDOT desktop. Next, an overview of the interface is provided, including the folder structure, toolbars, and document panels. Each folder and document in ProjectWise are associated with two

icons, indicating the access/permissions of the file and the application the file is associated with. The module walks through these access/permission icons, including the read only, checked out, and locked icon. Finally, the address bar is briefly reviewed. Because this module provided an overview of the ProjectWise interface, an interactive module was not required and thus not developed for this topic.

Navigating, Searching, and Finding Documents (Video and Interactive Module)

A primary ProjectWise challenge discussed in the survey and accompanying construction meetings was the inability to effectively search and find documents and/or projects in ProjectWise. This module aims to review the ProjectWise Explorer search tools and follow along with the existing PDF training document, “Using ProjectWise Searches.” First, the Quick Search bar is reviewed, where there are options to conduct a Full Text, All Content, and Document and Folder Properties search. The module conducts a search example using the Full Text search option. Next, it discusses how to create, save, and apply a custom search. This module creates a “PI number” search to more effectively search for a project by PI number. Following the Quick Search bar options, the module reviews the advanced search options: Search by Form and Search Builder. Finally, the module reviews how to save searches to the ProjectWise interface for future use.

Uploading and Extracting Files (Video and Interactive Module)

This module reviews various aspects of working with documents in ProjectWise and follows along with two existing PDF training documents: “ProjectWise Explorer Fundamentals” and “Working with Documents in ProjectWise.” First, the module walks through the various methods to open a document from the ProjectWise Explorer interface, including open, check out, and export. Next, the module reviews the various methods to check in a document once work has been completed, including check in and import. The three document creation methods are then described, including

saving a new document created in an application, drag and drop a document or documents into the ProjectWise interface, and using ProjectWise new document creation tools. Specific attention is given to the first two options, as these are the recommended document creation methods.

Document Setup, Labeling, and Organization (Video and Interactive Module)

A primary challenge discussed with ProjectWise was the inconsistencies and non-uniformity of the file naming system. This final beginner module focuses on the document setup, labeling, and organization of folders in the ProjectWise interface. Specifically, this module provides an overview of the project folder structure and walks through how to add or delete folders, if necessary. Because there is existing published documentation, a PDF guide was not developed for this topic.

Intermediate–Advanced ProjectWise

The intermediate–advanced ProjectWise training material comprises five modules that walk through more advanced actions and tools in ProjectWise. While the program was designed to be asynchronous, it is recommended new users first view the beginner material, as the following module topics are targeted toward more advanced ProjectWise users. Similar to the Beginner ProjectWise modules, existing PDF guides are currently available; thus, the intermediate–advanced ProjectWise topics focused specifically on video demo and interactive module development.

Deliverables Management Introduction (Video)

This module provides an overview of ProjectWise Deliverables Management and the basics of the interface and how to navigate the program. Specifically, this module shows the user how to open ProjectWise from the home screen, review the ProjectWise Explorer interface, and review the

ProjectWise address bar. First, the module starts by launching ProjectWise Explorer and highlighting the data sources shown on the interface. Additionally, it illustrates how to log in using GDOT credentials. The module then provides examples of the Explorer interface and the available toolbar options, such as data source, folder and document tools, viewing options, additional tools, and the window and help tab. The module discusses the application window, how to view projects, and the associated icons and their meaning that are located next to each document or folder. Finally, the address bar is identified, along with methods to copy the document location path and share with others.

Deliverables Management: Using ProjectWise Explorer (Video and Interactive Module)

This module provides an overview of Deliverables Management within ProjectWise Explorer and covers the basics of how to review and recall packages. The module walks the viewer through how to filter and search for deliverables in ProjectWise, review an issued package or response, and recall a package. The module shows the user how to filter and search for deliverables more efficiently within ProjectWise Explorer. Next, the video and interactive module examine how to review an issued package and a response to a package within Deliverables Management in ProjectWise Explorer. Finally, the module reviews how to recall a package.

Deliverables Management: Sending and Receiving Transmittals (Video and Interactive Module)

This module provides an overview of creating and sending transmittals in Deliverables Management within ProjectWise Explorer. The module demonstrates the process of creating and sending a transmittal package from a GDOT user to external parties for their acknowledgement, review, and response. The video and interactive module begin by navigating the user to the Deliverables Management folder within the respective project folder in ProjectWise and selecting “New Transmittal” to create a new package, entering the necessary information, and producing a

cover letter before sending to an external party. Next, the module shows the user how to select recipients and schedule the package to be sent. Additional options are reviewed, such as entering a Response Due Date and an Acknowledgement Due Date. Once everything is complete, all files are compiled and moved to the cloud where the external parties receive notification that a new package has been received for their review.

Deliverables Management: Receiving and Responding to Submittals (Video and Interactive Module)

This video and interactive module show how to receive, acknowledge, and respond to submittals through Deliverables Management within ProjectWise Explorer. The module begins by acknowledging a submittal package and informing the sender that the package has been received properly. Additionally, the module reviews the process of delegating to someone else within the organization the responsibility of acknowledging and responding to the package. After acknowledging receipt of the package, all files in the package are imported into the project's preconfigured folders for the organization that sent the package. Next, the user is able to begin a detailed review by opening the files from the submittal folder and commenting or marking up the file(s). The module concludes with reviewing the process to respond to a submittal package.

Deliverables Management: Working with RFIs (Video and Interactive Module)

This module provides an overview of working with Requests for Information (RFIs) in Deliverables Management within ProjectWise Explorer. The video and interactive module review the process of creating and editing an RFI and sending an RFI to an external party in ProjectWise Explorer. First, users are directed on how to navigate to the Deliverables Management folder within the respective project folder in ProjectWise, accessing the Outgoing subsection, and

creating a new RFI. Instructions are provided on how to enter information, select the recipient(s), set a priority level, schedule the acknowledgement and response of the RFI, and issue the package.

Beginner Bluebeam

The beginner Bluebeam training material comprises seven modules that walk through basic actions and tools in Bluebeam. This material is targeted toward new Bluebeam users and those that find the program challenging or difficult to use.

Interface and Navigation (ORG and Video)

This module provides an overview of the Bluebeam interface and a tour of the various tools and actions available in the program. Beginning with the top menu bar, each item is briefly reviewed, including the Revu, File, View, and Document dropdown menus. Next, the left toolbar is investigated where the toolbar icons are described, including the File Access, Tool Chest, Measurements, Properties, Search, and Studio Panel icons. While a description is provided for each icon, additional Bluebeam modules are mentioned that indicate where additional training is found. The navigation bar is then reviewed, including tools to navigate documents, split screen features, and zoom options. Finally, the markups list found below the navigation bar is briefly introduced. Because this module provided an overview of the interface, an interactive module was not required and thus was not developed for the topic.

General Markup Tools (ORG, Video, and Interactive Module)

As the primary use of Bluebeam in the Office of Construction, the General Markup Tools module was the most critical Bluebeam module developed. The module aims to provide a general overview of the markup tools in Bluebeam and how they are applied and edited on a drawing. Specifically, the module begins with a description of how the markup tools are accessed in the interface, both

under the Tools dropdown menu and the Tool Chest icon. Next, various markup tools are discussed and applied to a sample drawing sheet, including the textbox, typewriter, note, callout, 1D and 2D sketching, cloud, and cloud+ markup. Because many of the editing options are similar across the markup tools, the text callout editing options are extensively discussed, including how to edit the color, adjust the size, and add a border to the markup. Once various markups are applied to the drawing, the group and lock tools are discussed as an effective method to work with multiple markups at once. Finally, the markups list is reviewed where the full list of markups and accompanying markup properties are shown.

Converting File Types (ORG, Video, and Interactive Module)

This module aims to review the various file conversion options offered by Bluebeam and how to execute a file conversion. First, the module shows where the file conversion options are found under the File dropdown menu, followed by a brief description of the options, including image files and Word, Excel, and PowerPoint files. Next, multiple file conversions are shown, starting with a conversion from a PDF to a Word document. The Word document is then converted back to a PDF and opened in Bluebeam. Finally, two additional examples show conversion of a PDF document to a JPEG image file and an Excel workbook file.

Document Manipulation (ORG, Video, and Interactive Module)

Document manipulation techniques were discussed as a major challenge in the survey and subsequent construction meetings. This module aims to walk through various document manipulation techniques used on a regular basis by construction personnel. The module begins by describing where the document manipulation tools are found, including the Document tab and by right-clicking on a page in the Thumbnails section. Next, the module reviews the tools available, including how to insert, delete, and extract pages from a document; combine files; replace pages;

and rotate pages using a sample eight-page drawing set. Finally, the module describes how to pin the document manipulation tools to the toolbars for easy access. Toolbar and interface customization are the focus of the Interface Customization module.

Digital ID and Signing Documents (Video and Interactive Module)

Applying a digital signature in Bluebeam was one of the few existing GDOT training documents available for Bluebeam. Following along with the existing document, this module reviews how to create a Digital ID in Bluebeam. Next, the module shows how to apply a signature to the Digital ID and the various editing and appearance options available. Finally, the Digital ID is applied to a sample drawing sheet. Because an existing training document is available, a PDF guide was not developed for this topic.

Use of the Flatten Tool (ORG, Video, and Interactive Module)

The flatten tool was frequently discussed in the construction meetings. This training module aims to address the challenges and confusion brought up in the meetings regarding the flatten tool. First, a brief overview is provided, including what the tool does and why it is used. Next, the module reviews how to flatten individual markups on a drawing, followed by how to flatten an entire document. The module walks through the various options provided by the interface when flattening a document, including flatten options and document recovery options. Finally, the unflatten tool is reviewed so the user is able to edit the document once again.

Scale and Measurement Tools (ORG, Video, and Interactive Module)

While not initially brought up in the survey or construction meetings, the project advisory group discussed the addition of a module to discuss how to check the scale on a document, how to calibrate the scale, and the various measurement tools offered in Bluebeam. This module aims to

address these concerns, beginning with the Bluebeam interface scale options. First, the Measurements icon is reviewed, where there are options to set a preset scale or calibrate a new scale. This module is concerned with the calibration scale option. After calibrating the scale, the module reviews various measurement tools, including the length, polylength, perimeter, and area tools. The tools are applied to a sample roadway drawing sheet. Finally, the module indicates where the measurement tools are stored in the markups list, similar to other markup tools.

Intermediate–Advanced Bluebeam

The intermediate–advanced Bluebeam training material comprises six modules that walk through more advanced tools and actions in Bluebeam. While the program was designed to be asynchronous, it is recommended new users first view the beginner material, as the module topics presented below are targeted toward more advanced Bluebeam users.

Viewing Options in Bluebeam (QRG, Video, and Interactive Module)

One of the primary challenges associated with Bluebeam was the inability to use the program effectively and efficiently to its full capacity. A specific challenge was discussed on how to view multiple drawing sheets at a time when reviewing plans. This module aims to review the various viewing options provided in Bluebeam. First, the module reviews the different viewing options for a single page, including the fit page, fit width, and actual size options. Next, the single page, continuous pages, side-by-side, and continuous side-by-side viewing options are investigated and discussed. Additionally, the split screen tools are shown as a means to view separate documents at once, using a synchronized view and unsynchronized view. Finally, the compare and overlay tools are investigated using an old and updated version of a drawing sheet.

Advanced Markup Tools: Stamp and Hyperlink ([ORG](#), [Video](#), and [Interactive Module](#))

While the General Markup Tools module describes the basic markup tools, this module aims to review two more-advanced markup tools frequently used by the Office of Construction: the stamp and hyperlink tools. The stamp tool is discussed first, beginning with a review of the prebuilt stamps provided by Bluebeam, including the Approved and Date & Time stamps. Multiple stamps are applied to a sample drawing. Next, the module reviews how to create and edit a custom stamp. After the stamp tool review, the module investigates the hyperlink tool. Four hyperlink options are described, including the Jump to, Snapshot View, Hyperlink, and Open options. After applying multiple hyperlinks to the sample drawing, the module reviews how to edit and make the hyperlinks visible.

Advanced Markup Tools: Layers ([ORG](#), [Video](#), and [Interactive Module](#))

Working with Bluebeam layers was discussed as a challenge by the project advisory group. This module provides an overview of the layer tool and walks through how to create layers and layer configurations. First, the module walks through the creation of multiple new layers in the interface. Next, the module shows how to assign individual and multiple markups to layers. Various layer options are discussed, including layer visibility and print/export options. Finally, layer configurations are discussed. The module walks through how to create, name, and edit a new layer configuration. As with previous modules, the markups list is once again reviewed to indicate that layer properties are shown in that list.

As-Built Plan Process ([Video](#) and [Interactive Module](#))

The project advisory group indicated the importance of the As-Built Plan Process for construction operations and requested the process be shown in the Bluebeam training program. This module follows along with an As-Built Plan Process PowerPoint presentation provided by the project

advisory group that outlines both the electronic As-Built Plan and Shop Drawing Review process. Beginning in ProjectWise, the module reviews how to copy a drawing sheet from the current set of plans folder into the As-Built Plans folder. Next, the drawing is stamped with an As-Built stamp and checked back into ProjectWise. Shop drawings are produced in Bluebeam and then submitted through ProjectWise Deliverables Management that tracks the receipt and status of submittals, along with alerting individuals when submittals arrive and are due. Specifically, in Bluebeam, this module walks through how to combine markups from multiple reviewers into one master drawing. Because an existing PowerPoint presentation was available outlining the As-Built Plan steps, a PDF guide was not developed for this topic.

Interface Customization (ORG, Video, and Interactive Module)

The Bluebeam interface is completely customizable to fit specific user workflow needs. This module aims to walk through the various options to customize the interface to better fit specific user needs, which would allow for a more efficient use of the program. First, the module describes the prebuilt profiles offered by Bluebeam, including the Revu, Revu Advanced, Quantity Takeoff, and Field Issues profiles. Next, a custom profile is created. The remainder of the module focuses on interface customization, starting with the left toolbar where various icons are moved and hidden from view. Next, the top menu toolbars are edited and customized. Finally, the module walks through how to save and export the custom profile.

Bluebeam Studio (Video)

The final module in the Bluebeam training program reviews how to get started using Bluebeam Studio. Bluebeam Studio is a cloud-based service that allows multiple users to collaborate and mark up a document in real time. The project advisory group indicated Studio is a new feature in the Office of Construction and thus would be a benefit if included in the training program. This

module follows along with two existing GDOT documents pertaining to registering for, creating, and working in a Bluebeam Studio account. First, the module walks through how to create and log in to a Studio account. Next, the Studio session tools are described, including how to begin a session, join a session, invite users to a session, and upload plans to a session. The module describes how all activity is recorded in the session, including markups. Finally, options are reviewed on how to leave and conclude a session, followed by creating a session report. Because existing training documents were available for Bluebeam Studio and the module provided an overview of the session features and tools, a PDF guide and interactive module were not developed for this topic.

Beginner CATS

The beginner CATS training material comprises two modules that walk through basic functions and actions within CATS. This material is targeted toward new CATS users and those that find the program challenging or difficult to use. Because existing PDF guides are available, the CATS topics focused specifically on video demo and interactive module development.

Introduction to CATS (Video)

This video module provides a basic understanding of CATS and essential elements of the program interface. The module reviews the process of accessing CATS and navigating through various sections of the program interface with filters and user actions. The module begins by illustrating how to access the CATS program through the MyGDOT portal. The majority of the video reviews the essential elements of the CATS interface to provide a better understanding of how to efficiently and effectively use the program.

Navigating, Searching, and Finding Projects (Video and Interactive Module)

This video module provides an overview of navigating and searching CATS to find contract documents efficiently. Specifically, this module walks the user through the process of viewing contract status, searching for contracts, and filtering and sorting search results in CATS. The beginning portion of the video reviews how to view the status of a particular contracts within the CATS interface. The module then shows how to search for contracts within CATS. Next the video illustrates how to filter search results in CATS. Lastly, the video highlights how to sort results within CATS and the benefit it brings by easing the visualization of search results and finding documents more efficiently.

Intermediate–Advanced CATS

The intermediate–advanced CATS training material comprises two modules that walk through more advanced functions and actions in CATS. While the program was designed to be asynchronous, it is recommended new users first view the beginner material, as the following module topics are targeted toward more advanced CATS users. Similar to the Beginner CATS modules, existing PDF guides are currently available; thus, the CATS topics focused specifically on video demo and interactive module development.

Working with Contract Documents (Video and Interactive Module)

This video module provides an overview of working with contract documents within CATS to create, edit, and review contracts effectively. Specifically, this module walks the user through the contract approval process, generating a contract ID, editing and submitting contracts, and cancelling contracts in CATS.

Supplemental Agreements (Video and Interactive Module)

This video module provides an overview of Supplemental Agreements within CATS and the negotiation process between GDOT and external parties of a project. This module reviews the workflow process of Supplemental Agreement negotiations including the creation of a Supplemental Agreement Negotiation, Change Order information, and viewing or changing Vendor information in SA Negotiations in CATS.


Sample Training Material

This subsection provides sample training material and discussion from the beginner Bluebeam General Markup Tools module. As discussed previously, the QRG training documents provide the user with a quick reference of the actions carried out in the video demos and interactive modules. Screenshots from the Bluebeam General Markup Tools QRG are shown in figure 33 and figure 34.

