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| 7. Author(s) | Drs. Joanne E. Hale, David P. Hale and Shane Sharpe |
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| 9. Performing Organization Name and Address | The University of Alabama’s Aging Infrastructure Systems Center of Excellence, The University Transportation Center of Alabama and AISCE -106 Bevill 201 7th Avenue The University of Alabama Tuscaloosa, AL 35487-0208 205 348 5525;aisce@ua.edu |
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Executive Summary

We recommend the Alabama Department of Transportation (ALDOT) Bridge Maintenance section adopt a strategy to migrate the current Alabama Bridge Information Management System (ABIMS) to a new bridge management system (Pontis™) over the course of a 10-12 year period. As detailed in this report, this will provide ALDOT with a lower risk and more effective solution. The proposed system will be capable of supporting a multi-state CoRe rating process and extend ALDOT’s decision support processes for managing its bridge inventory as recommended by AASHTO. This recommendation is also in line with ALDOT’s immediate and longer-term needs for managing its bridge assets by providing immediate network-level decision support capabilities for managing the state’s bridge inventory while providing a migration path to enable project-level decision support capabilities.

This project delivered four asset management information system components for bridge maintenance management. These deliverables include the:

1. Detailed goals and processes to be used for the Bridge Maintenance Management Planning System and roadmap solution,
2. Bridge Inspector Sufficiency Rating Calculator,
3. Framework for calculating the Longitudinal Bridge Family Decay Curves, and
4. Process and numerical verification for GASB34 bridge condition ratings.
Introduction

The Alabama Department of Transportation is charged with the effective management of the state’s transportation assets. In addition the organization must allocate federal funding in accordance with federal guidelines and increasingly formalized “needs” analysis and project selection procedures. The current information system that aids in prioritizing projects (ABIMS) was created more than a decade ago prior to: GASB 34 requirements, generalized deployment of data visualization tools, and recent initiatives in bridge management systems and ratings promoted by AASHTO.

The establishment of GASB 34 requires ALDOT to set preservation levels associated with alternative condition targets and estimate the spending levels necessary to achieve these targets. This information provides a basis from which to establish attainable condition goals and evaluate the ongoing utilization of funding. Continued federal and state budget pressures are placing constraints on the availability of funds, and increasing accountability for the effective utilization of these funds. Consequently, ALDOT must now do more with less and is in need of decision support tools capable of assessing the trade-offs between alternative investment strategies and assist in the effective communication of alternatives to various stakeholders.

In response, The University of Alabama’s Aging Infrastructure Systems Center of Excellence (AISCE) has delivered the following four Asset Management information system components for bridge maintenance management:

1. Detailed goals and processes to be used for the Bridge Maintenance Management Planning System and roadmap solution (Appendix A). This includes goals, decision processes, algorithms, data, and workflow. The end product of this step includes:
   - Documentation of standard decision processes;
   - Evaluation of alternative analysis techniques;
   - Evaluation of currently available data and system components (Appendix B);
   - Detailed system requirements and gap analysis;
   - A preliminary evaluation of commercially-available system solutions;
   - A Bridge Maintenance Management Module Procurement Analysis to facilitate the buy/build/modify procurement decision

2. Framework for calculating Longitudinal Bridge Family Decay Curves (Appendix C);


4. Process and numerical verification for 2003 GASB34 condition ratings (Appendix E) for the state’s system of bridges, and reconciliation of differences between the 2002 and 2003 GASB 34 condition ratings if material (from an accounting perspective).
1. Bridge Maintenance Management Planning System and Roadmap

The initial activity was to verify and validate ALDOT’s existing bridge maintenance management system goals and refine the goals to meet future needs. This activity identified an initial prioritization for network-level management decision support as opposed to project-level decisions for managing the states’ bridge assets.

The initial systems analysis directly focused on required system “outcomes” necessary for Central Office decision-making needs; the needs of Division Maintenance Engineers and County and Local Engineers were also evaluated for desired system capabilities. The system definition provides mandatory capabilities required for a network-level analysis to optimize maintenance resources. In addition, consideration was given to desired capabilities for providing project-level bridge maintenance resource estimates and prioritization. The result of this process defined a system that is extensible and adaptable such that changes to bridge maintenance management practices can be accommodated.

Vital to this system’s definition is a comparison among the existence of data in the form used by the current FHWA-based bridge condition rating process (ABIMS-ALBRIDGE) and the acquisition costs associated with alternative systems. Thus Pontis™, TRDI, and ABIMS-ALBRIDGE were all evaluated. To aid in this evaluation, interviews were conducted to assess the current bridge maintenance management systems and practices from 17 state Department of Transportations (Appendix B) emphasizing budget optimization capabilities. In addition, two external consultants were subcontracted.

1. Paul Thompson, an independent consultant experienced with Pontis™ assisted in evaluating the coverage of required “outcomes” that Pontis™ could deliver, along with its implementation/deployment costs, and length of time before such an implementation would have enough data to enable “forecasting.”

2. Texas Research and Development Institute (TRDI) evaluated the time and costs to provide a custom installation of its Agile Bridge Manager™ (ABM) system. TRDI’s product provides a flexible configuration capable of utilizing ALDOT performance criteria, data and algorithms.

Both Paul Thompson’s and TRDI’s credentials were reviewed by ALDOT’s Bureau of Maintenance, both made site visits to Montgomery, and both made presentations to the Bureau.

The major deliverables associated with the bridge asset maintenance system include:

- Scope for both short-term and long-term needs
  Major Task: Identify and prioritize needed and desired system outcomes; and create a development and deployment project timeline.

The output of this stage is a Decision Support Scope document included in the Solution Analysis Document (Appendix A). Stakeholder groups included: Senior Management (Front Office) personnel, Maintenance Bureau personnel, Finance & Accounting personnel, Project Management/Transportation Planning personnel, Bridge Bureau personnel, County...
Transportation Bureau personnel, IT & Computer Services personnel, Division Maintenance Engineers, and County and City Engineers.

- Data and system capabilities required to support the scope of decisions for bridge maintenance management, prioritized into a requirements definition document.
  
  Major Task: **Define Required System Capabilities**

This stage extended the decision support scope document by defining the data and functional capabilities required to support the bridge maintenance management decisions. This enabled a needs-driven approach to defining the required I.S. features.

The **System Requirements Definition** document denotes the essential system features and data as well as secondary system features and data based on ALDOT’s short and long-term decision-making priorities and work practices. The Benchmarking Report was also instrumental in generating these requirements based on practices associated with 17 state Department of Transportation maintenance agencies from the southeastern U.S. or those exhibiting leading practices as per the literature.

- Current bridge management system capabilities, data quality and configuration (ABIMS, ALBRIDGE and CPMS).
  
  Major Task: **Evaluate the Current System**

In addition to defining system requirements, an analysis of current system capabilities was conducted and illustrated. The required data and system features were prioritized and evaluated against the capabilities of the current ABIMS, CPMS and ALBRIDGE systems. The **Current State of ABIMS** was delivered and used as input to the Gap Analysis.

- Gaps between the data and system capabilities associated with the current bridge management system and the future system’s essential needs.
  
  Major Task: **Analyze Requirements and Current System Capabilities**

The **Gap Analysis** deliverable denotes discrepancies between required system features/data and the current system’s capabilities and available data.

- Degree of fit for specific vendor products as determined by the results of benchmarking and evaluation of vendor products based on prioritized system requirements, data needs, analytical approaches (for network optimization and project prioritization), and system configurations.
  
  Major Task: **Product Benchmarking Analysis**

The product benchmarking analysis involved the development of a matrix of system criteria to evaluate commercially available vendor products. The prioritized **System Requirements** and essential data served as primary benchmarking criteria to facilitate this evaluation. In addition, the benchmarking analysis assessed the analytical approaches adopted by the vendor to perform functions such as decay forecasting, cost analysis, network optimization,
and project prioritization. The benchmarking analysis also evaluated factors such as product adaptability, extensibility, flexibility and vendor support, which can influence the maintainability and longer-term viability of a system.

This analysis also involved an assessment of the technical configuration of the product to determine the effort required for system integration.

The major vendor’s products were evaluated against the essential system requirements to determine the degree of fit based on ALDOT’s needs. These results are noted in the resulting Gap Analysis and Feasibility Assessment.

- Facilitate a buy/modify/build decision for a bridge maintenance management system based on the results of a benefit/risk analysis for each major vendor product.
  Major Task: Assess Product Feasibility

The degree of fit for each vendor’s product noted in the Gap Analysis aided in the determination of the level of work required to adopt a specific product. The acquisition, configuration, and maintenance of a product were assessed during this work stage. Important considerations in determining the feasibility of a product include: the work required to configure a product to meet ALDOT’s essential functional requirements; the magnitude of changes required to acquire additional data or reconfigure existing data for a product to function properly; the potential impact of personnel work changes required to operate a product or meet its data needs; the acquisition of new technologies and upgrading of IT personnel skills required for a new product to operate properly; an estimate of amount of time required to acquire and modify/build a system; and the time required to deploy the information system and necessary process changes required to meet ALDOT’s short and long-term needs. In addition to each of these major risks, the potential benefits from each of the systems were defined.

