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IMPLEMENTATION PLAN

NCHRP PROJECT 10-113, “QUALITY MANAGEMENT FOR 3D MODEL- BASED PROJECT DEVELOPMENT AND DELIVERY”

DATE: FEBRUARY 2025

1 Objective of the Implementation Plan

The purpose of this implementation plan is to provide suggestions for a variety of activities that will result in a wide outreach campaign to educate the intended audience regarding the use and application of the NCHRP 10-113 Quality Management for 3D Model-Based Project Development and Delivery Guide (the NCHRP 10-113 Guide). The NCHRP 10-113 Guide is the main product developed under the NCHRP 10-113 Project. Other products accompanying the NCHRP 10-113 Guide include a PowerPoint presentation, and a final report with several appendices that may be helpful when deploying technology transfer activities.

The NCHRP 10-113 Guide was developed as a national industry reference for quality assurance with 3D model-based project delivery. The shift to 3D model-based project delivery is redefining how agencies communicate, coordinate, review, and document project details during design. Over the past decade, it has become a common practice to deliver 3D engineered models as supplemental information for construction, and more State Departments of Transportation (DOTs) are starting to release 3D model-based information as the primary construction contract document (also known as Model as the Legal Document). However, formal quality management processes have remained paper or Portable Document Format (PDF) based. One of the challenges with quality control of 3D models is reviewing information in a dynamic 3D environment and documenting comments seen on a screen. Reviewers, such as design managers, who are typically responsible for design quality management lack the skillsets to complete their tasks in a 3D model environment. Engineers who are well versed in 3D modeling software, have learned to review models as part of the project development process organically. But no standard procedures have been published that systematize documentation of model-based design reviews that includes reviewing key design elements, engineering calculations, estimated quantities, and interdisciplinary coordination. The NCHRP 10-113 Guide provides:

- Knowledge and background where experience is missing so agencies can implement a quality management system that facilitates project delivery
- Suggestions for establishing a consistent, repeatable, reproducible, and traceable quality management process that is equal to or better than existing paper-based processes

The intended audience for the NCHRP 10-113 Guide include highway agency's project development and delivery staff, as well as their consulting partners.

The scope of major tasks to achieve the objective of this implementation plan include:

- Developing an educational program that offers a variety of methods to bring the contents of the NCHRP 10-113 Guide to intended audience
- Adopting the NCHRP 10-113 Guide as a recognized national set of guidelines
- Working with software providers to develop tools that assist in the implementation of the quality management practices suggested in the NCHRP 10-113 Guide, and filling the gap identified in the final report
- Providing a method for updating the NCHRP 10-113 Guide with new quality management methods using open data standards and emerging technology

1.1 Implementation Leadership Team

The following organizations, groups and/or individuals have been identified as potential parties for taking leadership roles in the implementation of the NCHRP 10-113 Guide.

- American Association of Highway and Transportation Officials (AASHTO), through a variety of programs and/or groups, such as
 - The Transportation Technical Service Council (TC3)
 - Technical Committees, such as Committee on Bridges and Structures (COBS) Technology Committee, the Joint Technical Committee on Electronic Engineering Standards (JTCEES)
 - AASHTO Innovation Initiative (A.I.I.)
- Federal Highway Administration (FHWA), in collaboration with highway agencies through a variety of programs and/or groups, such as
 - The National Highway Institute (NHI)
 - Technology Transfer Program
 - Highway agencies in partnerships with educational institutions and industry organizations, such as
 - Universities and technical colleges
 - American Council of Engineering Companies (ACEC)
 - Highway Engineering Exchange Program (HEEP)
- Software companies developing 3D-model-based software
- Transportation Research Board (TRB) Committees with a common interest in the topic, for example
 - AKL19 – Standing Committee on Geospatial Methods and Technologies
 - AED14 – Standing Committee on Geospatial and Visual Analytics
 - AKL16 – Standing Committee on Utilities and Rights of Way

1.2 Assumptions/Constraints/Risks

Considerations for developing and executing this implementation plan include:

- **Schedule:** Deployment of the major tasks should be completed within a 12-month period. The NCHRP 10-113 Guide provides suggestions that fill a major gap for successfully adopting the development and delivery of 3D-model based deliverables for construction projects.
- **Budget:** To successfully complete the major tasks of this implementation plan, a budget of \$400,000 should be considered. The budget will need to support the development of facilitation/training plans, train-the-trainer activities, an initial deployment of technology transfer activities, such as webinars and workshops. Long-term costs to consider include updates to the NCHRP 10-113 Guide, as well as the training materials, and establishment of a permanent curriculum that is offered for on-boarding design staff at highway agencies and engineering firms.
- **Resource availability and skill sets:** Major tasks described in this implementation plan will require technical experts who have the availability to prepare training material based on the contents of the NCHRP 10-113 Guide and have the capacity to undertake a national training program that can be completed within a 12-month period. Likely, a team of experts with a variety of knowledge and skills sets will be needed to create and deliver training content.
 - Suggested required qualifications include:

- General knowledge of quality management concepts presented in the NCHRP 10-113 Guide
- Technical engineering knowledge (highway/bridge projects)
- Extensive knowledge of design development and construction documents, including subprocesses and their dependencies within the project development process for transportation infrastructure
- Knowledge of instructional methodologies and curriculum development
- Strong organizational and planning skills
- Excellent verbal and written communication skills
- Experience in developing digital deliverables for highway and bridge construction projects
- Familiarity with civil modeling software and multiple common data environments (CDE) and collaboration platforms
- Familiarity with modern contract management methodologies for public infrastructure projects
- Suggested preferred qualifications include:
 - ISO 19650 Practitioner Certification
 - Knowledge of Open Data Standards
- **Buy-in from implementing organizations:** Many highway agencies are in the process of transitioning to the adoption of 3D model-based project development and delivery. Most of these agencies are at the beginning of their journey, with only a few considered advanced in their implementation. This NCHRP 10-113 Guide provides the foundation for assisting highway agencies in making updates to their design manuals, guidelines, checklists, and other policy documents. Obtaining buy-in from highway agencies supporting this implementation guide is likely high, as the NCHRP 10-113 Guide provides the materials necessary for project development and delivery staff update their policies and standard practices – a necessary step to help reduce uncertainty about liability exposure and accelerate digital transformation of project delivery.
- **Additional training required:** While the NCHRP 10-113 Guide provides the materials necessary to bring much needed training to project development and delivery staff, an implementing organization may need to identify key individuals to participate in the train-the-training activities being proposed in this implementation plan. A prerequisite for implementing this NCHRP 10-113 Guide is for lead organization implementers to assess or have a comprehensive understanding of their own organizational structure and resource availability.
- **Software and technology to be used or purchased:** Although the NCHRP 10-113 Guide does not make recommendations related to specific software or technology, it is important to note that implementation organizations may need to procure new software and technology that will allow them to deploy the suggestions, practices and procedures presented in the NCHRP 10-113 Guide.

2 Implementation Description

This section provides a description of major tasks being proposed in this implementation plan. It is important to note that the tasks being proposed are meant to assist implementing organizations deploy the suggestions specific to establishing new standards, processes, and updating manuals and checklists. The implementation approach described in this section is heavily dependent on designing an educational program that combines

webinars, workshops, peer exchanges, and other technology transfer activities that can reach a wide and large audience. Further, the implementation approach relies on quality management and technical experts using the NCHRP 10-113 Guide content to develop a variety of training modules and methods that are most effective for implementing organizations.

As a prerequisite to guide implementation, quality managers will assess or have a comprehensive understanding of their own organizational structure and resource availability. Barriers to implementation may include technical equipment or staffing resources which are both individual to the agency and subject to change.

2.1 Major Tasks

This section provides a brief description of each major task required for the implementation of the NCHRP 10-113 Guide, including

- General description and desired outcomes
- Resources required to accomplish the task
- Assumptions and constraints associated with the task
- Deliverables (products to be delivered)
- Criteria for successful completion of the task

2.1.1 National Educational Program

This task is proposed as an immediate activity that can be completed in the short-term to deploy the products of the NCHRP 10-113 Guide. Long-term implementation is discussed in Section 2.1.2.

2.1.1.1 General Description and Desired Outcomes

Develop a train-the trainer curriculum that includes lessons leveraging the NCHRP 10-113 Guide as the main source of training materials for intended audience. At a minimum, the curriculum should include

- A facilitation plan that
 - Defines learning objectives for overall course as well as individual modules
 - Provides suggestions for conducting each module, including effective learning methods (e.g., pre-recorded, or live webinars, workshops, peer exchanges) for technical audiences
- A syllabus that provides a list of the units and lessons that the instructor/trainer will need to teach, including assignments and activities given to participants
- Proposed training materials (e.g., presentation slides, handouts)
- Assessment survey to evaluate participant level of learning for each module being proposed
- Evaluation survey for course participants to assess effectiveness of training material and deployment methods

Potential modules may include, but not be limited to:

- Introduction to NCHRP 10-113 Quality Management for 3D Model-Based Project Development and Delivery Guide
- Quality Management Concepts (Guide Chapter 2)
- Records Management (Guide Chapter 3)
- Model Reviews (Guide Chapter 4)
- Components of a Review (Guide Chapter 5)

- Agency Considerations for Implementing NCHRP 10-113 Quality Management for 3D Model-Based Project Development and Delivery Guide (Guide Chapter 6)

Upon completion of the curriculum and training materials, in-person workshops should be considered to deploy the curriculum to up to four (4) regional train-the-trainer groups.