The QRG documents use callouts and numbered steps to walk through actions being carried out in the software. Each document is organized by sections, as seen in figure 33 with editing markups and figure 34 with the snapshot tool. After a brief description of the tool/process, the QRG displays screenshots, callouts, and/or numbered steps that indicate how to progress in the software.








The video demos provide the user with an engaging but non-interactive step-by-step video of actions being carried out in the software. Screenshots from the General Markup Tools video demo are shown in figure 35 and figure 36, discussing the same features as the QRG.

Editing Markups

Editing options are found by right-clicking on the markup with options to layer, flatten, or lock the markup, among other tools. The appearance and style of the markup can be edited by selecting the markup and navigating to the Properties icon, , on the left panel bar. For example, the following options are available for the callout markup. Many of these options remain the same for other types of markups:

Callout Properties

General
 Author: wts45869
 Subject: Callout
 Callout detail
 Modified: 6/15/2021 2:50:52 PM
 Lock (0) Replies

Appearance
 Color:  Color of the callout leaders
 Fill Color:  Textbox fill color
 Opacity: 100 Opacity of the text
 Fill Opacity: 100 Textbox fill opacity
 Line Width: 6.00
 Style:  Creates a line border around the text
 Shape: Rectangle
 End:  Auto  Edit the end of the arrow, options including a solid tip
 Font: Helvetica
 Font Size: 12 Font Size
 Line Space: 1.00 Text edits
 Margin: 3.00
 Font Color: 
 Alignment: 
 Font Style: B I T T' T

Layout
 X: 27.2631 Inches
 Y: 7.3122 Inches
 Document Width: 1.0374 Inches
 Document Height: 0.2778 Inches
 Rotation: 0°

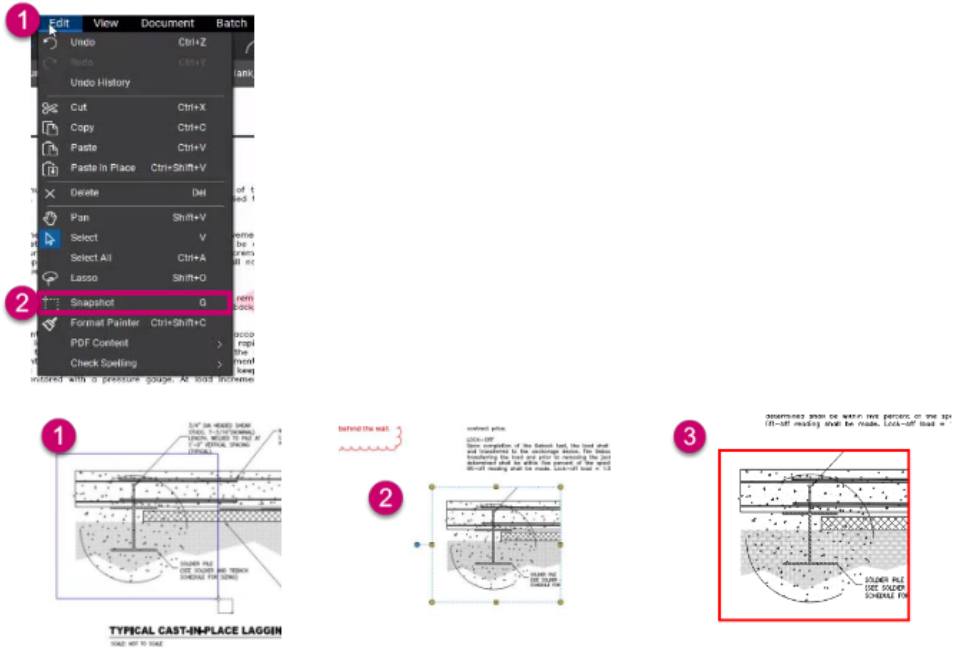
General information: Where the author, subject, and content can be edited. This is also where the markup can be locked

Layout information: Where the location and size of the markup can be edited, along with adding a rotation.

Figure 33. Image. Bluebeam General Markup Tools PDF guide: Screenshot 1.

Snapshot Tool

The snapshot tool provides a useful method to take a closer look at a portion of a drawing. To access the snapshot tool, navigate to Edit and select snapshot:



1. A cursor will appear that allows the user to click and drag on a portion of the drawing. Outline the desired area of the document for the snapshot.
2. Once the tool is released, it is automatically copied to the interface. Simply press escape and then paste the snapshot anywhere on the drawing.
3. The snapshot can be enlarged by clicking and dragging the image and a border can be added to it under the Properties icon.

Figure 34. Image. Bluebeam General Markup Tools PDF guide: Screenshot 2.

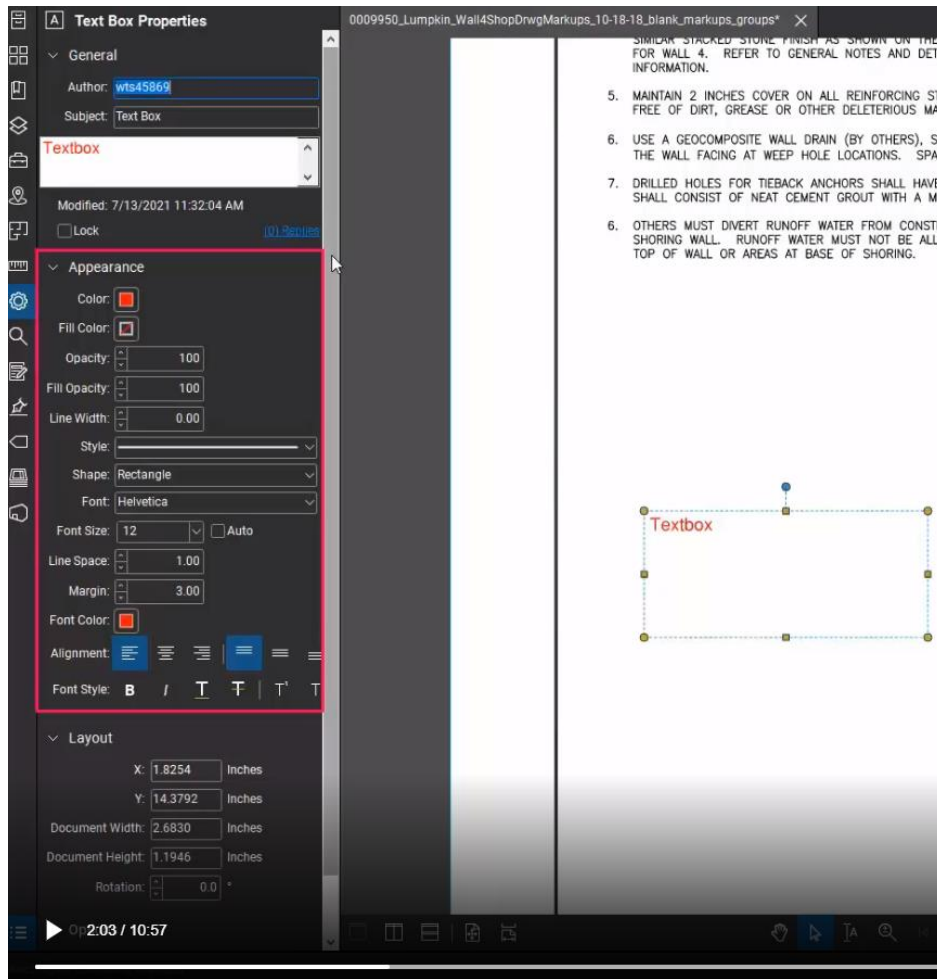


Figure 35. Image. Bluebeam General Markup Tools video demo: Screenshot 1.

Figure 35 shows the video demo walking through the editing options of a textbox. Similar features displayed in the QRG document, figure 33, are discussed and the textbox is edited to highlight these options. Similar callouts are used in the video as the QRG documents. Figure 36 shows the snapshot tool being applied and edited in the interface. Once again, the steps outlined in the QRG document, figure 34, are described in further detail in the video.

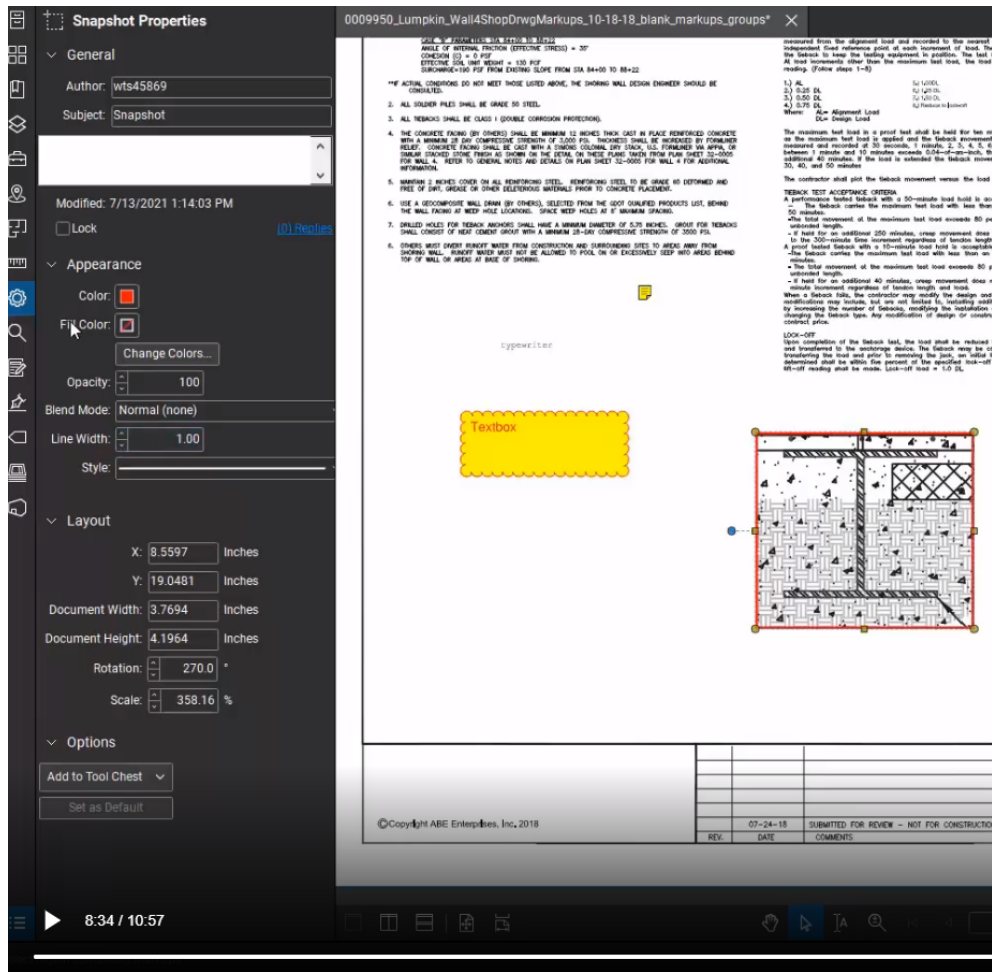


Figure 36. Image. Bluebeam General Markup Tools video demo: Screenshot 2.

The final piece of the training program is the interactive module. The interactive module provides users with the opportunity to walk through the software actions on their own using on-screen prompts. Figure 37 and Figure 38 display a screenshot from the Bluebeam General Markup Tools interactive module where the user is asked to edit a textbox markup that was applied to a sample drawing sheet.

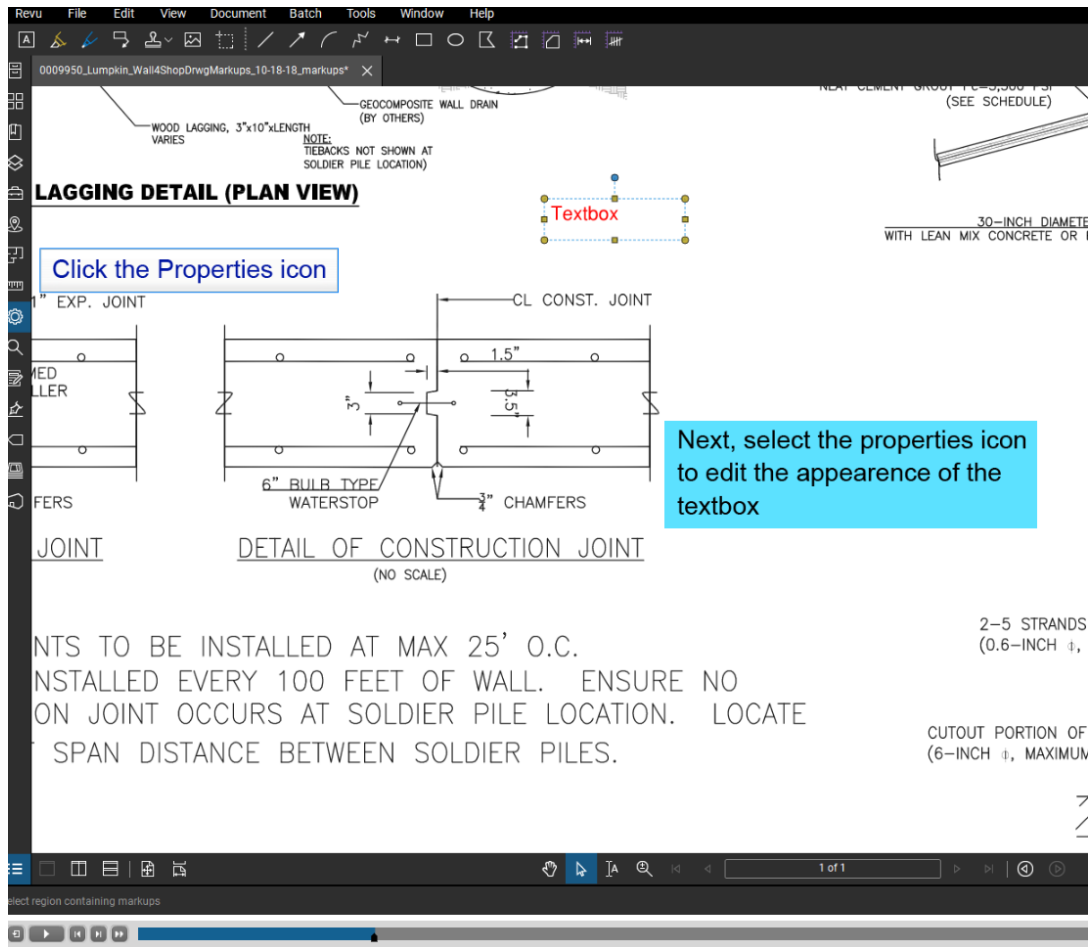


Figure 37. Image. Bluebeam General Markup Tools interactive module: Screenshot 1.

The interactive module uses various callouts and prompts to walk the user through the software actions discussed in the QRG guide and the video demo. Specifically, this interactive module asks the user to add a fill color and border to the textbox, as shown in Figure 38.

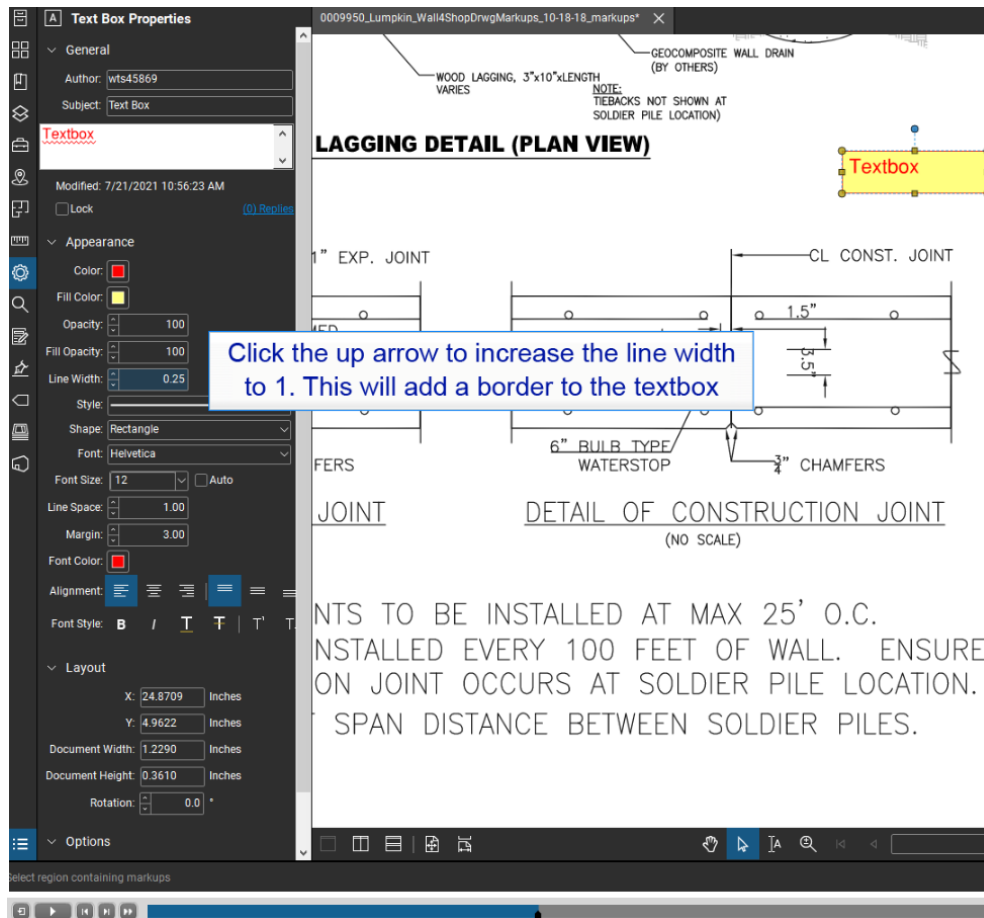


Figure 38. Image. Bluebeam General Markup Tools interactive module: Screenshot 2.