The major deliverable associated with this work stage is a benefit/risk analysis (Feasibility Assessment), which facilitates the buy/build/modify decision with respect to the activities (Statement of Work) required for a potential acquisition and/or configuration of a bridge maintenance management planning system.
2. *Longitudinal Bridge Family Decay Curves*

The primary goal of this project component is to provide a more accurate and reliable means of forecasting the condition of bridges and bridge maintenance needs. This project detailed the data requirements to facilitate the longitudinal analysis of bridge decay and the process for acquiring, structuring, storing and manipulating this temporally variant data. This research effort integrates, assesses and refines conceptual models of bridge decay based on empirical data including variations in combinations of variables such as structure types, environmental conditions and traffic patterns to enhance the forecasting of bridge condition ratings. The results of this investigation provide (1) a process to integrate temporal data from disparate sources as required for a longitudinal analysis of the decay patterns of bridges and (2) the basis of developing decay curves that better match the underlying structure of bridge components. Subsequently, agencies can more accurately determine their maintenance needs and comply with federal mandates such as GASB 34. The tasks included to deliver the deterioration models include:

- Benchmarking Current Bridge Decay Forecasting Algorithms
- Examining Current Data and Integration Needs
- Analyzing Decay Patterns of Structural Bridge-type Combinations
- Performing a Multi-criteria Analysis of Traffic and Environmental Factors on Decay Patterns of Structural Bridge-type Combinations
- Developing of Forecasting Models
3. Bridge Inspection Sufficiency Rating Calculator

Effective bridge maintenance management is dependent upon reliable information associated with the structural and functional sufficiency of the state’s bridges. The determination of a bridge’s sufficiency rating requires bridge inspectors to be knowledgeable of (1) numerous rating variables, (2) the process for consistently assigning values to these variables, and (3) factors that may influence individual values or the interaction between rating variables. The computation of a bridge sufficiency rating ultimately has an impact on eligibility for federal funding for maintenance, rehabilitation, or replacement.

This web sufficiency calculator allows bridge inspectors to gain a greater understanding by analyzing the influence of individual variables and their relationship to the overall sufficiency rating. This application enhances bridge inspector training, increases the consistency of the rating process across inspectors, and reduces the time taken to determine a bridge’s sufficiency rating through on-site use. Details of the web sufficiency calculator operations are found in the Web Sufficiency Calculator Users Manual (Appendix C).
4. Verification of the Process and Calculation of 2003 GASB 34 Condition Ratings

The goal of this portion of the project was to ensure that a standard and consistent process is followed for reporting the condition of the state’s bridge network as required for GASB 34 compliance. This process is essential for comparisons across years of the funding used to maintain the bridge network and the resulting conditions. The following activities were performed and included in Appendix E.

- Calculate, document and report the bridge condition ratings for 2003 following the procedure developed in the GASB 34 Phase II,
- Verify results and documentation with ALDOT personnel,
- Document deviations from the procedures used in the prior year, and
- Conduct follow-up meetings with state auditors related to the 2003 GASB 34 bridge sufficiency rating report as required (Appendix E.1).
Appendix A: BMS Solutions Analysis

Executive Summary

We recommend adoption of a strategy to migrate ABIMS to a new bridge management system (BMS) over the course of a 10-12 year period. As detailed in this appendix, this proposed migration will provide The State of Alabama with a lower risk and more cost effective solution. The proposed system will be capable of supporting a multi-state CoRe rating process and will extend its decision support processes for managing its bridge inventory as recommended by American Association of State Highway and Transportation Officials (AASHTO). This recommendation is also aligned with the Alabama Department of Transportation’s (ALDOT’s) immediate and long-term needs by providing immediate network-level decision support capabilities for managing the state’s bridge inventory while providing a migration path to enable project-level decision support capabilities.
Introduction

This appendix consists of a Requirements section detailing the primary functional capabilities of the Bridge Management System (BMS), a Benchmarking section identifying best practices used throughout the nation at state Departments of Transportation, and a Gap Analysis section that maps the variance between candidate solution capabilities and the specified requirements. The Statement of Work described in the Feasibility Assessment section details the work required to move Alabama Department of Transportation’s (ALDOT’s) BMS from its current configuration to the desired solution. The Risk Assessment section describes the risks associated with each solution and prioritizes the risks based on impact and likelihood of occurrence.

Requirements

The requirements section provides an overview of the reports and scenarios required by the Bridge Maintenance Management System as per AASHTO Guidelines¹ to facilitate standard procedures for evaluating and determining bridge maintenance funding needs and project priorities. For each required report, this section provides a high level description and references a more detailed listing of the report’s data attributes and procedures (provided in the following Requirements: Reports section). The references to the more detailed reports are indicated by the report type (A-E) and report number within each type (e.g. Report A.1. Network Prioritization Report). Appendix A.2 provides an overview of the system functions required to enable the development of these reports.

*Note: The Benchmarking Report served as input to the Requirements definition. The Benchmarking study resulted in a primary emphasis on Network-level decision support capabilities rather than on Project-level decision support capabilities for ALDOT’s BMS.

Key Terms

Definitions of key terms that are provided within this document are defined below:

- **Project** – A bridge or group of bridges that require specific actions. For example, a bridge or group of bridges on a specific route or a group of bridges within a county, or all bridges of a specific structural type, etc. The actions can consist of Preventative Maintenance, Rehabilitation, or Replacement.
- **Network Inventory** – The bridges that currently exist in the state of Alabama for a specified owner, e.g. state, county or municipality.
- **State of Inventory** – The combined condition states (comprised of each bridge’s elements) which represents the overall condition state of the inventory for a project or the network of bridges.
- **Scenario** – A state of the inventory at a fixed point in time that can be actual current, projected, historical or hypothetical.
Network Level Reports

Network Prioritization Report (Report A.1) - A report, generated on demand, to provide a prioritized list of bridges in need of replacement or rehabilitation based on sufficiency as well as deficiency scores. This report will identify the most appropriate bridges and rank them in order given specified criteria (Outlined in Report A.1 Output, Rank Criteria). The report will provide scheduling information prioritized across years for future activities to be conducted on the bridges [Appendix A.1; Performing Long and Short Term Budget Forecasting].

Simulation Model Report (Report A.2) - A scenario-driven report enabling a simulated state of the network given specified maintenance and funding actions as input variables (Outlined in Report A.2, Input) [Appendix A.1; Predicting Deterioration; Predicting Costs]

Scenario Comparison Report (Report A.3) – A network-level report that compares the differences between the states of the inventory given each scenario. It will perform this comparison at a network or project level.

Target Condition State Report (Report A.4) - A network-level report projecting the amount of capital required to maintain a particular overall average condition state for the inventory, based on continued decay, cost and time frame for MR&R [Appendix A.1, Recommending programs and schedules for implementation within policy and budget constraints].

Situational Comparison Report

Situational Comparison Report (Report B) - This situational report will be used to track continuous changes to the bridge inventory. The system will compare a baseline status for a bridge or project for a given time period to the status generated by a scenario report (Report A.3), thus detailing changes that have occurred to the inventory. The system will also be able to support multiple baselines for use in comparison. The need for multiple benchmarks can result from reasons such as:
- Updated condition grading performed on bridge to denote change over time.
- Effects of work performed on bridge.
- Changes in external trends such as traffic volume and type of traffic.
- Change in federal funding status due to the above actions.

Preventative Maintenance Report

Preventive Maintenance Report (Report C) – A prioritized list of the bridges with the most need for specified preventive maintenance action. The system will simulate the effects and cost of implementing a maintenance plan and show the converse as a result of inaction. The system will identify the most appropriate bridges for the project, but
the user will have the ability to alter the list by placing constraints on maintenance types and budget availability [Appendix A.1; Identifying Alternative Actions].

**Optimal Policy Report**

By comparing the Network Prioritization and Preventative Maintenance reports the system will be able to: (Report D)

- Generate a report showing the ideal distribution of replacement and preventative maintenance actions to provide the largest positive effect on the network based on prioritized goals and constraints. This will aid in the optimization of budget allocation to specific types of maintenance actions [Appendix A.1; Determining Optimal Policies]
- The system will enable the user to reprioritize the distribution of preventive maintenance and bridge prioritization to evaluate the effect on the inventory.
- This report can be manipulated to show what the effect will be based on the final distribution decision.

**Decay Modeling Report**

The system will also generate a deterioration report with visibility at the following levels: (Report E)

- Project
- Bridge
- Element
  [Appendix A.1, Predicting Deterioration]

This report will also provide multiple views of the network, including:

- Current status
- Forecasted status of annual time periods

**Requirements: Reports**

Intended to augment the Requirements section, this section provides a detailed breakdown of the inputs, outputs, and processes required to generate the reports previously outlined. This section focuses on the data attributes required to produce the required reports. Although not specified here, the reports may also contain graphs or other types of visual representation and the report outputs may be supplemented as needed.

**Network Level Reports**

**A.1 Network Prioritization Report**

A list of bridges ranked with respect to their qualification for maintenance action using the sufficiency, deficiency, and condition codes as ranking criteria and with funding as a constraint. Additional constraints or ranking criteria may also be specified on an ad
hoc basis. For example, the user may establish entrance criteria that must be met for a bridge to be eligible for the list. Additionally, the report will allow for second tier criteria to be set for the ranking for the report.

- The “what if” capability can be used to show the effects on bridge ranking of applying outside funding constraints or supplements.
- The system will be able to reprioritize the bridges using a user defined criterion as an additional constraint. (i.e. amount of traffic, type of traffic, length of detour, detour location)

**Input**

- Network Scheduling, given cost and budget constraints [Appendix A.1, Recommending programs and schedules for implementation within policy and budget constraints]
  - Federal dollar allocation
    - Preventive Maintenance
    - Replace
    - Rehab
  - State dollar allocation
    - PM
    - Replace
    - Rehab
- Estimated bridge replacement cost
- Deficiency code
- Optional Constraint
  - User Cost
  - Additional Constraints

**Output**

- Prioritized list of all bridges according to overall condition state roughly allocated on a yearly time frame
  - Rank Criteria
    - Sufficiency code
    - Deficiency code
    - Overall condition state
    - Federal funding status
  - BIN
  - Type
  - Location
  - Agency Cost estimation

**Output Attributes**

- Rank
- Location/District
- BIN
- Bridge Structure Type
• Rating level
• Federal Funding Status

Process
• Calculate an overall bridge condition state for each bridge.
  • Sum of the weighted average of criteria (i.e. sufficiency, deficiency)
• Generate a prioritized listing of bridges based on:
  • overall bridge condition state
  • agency costs
• Constrain list given budget

A.2 Simulation Model Report.