2.1.1.2 Resources

- Funding for the development of the curriculum, deployment of curriculum and travel assistance for highway agencies
- Technical team meeting the qualifications identified in Section 1.2 Assumptions/Constraints/Risks

2.1.1.3 Assumptions

- Training materials will be limited to general content of the NCHRP Guide. It is assumed that each implementing organization will tailor the provided curriculum to meet their individual unique needs
- The team developing the curriculum may be available as part of a separate effort to assist implementing organization with any customizations to the curriculum to meet their unique needs
- Development of the curriculum will take approximately 4 months to complete
- How-to videos will not be included as part of the training materials as they are too specific to software and technology
- Up to four (4) in-person workshops are being suggested, but more may be offered if additional budget is provided. In-person workshops are highly encouraged
- Travel cost for each in-person workshop is estimated at a cost of \$50K for 20 individuals, including the presenter (estimate of \$2,500 per person). A total of \$200,000 budget is suggested for covering travel cost for up to four (4) in-person workshops, not counting cost of facilities to host the workshop.
- Additional budget of \$200,000 is estimated for time, materials, and overhead to prepare the curriculum, coordinate, and plan four (4) in-person workshops.

2.1.1.4 Deliverables

- Facilitation plan
- Syllabus
- Training materials (e.g., presentation slides, handouts)
- Assessment survey

2.1.1.5 Measuring Success

The success of the program will be measured through both quantitative and qualitative methods, ensuring that the program meets its intended outcomes and provides value to the participants and their respective organizations.

Participants Feedback

- Post-training feedback: Collect feedback from participants after each module and in-person workshop to gauge their understanding, satisfaction, and perceived relevance of the material
- Net promoter score: Measure participants' likelihood to recommend the training to others in their organization

Knowledge Retention and Application

- Participant scores on assessments administered before and after each module/workshop to measure learning gains
- Follow-up surveys: Conduct surveys 3–6 months after the training to assess participants’ ability to apply learned concepts and tools in their roles

Implementation Outcome

- Adoption of practices: survey organizations to evaluate how they have implemented the quality management practices suggested in the NCHRP 10-113 Guide
- Customized curriculum: track how many organizations adapt and use the curriculum to fit their needs

2.1.2 Long-Term Stewardship of the NCHRP 10-113 Guide as National Guidelines

This task is proposed as a series of activities that can be completed after the initial implementation of the NCHRP 10-113 Guide.

2.1.2.1 General Description and Desired Outcomes

National Technical Working Group

Establish a technical working group (TWG) composed of highway agencies and consulting firms to work closely with software providers to develop tools that assist in the implementation of the quality management practices suggested in the NCHRP 10-113 Guide, and filling the gap identified in the final report. Ideally, this should be a small group (approximately 8-10 people) overseeing the implementation of the NCHRP 10-113 in their organizations.

Stewardship of NCHRP 10-113 Guide

Work with the FHWA and/or AASHTO Joint Committee on Data Standardization to establish a process to:

- Adopt the NCHRP 10-113 Quality Management for 3D Model-Based Project Development and Delivery Guide as a recognized national set of guidelines
- Provide a method for updating the NCHRP 10-113 Guide with new quality management methods using open data standards and emerging technology

Long-Term Standardized Training Program

Once the NCHRP 10-113 Guide has been adopted as a national set of guidelines either AASHTO or FHWA, it is suggested to

- Review and update the initial implementation curriculum and training materials (developed under Task 2.1.1 National Education Program)
- Develop a long-term educational program offered by AASHTO or FHWA through a variety of programs, such as the TC3, or the NHI. Alternatively, highway agencies may partner with private industry or educational institutions to offer paid programs featuring the newly nationally approved/endorsed NCHRP 10-113 Guide

2.1.2.2 Resources

- National TWG members with the following qualifications
 - Expertise in 3D model-based project development and delivery
 - Experience with software development

- Expertise and experience with instructional design and deploying training programs
- Partnerships with AASHTO, FHWA, industry and educational institutions to oversee long-term standardized training program(s)
- Funding for establishing a partnership consortium composed of software companies and project development and delivery practitioners, and educators to guide the development and testing of new software functionality. It is possible that this consortium works in collaboration with buildingSMART USA as part of the Technical Committee