The combination of QRG training guides, video demonstrations, and interactive modules creates an engaging and multi-layered training program that software users of varying experience levels and preferences can utilize to further enhance their efficiency with the e-construction software.

TRAINING PROGRAM PUBLISHING

The project advisory group requested that the new training material be housed in two locations:

1. The Certifications and Training public site ([GDOT 2022a](#)), under the Training Modules section.

2. The Office of Construction internal site on the MYGDOT page.

Significant coordination with the Office of IT was necessary to post a set of sample materials, three video demos, three PDF documents, and three interactive modules covering the flatten tool, document manipulation, and scale/measurement tools to the specified locations to test the training accessibility. Before publishing the material, the Office of IT offered various recommendations for the material, primarily dealing with the style and format to keep consistency with existing IT training. The updates are outlined in the following subsections.

QRG Document Updates

GDOT formatting additions, including header, callouts, and subheaders, were incorporated. Additionally, style updates with GDOT training colors and guidelines were included. Specifically, the GDOT heading and subheading details are shown in Figure 39 with the Bluebeam General Markup Tools and Document Manipulation training guides.

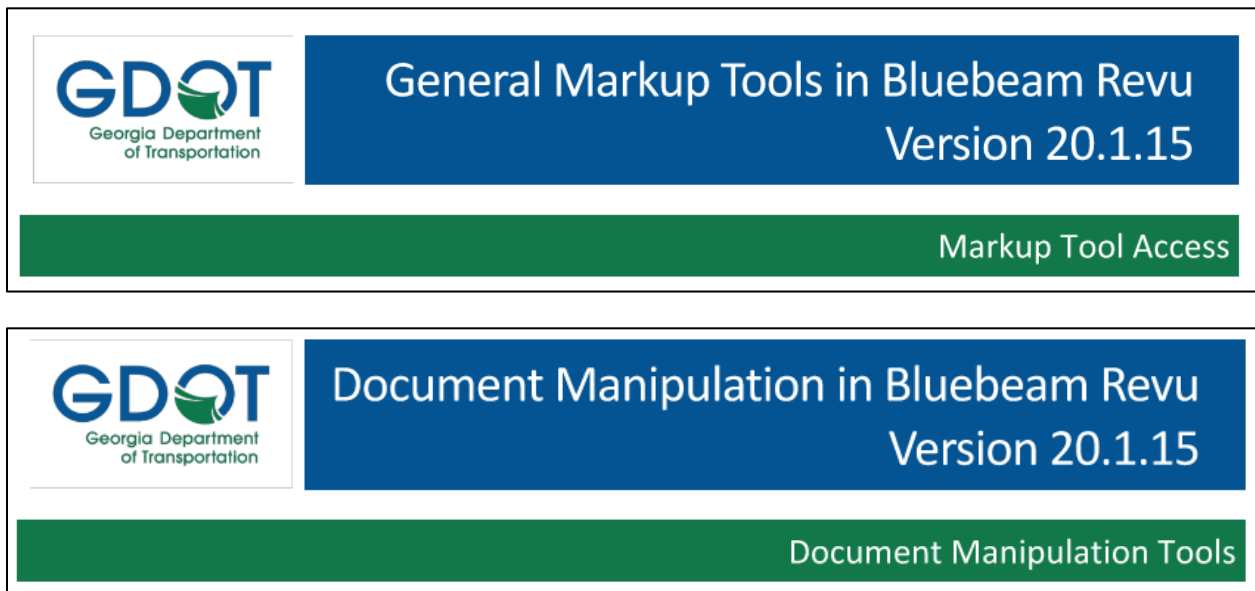


Figure 39. Images. GDOT PDF guides header and subheader samples.

An additional update requested by IT was the incorporation of supplementary numbered step-by-step instructions in the documents, rather than instructions written in paragraph form. An example of this type of update is shown in figure 40, taken from the Bluebeam Document Manipulation training document.

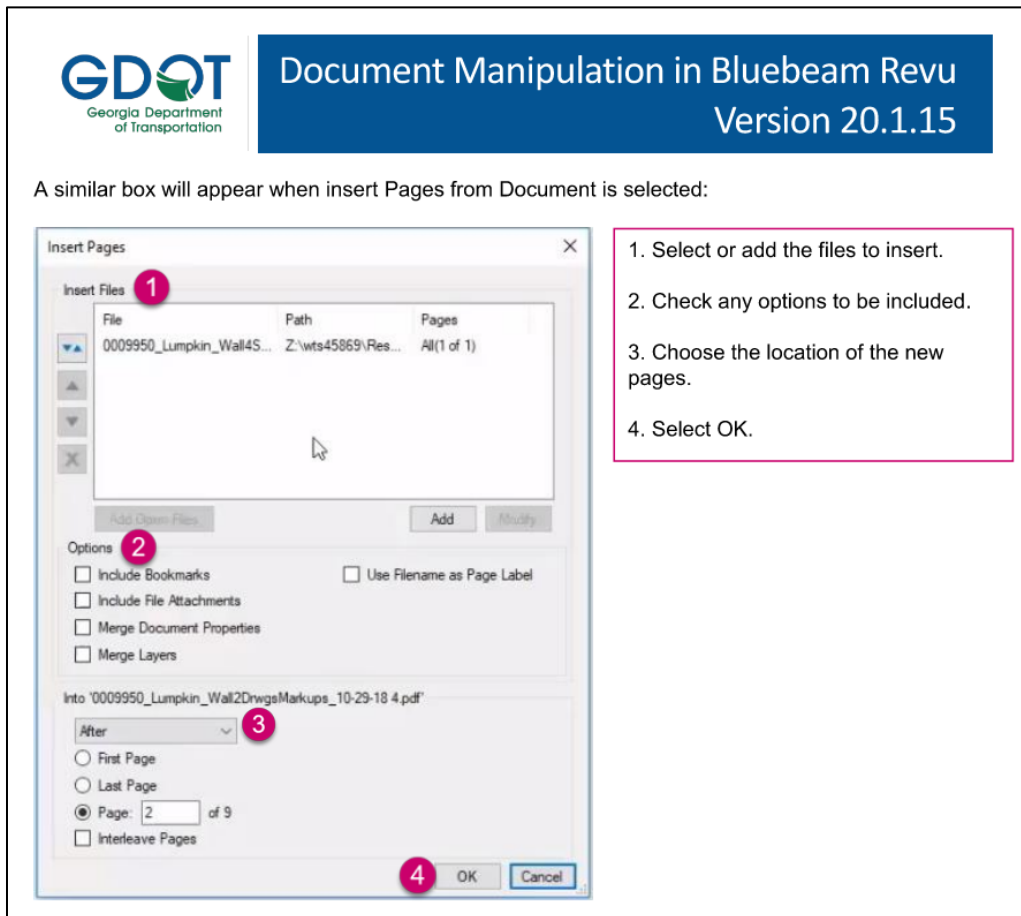


Figure 40. Image. PDF guide with numbered step-by-step instructions.

Video Updates

The addition of beginning slides that outline the goals and objectives of the videos were recommended. Additionally, minor format/content updates throughout the videos were required. An example of a beginning slide is shown in figure 41 from the Bluebeam Document Manipulation video demo where three primary module goals are defined.

Goals and Objectives

- Accessing the document manipulation tools
- Document manipulation tools including inserting, deleting, and extracting pages, combining files, replacing and rotating pages
- Pin the tools to the interface toolbars for quick access

▶ 0:15 / 8:43



Figure 41. Image. Document Manipulation video demo goals and objectives slide.

Interactive Module Updates

Significant workflow updates were recommended that included placing textbox instructions first, followed by arrow indicators if the user mis-clicks. Figure 42 provides an example where an arrow indicator appears after a mis-click, showing the user where to click to progress through the module.

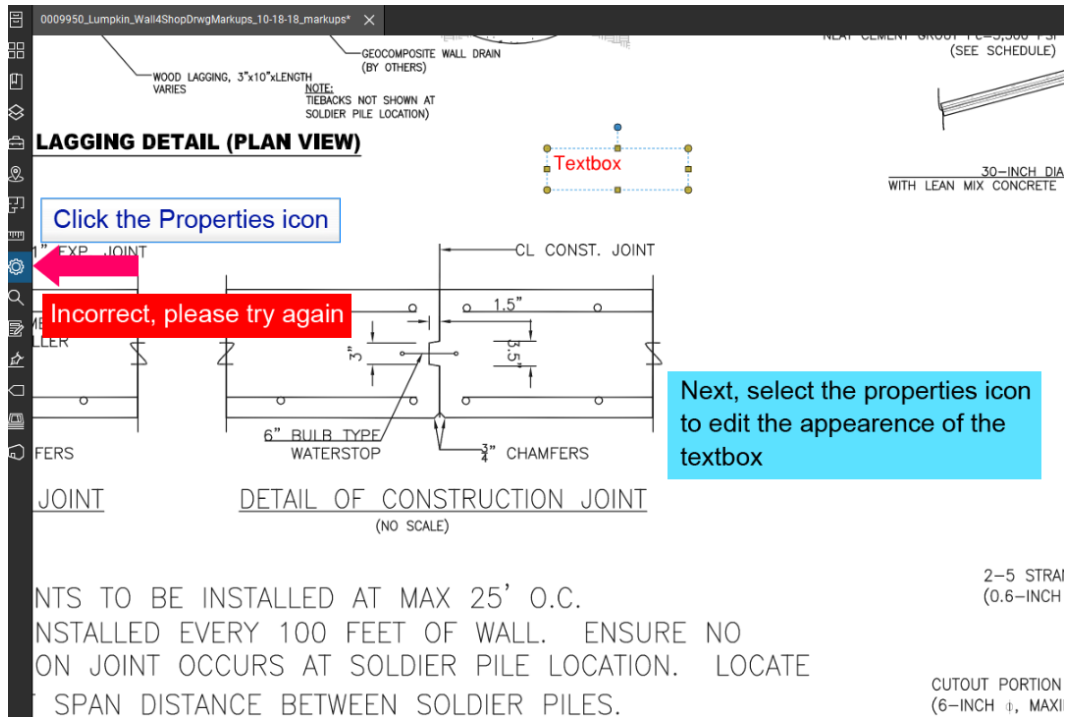


Figure 42. Image. Interactive module workflow update.

Similar to the videos, a beginning slide containing module objectives was added. Additionally, a click action was created at the end of the modules that requires users to click in a specified area to end the module. Finally, an interactive module “navigation guide” was developed that outlines how to navigate and complete the interactive modules.

Following these updates, the material was posted to the two specified locations, along with the internal MYGDOT training tutorials page. Because no Bluebeam training previously existed, the Office of IT created a Bluebeam icon on the training page to house the new material. Additionally, a Bluebeam section was created for the content on the Certifications and Training page ([GDOT 2022a](#)) and the internal Office of Construction site.

TRAINING PROGRAM PROMOTION

One of the primary obstacles with new training implementation is successfully promoting the material to maximize user engagement. As previously discussed in this chapter, 25.00 percent of survey respondents were unaware of the existing ProjectWise material. Additionally, District 1 and 2 construction personnel indicated they were unaware of both the ProjectWise training material and CATS training material located on the internal MYGDOT page. In order to fully implement and promote the new ProjectWise, Bluebeam, and CATS training programs, the research project requires the “Delivery of updated *Construction Manual* and training modules through an in-person workshop.” This workshop occurred at the University of Georgia Engineering Leadership and Development Center on August 30, 2022. The program was organized as a half-day event geared toward personnel within the Office of Construction and district/area offices. The objective of the workshop was to:

- Provide an introduction and overview of the training program (types of training: Bluebeam, ProjectWise, and CATS along with goals and outcomes for the training).
- Review the training modules and what can be expected from each.
- Show selected video modules and work through several interactive modules.
- Promote the training program to encourage use and adoption.

Because the training material is housed in multiple locations, the UGA research team reviewed exactly how to locate and access the material, both on the public website and the internal MYGDOT page. Finally, the meeting aimed to address any comments, questions, or concerns from the construction staff and promote additional ideas from the staff about how to improve future e-construction training. All program participants received a digital and printed workshop book that

included a summary of the training content that is available, as well as the QRG documents for the Bluebeam modules and the workflow model flowcharts.

ENHANCEMENTS TO THE CURRENT GDOT *CONSTRUCTION MANUAL*

Electronic As-built Plans Process

As-built drawings (also known as record drawings) are contract drawings marked up to reflect changes made during the construction process. Redlining is the act of drawing corrections or changes on previous drawings. As the name implies, the term comes from the red pen used to traditionally amend the drawings by hand. Redlining is essentially the process of creating as-built drawings. This study generated the following process maps to enhance the current practice of as-built processes. The process maps shown in figure 43, figure 44, figure 45, and figure 46 are suggested to be included in Chapter Five – Source, Supporting, Measurement and Material of the *Construction Manual*.

Figure 43 demonstrates how to document electronic as-built plans in Bluebeam. The figure contains two columns: the column on the left shows the general process for documenting as-built plans, and the column on the right shows how Engineering Document Management (EDM) staff assign document (or plan) type in Bluebeam.

Figure 44 demonstrates how to combine current plan sheets in Bluebeam. The figure consists of four columns. Each column shows a step in the process. In each column, the name is at the top, and related operations are listed below.

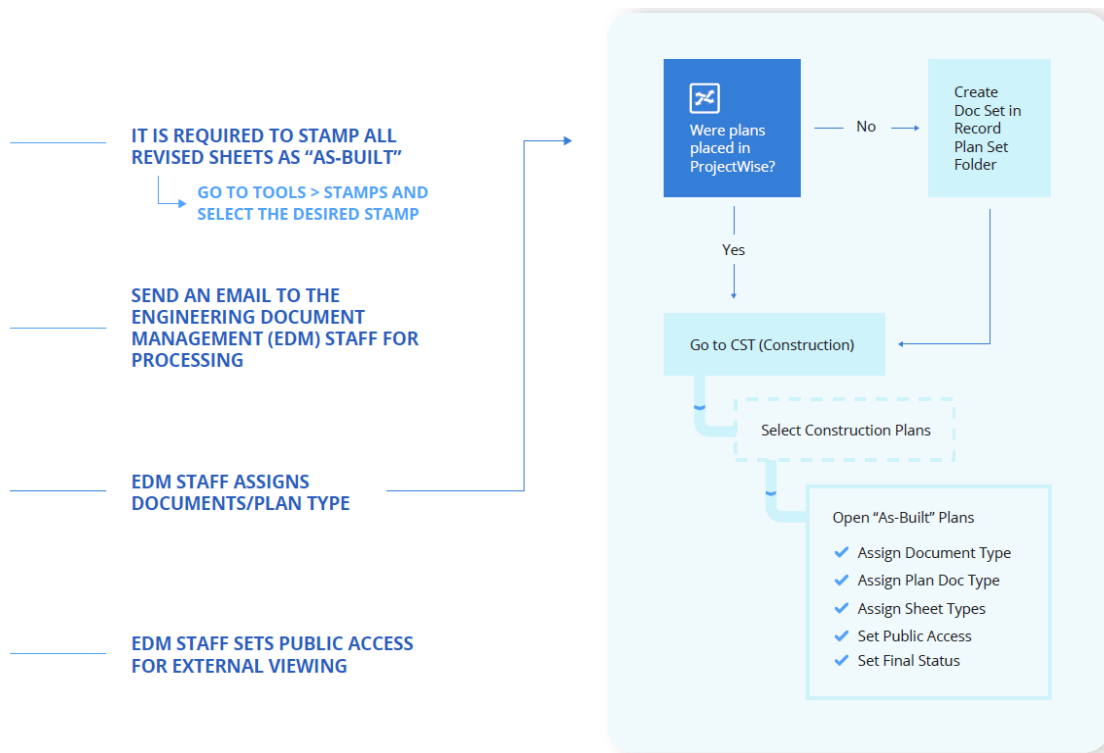


Figure 43. Image. Documenting electronic as-built plans process in Bluebeam.



Figure 44. Image. Combining current plan sheets in Bluebeam.

Figure 45 demonstrates how to complete elemental edits in Bluebeam. The figure consists of four columns. Each column shows a step in the process. In each column, the name and corresponding explanation are in the blue textbox, and related operations are listed below.

Figure 46 demonstrates how to redline as-built sheets in Bluebeam. The figure explains where to find and how to use the five commonly used functions for redlining, i.e., snapshot tool, “markup” tab, hyperlink, stamp tool, and calibrate tool. The definitions of the five functions are also introduced in the figure.