A scenario-driven report enabling a view of the network conditions given specified actions. This report will simulate a future state of the network given specific input variables. This report may have multiple iterations given (1, 2, 5, 10, 15, >15 years). The report will include the ability to create multiple snapshots of the inventory’s condition, also referred to as save-points. These save-points can be compared at a later time using the Baseline Comparison Report. New projects must be input during each iteration. This relies on the underlying deterioration modeling (Appendix A.2: Function I) and cost modeling (Appendix A.2: Function III) capabilities of the BMS.

Input
• Time Frame
  • Number of Years to Simulate
• Given Project(s), i.e. from Network Prioritization Report or Preventative Maintenance Report or combination the two
  • Project Number
    • BIN or List of BINs
• Specified Actions per Project
  • Affected elements
  • State of affected elements
• Decay and Cost Models
• Action / Result Models

Output
• State of Inventory given Specified Actions
  • Elements in network affected by action
  • Condition state of elements affected
• State of Inventory given Inaction (use of Decay Modeling Report)
  • Decayed condition state of elements in network
• Current State of Inventory
  • Condition state of elements in network
Process
• Simulate specified actions on inventory given decay and cost information.
  • Compute effects of actions given the action type and bridge type. Apply these effects to the current condition codes.

What-If Scenarios
• Ability to manipulate inputs for each iteration

A.3 Scenario Comparison Report
A network-level report comparing two scenarios from the Simulation Model Report. It will allow the user to evaluate changes in baseline data at a network or project level.

Input
• Scenario selection criteria for each baseline
  • Scenario date of criteria changes

Output
• A Simulation Model Report for each scenario
  • Projects
  • State of network
• Relative variations between each scenarios
  • Projects
  • State of network

Process
• Retrieve data from both baseline selection criteria.
• Display scenario one data, then scenario two data.
• Compare the data on a network, bridge, and element level between each scenario.
• Constrained based on same bridge given varying distributions of preventative maintenance/rehab.
• Display the comparison of the two scenarios.

A.4 Target Condition State Report
A network-level report demonstrating the amount of capital required to attain or maintain a particular overall average condition state for the given project of bridges over a specified time period. The user will input the target condition state and the time period by which he or she wishes to perform the analysis. The report generated will display the funding required to achieve the target within the given time frame. This system will provide two views of the report. The first view will
provide the results if preventative maintenance is considered and the second will provide results without considering preventative maintenance. The report will also show the specific actions required to reach target condition state.

**Input**
- Given Project, i.e. from Network Report or Preventative Maintenance Report or combination of the two
- Target condition state
- Time Frame

**Output**
- List of bridges in project
  - BIN
  - Location
  - Type
  - Action performed
  - Agency cost of action
  - Budget percentage of agency cost
- Dollar amount of capital required to achieve target condition state per bridge
- Total amount of capital required to achieve target condition state across the project
- Difference of current overall average condition state and target condition state

**Process**
- Accept the list of bridges in the project, target condition state and time frame. Identify scenario to reach target by determining optimal policies (Report D) given the specified projects.

**What-If Scenarios**
- Ability to factor in preventative maintenance

### B. Situational Comparison Reports

This set of reports will display the changes incurred due to a particular situation.

**Situation - Updated condition grading performed on bridge**

**Input**
- Given Project, i.e. from Network Report or Preventative Maintenance Report (user can modify)
- Baseline Data (Used for comparison with current data)

**Output**
- BIN
- Bridge location
- Bridge Type
- List of inventory items that have received a new condition state.
- The old and new condition of the inventory item as well as the difference.
- Overall bridge sufficiency and deficiency score.

**Process**
- Compare baseline data to current data.
- Filter and display changes.

**Situation - Effects on inventory of work performed on bridge**

**Input**
- Given Project, i.e. from Network Report or Preventative Maintenance Report (user may modify)
- Baseline Data (Data from last report. Used for comparison with current data)

**Output**
- BIN
- Bridge location
- Action performed
- Percent of budget dedicated to action
- Actual effect on Inventory
- Simulated effect on Inventory (from previously saved baseline – Simulation Model Report)

**Process**
- Compare baseline data to current data.
- Filter and display changes.

**Situation – Changes in external trends such as traffic volume and type of traffic**

**Input**
- Given Project, i.e. from Network Report or Preventative Maintenance Report (user may modify)
- Baseline Data (Data from last report. Used for comparison with current data)

**Output**
- BIN
- Bridge location
- Actual effect on Inventory
- Simulated effect on Inventory (from previously saved baseline – Simulation Model Report)

**Process**
- Compare baseline data to current data.
- Filter and display changes
**Situation - Changes to a bridge due to a change in federal funding status**

**Input**
- Given Project, i.e. from Network Report or Preventative Maintenance Report (user can modify)
- Baseline Data (Data from last report. Used for comparison with current data)

**Output**
- BIN
- Bridge location
- Old funding status
- New funding status
- Reason for transition

**Process**
- Compare baseline data to current data.
- Filter and display changes.

**C. Preventative Maintenance Report**

This report will accept as a parameter the “Action” to be analyzed (i.e. spot painting, open joint repair, etc.). This report will generate a prioritized list of bridges with the most need for the specified “Action” or type of maintenance and will identify the most appropriate bridges for the project. The report will show the effects of implementing a maintenance policy and the results of inaction. The system will be able to accrue the effects of different “actions” or projects beginning with:
- Painting plan
- Open joint replacement
- Bearing replacement

**Input**
- Simulated Action Performed
- Project attributes
- Decay attributes
- Agency cost of action
- List of elements which will be affected most by action

**Output**
- List of bridges in project
- Location of each bridge
- Structure type & owner(s) per bridge
- Sufficiency
- Deficiency
- Federal funding options status per bridge
- Estimated cost to perform the project
- The improved network will have a <system output> condition state given [Action].
Process
• Query ABIMS.
• Calculate overall PM rating based on the condition of elements affected by proposed action.
• Select bridges with the lowest rating in area(s) relating to [Action].
• Add/remove bridges from the project as user specifies.

D. Optimal Policy Report

By comparing the Network Prioritization and Preventative Maintenance reports the system will:
• Generate a report showing the recommended distribution of replacement and preventative maintenance actions that will result in the largest positive effect on the network based on prioritized goals. This will aid in the optimization of budget allocation to specific types of maintenance actions. The report will also be able to use a targeted GASB rating, to allow for the targeted network or project condition rating.
• The system will allow for the comparison of different distribution scenarios and show the difference in the effects on the network.
• This report may be manipulated to show what the effect will be based on the final distribution decision.

Input
• Given Project, i.e. from Network Prioritization Report or Preventative Maintenance Report or combination of the two

Output
• Bridge BIN.
• Bridge location.
• The distribution of MR&R actions to provide the largest effect on the network based on prioritized goals.
  • Optimized action(s) to be performed per bridge.

Process
• Retrieve data from given project.
• Perform optimization routine (Appendix A.2: Function IV)

E. Decay Modeling Report

Bridge Deterioration Simulation Report (Project Level) - Report capable of showing ongoing deterioration on a project level over a given period of time.

Input
• Given Project, i.e. from Network Report or Preventative Maintenance Report (user can modify)
• Time Frame

Output
Rank
Bridge BIN
Bridge Location
Type
Sufficiency code
Deficiency code
Federal funding status
Overall Condition state per bridge at time t
Overall Condition state per bridge at time t + [time frame]

Process
- Apply elemental deterioration curves to each element contained in each bridge (Appendix A.2: Function I).
- Generate projected overall bridge condition state at the end of specified time frame.

Bridge Deterioration Simulation Report (Bridge Level) - Report capable of showing ongoing deterioration on a bridge level over a given period of time.

Input
- Given bridge, i.e. from Network Report or Preventative Maintenance Report (user can modify)
- Time Frame

Output
- Condition state per element at time t
- Condition state per element at time t + [time frame]

Process
- Apply elemental deterioration curves to each element contained in the bridge to determine an overall bridge rating (Appendix A.2: Function I).
- Generate projected elemental condition state at the end of specified time frame.

Elemental Deterioration Simulation Report - Report capable of showing ongoing deterioration of a particular element across the network.

Input
- Time Frame
- Network element attributes

Output
- Condition state per element at time t
- Condition state per element at time t + [time frame]

Process
- Apply elemental deterioration curves to each element within the network
- Generate projected elemental condition state at the end of specified time frame
Gap Analysis

The purpose of the Gap Analysis is to identify the differences between desired best practices of a BMS as defined by AASHTO Guidelines for a Bridge Management System and the capabilities of each BMS option under evaluation. According to AASHTO, “A Bridge Management System (BMS) should help transportation agencies evaluate current and future conditions and needs and determine the best mix of maintenance and improvement work on a road network over time with and without budget limitations.” This gap analysis also measures the degree of compliance in order to estimate the scope of work required for the project. The customization of the following BMS options differs in the types of customization required for each solution. The variances in customization will be covered thoroughly in the Statement of Work section.

