Applications of Enterprise GIS in Transportation (AEGIST)

ABJ60: Geographic Information Science & Applications Committee Meeting, TRB

Joseph Hausman, FHWA
January, 2020
Agenda

— AEGIST Vision, Goals and Objectives
  — Phase 1: Guidebook and Key Recommendations
  — Phase 2: Schedule, Scope and Key Milestones

— Enterprise GIS for Civil Integrated Management and Data Governance
  — Asset & Road Network Data Management
    — Business Rules
    — Relational Data Model
    — System Integrations
  — Project Planning & Programming
  — Pavement, Bridge and Maintenance Management Decision Support
  — Safety Analysis: Highway, Intersections, Ramps
  — Reporting & Analytics: HPMS, ARNOLD, MIRE, GIS Portals, Data Warehouses
AEGIST Vision, Goals & Objectives

— **Vision:** Deployment of Enterprise GIS at State DOTs

— **Goals:**
  — **Phase 1:** Development of a Guidebook
  — **Phase 2:** Application of Guidebook to assist States in Implementing Enterprise GIS; Capture Implementation Experiences, Lessons Learned and Update Guidebook

— **Objectives:**
  — Integrated GIS Systems for Managing and Governing Road Network and Asset Data
  — Spatial Data Management Business Rules
  — Open Standard for Modeling Road Network and Asset Data
  — Utilize Location Referencing Standards to Linearly / Geographically reference Asset Data
  — Spatial Data Reporting (e.g. HPMS, ARNOLD, MIRE)
  — GIS-based Asset Management Systems for Data Driven Analytics & Decisions
AEGIST Vision, Goal and Objectives

A peer-reviewed standard method for Enterprise GIS Implementation

Support Data Modeling, Integration, Reporting & Analytics requirements across multiple business units
Planning, Design, construction, Safety, Traffic, Operations & Maintenance

State Data Management Systems

- Pavement Management System (PMS)
- Asset Management Systems (AMS)
- Traffic Data System
- Crash Records System
- Local Agency Roads, Assets

Geographic Information System (GIS)

- Assets
- Crashes
- Traffic
- MIRE

Linear Referencing System (LRS)

FHWA Applications

HPMS (with ARNOLD)
MIRE FDEs

Traffic

Safety

Planning

Design & Construction

Asset Management
AEGIST Guidebook: Phase 1

— Enterprise GIS for Data Governance
— Linear Referencing Fundamentals
— Business Rules for Managing Spatial and Linearly Referenced Data
— Temporality Management: Tracking Routes & Assets across life-cycle stages
— Relational Roadway Data Model for:
  — Inventory Routes, Route Segments
  — Intersections: Hashtag, Median Cut, Continuous Flow, Roundabouts etc.
  — Interchanges: Ramps, Ramp Extensions, Mainline, Interchange Point
  — Assets & Components: Bridge, Guardrail, Sign
  — Projects

Open Specification: Enterprise Data Dictionary, Transportation Data Entity Relationships, Coded-value Domains (Reference Data)
AEGIST - Phase 2
Project Scope, Schedule & Milestones
Participating States

AEGIST Phase 2 Goal

Pilot Deployment of AEGIST Guidebook, Document Implementation Experience, Update Guidebook.

— Base Period (Oct 2019 – May 2021)
  — California
  — Connecticut
  — Georgia
  — Idaho
  — Tennessee
  — Pennsylvania

— Performance Period 1 (June 2021 – Jan 2023)
  — Arizona
  — North Carolina
  — Ohio
  — New Mexico
  — Washington

— Performance Period 2 (Feb 2023 – Sep 2024)
# Phase 2 Scope, Schedule and Work Approach

## Period 1: Oct 1, 2019 – May 31st, 2021

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## Task 2: Technical Support Services to States

- DOT Systems & Practices Review
- Backlog Preparation & Prioritization

## TECHNICAL SUPPORT SERVICES & BACKLOG UPDATES

- Planning, Design, Architectural Changes, Implementation Steps
- Configuration, Development & Deployment Services

## Task 3: Marketing, Communications, Outreach

- GIS-T 2020 Workshop
- Article 1
- Workshop or Presentation 2
- Article 2
- Webinar 1
- Webinar 2

## Task 4: Annual Peer Exchange

- Peer Exchange 1
- Peer Exchange 2

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**Pilot Deployment and Document Experience, Improvement Opportunities & Next Steps**
## Phase 2 Scope, Schedule and Work Approach

**Period 2: June 1, 2021 – Jan 31st, 2023**

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## Phase 2 Scope, Schedule and Work Approach