Construction Manual Workflow Models and Flowcharts

The workflow models show the sequential series of tasks that comprise a construction administration process. The visual representations identify all parties involved in the process and define the sequences of tasks that these stakeholders should execute. Main decision points will be specified on the workflow models. Points of information interchange among parties will be defined on the workflow models. One of the main benefits of the workflow models is to help GDOT employees see how construction administration processes work. The workflow models are developed to supplement the training videos as an additional resource for GDOT staff to standardize and streamline the construction administration process. This study aimed to enhance the workflow charts retrieved from the GDOT *Construction Manual* by developing the workflow models for significant subjects yet to be created and presenting visual flowcharts through textual information. These workflow models are anticipated to be incorporated as an appendix or as supplementary documents in the *Construction Manual*. This study identified critical areas needed to develop visual aids. Based on feedback from the GDOT Office of Construction, seven broad areas were selected (see table 9).table 9. a summary of flowchart

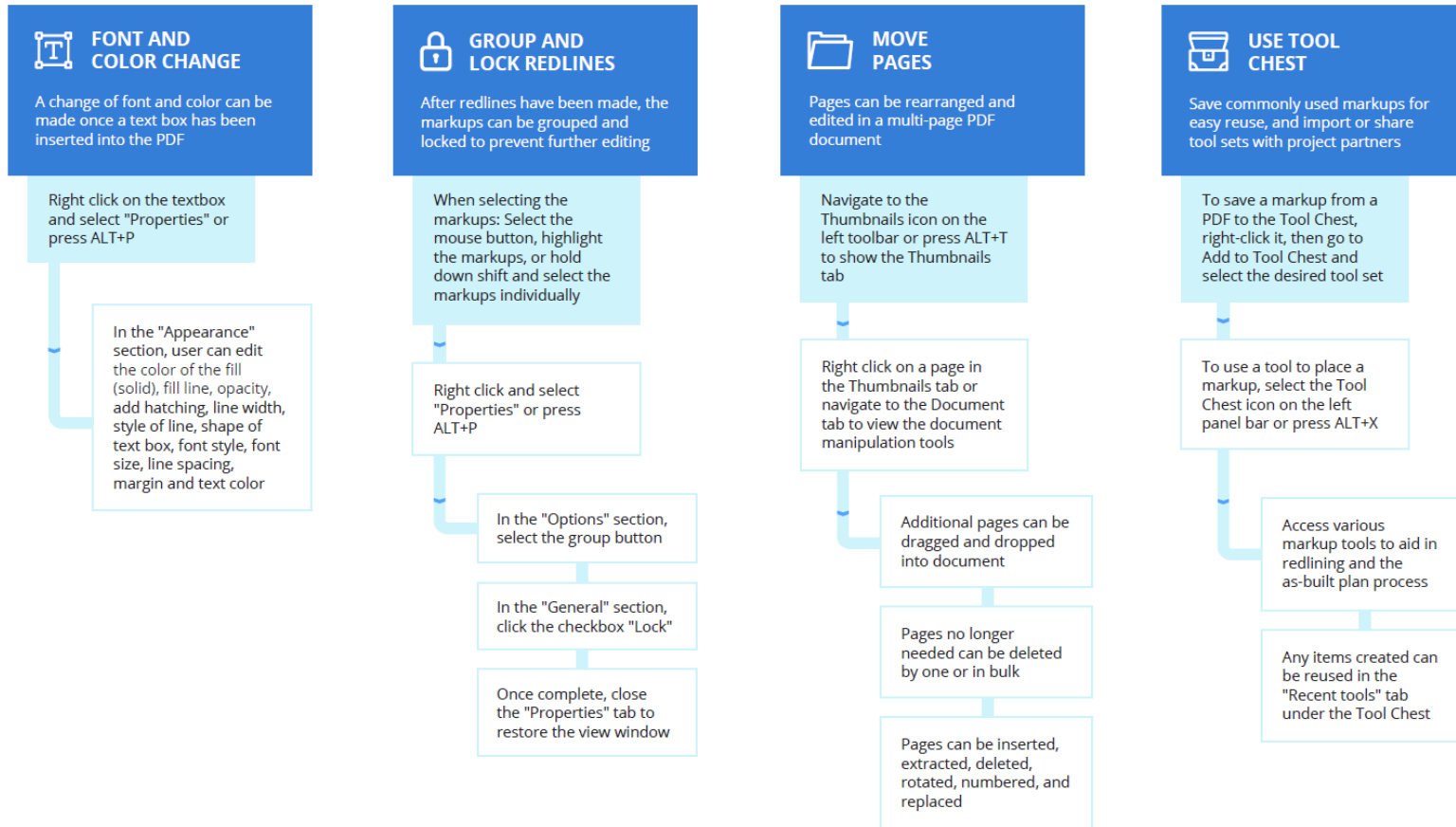


Figure 45. Image. Editing documents – Completing elemental edits in Bluebeam.

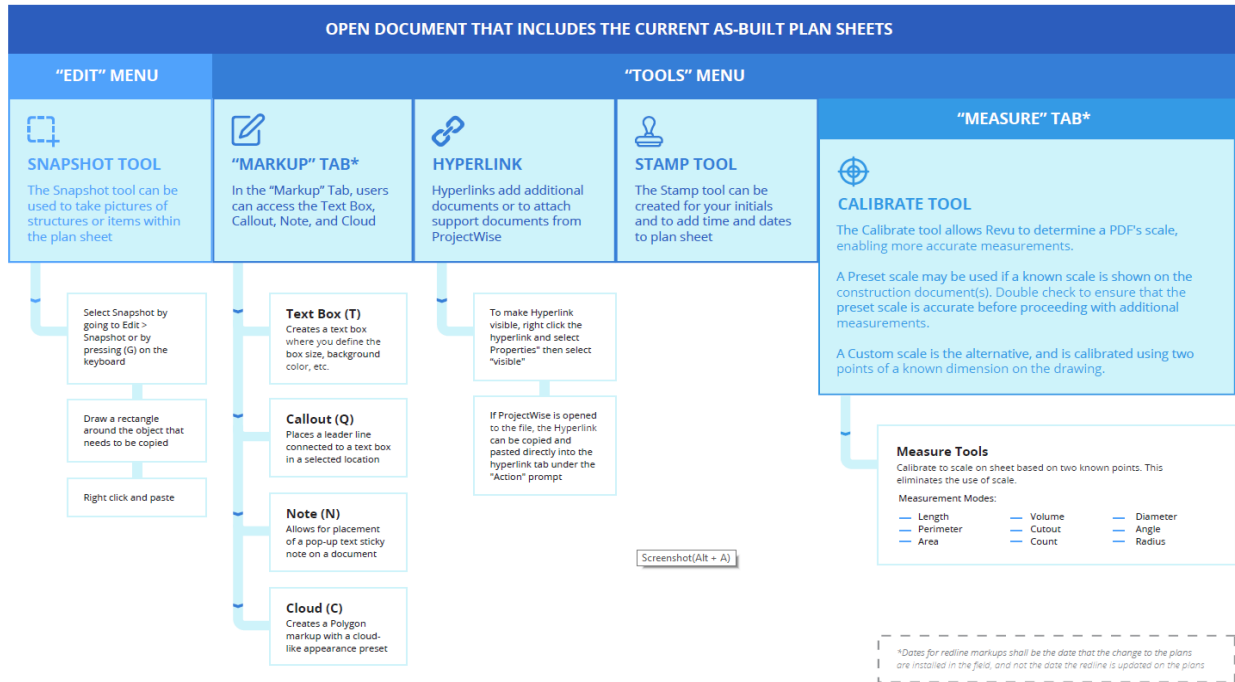


Figure 46. Image. Editing documents – Redlining as-built sheets in Bluebeam.

Table 9. A summary of flowchart candidates.

Topic	Item	Construction Manual
Time	Notice to Proceed (NTP)	1-1 (p. 10)
	Time Extensions	2-8 (p. 21)
Material	Materials Certificate	5-8 to 5-12 (pp. 46–50)
	Materials Reconciliation Checklist Reporting and Finalizing	5-8 to 5-12 (pp. 46–50)
Contract Management	Contract Modifications	9-3, 12-1 to 12-3 (pp. 72, 95–97)
	Change Orders	14-4 to 14-9 (pp. 120–125) (CATS)
QA/QC	Field Inspection	3-1 to 3-2 (pp. 30–31)
	Final Inspection	21-2, 23-2 (pp. 184, 209)
	Final Acceptance	21-3, 23-2 (pp. 185, 209)
	Projects Pending Final Payment Reports (PPFPR)	10-4 to 10-5 (pp. 81–82)
	Contract Close Out	21-6 to 21-13 (pp. 188–195)
	Final Audit	19-2 to 19-3 (pp. 180–181)
Traffic Control	Accident Documentation	7-2 (p. 57)
	Traffic Interruption Reports	7-3 to 7-4 (pp. 58–59)
Others	Daily Work Report	6-1 to 6-2 (pp. 54–55)
Local Administered Projects	Contract Bidding	9-1 (p. 70)
	Audit	9-2 (p. 71)
	Contract Modifications	9-3 (p. 72)
	Progress Payments	9-4 (p. 73)

Time Topic

The first topic, *Time*, has two sub-items: *Notice to Proceed (NTP)* and *Time Extensions*. Figure 47 depicts four primary parties involved in the NTP. The Area Manager initiates the process of issuing the NTP. Followed by the Area Manager, the District Right of Way Office confirms all obstruction has been cleared, and the Construction Bidding Administration ensures that the right of way is certified. It is important that the Contractor not perform any work on a project until receipt of the NTP.

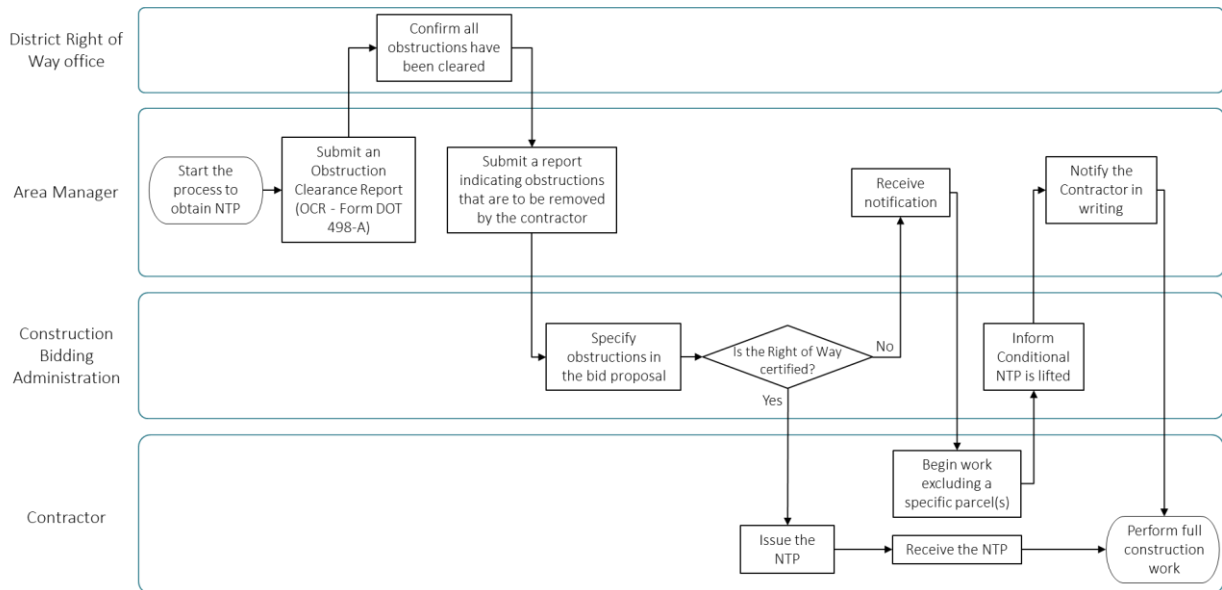


Figure 47. Flowchart. *Notice to Proceed* topic.

The second item related to *Time* is *Time Extensions*, which is an important item. Figure 48 presents how the Contractor requests a time extension and receives the time extension decision from the Construction Manager. According to the *Construction Manual*, the reasons for *Time Extensions* usually occur if “the Contract requires the performance of Work in greater quantities than those in the Proposal, including significant overruns or extra Work” or if “it is determined

that the controlling items of Work were delayed because of conditions beyond the control of and without the fault of the Contractor” ([GDOT 2020a](#)).

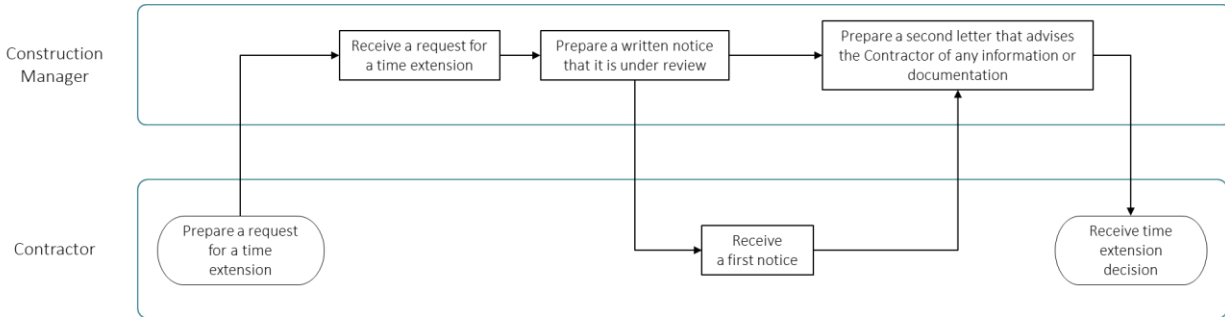
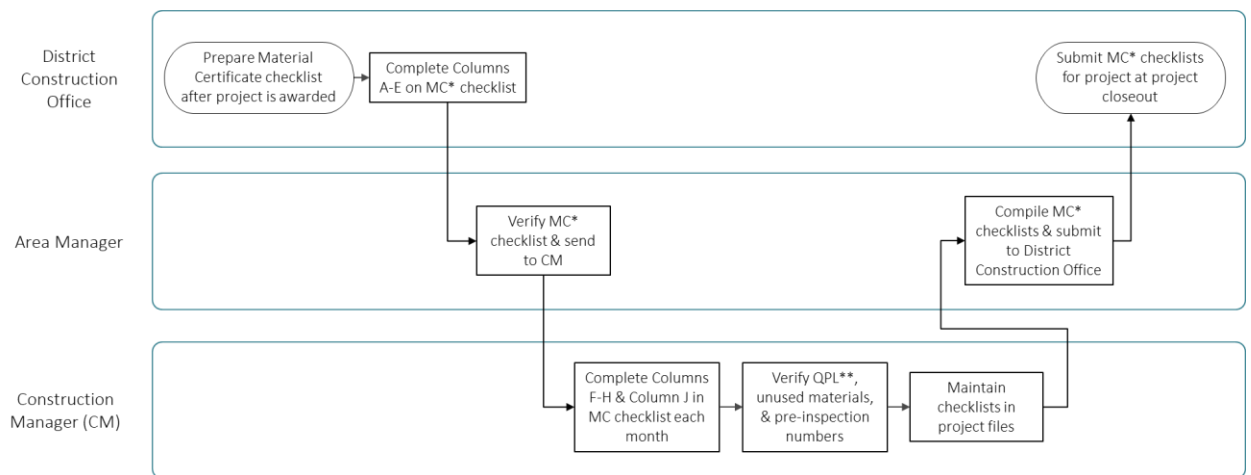


Figure 48. Flowchart. *Time Extensions* item.

Material Topic

Moving to the second topic, *Material*, Figure 49 presents the *Materials Certificate* (MC) required for all DOT projects, other than off-system “State-Aid” projects. The District Construction Office develops an MC checklist, which is used to obtain the MC and the *Materials Reconciliation* (MR) after the project is awarded.



*MC = Materials Certificate
 **QPL = Qualified Products List

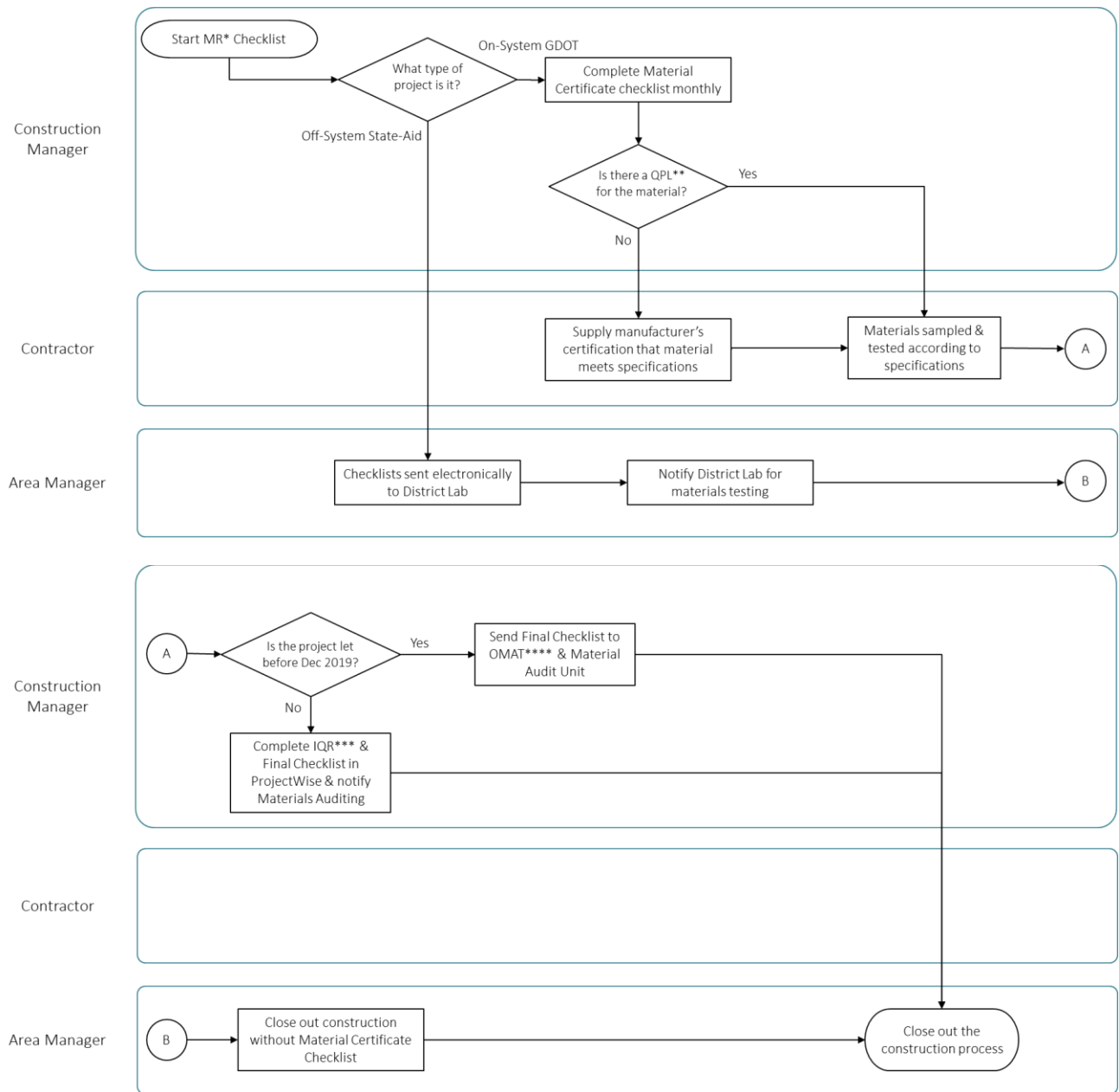
Figure 49. Flowchart. *Materials Certificate* item.