**ALDOT BMS Options**

- **ABIMS (“Wait and See”) Solution**: This option entails ALDOT continuing to use its current BMS (ABIMS) until the offering of a commercially-available BMS that more closely aligns with the needs of ALDOT.

- **Full Pontis™ Solution (FPS)**: This option would require the complete implementation of the Pontis™ software application to replace ALDOT’s current BMS. Pontis™ requires a multi-state rating process that uses CoRe element-level data. This option would result in the loss of ALDOT’s historical bridge data, which is not used in the full Pontis™ solution.

- **Conversion-Based Transition Solution (CTPS)**: This option would entail a migration path from ABIMS to Pontis™. ALDOT’s element-level data would be retrofitted for use in Pontis™. Therefore, ALDOT would initially retain its historical data for use in Pontis™. This transition would include the collection of CoRe element-level data so that Pontis™ is populated with a sufficient amount for reliable forecasting and trend analysis. This process requires a minimum of 2 years of transition.

- **NBI-Based Transition Solution (NTPS)**: This option would also entail a migration path from ABIMS to Pontis™. However, instead of converting ALDOT’s single-state NBI data to multi-state CoRe data, ALDOT’s NBI data would be used ‘as is’ in Pontis™. However, the rating scale of 0-9 would be converted to a 1-5 scale. The Louisiana Department of Transportation and Development (LADOTD) are currently attempting this approach; LADOTD would serve as the model for this solution.

- **TRDI Agile Bridge Manager (ABM)**: This option entails implementing the reporting software application to interface with ALDOT’s ABIMS software. This solution alternative allows ALDOT to retain its current NBI-based sufficiency rating data and current capabilities of ABIMS, but will require several defined enhancements to ABM’s current capabilities.

- **Custom Built Solution**: This option would be developed according to the client’s custom requirements and rely on the data & structure of ABIMS. This option will
fully comply with all of the required capabilities, leaving no requirements gaps to report in a Gap Analysis. Therefore, it will be dropped from further analysis. It should be noted, however, that the costs and risks associated with this solution will be substantially higher than the other options.

Table 1: Requirements Gap Analysis Summary

<table>
<thead>
<tr>
<th>Reporting Requirement</th>
<th>ABIMS</th>
<th>FPS</th>
<th>NTPS</th>
<th>TRDI</th>
<th>ABIMS Customization</th>
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<tr>
<td><strong>Network-Level Reports</strong></td>
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<tr>
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<tr>
<td><strong>Preventive Maintenance Report</strong></td>
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<tr>
<td>Optimal Policy Report</td>
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<td><strong>Situational Comparison Reports</strong></td>
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<td>Updated Condition State</td>
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<td>Change in Federal Status</td>
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</tr>
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</table>

**AASHTO Recommended BMS Capabilities**

The AASHTO recommended capabilities for a BMS include [Appendix A.1]:
- Collecting, Processing, and Updating Data
- Budget Forecasting (Short and Long-term)
- Deterioration
- Preventative Maintenance
- Determining Optimal Policies
- Identifying Alternative Actions
- Predicting Cost
These capabilities are explained below with respect to each viable BMS option under consideration. Any inconsistencies or contradictions are noted as well.

1. **Collecting, processing, and updating data**
   - The system’s database needs to have the capability to retain, edit, and update inventory, inspection, and appraisal data as well as complete historical information and codes. It should contain NBI data as well as detailed elemental data.

   **ABIMS:** ABIMS contains NBI data on the four main components of a bridge. These are broken down into subcomponents, which are representative of about 70% of all CoRe elements.

   **Pontis™:** Pontis™ is capable of collecting, processing, and updating CoRe element-level data. A full Pontis™ implementation would result in the loss of ALDOT’s historical NBI-based data. Inspectors would also have to be trained to collect CoRe element-level data using a multi-state rating process.

   **Conversion-Based Transition Solution:** This solution would be capable of collecting, processing, and updating ALDOT element-level data. An implementation of Pontis™ with historical ALDOT data would require assumptions of estimating quantity and associated cost. Additionally, a conversion from the NBI scale to the CoRe elemental rating scale would be required with a Pontis™ implementation. Inspectors would also have to be retrained to collect quantity (%) based data using a multi-state rating process.

   **NBI-Based Transition Solution:** This solution would be capable of collecting, processing, and updating ALDOT NBI data for use in Pontis™. This data will be used until a sufficient amount of CoRe element-level data has been collected in order for Pontis™ to provide reliable forecasting and trend analysis which takes a minimum of two years (Benchmarking Report, p11).

2. **Predicting Deterioration**
   - Refers to the ability of the BMS to provide decay curves and specific element degeneration forecasts from past data and/or expert elicitation.

   **ABIMS:** Not available

   **Pontis™:** Pontis™ can provide this function for any given element as well as take into account different bridge types. The standard Pontis™ model has no place for age of structure / component. This could result in a problem as some of the deterioration modeling would require measurement of asset ‘age.’

   **Conversion-Based Transition Solution:** Would have the ability to provide deterioration modeling, and provide this function for any given element, as well as take into account different bridge types. This solution would require ABIMS element-level data to be converted to CoRe element data. This may result in the loss of precision in deterioration models due to the data conversion.

   **NBI-Based Transition Solution:** This solution would provide the capability to initially view the deterioration of ALDOT’s NBI data. Decay curves of ALDOT’s NBI data would be developed for use in Pontis™. CoRe data would also have decay curves developed through expert elicitation. These curves would be used after the migration to the CoRe rating standard.
**Decay curves should be initially generated from two sources: historical data and expert elicitation. The accuracy of the decay curves should be updated based on reported condition data.**

3. **Predicting Agency Costs** → In order to achieve cost estimation, the system should contain procedures for estimating costs of any action ranging from maintenance of individual elements to full bridge replacement. Cost estimates should be derived from historical data files and/or engineering judgment.

   **ABIMS:** Not available

   **Pontis™** Has this capability. When predicting agency costs, a BMS must derive cost estimates “from historical data files and/or engineering judgment” (AASHTO, p2).

   **Conversion-Based Transition Solution:** Would have this capability. However, when predicting agency costs, a BMS must derive cost estimates “from historical data files and/or engineering judgment” (AASHTO, p2). This solution may be somewhat inaccurate in this area due to the ALDOT data conversion to CoRe element data and the aforementioned guideline.

   **NBI-Based Transition Solution:** Would have this capability. ALDOT’s historical cost data could be used for cost estimates.

4. **Preventative Maintenance Capabilities** → The system should suggest various levels and types of maintenance (versus replacement). Recommends programs and schedules for implementation within policy and budget constraints. The system should be able to compute and suggest different measures of maintenance based on long-term and short-term cost benefit and the representative change in overall structure ratings.

   **ABIMS:** only uses replacement methods.

   **Pontis™** Includes both preventative maintenance and replacement actions. Models recognize the impacts of preventative maintenance. The Pontis™ models recognize the point at which preventative maintenance is inappropriate because a bridge has deteriorated beyond a point of repair and requires replacement.

   **Conversion-Based Transition Solution:** would have the same preventive maintenance capability as the full Pontis™ option. However, a different data set would be used.

   **NBI-Based Transition Solution:** The same preventive maintenance capability as Pontis™ would be provided by this solution. However, a different data set would be used.

5. **Identifying Alternative Actions** → System should include the comparison of multiple actions on a given element or bridge. These actions include all forms of rehabilitation, replacement, and preventive maintenance. The system should then show the forecasted costs and benefits from each identified action allowing the user to select the best alternative or series of actions.

The system should be able to identify the optimal actions from several different perspectives.
• Network Level – The system should group bridges and provide the best candidates per group. Groups can include the entire network of bridges, divisions, bridge types, or others based on specified attributes.
• Project Level – Optimization across all bridges in a given project
• Bridge Level – Optimization by providing the best time/action alternative for a specific bridge

**ABIMS:** Not available

**Pontis™:** Pontis™ identifies alternative actions for each element at each condition state via the ‘models_002_preservation_needs’ report.

**Conversion-Based Transition Solution:** Pontis™ identifies alternative actions for each element at each condition state via the ‘models_002_preservation_needs’ report. This solution may be somewhat inaccurate in this area due to the ALDOT data conversion to CoRe element data.

**NBI-Based Transition Solution:** Actions would be defined for each of ALDOT’s NBI components at each condition state (1-5). This solution would suggest the appropriate actions on a given component. As previously mentioned, Pontis™ has pre-defined alternative actions for each CoRe element at each condition state and can be viewed in the ‘models_002_preservation_needs’ report.

6. **Performing Short and Long-term Budget Forecasting** ➔ Defined as the ability of a BMS to forecast how the budget will be affected over a given amount of time by various rates of deterioration.

**ABIMS:** Has limited ability to do a long-term budget forecast, but the solution is semi-automated & not tied to deterioration differential cost models.

**Pontis™:** Has the ability to provide a forecast for what the budget will look like in a specified number of years.

**Conversion-Based Transition Solution:** Would have the ability to provide a forecast for what the budget will look like in a few years. Initially, using single-state data could result in a lack of precision of cost estimates. Decisions are made based on cost of performing an action and on the benefit they provide.

**NBI-Based Transition Solution:** Would have the ability to provide a forecast for what the budget will look like in a few years. Initially, using single-state data could result in a lack of precision of cost estimates. Decisions are made based on cost of performing an action and on the benefit they provide.

7. **Optimization (Determining Optimal Policies)** ➔ Defined as the ability of the system to provide the best cost alternative action for bridge projects.