**Period 3: Feb 1, 2023 – Sep 30, 2024**

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**Projects:***

- **GIS-T 2020 Workshop 7**
- **GIS-T 2021 Workshop 9**
- **Webinar 4**
- **Webinar 5**
- **WorkShop 7**
- **Workshop or Presentation 8**
- **Article 4**
- **Article 5**
## State Backlogs for Enterprise GIS Implementation

### Work in Progress
- Develop Backlogs for each State for Enterprise GIS Implementation
- Start from Existing State DOT Goals, In-Flight Projects and Backlog Items
- Collaborate to Identify Spatial Data Management Projects, Goals for Enterprise GIS Implementation
- Review Backlog and Prioritize work that needs to be executed over next 16 months

<table>
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<tr>
<th>State</th>
<th>Backlog Items</th>
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| California| 1. AEGIST Data Model Evaluation  
2. Data Exchange with Local Agencies [300]  
3.  
4.  
5.  
6.  |
| Connecticut| 1. AEGIST Data Model Evaluation  
2.  
3.  
4.  
5.  
6.  |
| Georgia   | 1. Backlog Preparation  
2. AEGIST Data Model Evaluation  
3. AEGIST Guidebook Updates  
4. AEGIST Business Rules & Data Model - Shoulder, Bridge, Intersection  
5. Alignment & Attributes Data Extraction from Plan Sheets in ProjectWise (utilize Project ID)*  
6. AEGIST Guidebook Workshop & IT Training |
| Idaho     | 1. AEGIST Data Model Evaluation  
2.  
3.  
4.  
5.  
6.  |
| Tennessee | 1. AEGIST Data Model Evaluation  
2. Project & GIS System Integration  
3.  
4.  
5.  
6.  |

*Already identified project, DOT working with a consultant
Enterprise GIS for Civil Integrated Management (CIM) and Data Governance
Civil Integrated Management (CIM) is the technology-enabled collection, organization, managed accessibility, and the use of accurate data and information throughout the life cycle of a transportation asset.

**Strategy & Vision**

**Benefits**

“To ensure that information quality and integrity is not compromised as it is passed between organisations and applications during the delivery of the infrastructure asset”
Data Governance for Civil Integrated Management (CIM)

For Enterprise Data Governance, need to deploy governance for:

— Data Architecture
  ❖ What road and asset data?
  ❖ What business rules captured in data?

— Data Modeling
  ❖ Road Network (LRS), Topology, Routable Network
  ❖ Asset Data Model (LRS or GIS referenced)

— Data Quality, Master & Reference Data
  ❖ Coded Domains, Referential Integrity, Data Rules

— Data Integration
  — Open Standards, Data Exchange Specifications

— Data Analytics
  ❖ Federated Systems, Common Data Environment
Civil Integrated Management Using BIM and GIS Data Models

— **BIM**
  — *Building Information Model; where, “Building” was Noun; but now is a Verb (given highway infrastructure assets)*
  — *Building Information Model: The act of creating a digital representation of an asset during design and construction*

— **Both BIM and GIS data models**
  — *Focus on transportation assets*
  — *Tools for asset-centric data governance*
  — *Can include business data attributes*
  — *Can be created from CAD data models*
  — *Involve utilizing standards for information capture*

Figure 3. CIM can be a container for other asset production and management tools.
GIS & BIM Data Models to Enable Data Flows across Enterprise and Deploy CIM

Figure 1. Typical transportation facility life cycle workflow.

Figure 2. GIS-BIM data flows.
GIS & BIM Data Models to Enable Data Flows across Enterprise and Deploy CIM

**Program & Project Management System**
- Planned Projects
- Program List & LRS Referenced Locations, Assets
- Project Updates

**Preconstruction and Construction Management System**
- Project List & LRS Referenced Locations, Assets
- Project Updates
- Linear Referencing System (LRS)
- Route Network, Assets, Version Updates
- Route Network & Event Updates

**Asset Management Systems**
- Completed Projects (Work Done, New & Retired Assets)
- Asset and Projects Data
- MMS
- BMS
- Safety
- PMS

**Design System**
- New, Existing Assets, Line Items, Quantities
- BIM
- CAD

**Document, Content Management**
- Asset and Projects Data
- BIM

**Reporting, Data Warehouse Business Intelligence**
- Programmed Projects

**GIS**
- Route Network, Assets, Version Updates
- GIS

**BIM**
- GIS

**CAD**
- GIS

**GIS & BIM Data Models to Enable Data Flows across Enterprise and Deploy CIM**
Intersection Data Model

Relational Data Model of Road Network & Assets for Enabling Enterprise GIS
Thank You