Figure 50 describes *Material Reconciliation Checklist Reporting & Finalizing*. As mentioned above, MC has no requirements if the project is the off-system “State-Aid” project. In this case, the Area Manager needs to send checklists electronically to the District Lab. If the project is an on-system GDOT project, the Construction Manager should complete a monthly MC checklist. Using materials not on the qualified projects list (QPL) requires contractors to submit a manufacturer’s certificate separately that indicates materials meet specifications. For those projects that are let after December 2019, an Item Quantity Report (IQR) can be submitted via ProjectWise. Otherwise, the Construction Manager should send the final checklist to the Office of Materials and Testing.

Contract Management Topic

The third topic—*Contract Management*—includes two items: *Contract Modifications* and *Change Orders*. Figure 51 describes how the Construction Manager addresses the contract modifications, which can be handled differently depending on the changes due to adding new items, time, or both item and time.

In continuation of the process described in figure 51, figure 52 explains the *Change Order* process in SiteManager. Once the Contractor requests a change order, the Construction Manager verifies the request and initiates the Contract Authorization Tracking System Supplemental Agreement (CATS SA) process; the District Engineer will approve the CATS SA. It is noted that the Contractor needs to remind the Construction Manager to constantly check the flow of the SA in CATS for delays.



*MR: Material Reconciliation; **QPL: Qualified Products List; ***IQR: Item Quantity Report; ****OMAT: Office of Materials & Testing

Figure 50. Flowchart. *Material Reconciliation Checklist Reporting & Finalizing item.*

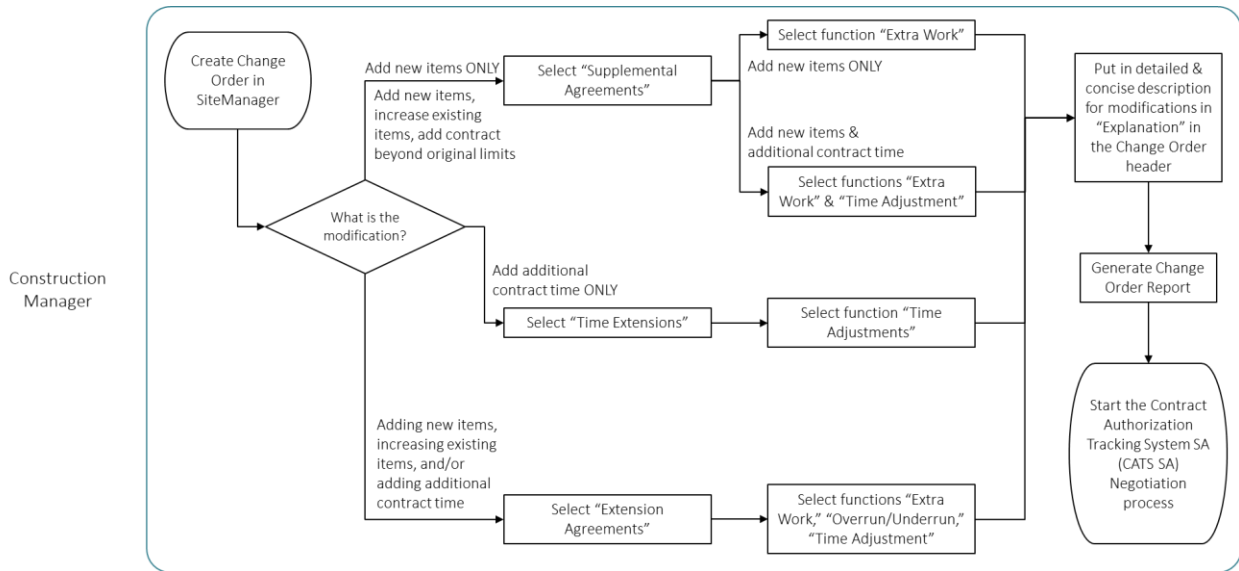


Figure 51. Flowchart. *Contract Modifications* item.

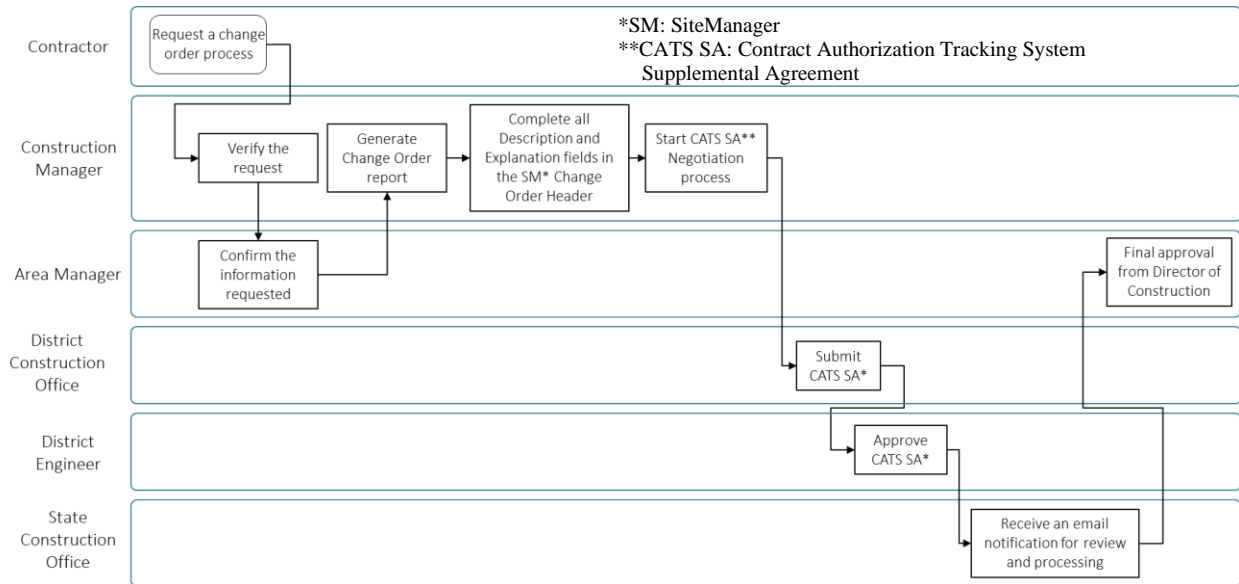


Figure 52. Flowchart. *Change Orders* item in SiteManager.

QA/QC Topic

The fourth topic, *Quality Assurance / Quality Control (QA/QC)*, has six items: *Field Inspection*, *Final Inspection*, *Final Acceptance*, *Projects Pending Final Payment Reports (PPFPR)*, *Contract Close Out*, and *Final Audit*. Figure 53 presents the *Field Inspection* process. The FHWA Transportation Engineer will take a different action depending on the project type, whether Projects of Division Interest (PoDI) or State Administered Projects. If the project is identified as PoDI and requires changes such as supplemental agreement or time extensions, the FHWA Transportation Engineer should accompany during the inspection. It is also noted that inspections are at the discretion of the FHWA.

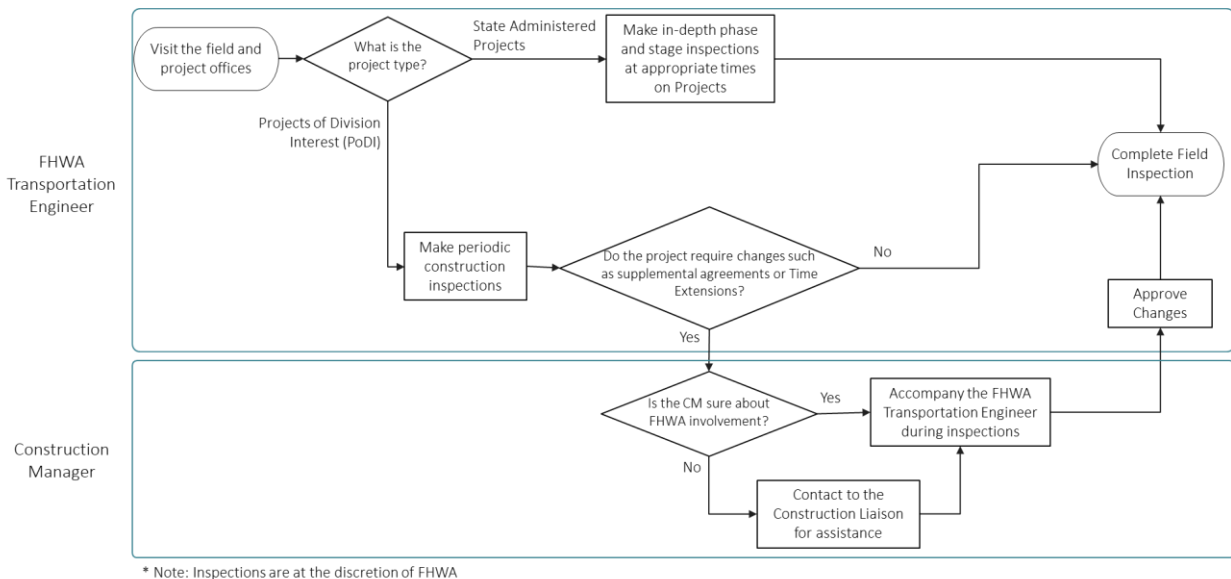


Figure 53. Flowchart. *Field Inspection* item.

Besides the two parties presented in figure 54, there are a number of other participants necessary for the *Final Inspection* item. From the Department of Transportation side, the following positions need to participate in the final inspection: District Construction Manager, Assistant District Construction Manager, Area Manager, Assistant Area Manager – Construction,

Construction Manager, State Construction Liaison, State Bridge Construction Liaison, Erosion and Sedimentation Control Liaison, and District Maintenance Representative. An additional two positions are required from the Contractor’s side: Owner or Qualified Representative and Project Superintendent. In addition, other companies, local governments, or officials may need to attend as determined by the Area Manager or Construction Manager. For projects identified by the FHWA as PoDI, the FHWA Transportation Engineer for the District where the project is located is to be invited.

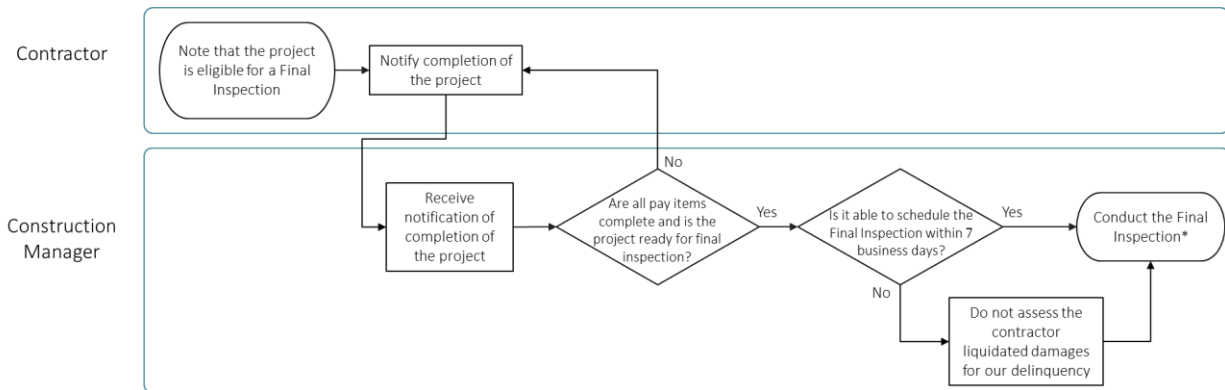


Figure 54. Flowchart. *Final Inspection* item.

Figure 55 represents the *Final Acceptance* process. Depending on the project type, whether state-aid or federal-aid projects, three to five parties are involved in this process. Once the Area Manager completes the work and receives all MC, the District Construction Manager, Office of Construction, and State Construction Engineer follow the process until the District Construction Manager sends the Final Acceptance letter to the Contractor.

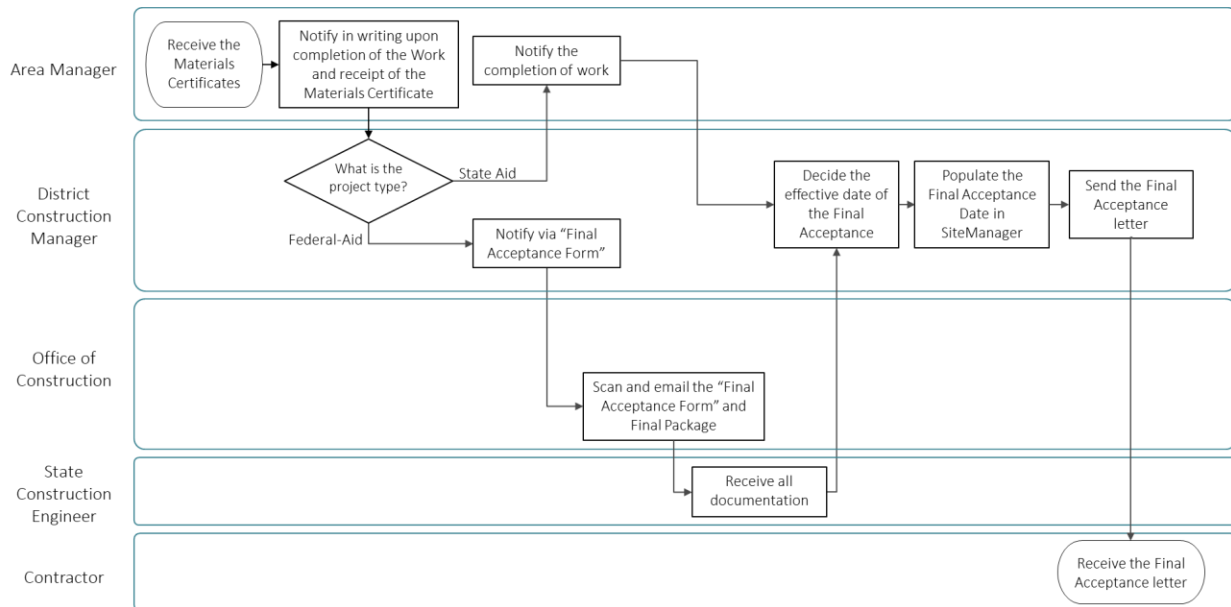


Figure 55. Flowchart. *Final Acceptance* item.

Figure 56 describes the *Projects Pending Final Payment Reports* item. After the Construction Manager submits a copy of the PPFPR to the Office of Construction by the 15th of each month, the Area Manager includes various project information, such as project number, contractors, and punch list, to the Contractor, after the closing conference. The District Construction Office will put dates on the PPRPR for approval.