**ABIMS:** Has no optimization capabilities, but rather relies on standard policies & procedures for bridge project selection. “A manual, judgmental approach is unacceptable” (AASHTO, p2).

**Pontis™:** Can provide optimization based on varying criteria on all levels of project classifications.
**Conversion-Based Transition Solution:** This solution would have the same optimization capabilities as full Pontis™ implementation. The use of non-precise ALDOT-converted data may cause optimization figures to be somewhat less accurate.

**NBI-Based Transition Solution:** This solution would have the same optimization capabilities as full Pontis™ implementation. The use of NBI data may cause optimization figures to be somewhat less accurate.

**ALDOT Reporting Requirements**

**Network-Level Reports**

**Network Prioritization Report** → A report will be generated on demand to provide a prioritized list of bridges in need of replacement or rehabilitation based on sufficiency as well as deficiency scores. This report will identify the most appropriate bridges and rank them in order given specified criteria. The report will provide scheduling information for future activities to be conducted on the bridges [Statement of Work; Full Pontis™ Solution; Implementation].

*ABIMS* - ABIMS currently accommodates this requirement by way of Screen 12, Deficiency & Sufficiency Points and Ranking.

*Pontis™* - Although Pontis™ is capable of creating a similar report (Bridge Condition Summary Report); Pontis™ carries a sufficiency status as opposed to a deficiency status.

**Conversion-Based Transition Solution** - A successful generation of this report is dependent upon importing and mapping of ALDOT elemental data correctly.

**NBI-Based Transition Solution:** A successful generation of this report is dependent upon importing of ALDOT NBI data correctly.

**Simulation Model Report** → A scenario-driven report enabling the visibility of the network given specified actions. This report would simulate a “to-be” state of the network given input variables [Statement of Work; Full Pontis™ Solution; Implementation].

*ABIMS* - Not available.

*Pontis™* - Pontis™ has a module that can handle this requirement. It is capable of running a simulation on the network that can take into account certain actions on the network. This results in a number of relevant reports.

**Conversion-Based Transition Solution** - Pontis™ is capable of running a simulation on the network that can take into account certain actions on the network. This results in a number of pertinent simulation reports.

**NBI-Based Transition Solution:** Pontis™ is capable of running a simulation on the network that can take into account certain actions on the network. This results in a number of pertinent simulation reports.

**Scenario Comparison Report** → A network-level report that will compare the differences between the states of the inventory given each scenario. It will perform this
comparison across a network or bridge level [Statement of Work; Full Pontis™ Solution; Additional Customization].

**ABIMS** - Not available

**Pontis™** – Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report.

**Conversion-Based Transition Solution** - Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing and mapping of ALDOT elemental data correctly.

**NBI-Based Transition Solution**: Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing and mapping of ALDOT NBI data correctly.

**Target Condition State** Report - A network-level report detailing the amount of capital required to maintain a particular overall average condition state for the inventory, based on continued decay, cost and time frame for MR&R [Statement of Work; Full Pontis™ Solution; Additional Customization].

**ABIMS** – Not available

**Pontis™** – Pontis™ is currently not capable of this. Cambridge Systematics has just begun work on this functionality. They estimate that it will be released in two years. CalDOT noted, however, that the functionality would be available in August 2004.

“Pontis™ does not support the “What-if” functionality that would allow a user to enter desired performance measures and request the system to calculate the funding and projects that would result in achieving these measures. Instead, the system predicts the performance measures that would result from a particular budget, planned projects and specified scenario parameters. Users would need to do this in an iterative way until they obtain an acceptable result. There are plans for a future version of Pontis™ to include development of performance targeting at some level. Providing this functionality, even in a custom built solution, would be very difficult/expensive.”(Cambridge & Bearing Point, p 89)

**Conversion-Based Transition Solution** - Pontis™ is currently not capable of this. See above reference.

**NBI-Based Transition Solution**: Pontis™ is currently not capable of this. See above reference.
This set of reports will display the condition changes incurred due to a specified situation (such as work performed or changes in federal status).

**Updated Condition State Report**

**ABIMS** – Not available

**Pontis™** – Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report.

**Conversion-Based Transition Solution** – Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing and mapping of ALDOT elemental data correctly.

**NBI-Based Transition Solution**: Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing of ALDOT NBI data correctly.

**Updated Condition State due to Work Performed on Bridge Report**

**ABIMS** – Not available

**Pontis™** – Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report.

**Conversion-Based Transition Solution** – Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing and mapping of ALDOT elemental data correctly.

**NBI-Based Transition Solution**: Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing of ALDOT NBI data correctly.

**Change in Federal Status Report**

**ABIMS** – Not available.

**Pontis™** – Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report.

**Conversion-Based Transition Solution** – Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing and mapping of ALDOT elemental data correctly.

**NBI-Based Transition Solution**: Pontis™ does not currently have this as a pre-written report. However, this report can be custom built into Pontis™ to be a standard report. A successful generation of this report is dependent upon importing of ALDOT NBI data correctly.
Optimal Policy Report [Statement of Work; Full Pontis™ Solution; Additional Customization]

A report showing the ideal distribution of replacement and preventative maintenance actions to provide the largest positive effect on the network based on prioritized goals.

**ABIMS** – Not available

**Pontis™** – Has this capability. Pontis™ identifies the optimal mix of “actions” for each bridge in a given project via the ‘plan008_Pontis™_candidate_list’. ‘models_002_preservation_needs’ report.

**Conversion-Based Transition Solution** - Would have this capability. Pontis™ identifies the optimal mix of “actions” for each bridge in a given project via the ‘plan008_Pontis™_candidate_list’ report. This solution may be somewhat inaccurate in this area due to the ALDOT data conversion to CoRe element data.

**NBI-Based Transition Solution**: Would have this capability. Pontis™ identifies the most appropriate mix of “actions” for each bridge in a given project via the ‘plan008_Pontis™_candidate_list’ report. This solution may be somewhat inaccurate in this area due to the use of ALDOT’s NBI data as input.

Preventive Maintenance Report [Statement of Work; Full Pontis™ Solution; Implementation]

This report will accept as a parameter the “Action” to be analyzed (i.e. spot painting, open joint repair, etc). This report will generate a prioritized list of bridges with the most need for the given “Action” or type of maintenance. Not only will the system be able to show the effects of implementing a maintenance policy but it will also be able to show the results of inaction. The system will identify the most appropriate bridges for the project. The system will be able to accrue the effects of different “actions” or projects beginning with painting plan, open joint replacement, and bearing replacement

**ABIMS** – Not available

**Pontis™** – Pontis™ has a module that can meet this requirement. It is capable of running a simulation on the network that can take into account certain preventive maintenance actions on the network.

**Conversion-Based Transition Solution** - Pontis™ has a module that can meet this requirement. It is capable of running a simulation on the network that can take into account certain preventive maintenance actions on the network. A successful generation of this report is dependent upon importing and mapping of ALDOT elemental data correctly.

**NBI-Based Transition Solution**: Pontis™ has a module that can meet this requirement. It is capable of running a simulation on the network that can take into account certain preventive maintenance actions on the network. A successful generation of this report is dependent upon importing of ALDOT NBI data correctly.
**Bridge Deterioration Simulation Report (Project Level)**  
Report capable of showing ongoing deterioration on a project level over a given period of time.

- **ABIMS** – Not available
- **Pontis™** – Pontis™ provides this capability via the ‘Bridge Analysis’ functionality of the ‘Programming’ module.

**Conversion-Based Transition Solution** – Pontis™ provides this capability via the ‘Bridge Analysis’ functionality of the ‘Programming’ module.

**NBI-Based Transition Solution**: Pontis™ provides this capability via the ‘Bridge Analysis’ functionality of the ‘Programming’ module.

**Bridge Deterioration Simulation Report (Bridge Level)**  
Report capable of showing ongoing deterioration on a bridge level over a given period of time.

- **ABIMS** – Not available
- **Pontis™** – Pontis™ provides this capability via the ‘Bridge Analysis’ functionality of the ‘Programming’ module.

**Conversion-Based Transition Solution** – Pontis™ provides this capability via the ‘Bridge Analysis’ functionality of the ‘Programming’ module.

**NBI-Based Transition Solution**: Pontis™ provides this capability via the ‘Bridge Analysis’ functionality of the ‘Programming’ module.

**Bridge Deterioration Simulation Report (Element Level)**  
Report capable of showing ongoing deterioration of a particular element across the network.

- **ABIMS** – Not available
- **Pontis™** – Would have this capability.

**Conversion-Based Transition Solution** – Would have this capability.

**NBI-Based Transition Solution**: Would have this capability.
Feasibility Assessment

The Feasibility Assessment uses the Requirements and Gap Analysis to generate a Statement of Work and a Risk Assessment for the proposed solutions. The Statement of Work includes the Full Pontis™ Solution (FPS), the Conversion-Based Transitional Pontis™ Solution (CTPS), the NBI-based Transitional Pontis™ Solution (NTPS), and the TRDI solution. The Risk assessment includes the FPS, CTPS, NTPS, TRDI, wait-and-see, and a custom solution. The custom solution is not included in the statement of work because its high risk excludes it as a viable solution.

Current State of ABIMS

ABIMS currently serves as the BMS for ALDOT. It tracks bridge inventory data, element condition grading, deficiency ratings, required maintenance, maintenance performed, and scour data & plotting. ABIMS currently relies on NBI data. The following details the current reporting, recording, and inspection entry capabilities of ABIMS (listed by module).