2.1.2.3 Assumptions

- No direct cost associated with this task. It is assumed that National TWG members will work on a volunteer basis
- Cost for developing a formal educational program through NHI, AASHTO TC3, or educational institutions is not accounted in the budget proposed in this implementation plan

2.1.2.4 Deliverables

- Creation of a National TWG
- Technical memorandum proposing a long-term training program (using updated NCHRP 10-113 Guide)

2.1.2.5 Measuring Success

Adoption Rate and Utilization of NCHRP 10-113 Guide

- Track the number of organizations adopting the guide as a standard practice
- AASHTO guide development based on the findings from NCHRP 10-113
- Measure the usage and effectiveness of tools developed for implementing the guide

Case Studies and Stakeholder Feedback

- Document and track the number of case studies from organizations successfully implementing the NCHRP 10-113 Guide's practice and developed tools
- Measure the usage and effectiveness of tools developed for implementing the guide
- Evaluate the reach and educational impact of training programs through participant feedback and knowledge retention assessments

2.2 Target Audience

Because the NCHRP 10-113 Guide is intended for any personnel involved in the development and delivery of 3D model-based deliverables for construction, including highway agencies and their consulting partners; the activities proposed in this implementation plan are intended for people responsible for establishing, training, and adopting the practices suggested in the NCHRP 10-113 Guide. Overall, activities proposed under this implementation plan focus primarily on developing specific training for each of the audiences listed in Table 1.

TABLE 1. TARGET AUDIENCE FOR IMPLEMENTATION EFFORTS AND BENEFITS

Target audience	Benefits
Digital delivery technology and process implementers	Highway agencies and their consulting partners need actionable guidance on how to update their quality management frameworks to address risks associated with delivering design information using new 3D model media. The NCHRP 10-113 Guide provides high-level guidance to assist with implementation, but it is not granular enough to be used as direct content for training and updating agency-specific procedures. The activities proposed in this implementation plan will result in the development of a train-the-trainer educational program that will enable those responsible for deploying and updating 3D model-based technology and processes to apply the concepts in the NCHRP 10-113 Guide at their specific organizations and within discipline-specific workflows.
Design staff producing digital deliverables	The NCHRP 10-113 Guide introduces new types of reviews, new approaches to digital review documentation, offers opportunities for introducing new software tools and features, and provides sample checklists and other quality artifacts. However, the NCHRP 10-113 Guide was not intended to be used as a step-by-step instructional manual for updating quality management practices at any agency. Thus, activities proposed in this implementation plan will provide much needed training for this specific audience related to the application of the review procedures, check lists and other effective practices offered in the NCHRP 10-113 Guide.
Project managers/technical reviewers	More experienced design managers are unlikely to use 3D modeling software, creating a skill gap in the largest pool of qualified design reviewers. Activities under this implementation plan will result in the development of specific training to this audience to upscale their skill sets for performing quality management and technical reviews using a hybrid approach of digital and document based practices during this transition period. Long-term activities will result in an action plan to work with software providers to develop tools that make it easier for this audience to perform reviews, but also to extract reports from the 3D models to document the review process in a way that is consistent, repeatable, reproducible, and traceable.
Quality managers	Long-standing quality management procedures for reviewing designs are based on 2D plans and struggle to handle the content of 3D models. Further documentation of the quality control process, including comments and responses located on or attached to model elements, or views is a new process and can be cumbersome. Implementation will provide much needed training to help quality managers with the transition from analog to digital methods of validating and documenting the review of contract plans, and the auditing process. Quality managers will need support in assessing their existing workflows while they move toward integrating the full complement of 3D design details.

2.3 Additional Support

Facilities to host in-person workshops for up to 20 people will need to be provided. Implementation plan budget proposal does not include the cost of workshop facilities.

In addition, implementation organizations may need to procure new software and technology that will allow them to deploy the suggestions, practices and procedures presented in the NCHRP 10-113 Guide.

Details for additional support for technical experts have been included in Section 2.1 Major Tasks.

2.4 Evaluation and Monitoring

The success of the NCHRP 10-113 Guide implementation will be measured through both quantitative and qualitative methods as described under Section Task 2.1 Major Tasks.

3 Final Deliverables

The activities proposed under this implementation plan have been designed to provide deliverables for each of the proposed tasks. However, it is a good idea to document the entire project through a final report summarizing the participation and outcomes of the 12-month implementation schedule. Further, an additional task may be added to follow-up with implementing organizations to document case studies and report back to AASHTO, FHWA, and TRB Committees.