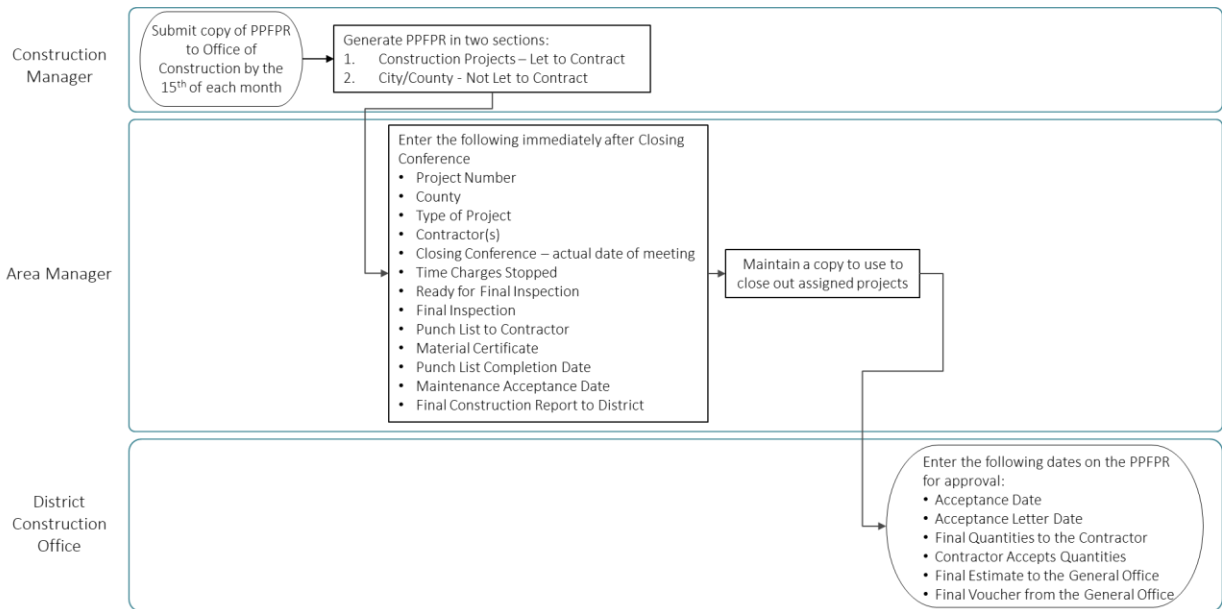


Figure 56. Flowchart. *Projects Pending Final Payment Reports (PPFPR)* item.

Figure 57 describes three main parties related to the *Contract Close Out* item. The Construction Manager generates estimates and ensures that all pay items are completed. The District Construction Office begins the final payment process once the Area Manager reviews and ensures each estimate is completed per the contract specifications.

Once all progress measurements and payment issues are resolved, the Contract Liaison generates the final audit (see Figure 58). The District Contract Administrator will sign the audit exception and the resolution date and submit the final audit to the Office of Construction for final estimate approval.

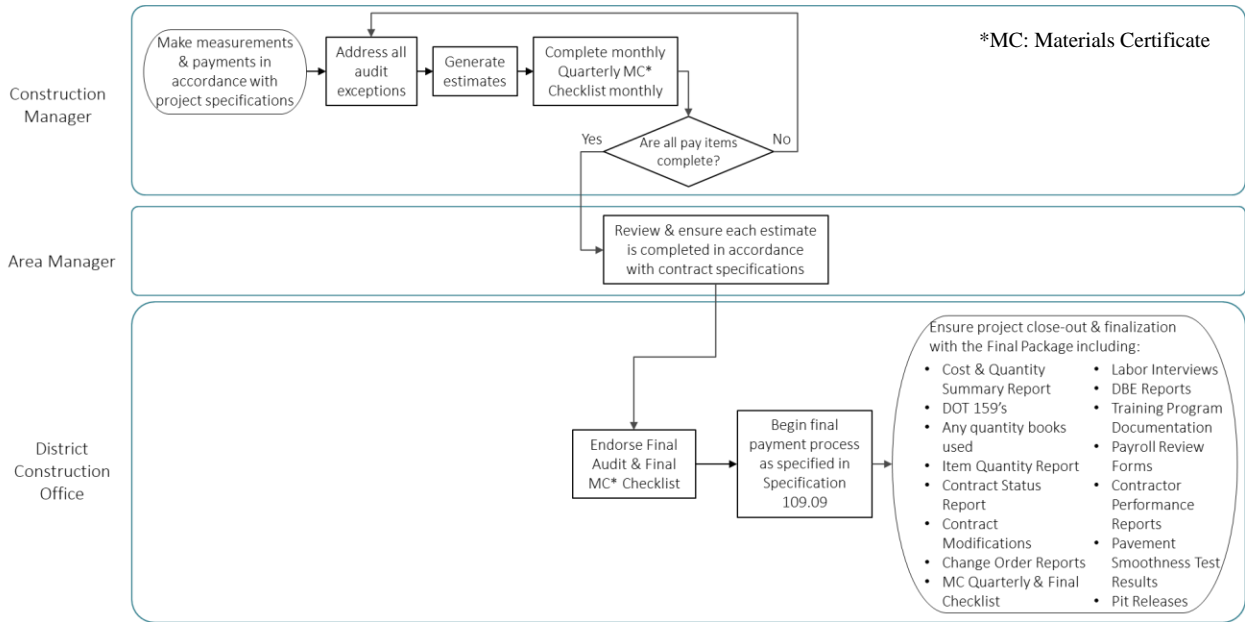


Figure 57. Flowchart. *Contract Close Out* item.

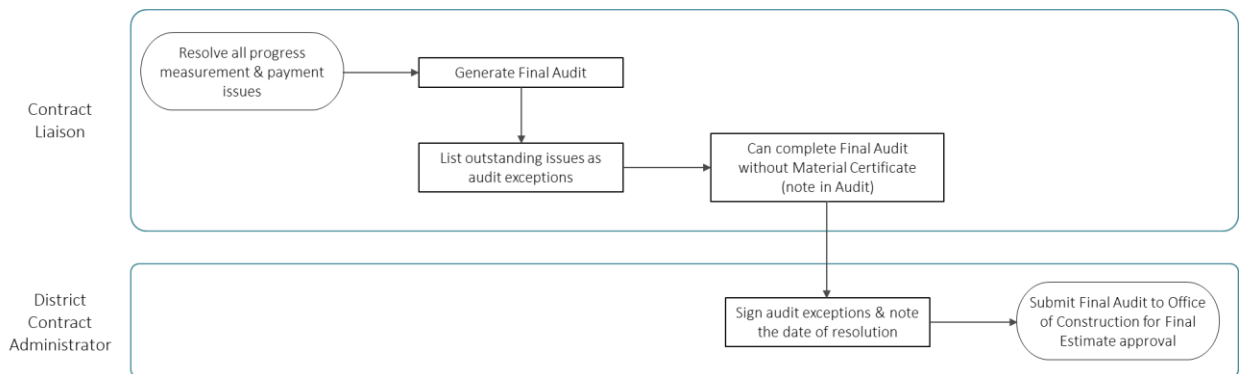


Figure 58. Flowchart. *Final Audit* item.

Traffic Control Topic

The fifth topic, *Traffic Control*, includes the *Accident Documentation* and *Traffic Interruption Reports (TIRs)* items. Figure 59 describes how the Construction Manager reports the accidents after acknowledging the accidents occur within the project limits. The Construction Manager will collect photographs, videos, and police reports and report the accidents to the Area Manager, the

District Construction Manager, the State Construction Engineer, and the Traffic Management Center.

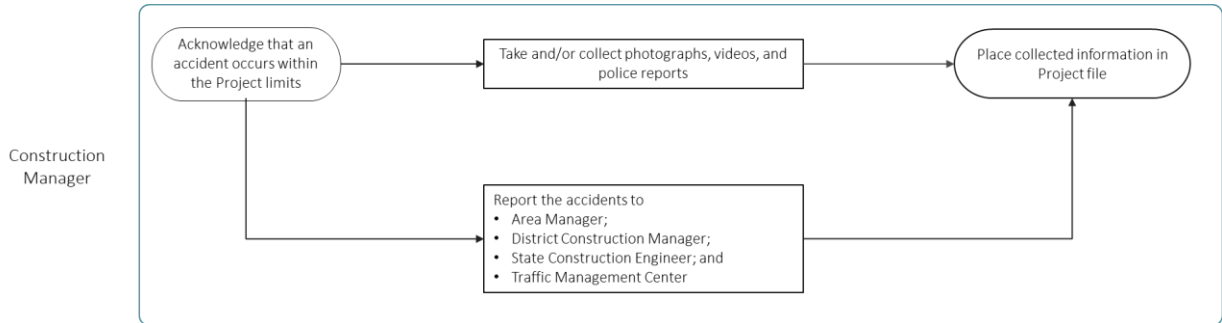


Figure 59. Flowchart. *Accident Documentation* item.

Additionally, the Construction Manager will make a TIR when the flow of traffic is interrupted by the Contractor’s work. If traffic interruption occurs before the commencement of work, the Construction Manager will submit a TIR form to the specified email, shown in figure 60. Should the interruption occur at the commencement of work, the Travel Management Center (TMC) will update information into the TIR and ensure the TIR applications are updated promptly until the road closure is lifted.

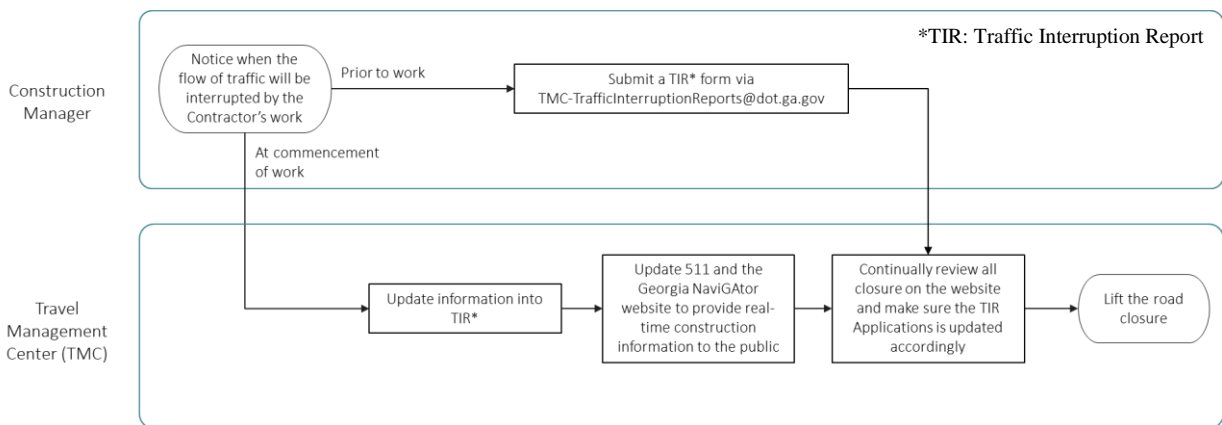


Figure 60. Flowchart. *Traffic Interruption Reports* item.

Others Topic

Further, figure 61 describes the *Daily Work Report* (DWR) item that is “an up-to-date record of the construction activities occurring each day on the Project [and] [...] the source record of working conditions and work performed” ([GDOT 2020a](#)). Project information should be recorded in the DWR. The Construction Manager will generate the estimation after reviewing and approving DWRs.

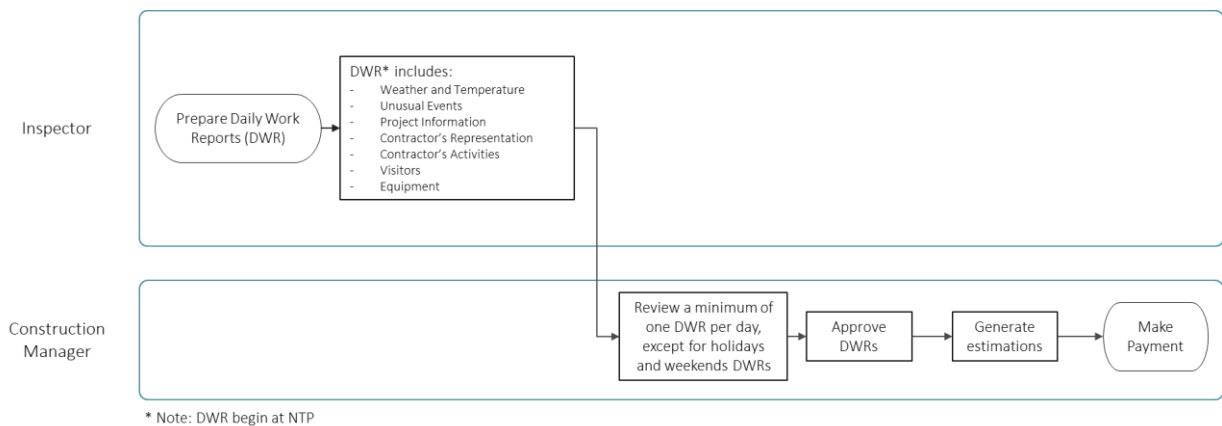


Figure 61. Flowchart. *Daily Work Report* item.

Local Administered Projects Topic

The last topic is *Local Administered Projects (LAP)* by the local governments (LGs). “All LAP is typically financed with federal funds and a match from local authorities who are the Project Sponsors. GDOT is responsible for oversight on LAP Projects, similar to other GDOT-let Projects, except that the LG or their approved Consultants will be the direct construction managers, inspectors and testing personnel over the Work” ([GDOT 2020a](#)). Under this topic, four sub-items are selected to develop flowcharts: *Contract Bidding*, *Audit*, *Contract Modifications*, and *Progress Payments*. First, figure 62 describes the contract bidding process from the advertisement to the

execution of the project. The LG, the Project Manager from the Office of Program Management, and the District Manager are involved throughout the process.

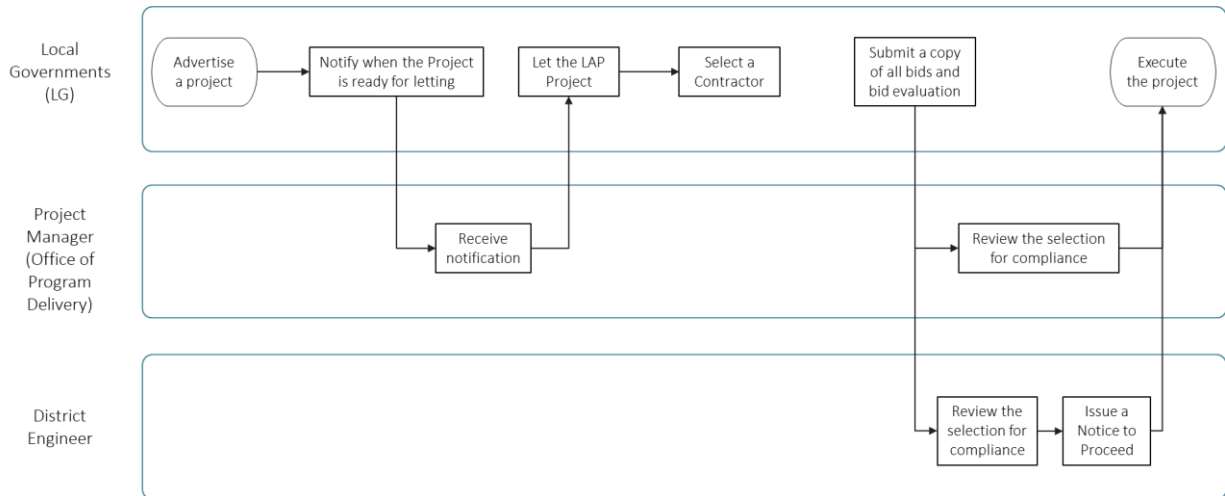


Figure 62. Flowchart. *Contract Bidding* item.

Figure 63 explains how to perform an *Audit* for LAP. If the projects are identified as PoDI, then GDOT is involved and performs routine audits. If not, the audits on a progress estimate are performed by the LG until they address all exceptions and provide missing data.

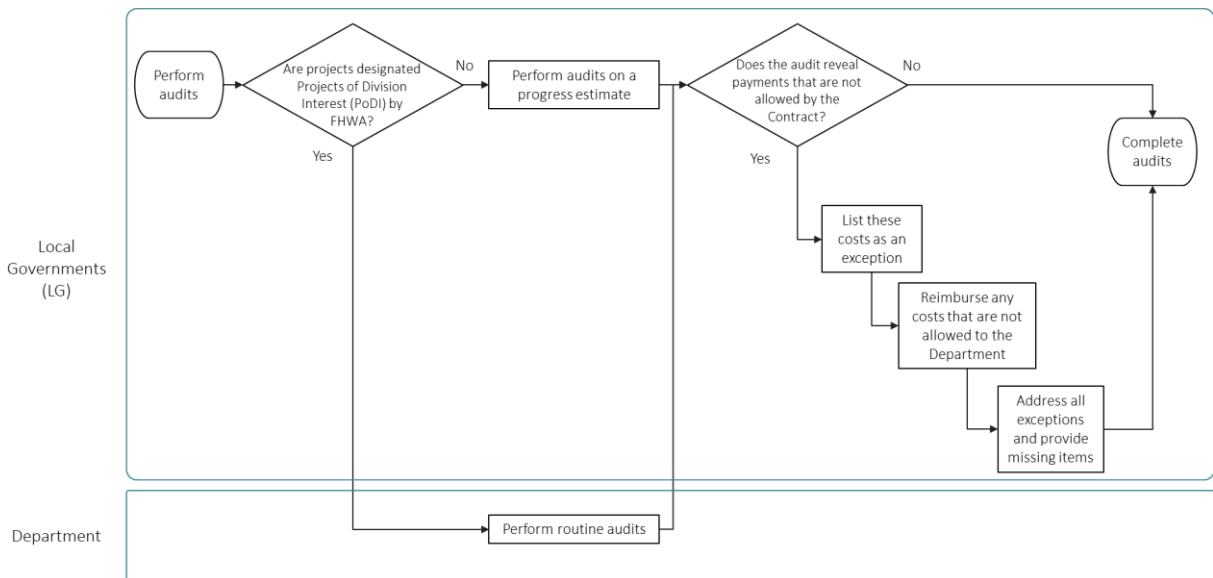


Figure 63. Flowchart. *Audit* item.