- **BI-1: BIN Assignment Card**
  - Uses a BIN form to request a BIN for a new bridge
- **BI-4: Streambed Cross Sections**
  - Used to record streambed cross sections for scour critical bridges
- **BI-5: Bridge Inspection Condition Report**
  - Provides a form for inspectors to enter the rating of each element
  - Provides additional space for comments
  - A composite score for the bridge is then entered
  - Provides space for further comments regarding the bridge as a whole
- **BI-6: Structural Inventory and Appraisal**
  - Official record of the most recent bridge inspection for any individual structure
- **BI-7: Field Review Check List**
  - Provides a check list for use during the department’s regularly scheduled field reviews
    - Mandated by FHWA
- **BI-8: Scour Observation**
  - Contains information as to whether a bridge will scour and to what degree
- **BI-9: Structure Maintenance Needed Estimate**
  - Used to transfer maintenance and repair requirements from the bridge inspector to the individual responsible for scheduling bridge maintenance operations
- **BI-10: State Structure Maintenance Performed**
  - Used to record maintenance performed on state bridges as well as labor, equipment and materials involved in the performed maintenance
- **BI-11: Secondary Road Structure Maintenance Performed**
• Used to record maintenance on local bridges owned non-state agencies such as counties or cities
• BI-12: State Structure Contract Maintenance Performed
  • Used to record maintenance activities performed on state-owned bridges by contract forces
• BI-13: General Narrative Form
  • Used to record any narrative information that is not otherwise covered by a numbered item
• BI-14: Structure Load Rating Narrative Form
  • Used to record information produced during the rating process by the bridge raters
**Statement of Work**

The statement of work details, for each solution alternative, the work required to deliver the capabilities defined in the Gap Analysis document while considering the current state of ABMIS. This statement of work will be broken down into three categories. *Preliminary work* will include tasks required to modify ALDOT’s current environment to accept the proposed solution. *Implementation work* will include tasks required to implement the foundation (core) of the proposed solution. *Customization work* will include tasks required to modify the solution to meet ALDOT’s stated requirements. *Post implementation work* will include tasks required to ensure that the solution is achieving ALDOT objectives.

**Full Pontis™ Solution (FPS)**

The FPS will require migrating to Pontis™ after initial collection cycles. ALDOT will be dependent upon ABIMS for another four years. ALDOT will then be completely migrated to Pontis™. NBI data will no longer be collected at this point.

**Preliminary Work**

**Technology Update Stage**
- Update ALDOT systems hardware to comply with Pontis™ minimum requirements

**Data Setup Stage** [Benchmarking Report; Appendix B]
- Map ALDOT elemental data to AASHTO elemental data
- Define additional elemental entities
  - Define element ID
- Define structure types
  - Define structure units
  - Define process for defining future structures [ BI-1 ]
- Assign environment types
  - Define any additional environment types
- Define actions
  - Define action categories
  - Define additional work actions for each element condition state
- Define relationships between elements and their structures
- Define relationships between structures and environments
- Assign roadway for each structure
- Define additional parameters as needed
- Format Database information to Pontis™ acceptable format
  - BIN
  - NBI data
- Configure User Administration settings
• Assign user ID
• Grant privileges
• Enter user descriptive information
• Import Historical Data into Pontis™
  • NBI Data
  • Cost Data
  • Develop process for retrieving historical data [BI-6]

**Training Stage** [Benchmarking Report; Appendix B]

• Conduct training for data entry personnel
  • Customize data entry to handle information recorded in BI-5
• Conduct training for inspectors on taking multi-state rating data
  • Develop a Pontis™ element-level coding guide for inspectors
  • Develop and organize 12 hour training curriculum
  • Customize Pontis™ to produce field review checklist [BI-7]

**Collecting Data Stage**

• Collect and enter two cycles of multi-state rating data
  • Create data interchange (PDI) files to exchange data between different Pontis™ databases
• Perform quality control on initial multi-state data inspection cycles

**Activity Recording Customization Stage**

• Develop process for assigning maintenance and repair activities to individuals responsible [BI-9]
• Develop process for recording maintenance and repair activities and narrative [BI-11, BI-12, BI-13]
• Develop process for keeping track of scour observations [BI-8]
  • Develop process for recording streambed cross sections for scour-critical bridges [BI-4]

**Implementation Work**

**Pontis™ Model Configuration Stage**\(^5\)

• **Develop Preservation Optimization model** [Final Requirements; Optimal Policy Report given Optimal policy definition]
  • Develop Deterioration models for each element or element groupings
    • Customize deterioration models using expert elicitation
    • Update deterioration models as based on collection of new multi-state inspection data
  • Develop Cost models for preservation and replacement actions
• Customize cost models using expert elicitation
• Combine element and labor costs to define costs associated with various actions on both single and coupled elements.
• Customize reporting module to replicate data in BI-10

• **Develop Bridge Program Simulation model** [Requirements; Simulation Model & Preventative Maintenance Report]
  • Develop program (Preservation Model and Network Improvement Strategies)
  • Develop functional improvement policy standards
    • Establish service and design standards
  • Modify improvement benefits and costs
    • Develop unit costs
    • Develop user costs
  • Develop one or more sets of improvement modeling assumptions
  • Develop one or more sets of Simulation rules
    • Scoping Rules
    • Look Ahead Rules
    • Major Rehab Rules
    • Agency Policy Rules
    • Paint Rules
  • Develop one or more budgets

• **Develop Project Planning model** [Requirements; Network Prioritization Report]
  • Set up funding sources
  • Set up programs for organizing projects

---

**Customization Work**

**Pontis™ Reporting Customization Stage**

• All custom reports must be generated using Sybase Infomaker software
  • Screen Layouts
  • Reports
  • Data Entry Forms
  • Reports to be created and placed in Pontis™ Report Manager
    • Scenario Comparison Report
    • All Situational Comparison Reports
    • Optimal Policy Report
  • Two options if reports are to be implemented:
    • Train employee on Infomaker software
    • Outsource custom reporting to expert

**Requirement Reporting Customization Stage**

[Benchmarking Report; Appendix B.2, Final Requirements]

• Develop archival process to store scenario report data
  • Export to PDI file
• Develop Scenario Comparison Report
  • Select two reports from archival module
  • Infomaker report to calculate differences in two selected reports
  • Display results

• Develop Situational Comparison Report
  • Select two reports from archival module
  • Infomaker report to calculate differences in two selected reports
  • Filter out all irrelevant results
  • Filter out results where no change occurred
  • Display results

• Develop Optimal Distribution given actions
  • Integrate external GIS display application with Pontis™ database
  • Integrate load rating calculation module with Pontis™
  • Develop optimal policy application that will support predictive modeling given desired actions, budget, and desired results
    • Develop algorithms and rules for action cost and result comparison
    • Develop reports for model

Pontis™ Data Access Customization Stage [Benchmarking Report; Appendix B.2, Final Requirements]
• Integrate application with Pontis™ Develop thin-client access
  • Web based data entry or Citrix server
  • For Citrix
    • Purchase of Citrix MetaFrames
    • Install Citrix software installed on each user’s machine

Post-Implementation Work

Perform quality assurance tests using comparative analysis
• Deterioration models
  • Take results from past deterioration model projected to current day
  • Compare results with current deterioration model
  • Chart disparities between the two models.

• Cost models
  • Take estimated costs
  • Compare results with actual costs over a period of time
  • Highlight discrepancies in cost estimations.

• Forecasting
  • Derive and forecast short-term budget
  • Compare forecasting results with effectiveness of forecasted budget spending
  • Determine the strengths and weaknesses of forecasted budget

• Goal-driven policy distribution
• Distribute budget between available actions
• Chart effectiveness of budget distribution with past distributions.
• Determine strengths and weaknesses of budget distribution.

**Perform hardware and software maintenance testing**

**Conversion-Based Transitional Pontis™ Solution (CTPS)**

The CTPS solution alternative entails providing immediate use of functionally limited modules within Pontis™. In this solution alternative, dependency on ABIMS will be gradually phased out [Appendix A3; Figure 1.0]. All work implemented in the Full Pontis™ Solution will also be implemented in this solution as well. These two solutions differ in the stage at which each additional module will be implemented. This section details only the additional work necessary for CTPS beyond that outlined previously for FPS.

**Preliminary Work**
**Stage 1 [Appendix A.4; Figure 2.1]**
• Develop Data Conversion Module
  • Develop Conversion Rules
    • Map ALDOT data to CoRe data
    • Derive additional CoRe data elements not represented by ABIMS data
    • Assign multi-state values to single state data
• Develop Data Translation Module
  • Formatting CPMS data into Pontis™ acceptable Format
• Setup Deterioration and Cost Models using data from translation and conversion modules

**Customization Work**
**Stage 2 [Appendix A.4; Figure 2.2]**
• Develop Quality Control Module
  • ABIMS data
    • Compare output of Data Conversion Module with collected Pontis™ multi-state data
    • Align Converted Data with actual inspection data
    • Update Pontis™ deterioration Model
  • CPMS data
    • Collect costs for assigned projects
    • Compare assigned project costs to data translation model costs
    • Align Pontis™ cost model with actual cost data
• Modify Data Conversion Module
• Modify direction in which converted data is sent
  • Data will now be sent to QC module
• Modify Data Translation Module
  • Modify direction in which converted data is sent
  • Data will now be sent to QC module

Stage 3 [Appendix A.4; Figure 2.3]
• Modify Quality Control Module
  • Modify input types
    • Data will no longer be received from the Data Conversion Module
    • Only Deficiency/Sufficiency information will be pulled from ABIMS now
  • Modify comparison types
    • Pontis™ data will no longer be compared with ABIMS data
    • Pontis™ data will now be compared with previous cycles of Pontis™ data
• Remove Data Conversion Module
  • Data Conversion Module is no longer needed due to completion of Pontis™ data collection

