NCHRP Synthesis 50-12
Development and Use of As-Built Plans by State DOTs

Tim Taylor, P.E., Ph.D.
Victoria Lasley, E.I.T.
Steve Waddle, P.E.
Ying Li, Ph.D.
Roy Sturgill, P.E., Ph.D.
Background

Real Whiskey
Background
Objective and Methodology

- **NCHRP Synthesis**: “current knowledge and state of practice”

- **50-12 Objective**: Document how as-built plans are developed, used, and updated for various delivery methods by State Transportation Agencies

- **Methodology**
  - Literature Review
  - State Transportation Agency Survey
    - *(Distributed to AASHTO COC/COD)*
  - Structured Interviews for Case Examples
Survey Response

42 States (84%)
Documented definition of as-built plans?

- Yes: 50%
- No: 37%
- Unsure: 13%

Documented as-built development procedure?

- Yes: 68%
- No: 24%
- Unsure: 7%
Information Documented in As-Built Plans

Underground DOT Infrastructure

- Changes to drainage structures such as length, flow line elevation, station or offset dimensions, sizes, thicknesses, and types of inlets and manholes: 26
- Foundation elevations and subsurface structural details: 23
- Changes in horizontal and vertical alignments: 23
- Locations and dimensions of all structures: 22
- Corrections and adjustments to stationing: 22
- Changes to typical sections: 21
- Grade revisions: 21
- Changes to right-of-way lines, distances, and markers: 17
- Location and elevation of monuments, benchmarks, freeway fences, and gate: 16
- Utility locations, depths, elevations, offsets, and clearances: 14

Underground Utility Infrastructure

Total Number of Responses: N=42
Methods Used to Capture and Document As-Built Data

- Hand Written Notes: 36 respondents (89%)
- Electronic Notes: 32 respondents (76%)
- Photographs: 14 respondents (33%)
- Google Earth: 4 respondents (10%)
- LiDAR: 4 respondents (10%)
- 3D Models: 3 respondents (7%)
- Ground Penetrating Radar: 3 respondents (7%)
- Other: 3 respondents (7%)
- Drones: 1 respondent (2%)

Total Number of Responses: N=42

11% - Hand written only
89% - Hand written +
Platforms Used to Establish As-Built Plans

- Paper mark ups: 28 respondents
- Adobe: 18 respondents
- Bluebeam: 17 respondents
- MicroStation: 16 respondents
- Microfilm/fiche: 5 respondents
- Mylar Sheets: 4 respondents
- AutoCAD: 4 respondents
- 3-D Modeling: 3 respondents
- Other: 2 respondents

Total Number of Responses: N=42

14% - Paper plans only
86% - Paper plans +
Entity Developing As-Built Plans

In-house employees only 52%

Outside entities only 3%

In-house employees and outside entities 45%
Entity Developing As-Built Plans

**In-house staff**
- Construction: N=36
- Design: N=7
- Other: N=3

**Outside entity**
- Contractor: N=16
- Design Consultant: N=9
- Other: N=1
Documented as-built approval process

Documented as-built storage process
As-Built Storage Systems

Electronic Document Management System: 23
Central Office as electronic files: 16
District Offices as hard copy prints: 15
Central Office as hard copy prints: 9
District Offices as electronic files: 9
Project Archives: 5

Total Number of Responses: N=42

DOT Developed
Bentley Projectwise
Falcon System
FileNet
OnBase
Microsoft Sharepoint
Microsoft Access
As-Built Updates After Construction Completion

- Yes: 11%
- No: 76%
- Unsure: 13%
Information Used from As-Built Plans

- Alignments: 28
- Typical Sections: 28
- Stationing Information: 27
- Footing Information: 26
- Pile Tip Elevations: 24
- Subgrade Details: 23
- Depths and clearances: 23
- Foundation Layouts: 23
- Intersection Grades: 22
- Pile Length: 22
- Cut and Fill Slopes: 21
- Culvert Fill Heights: 21
- Subsurface Utility Information: 20
- Bearing Details: 20
- Right-of-Way Plans: 17
- ADA Ramps Information: 17
- Actual Courses Placed: 17
- Rock Cut Slopes: 15
- X Dimensions: 14
- Beam Seat Information: 14
- Maintenance History: 10
- Pictures and/or LiDAR Scans: 8
- Other: 4

Total Number of Responses: N=38
As-Built Improvements Needed

Total Number of Responses: N=37
As-Built Refinements In Process

57% Improved accuracy
70% Improved usability
68% Incorporation of new technology
19% Applicability to multiple delivery methods
49% Increased feedback between divisions
68% Better linkage to asset management
11% Other

Total Number of Responses: N=18
Case Examples
Case Examples: Highlights

- **ADOT** (Arizona Department of Transportation)
  - As-built web portal

- **CDOT** (Colorado Department of Transportation)
  - Contractor developed as-builts

- **VDOT** (Virginia Department of Transportation)
  - Two-person system, varies by delivery method
  - As-built Record Management System (ARMS)

- **KY** (Kentucky Transportation Cabinet)
  - Streamline process to minimize collection/maximize use
Key Findings

• The majority of STAs indicate that as-built information is recorded using hard-written notes but this is often supplemented with other technology.

• As-built storage continues to evolve at STAs, with most states migrating to electronic storage systems.

• Uses of as-built plans still fall under traditional use scenarios (e.g. informing preliminary design) but some states are incorporating as-builts into asset management systems.
Future Research Needs

• Improvements in as-built data capture methods was the most frequently cited (94% of respondents) area of needed improvement in current STA as-built processes.

• Improve the overall efficiency of the as-built creation process.

• Incorporate as-built data into asset management systems.
Challenges Faced in Improving As-Builts

- IT issues: 32%
- Lack of technical staffing: 52%
- Lack of management support: 6%
- Uncertainty on where to begin: 26%
- Lack of available technology: 32%
- Other: 26%

Total Number of Responses: N=31