Figure 64 describes the overall *Contract Modification* process made by the LG and the four parties involved. When the LG requests contract modifications or change orders, the Project Manager approves its requests, and the Office of Construction modifies the contract amount in SiteManager.

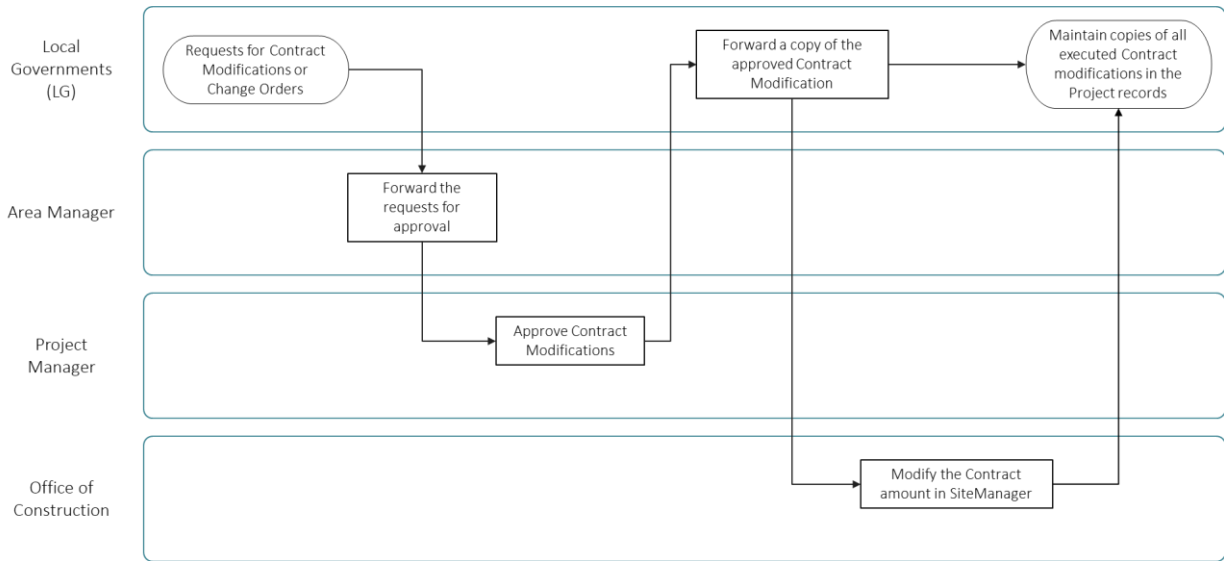


Figure 64. Flowchart. *Contract Modifications* item.

Finally, figure 65 explains how the Contractor requests *Progress Payments* when working for LAP. After receiving the Contractor’s requests, the LG will submit the invoice to the Area Manager using GDOT forms. The Area Manager will estimate the percentage of the work completed each month and then submit approval to the Office of Construction.

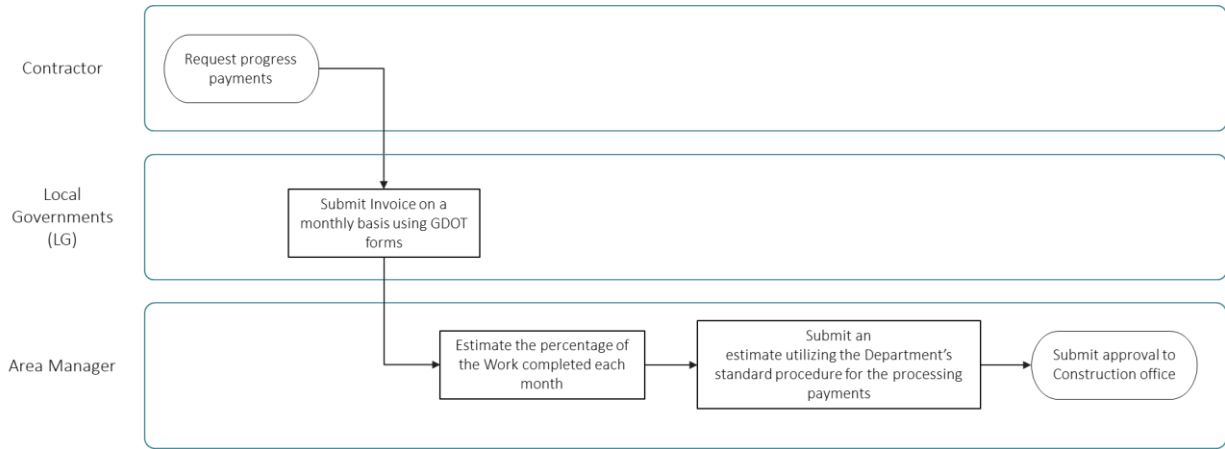


Figure 65. Flowchart. *Progress Payments* item.

CHAPTER 7. CONCLUSION/RECOMMENDATIONS

This study investigated the development of an innovative and engaging training program to increase usage and understanding of agency-wide software programs ProjectWise, Bluebeam, and CATS for use by GDOT construction staff. An extensive literature review was conducted at the national, state DOT, and commercial level to determine optimum e-construction training practices. Noteworthy training practices included short and relevant video modules with a specific topic focus, well-organized training topics that are easily accessible/navigated, and training that is workflow-specific to DOT needs. In order to comprehensively understand GDOT construction staff's specific software and training challenges, a survey was developed and provided to district construction staff and their constituents. Further, meetings were conducted with District 1 and 2 construction staff, managers, and inspectors to elaborate on the survey results and understand specific software challenges. Following the survey analysis and subsequent construction meetings, a complete training program was developed for Bluebeam, ProjectWise, and CATS.

The training topics were structured around beginner and intermediate–advanced topics. Three types of materials were developed as part of the training program: PDF go-by documents, video demonstrations, and interactive software simulation modules. Both the video demonstrations and interactive software simulations were developed in Adobe Captivate. The different levels and training materials were developed to account for multiple user experience levels and learning preferences. The training program topics and content are outlined in table 8. The materials for each of the three programs are summarized as follows:

- The Bluebeam material focused on frequently used tools and processes conducted by construction personnel, including working with and manipulating documents, markup and

measurement tools, interface navigation and customization, the GDOT As-Built Plan and Shop Drawing Review process, and getting started with Bluebeam Studio.

- The ProjectWise material focused on interface and navigation, effectively searching, uploading and extracting files, document organization as well as Deliverables Management using ProjectWise Explorer, creating and sending transmittals, receiving and responding to submittals, and working with RFIs.
- The CATS training material included an introduction to the program, navigation and searching for projects, working with contract documents, and supplemental agreements.

Close collaboration with the project advisory group and Office of IT was required to update the format and style of the training material. Ultimately, the training materials are posted internally on the MYGDOT Training Tutorials site, the internal MYGDOT Office of Construction site, and the public Certifications and Training site ([GDOT 2022a](#)). An in-person workshop was held in August 2022 to deliver, outline, and discuss the ProjectWise, Bluebeam, and CATS training programs.

In order to successfully adopt and implement e-construction technologies, effective training must be developed with the end user in mind. The end user, i.e., construction personnel, must take an active role in the training program design and development to ensure meaningful content is created. As this research showed, although minimal training material existed for ProjectWise and Bluebeam, various district construction personnel had developed guides and recommendations for using the software. By building from these guides and recommendations, the new training programs provide more standardized on-demand material that construction personnel across the state are able to utilize. Additionally, software experience and training preferences are often varied amongst DOT employees. Through the development of a multi-level training program

delivered through a variety of materials, the training content impacts a broader range of users and therefore has a more significant impact across the DOT.

APPENDIX A. LIST OF STATE DOT AND TRANSPORTATION INSTITUTE WEBSITES REVIEWED

Alabama Department of Transportation (ALDOT). (2020). “ALDOT eLearning.” (website) Montgomery, AL. Available online: <http://www.enterprisetraining.com/aldot/index.html>, last accessed June 2020.

Alaska Department of Transportation and Public Facilities. (2020). “Statewide Environmental Office Training.” (website) Juneau, AK. Available online: <https://dot.alaska.gov/stwddes/desenviron/resources/training.shtml>, last accessed June 2020.

Arizona Department of Transportation (ADOT). (2020). “Education and Training Schedule.” (website) Phoenix, AZ. Available online: <https://azdot.gov/motor-vehicles/professional-services/authorized-third-party-services/education-and-training-schedule>, last accessed June 2020.

Arkansas Department of Transportation (ARDOT). (2021). “Doc Express.” March 4 (website) Little Rock, AR. Available online: <https://www.ardot.gov/divisions/construction/doc-express/>, last accessed June 2020.

California Department of Transportation (Caltrans). (2020). “ProVAL Training Videos.” (website) Sacramento, CA. Available online: <https://dot.ca.gov/programs/construction/training/proval-training-videos>, last accessed June 2020.

Colorado Department of Transportation (CDOT). (2021). “CADD & ProjectWise PROGRAMS: Highway Engineering Design Processes.” August 10 (website) Denver, CO. Available online: <https://www.codot.gov/business/designsupport/cadd>, last accessed June 2020.

Commonwealth of Massachusetts. (2020). “Training & Assistance.” Mass.gov (website) Boston, MA. Available online: <https://www.mass.gov/topics/training-assistance>, last accessed June 2020.

Connecticut Department of Transportation (CTDOT). (2020). “Projectwise/Digital Project Resources.” CT.gov: Connecticut’s Official State Website (website) Newington, CT. Available online: <https://portal.ct.gov/DOT/Engineering-Applications/ProjectwiseDigital-ProjectResources>, last accessed June 2020.

Delaware Department of Transportation (DelDOT). (2020). “Design Resource Center.” (website) Dover, DE. Available online: <https://deldot.gov/Business/drc/index.shtml?dc=cadd#horizontalTab3>, last accessed June 2020.

Federal Highway Administration (FHWA). (2018). “EDC 4 e-Construction and Partnering Webinar Series.” Every Day Counts partnership, U.S. Department of Transportation, Federal Highway Administration, Washington, DC. Available online: <https://www.fhwa.dot.gov/construction/econstruction/webinar.cfm>.

Federal Highway Administration (FHWA). (2019). *Guide For e-Construction & Partnering: Training the 21st Century e-Construction Workforce*. FHWA-HIF-19-024, U.S. Department of Transportation, Washington, DC, July. Available online: <https://www.fhwa.dot.gov/construction/econstruction/hif19024.pdf>.

Federal Highway Administration (FHWA). (2021). “e-Construction.” U.S. Department of Transportation, Federal Highway Administration (website) Washington, DC. Available online: <https://www.fhwa.dot.gov/construction/econstruction/>.

Florida Department of Transportation (FDOT). (2015). *e-Construction How-To Guide*. Version 2.3, Document 12.07-2015, FDOT, Tallahassee, FL. Available online: <https://www.fhwa.dot.gov/construction/econstruction/florida/howto.pdf>.

Florida Department of Transportation (FDOT). (2020). “FDOT CADD Training.” (website) Tallahassee, FL. Available online: <https://www.fdot.gov/cadd/main/fdotcaddtraining.shtm>, last accessed June 2020.

Florida Department of Transportation (FDOT). (2022). FDOT Training (website) Tallahassee, FL. Available online: <https://www.youtube.com/FDOTTraining>, last accessed August 2022.

Georgia Department of Transportation (GDOT). (2016). *Batch Plotting Using Bluebeam Revu*. GDOT, Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/DesignSoftware/ProjectWise/Batch%20Plotting%20Using%20Bluebeam%20Revu.pdf>.

Georgia Department of Transportation (GDOT). (2017). *Batch Stamping in Bluebeam Revu*. GDOT, Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/DesignManuals/ProjectWise/Batch%20Stamping%20in%20Bluebeam%20Revu.pdf>.

Georgia Department of Transportation (GDOT). (2022). Certifications and Training (website) Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/Training/Pages/default.aspx>, last accessed August 2022.

Georgia Department of Transportation (GDOT). (2020a). *Construction Manual*. GDOT, Office of Construction, Atlanta, GA. Available online: <http://www.dot.ga.gov/PartnerSmart/Business/Source/construction/cm001.pdf>, last accessed: July 18, 2022.

Georgia Department of Transportation (GDOT). (2022). Georgia DOT IT Training (website) Atlanta, GA. Available online: https://www.youtube.com/channel/UCyB4G_yOkFZZRhr71ylrACw, last accessed August 2022.

Georgia Department of Transportation (GDOT). (2020b). *Process for Digitally Signing Documents in Bluebeam Revu*. GDOT, Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/DesignSoftware/ProjectWise/Digitally%20Signing%20ProjectWise%20Documents%20using%20Bluebeam%20Revu.pdf>.

Georgia Department of Transportation (GDOT). (2020c). “ProjectWise.” Design Manuals & Software (website) Atlanta, GA. Available online: <https://www.dot.ga.gov/PS/DesignSoftware/Projectwise>, last accessed June 2020.

Idaho Transportation Department (ITD). (2020). “Standard Details, Revised November 2018.” (website) Boise, ID. Available online: <https://apps.itd.idaho.gov/apps/standarddetails/standarddetails.htm>, last accessed June 2020.

Illinois Department of Transportation (IDOT). (2020). “Training.” Technology Transfer Center (website) Springfield, IL. Available online: <https://idot.illinois.gov/transportation-system/local-transportation-partners/county-engineers-and-local-public-agencies/technology-transfer-center/index>, last accessed June 2020.

Indiana Department of Transportation (INDOT). (2020). “CAD Support.” *Doing Business with INDOT*, August 9 (website) Indianapolis, IN. Available online: <https://www.in.gov/indot/doing-business-with-indot/other-business/cad-support/>, last accessed June 2020.

Iowa Department of Transportation (IDOT). (2020). “Training.” (website) Ames, IA. Available online: <https://iowadot.gov/training>, last accessed June 2020.

Kansas Department of Transportation (KDOT). (2020). “KART Service Accounts.” (website) Topeka, KS. Available online: <https://kart.ksdot.org/>, last accessed June 2020.

Kentucky Transportation Cabinet (KYTC). (2020). “Software & Support.” (website) Frankfort, KY. Available online: <https://transportation.ky.gov/Pages/Home.aspx>, last accessed June 2020.

Louisiana Department of Transportation & Development (LaDOTD). (2020). “Training.” (website) Baton Rouge, LA. Available online: http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Administration/LPA/Pages/Training.aspx, last accessed June 2020.

Maine Department of Transportation (MaineDOT). (2020). “LPA Certification Training and Course Material.” (website) Augusta, ME. Available online: <https://www.maine.gov/mdot/lpa/ccm/>, last accessed June 2020.

Maryland Department of Transportation (MDDOT). (2020). “Manuals, Standards and Publications.” MDOT State Highway Administration (website) Baltimore, MD. Available online: <https://www.roads.maryland.gov/mdotsha/pages/Index.aspx?PageId=65>, last accessed June 2020.

Michigan Department of Transportation (MDOT). (2020). “ProjectWise Support.” (website) Lansing, MI. Available online: <https://mdotjboss.state.mi.us/SpecProv/projectwisesupport.htm>, last accessed June 2020.

Minnesota Department of Transportation (MnDOT). (2020). “Computer Aided Engineering Services.” MnDOT CAES Unit – Tech Sheets / Help (website) St. Paul, MN. Available online: <https://www.dot.state.mn.us/caes/tech.html>, last accessed June 2020.

Mississippi Department of Transportation (MissDOT). (2020). “Search and Download Engineering Standards/Guides/Manuals.” (website) Jackson, MS. Available online: https://mdot.ms.gov/portal/engineering_standards_guides_manuals, last accessed June 2020.

Missouri Department of Transportation (MoDOT). (2020). “CADD Services Support.” (website) Jefferson City, MO. Available online: <https://www.modot.org/cadd-services>, last accessed June 2020.

Montana Department of Transportation (MDT). (2020). “CADD Info.” (website) Helena, MT. Available online: <https://www.mdt.mt.gov/business/contracting/cadd.shtml>, last accessed June 2020.

Nebraska Department of Transportation (NDOT). (2020). “Training.” Official Nebraska Department of Transportation Website (website) Lincoln, NE. Available online: <https://dot.nebraska.gov/business-center/lpa/boards-liaison/training/>, last accessed June 2020.

Nevada Department of Transportation (NDOT). (2020). “Construction.” (website) Carson City, NV. Available online: <https://www.dot.nv.gov/doing-business/contractorsconstruction/construction>, last accessed June 2020.

New Hampshire Department of Transportation (NHDOT). (2020). “MicroStation.” CAD/D Section (website) Concord, NH. Available online: <https://www.nh.gov/dot/cadd/microstation/index.htm>, last accessed June 2020.

New Jersey Department of Transportation (NJDOT). (2020). “NJDOT Engineering.” Official Site of the State of New Jersey (website) Trenton, NJ. Available online: <https://www.state.nj.us/transportation/eng/#Design>, last accessed June 2020.

New Mexico Department of Transportation (NMDOT). (2020). “Program Management & Engineering Support.” (website) Santa Fe, NM. Available online: https://dot.state.nm.us/content/nmdot/en/Program_Management.html, last accessed June 2020.

New York State Department of Transportation (NYSDOT). (2020). “ProjectWise Web CONNECT Edition.” (website) Albany, NY. Available online: <https://www.dot.ny.gov/main/business-center/engineering/cadd-info/general/projectwise>, last accessed June 2020.