Stage 4 [Appendix A.4; Figure 2.4]
• Modify Data Translation Module
  • Store Assigned Project Data into CPMS
    • Send project action and cost data back through Data Translation
    • Reformat from Pontis™ to CPMS
    • Store data in CPMS
• Remove Quality Control Module
  • Quality Control Module will no longer be needed
  • Integrity of data will be validated by this point

NBI-Based Transitional Pontis™ Solution (NTPS)

The NTPS entails providing immediate use of functionally limited modules within Pontis™ while relying on NBI data. In this alternative the dependency on ABIMS will be gradually phased out. All work implemented in FPS will also be implemented in this solution as well (a more detailed breakdown of Pontis™ model implementation, report customization, and data collection are defined in the FPS subsection). The NTPS and FPS solutions differ in the source of data types being used by Pontis™ and the resulting accuracy of the results derived from each set of data. This section details only the additional work necessary for NTPS beyond that outlined previously for FPS.
**Preliminary Work**

**Stage 1 [Louisiana DOT NBI Analysis Document]**
- Develop element database for Pontis™ that consists of the element types for Deck, Superstructure, and Substructure
  - Specify ALDOT element types
    - Steel, Timber, Concrete, Pre-stress
  - Measure quantity of elements for each element type
- Map multi-state rating data to NBI data for each element type
- Develop deterioration models for each element
  - Given length of element for each element type
- Modify deterioration model based on ALDOT historical data and LaDOTD derived data
- Conduct Pontis™ training
  - User and Inspector training
- Begin CoRe data collection
- Derive ALDOT cost data from historical project costs housed in CPMS
- Define preservation actions
  - Assign costs
  - Assign condition states

**Implementation Work**

**Stage 2 [Louisiana DOT NBI Analysis Document]**
- Define input parameters and scenarios
  - Configuration parameters
  - Scenario parameters
  - Maintenance and rehabilitation rules
- Implement Optimization model
- Implement Simulation model
- Report customization
  - Scenario comparison
  - Situation comparison

**Customization Work**

**Stage 3 [Louisiana DOT NBI Analysis Document]**
- Conduct Quality Control
  - Refine cost and deterioration models
- Additional reporting customization
  - Target Condition state report
TRDI Solution

TRDI has an Agile Bridge Manager (ABM) program available that claims to meet all of ALDOT’s needs. The work required to meet these needs is divided into three phases.

**Implementation Work**

**Phase I: Familiarization**
- Base system implementation
- Software adjustments
- One year of software maintenance
- Additional Implementation
- Training Service

**Customization Work**

**Phase II: Customization**
- Software modifications
  - Develop budget funding and funding status rules
    - Used to constrain budget scenario analysis
  - Develop detailed scenario results capability for future condition values
- Software enhancements
  - Develop Deterioration rates based on ALDOT historic data
    - Develop variation capability based on environment type
  - Customize Decision Trees for Preventative Maintenance
  - Develop goal-oriented decision-making capabilities [Appendix A.1]
    - Alternative Actions
    - Optimal Policy
  - Develop cost models
    - Labor costs
    - Equipment and materials costs
    - Unit costs

**Post-Implementation Work**

**Phase III: Operation**
- Additional software maintenance
  - Quality Assurance
  - CoRe Conversion
Risk Analysis

This section details and analyzes the risks associated with each candidate solution. The likelihood of occurrence is noted as well as the potential impact to scope, time, quality and cost. Additionally, recommendations on how to mitigate risk are noted for high risk items.

Risk Analysis Summary

The method followed in this analysis is as follows:
• For each viable solution
  • Identify the potential risks
  • Analyze each risk with respect to
    • Likelihood of occurrence (Low, Medium, High)
    • Impact (Low, Medium, High)
  • Prioritize
    • By using the nine-cell matrix below, each risk is given a priority ranking based upon its likelihood and impact ratings.
  • Mitigate: Recommend action(s) that will reduce the impact of each risk with a priority rating greater than level 5.
Figure 1: Risk analysis scoring summary
### Table 2: ABIMS (“Wait and See”) Risk Identification

<table>
<thead>
<tr>
<th>RID#</th>
<th>Name</th>
<th>Likelihood</th>
<th>Impact</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.001</td>
<td>Regulatory: Federal mandate of CoRe</td>
<td>H</td>
<td>H</td>
<td>9</td>
</tr>
</tbody>
</table>

### Table 3: Full Pontis™ Solution (FPS) Risk Identification

<table>
<thead>
<tr>
<th>RID#</th>
<th>Name</th>
<th>Likelihood</th>
<th>Impact</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.001</td>
<td>System doesn’t interface with CPMS</td>
<td>L</td>
<td>H</td>
<td>6</td>
</tr>
<tr>
<td>2.002</td>
<td>Results: Inaccuracy due to loss of Historical data</td>
<td>M</td>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td>2.003</td>
<td>Risk of inappropriate allocation of funds</td>
<td>M</td>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td>2.004</td>
<td>Vendor Management: Undelivered Requirements</td>
<td>M</td>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td>2.005</td>
<td>Vendor Management: Process for managing &amp; monitoring vendors are not effective</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>2.006</td>
<td>Vendor Management: Undelivered expectations</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>2.007</td>
<td>Training: System is difficult to use</td>
<td>M</td>
<td>L</td>
<td>2</td>
</tr>
<tr>
<td>2.008</td>
<td>Training: Rating system is difficult to use</td>
<td>M</td>
<td>L</td>
<td>2</td>
</tr>
<tr>
<td>2.009</td>
<td>People: Limited access to needed resources; difficult to obtain</td>
<td>L</td>
<td>L</td>
<td>1</td>
</tr>
<tr>
<td>2.010</td>
<td>Network response time is high</td>
<td>L</td>
<td>L</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4: Conversion-Based Transition Solution (CTPS) Risk Identification

<table>
<thead>
<tr>
<th>RID#</th>
<th>Name</th>
<th>Likelihood</th>
<th>Impact</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
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<td>System doesn't interface with CPMS and/or ABIMS</td>
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<td>6</td>
</tr>
<tr>
<td>3.002</td>
<td>Risk of inappropriate allocation of funds</td>
<td>M</td>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td>3.003</td>
<td>Vendor Management: Undelivered Requirements</td>
<td>M</td>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td>3.004</td>
<td>Vendor Management: Failure to meet expectations</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>3.005</td>
<td>People: Limited access to needed resources; difficult to obtain</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>3.006</td>
<td>Vendor Management: Process for managing &amp; monitoring vendors are not effective</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>3.007</td>
<td>Regulatory: CoRe rating system is mandated within the next two years</td>
<td>L</td>
<td>M</td>
<td>3</td>
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<tr>
<td>3.008</td>
<td>Results: Inaccuracy due to data conversion</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>3.009</td>
<td>Training: Rating system is difficult to use</td>
<td>M</td>
<td>L</td>
<td>2</td>
</tr>
<tr>
<td>3.010</td>
<td>Training: System is difficult to use</td>
<td>M</td>
<td>L</td>
<td>2</td>
</tr>
<tr>
<td>3.011</td>
<td>Network response time is high</td>
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<td>L</td>
<td>1</td>
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</tbody>
</table>

Table 5: NBI-Based Transition Solution (NTPS) Risk Identification

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<th>Name</th>
<th>Likelihood</th>
<th>Impact</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
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<td>System doesn't interface with CPMS and/or ABIMS</td>
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<td>H</td>
<td>6</td>
</tr>
<tr>
<td>4.002</td>
<td>Risk of inappropriate allocation of funds</td>
<td>M</td>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td>4.003</td>
<td>Regulatory: CoRe rating system is mandated within the next two years</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>4.004</td>
<td>Results: Inaccuracy due to lack of data</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>4.005</td>
<td>People: Limited access to needed resources; difficult to obtain</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>4.006</td>
<td>Training: Rating system is difficult to use</td>
<td>M</td>
<td>L</td>
<td>2</td>
</tr>
<tr>
<td>4.007</td>
<td>Training: System is difficult to use</td>
<td>M</td>
<td>L</td>
<td>2</td>
</tr>
<tr>
<td>4.008</td>
<td>Network response time is high</td>
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Table 6: Custom Solution Risk Identification

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<th>Priority</th>
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<td>5.002</td>
<td>Results: Infeasible requirements</td>
<td>H</td>
<td>H</td>
<td>9</td>
</tr>
<tr>
<td>5.003</td>
<td>Vendor Management: Undelivered requirements</td>
<td>H</td>
<td>H</td>
<td>9</td>
</tr>
<tr>
<td>5.004</td>
<td>Regulatory: Federal Mandate of CoRe</td>
<td>H</td>
<td>M</td>
<td>7</td>
</tr>
<tr>
<td>5.005</td>
<td>Vendor Management: Process for managing &amp; monitoring vendors are not effective</td>
<td>L</td>
<td>M</td>
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<tr>
<td>5.006</td>
<td>Vendor Management: Failure to meet expectations</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>5.007</td>
<td>People: Limited access to needed resources; difficult to obtain</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
</tbody>
</table>

Average Risk for Each Solution

Figure 2: Average risk for each solution
Table 7: ABIMS ("Wait and See") Risk Analysis