North Carolina Department of Transportation (NCDOT). (2020). “Roadway Design CADD: Roadway Design – Corridor Modeling, Hearing Maps, Microstation & Geopak.” Connect NCDOT (website) Raleigh, NC. Available online: <https://connect.ncdot.gov/projects/Roadway/Training/Forms/AllItems.aspx>, last accessed June 2020.

Ohio Department of Transportation (ODOT). “eLearning.” (website) Columbus, OH. Available online: <https://www.transportation.ohio.gov/wps/portal/gov/odot/programs/ltap/allevents/elearning#page=1>, last accessed June 2020.

Oregon Department of Transportation (ODOT). (2020). “Projectwise.”: ProjectWise: Doing Business (website) Salem, OR. Available online: <https://www.oregon.gov/ODOT/Business/Pages/ProjectWise.aspx>, last accessed June 2020.

Pennsylvania Department of Transportation (PennDOT). (2020a). “Online Services.” (website) Harrisburg, PA. <https://www.penndot.gov/DoingBusiness/OnlineServices/Pages/OnlineServices.aspx>, last accessed June 2020.

Pennsylvania Department of Transportation (PennDOT). (2020b). “State Transportation Innovation Council.” (website) Harrisburg, PA. Available online: www.penndot.gov/about-us/StateTransportationInnovationCouncil/Pages/default.aspx, last accessed June 2020.

Rhode Island Department of Transportation (RIDOT). (2020). “Contractors & Consultants.” (website) Providence, RI. Available online: <https://www.dot.ri.gov/business/contractorsandconsultants.php>, last accessed June 2020.

South Carolina Department of Transportation (SCDOT). (2020). “CADD Design.” *CADD Design Standards and Procedures for Consultants* (website) Columbia, SC. Available online: <https://www.scdot.org/business/CADD-Design.aspx>, last accessed June 2020.

Tennessee Department of Transportation (TDOT). (2020). “Roadway Design Training – Tutorials and Training Guides.” Tennessee State Government – TN.gov (website) Nashville, TN. Available online: <https://www.tn.gov/tdot/roadway-design/training/roadway-design-training---tutorials.html>, last accessed June 2020.

Texas Department of Transportation (TxDOT). (2020). “Access and Training.” (website) Austin, TX. Available online: <https://www.txdot.gov/inside-txdot/division/transportation-programs/mppm/training.html>, last accessed June 2020.

Upper Great Plains Transportation Institute (UGPTI). (2020). “DOTSC – Tech Training Section.” North Dakota State University, DOT Support Center (website) Fargo, ND. Available online: <https://www.ugpti.org/dotsc/training/>, last accessed June 2020.

Utah Department of Transportation (UDOT). (2020). “UDOT Digital Delivery.” (website) Salt Lake City, UT. Available online: <https://digitaldelivery.udot.utah.gov/>, last accessed June 2020.

Vermont Agency of Transportation. (2020). “VAOT CADD Help (Sharepoint).” (website) Available online: <https://outside.vermont.gov/agency/VTRANS/external/CADD/default.aspx>, last accessed June 2020.

Virginia Department of Transportation (VDOT). (2020). “Location and Design Division.” (website) Richmond, VA. Available online: <https://www.virginia.gov/business/locdes/projectwise.asp>, last accessed June 2020.

Washington State Department of Transportation (WSDOT). (2020). “ProjectWise.” (website) Olympia, WA. Available online: <https://www.wsdot.wa.gov/Mapsdata/geomatrix/projectwise.htm>, last accessed June 2020.

West Virginia Department of Transportation (WVDOT). (2020). “Training and Development.” (website) Charleston, WV. Available online: <https://transportation.wv.gov/highways/training/Pages/Online-Training.aspx>, last accessed June 2020.

Wisconsin Department of Transportation (WisDOT). (2020). “Training Courses.” (website) Madison, WI. Available online: <https://c3dtkb.dot.wi.gov/Content/c3d/trn-cors.htm>, last accessed June 2020.

Wyoming Department of Transportation (WYDOT). (2020). "CADD Support." (website) Cheyenne, WY. Available online: https://www.dot.state.wy.us/home/engineering_technical_programs/cadd_support.html, last accessed June 2020.

APPENDIX B. SURVEY QUESTIONNAIRE

Block 1: General Information



**UNIVERSITY OF
GEORGIA**

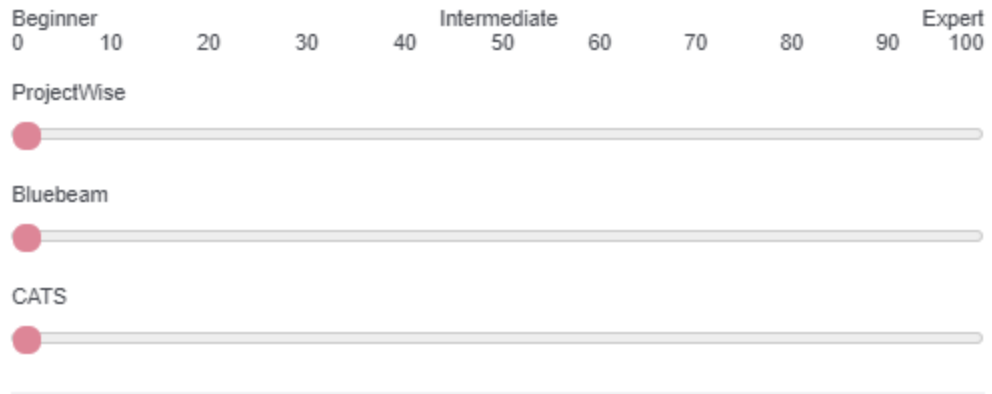
Please provide your name, GDOT office and position, and your contact information for any follow up questions/comments.

Name	<input type="text"/>
Office	<input type="text"/>
Position	<input type="text"/>
Contact Information (email)	<input type="text"/>

How often does your office use ProjectWise, Bluebeam, and CATS?

	Never	Sometimes	Often	Always
ProjectWise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bluebeam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CATS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In general, how confident are you with using the 3 software programs? 0 being no knowledge at all and 100 being an expert user.



Please provide a brief overview of how your office currently uses ProjectWise, Bluebeam, and CATS.

ProjectWise

Bluebeam

CATS

Three empty rectangular text boxes are provided for the user to describe office usage. Each box is labeled to its left: 'ProjectWise', 'Bluebeam', and 'CATS'. Each box has a small double-slash icon in the bottom right corner.



Block 2: Training Information

How often does software training occur in your office?

Daily

Weekly

Monthly

Quarterly

Yearly

Never

Training only occurs if an issue/need arises

Other: Please indicate below

What type of software training is currently used in your office? Please select all that apply.

PDF documents

Online or in person classes

Videos/modules

Powerpoints/presentations

Commercial training material (i.e. Bentley)

Other: Please indicate below

For your office operations, what software (ProjectWise, Bluebeam, or CATS) is the top priority for new training? Please rank the three programs, with 1 being top priority.

ProjectWise

Bluebeam

CATS



Block 3: ProjectWise, Bluebeam, and CATS Challenges

Please provide any current office challenges associated with ProjectWise, Bluebeam, and CATS.

ProjectWise	
Bluebeam	
CATS	

Does your office find the existing GDOT ProjectWise training and workflows to be effective training material?

Very effective
Effective
Somewhat effective
Not effective
Unaware of existing ProjectWise training material

Concerning the previous question, what is missing from the existing ProjectWise training materials?

Compared to traditional material (PDFs and short videos outlining key concepts), would your office be interested in more interactive online training for ProjectWise, Bluebeam, and CATS?

Yes

No

Along with developing GDOT specific training material, is it also important for the new training modules (concerning ProjectWise and Bluebeam) to include training on general software features and operations, or is the commercial material provided by Bentley and Bluebeam adequate for general software features?

No further general software training is needed

General software training is needed



Block 4: *Construction Manual Use*

How often does your office use the construction manual?

Very often

Often

Sometimes

Not very often

Rarely

Never



Block 5: Construction Manual Challenges

How effective do you find the construction manual as far as incorporating e-construction processes and technologies?

Very effective

Effective

Somewhat effective

Not effective

In your opinion, what sections of the construction manual are outdated related to e-construction?

Regarding CATS, Bluebeam, and ProjectWise, what are major areas that should be included and/or improved in the construction manual?

ProjectWise

Bluebeam

CATS

Do you have any recommendations on how the construction manual can be updated to improve collaboration among the project team?

What is a task related to ProjectWise, Bluebeam, and CATS that the construction manual could help streamline?

ProjectWise

Bluebeam

CATS



ACKNOWLEDGEMENTS

The success of this research would not have been possible without the support of several individuals. The study team would like to thank the Georgia Department of Transportation (GDOT) for their financial support and involvement during this research study. Specifically, we thank John Hancock, P.E., GDOT State Construction Engineer; Beau Quarles, P.E., Assistant State Construction Engineer; and Brennan Roney, Research Engineer, for their direct involvement with the project. Additionally, the team wishes to thank Frank Flanders, Assistant State Design Policy Engineer; Glenn Williams, Technology Implementation Manager; and Devon Wheatle, Office of IT, for their help with the training program development. Finally, the team would like to thank GDOT IT personnel Teague Buchanan, Assistant Administrator; Tabatha Doby, Team Lead—Training; Ana Maria Marin, Instructional Designer/Trainer; and Dennis Fuller, Training and Development Specialist, for their support with posting the training material.

REFERENCES

- Alaska Department of Transportation and Public Facilities. (2020). "Statewide Environmental Office Training." (website) Juneau, AK. Available online: <https://dot.alaska.gov/stwddes/desenviron/resources/training.shtml>, last accessed June 2020.
- Basinger, K., Lahijanian, B., and Ortega, A. (2021). "Creating ACTIVE Learning in an Online Environment." *2021 ASEE Virtual Annual Conference Content Access Proceedings*, July. Available online: <http://dx.doi.org/10.18260/1-2--36870>.
- Bentley Systems, Inc. (2020). "Bentley Institute LEARNservices Training Programs, Communities." (website) Exton, PA. Available online: <https://www.bentley.com/en/learn/for-users/training-programs>, last accessed August 2020.
- Bluebeam Inc. (2020). "Revu, Digital Workflow Solution with Studio." (website) Pasadena, CA. Available online: <https://www.bluebeam.com/solutions/revu>, last accessed August 2020.
- Cassar, C and Wilkerson J. (2018). *Michigan DOT Partnering With Industry for a Digital Tomorrow*. (lecture) Lincoln, NE. Available online: <https://www.heep.org/conference/archive/2018/docs/Presentations/Michigan%20DOT%20Partnering%20with%20Industry%20for%20a%20Digital%20Tomorrow%20%20John%20Wilkerson%20Cathy%20Cassar%20Rachelle%20VanDeventer.pdf>, last accessed June 2020.
- Colorado Department of Transportation (CDOT). (2021). "CADD & ProjectWise PROGRAMS: Highway Engineering Design Processes." August 10 (website) Denver, CO. Available online: <https://www.codot.gov/business/designsupport/cadd>, last accessed June 2020.
- Dalto, Jeff. (2015). "Testing Employees after Training: Best Practices for Workforce Training Assessment." *Vector Solutions*, May 4. Available online: <https://www.vectorsolutions.com/resources/blogs/testing-employees-after-training/>.
- Damelio, R. (2016). *The basics of process mapping, 2nd edition*. Productivity Press, NY, USA
- Durham, S.A., Ashuri, B., and Shannon, L. (2018). *Development of Implementation Plan for GDOT e-Construction Program*. FHWA-GA-19-1713, University of Georgia, Athens, GA. Available for download: https://www.fhwa.dot.gov/construction/econstruction/edc4/implementation_plan.pdf.
- Elmedorp, E. and Ridgell, R. (2018). *e-Construction Confessions from the Field*. (lecture) Lincoln, NE, September 2018.
- Federal Highway Administration (FHWA). (2021). "e-Construction." U.S. Department of Transportation, Federal Highway Administration (website) Washington, DC. Available online: <https://www.fhwa.dot.gov/construction/econstruction/>.

Florida Department of Transportation (FDOT). (2015). *e-Construction How-To Guide*. Version 2.3, Document 12.07-2015, FDOT, Tallahassee, FL. Available online: <https://www.fhwa.dot.gov/construction/econstruction/florida/howto.pdf>.

Florida Department of Transportation (FDOT). (2020). “FDOT CADD Training.” (website) Tallahassee, FL. Available online: <https://www.fdot.gov/cadd/main/fdotcaddtraining.shtm>, last accessed June 2020.

Georgia Department of Transportation (GDOT). (2016). *Batch Plotting Using Bluebeam Revu*. GDOT, Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/DesignSoftware/ProjectWise/Batch%20Plotting%20Using%20Bluebeam%20Revu.pdf>.

Georgia Department of Transportation (GDOT). (2017). *Batch Stamping in Bluebeam Revu*. GDOT, Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/DesignManuals/ProjectWise/Batch%20Stamping%20in%20Bluebeam%20Revu.pdf>.

Georgia Department of Transportation (GDOT). (2022a). *Certifications and Training* (website) Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/Training/Pages/default.aspx>, last accessed August 2022.

Georgia Department of Transportation (GDOT). (2022b). *Georgia DOT IT Training* (website) Atlanta, GA. Available online: https://www.youtube.com/channel/UCyB4G_yOkFZZRhr71ylrACw, last accessed August 2022.

Georgia Department of Transportation (GDOT). (2020a). *Construction Manual*. GDOT, Office of Construction, Atlanta, GA. Available online: <http://www.dot.ga.gov/PartnerSmart/Business/Source/construction/cm001.pdf>, last accessed: July 18, 2022.

Georgia Department of Transportation (GDOT). (2020b). *Process for Digitally Signing Documents in Bluebeam Revu*. GDOT, Atlanta, GA. Available online: <https://www.dot.ga.gov/PartnerSmart/DesignSoftware/ProjectWise/Digitally%20Signing%20ProjectWise%20Documents%20using%20Bluebeam%20Revu.pdf>.

Henri, M., Johnson, M.D., and Nepal, B. (2017). “A Review of Competency-Based Learning: Tools, Assessments, and Recommendations: A Review of Competency-Based Learning.” *Journal of Engineering Education*, 106(4), pp. 607–638. <http://dx.doi.org/10.1002/jee.20180>.

Holsapple, C.W. and Lee-Post, A. (2006). “Defining, Assessing, and Promoting e-Learning Success: An Information Systems Perspective.” *Decision Sciences Journal of Innovative Education*, 4(1), pp. 67–85. <https://doi.org/10.1111/j.1540-4609.2006.00102.x>.

Iowa Department of Transportation (IDOT). (2020). “Training.” (website) Ames, IA. Available online: <https://iowadot.gov/training>, last accessed June 2020.

Kim, S., Durham, S.A., and Chorzepa, M. (2020). *Development of Innovative and Effective Training Methods for Pavement Designers for Rapid Deployment and Continuous Operation of MEPDG*. FHWA-GA-19-1718, University of Georgia, Athens, GA. Available for download: <https://trid.trb.org/view/1729233>, last accessed August 2022.

Kirkpatrick, R. (2020). “PennDOT Advances e-Construction Plans.” *PennDOT Way*, May 6 (blog), Pennsylvania Department of Transportation, Harrisburg, PA. Available online: <https://www.penndot.pa.gov/PennDOTWay/pages/Article.aspx?post=304>.

Mansell, T. (2014). “How to Implement a Training Program for Your Construction Crew.” *For Construction Pros*, October 1. <https://www.forconstructionpros.com/home/article/12002367/how-to-implement-a-training-program-for-your-construction-crew>.

Michigan Department of Transportation (MDOT). (2020). “ProjectWise Support.” (website) Lansing, MI. Available online: <https://mdotjboss.state.mi.us/SpecProv/projectwisesupport.htm>, last accessed June 2020.

Missouri Department of Transportation (MoDOT). (2020). “CADD Services Support.” (website) Jefferson City, MO. Available online: <https://www.modot.org/cadd-services>, last accessed June 2020.

Mitchell, A. (2018). “Creating a Roadmap to Implement e-Construction Practices and Strategies for Assessing and Procuring Technology.” Every Day Counts (EDC) 4 e-Construction and Partnering Webinar Series, Webinar #3, March 28, Federal Highway Administration, Washington, DC. Available online: <https://www.fhwa.dot.gov/construction/econstruction/webinar.cfm>, last accessed August 2022.

Oregon Department of Transportation (ODOT). (2020). “Projectwise.”: ProjectWise: Doing Business (website) Salem, OR. Available online: <https://www.oregon.gov/ODOT/Business/Pages/ProjectWise.aspx>, last accessed June 2020.

Texas Department of Transportation (TxDOT). (2020). “Access and Training.” (website) Austin, TX. Available online: <https://www.txdot.gov/inside-txdot/division/transportationprograms/mppm/training.html>, last accessed June 2020.

Washington State Department of Transportation (WSDOT). (2020). “ProjectWise.” (website) Olympia, WA. Available online: <https://www.wsdot.wa.gov/Mapsdata/geometrix/projectwise.htm>, last accessed June 2020.

Weisner, K., Cawley, B., and Sindlinger, A. (2017). “The Age of e-Construction.” *Public Roads* 81(1). <https://highways.dot.gov/public-roads/julyaugust-2017/age-e-construction>.