<table>
<thead>
<tr>
<th>Name</th>
<th>Regulatory: Federal Mandate of CoRe</th>
<th>RID#: 1.001</th>
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<tbody>
<tr>
<td>Description</td>
<td>If the FHWA decides to mandate the use of CoRe element level data, ALDOT would not be eligible for federal funding. ABIMS currently does not have the capacity for CoRe data.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td>Impact Rating</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td>Mitigate</td>
<td>This solution could be modified to include the collection of CoRe data.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>System doesn’t interface with CPMS</th>
<th>RID#: 2.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>If Pontis™ does not interface properly with CPMS, financial data transfer is not possible disabling some functionality.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Impact Rating</td>
<td>H</td>
<td></td>
</tr>
<tr>
<td>Mitigate</td>
<td>The data being exported from CPMS or ABIMS could be transferred into Pontis™ via an intermediary capable of interfacing with both applications.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Full Pontis™ Solution (FPS) Risk Analysis

<table>
<thead>
<tr>
<th>Name</th>
<th>Results: Inaccuracy due to loss of Historical data</th>
<th>RID#: 2.002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Since ALDOT will be losing their historical data, they must use expert elicitation to perform such tasks as forecasting cost and deterioration curves. This may cause their estimates to be somewhat inaccurate</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Impact Rating</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Mitigate</td>
<td>This solution could be modified to include additional expert elicitations to increase the accuracy.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Risk of inappropriate allocation of funds</th>
<th>RID#: 2.003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>It has never been proven that Pontis™ appropriately allocates funding toward bridge projects that would result in the greatest cost/benefit.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Impact Rating</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Mitigate</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td>Priority Rating</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Vendor Management: Undelivered requirements.</th>
<th>RID#: 2.004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Vendor is unable to perform to the requirements of the contractual arrangements resulting in substandard components or delayed delivery</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Impact Rating</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Mitigate</td>
<td>Specifications and requirements should be clearly stated in the vendor contract. Stringent management of this contract is essential.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Name: Vendor Management: Processes for managing &amp; monitoring vendors are not effective</td>
<td>RID#: 2.005</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description: Appropriate vendor management policies and procedures are not in place, not enforced, and/or fail.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating: L According to the benchmarking report, most other states have not had many problems with management of the vendor. However, some states, such as Florida, did report problems of budget overrun, un delivered requirements, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact Rating: M This could significantly impact the success of the project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitigate: Specifications and requirements should be clearly stated in the vendor contract. Stringent management of this contract is essential.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priority Rating: 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Name: Vendor Management: Undelivered expectations | RID#: 2.006 |
|---------------------------------------------------------------|
| Description: Vendor meets all aspects of the contract, yet fails to deliver a system meeting ALDOT’s expectations |
| Likelihood Rating: M The vendor has had adequate experience implementing Pontis™ in other states. However, other states' expectations are not always met in full. |
| Impact Rating: M More customization might be required in order to meet ALDOT’s expectations which would result in additional time and costs. |
| Mitigate: Specifications and requirements should be clearly stated in the vendor contract. Stringent management of this contract is essential. |
| Priority Rating: 5 |

| Name: Training: System is difficult to use | RID#: 2.007 |
|---------------------------------------------------------------|
| Description: Pontis™ has a complex user interface. Additionally, some of the modules can be confusing and difficult to understand, especially for first-time users. |
| Likelihood Rating: M According to the benchmarking report, many states have found Pontis™ difficult to use. |
| Impact Rating: M This could result in reduced productivity for the users. |
| Mitigate: Additional training may be required in order to better verse the users of Pontis™. |
| Priority Rating: 5 |

| Name: Training: Rating system is difficult to use | RID#: 2.008 |
|---------------------------------------------------------------|
| Description: Pontis™ uses the CoRe element-level rating system. ALDOT is currently only collecting NBI data. The two rating systems are quite different. |
| Likelihood Rating: M According to the benchmarking report, bridge inspectors in other states have found the rating system somewhat difficult to use. |
| Impact Rating: L More time may be required to gather the first batch of CoRe data. Additionally, more training may be required. |
| Priority Rating: 2 |

| Name: People: Limited access to needed resources or difficult to obtain resources | RID#: 2.009 |
|---------------------------------------------------------------|
| Description: Sometime in system implementation, critical resources aren’t available or supplied or aren’t supplied in a timely fashion. |
| Likelihood Rating: L There is always a risk that the vendor will not be given sufficient access to critical resources, but we see this chance as low. We feel that ALDOT will cooperate in-full due to their overwhelming need for a new BMS. |
| Impact Rating: M If sufficient access to critical resources was not granted to the vendor, this could impact the implementation of the system. We view this as a medium-level threat to the successful implementation of the system. |
| Priority Rating: 3 |

<p>| Name: Network response time is high | RID#: 2.010 |
|---------------------------------------------------------------|
| Description: By the fact of the Pontis™ system architecture employing the use of a fat client, there have been cases of Pontis™ causing the local network to be less responsive. |
| Likelihood Rating: L According to Mike Johnson of AASHTO, Pontis™' fat client architecture is capable of slowing down a network. However, he noted that the likelihood of this occurrence is not common. |
| Impact Rating: L Since this isn’t going to occur on a daily basis, the impact on ALDOT’s overall network response time would be less significant. |
| Mitigate: Processes that require a large amount of network resources could be run only on the server. They could also only be run at night or when the network is not being used. Another option would be to change the architecture to thin client. |
| Priority Rating: 1 |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>RID#</th>
</tr>
</thead>
<tbody>
<tr>
<td>System doesn’t interface with CPMS and/or ABIMS</td>
<td>If Pontis™ does not interface properly with CPMS, financial data transfer is not possible disabling some functionality.</td>
<td>3.001</td>
</tr>
<tr>
<td>Name: Risk of inappropriate allocation of funds</td>
<td>It has never been proven that Pontis™ appropriately allocates funding toward bridge projects that would result in the greatest cost/benefit.</td>
<td>3.002</td>
</tr>
<tr>
<td>Name: Vendor Management: Undelivered requirements.</td>
<td>Vendor is unable to perform to the requirements of the contractual arrangements resulting in substandard components or delayed delivery</td>
<td>3.003</td>
</tr>
<tr>
<td>Name: Vendor Management: Failure to meet expectations</td>
<td>Vendor meets all aspects of the contract, yet fails to deliver a system meeting ALDOT’s expectations</td>
<td>3.004</td>
</tr>
<tr>
<td>Name: People: Limited access to needed resources; difficult to obtain</td>
<td>As with most all projects, there is a risk that the vendor will not be given sufficient access to critical resources</td>
<td>3.005</td>
</tr>
<tr>
<td>Name: Vendor Management: Processes for managing &amp; monitoring vendors are not effective</td>
<td>Appropriate vendor management policies and procedures are not in place, not enforced, and/or fail.</td>
<td>3.006</td>
</tr>
</tbody>
</table>

Likelihood Rating:

- L: On most attempts, Pontis™ has been successfully interfaced with other state DOT project management systems.
- M: Inaccurate deterioration and cost models resulting from RID 3.001 could cause funds to be inappropriately allocated. Also, since it is not known if Pontis™ makes recommendations on the allocation of funds towards bridge projects that result in the greatest cost/benefit, the likelihood of occurrence is increased.
- H: Pontis™ cannot be supplied with cost information resulting in inappropriate recommendations.

Impact Rating:

- L: We see this chance as low and feel that ALDOT will cooperate in-full due to their overwhelming need for a new BMS.
- M: The impact of this risk would result in the inappropriate allocation of funds.
- H: A large amount of customization to Pontis™ in order to meet all or most of the requirements.

Mitigate:

- The data being exported from CPMS could be transferred into Pontis™ via an intermediary capable of interfacing with both applications.
- Specifications and requirements should be clearly stated in the vendor contract. Stringent management of this contract is essential.
- Specifications and requirements should be clearly stated in the vendor contract. Stringent management of this contract is essential.
- This could significantly impact the success of the project.
### Table 9: Conversion-Based Transition Solution (CTPS) Risk Analysis, continued

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>RID#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory: CoRe rating system is mandated within the next two years</td>
<td>If the CoRe elemental rating system is mandated by the federal government anytime before completion of the transition to a CoRe system, ALDOT will not be in compliance with the federal mandate.</td>
<td>3.007</td>
</tr>
<tr>
<td>Likelihood Rating: L</td>
<td>The FHWA has not yet mandated the use of CoRe element level data. However, it is presumed that the federal government will eventually require this of all state DOTs. It is not very likely that it will be mandated in the next two years; however, the possibility does exist.</td>
<td></td>
</tr>
<tr>
<td>Impact Rating: M</td>
<td>The impact would be somewhat significant. ALDOT could lose its federal funding until they become compliant.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating: 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>RID#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory: CoRe rating system is mandated within the next two years</td>
<td>If the CoRe elemental rating system is mandated by the federal government anytime before completion of the transition to a CoRe system, ALDOT will not be in compliance with the federal mandate.</td>
<td>3.007</td>
</tr>
<tr>
<td>Likelihood Rating: L</td>
<td>The FHWA has not yet mandated the use of CoRe element level data. However, it is presumed that the federal government will eventually require this of all state DOTs. It is not very likely that it will be mandated in the next two years; however, the possibility does exist.</td>
<td></td>
</tr>
<tr>
<td>Impact Rating: M</td>
<td>The impact would be somewhat significant. ALDOT could lose its federal funding until they become compliant.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating: 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>RID#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory: CoRe rating system is mandated within the next two years</td>
<td>If the CoRe elemental rating system is mandated by the federal government anytime before completion of the transition to a CoRe system, ALDOT will not be in compliance with the federal mandate.</td>
<td>3.007</td>
</tr>
<tr>
<td>Likelihood Rating: L</td>
<td>The FHWA has not yet mandated the use of CoRe element level data. However, it is presumed that the federal government will eventually require this of all state DOTs. It is not very likely that it will be mandated in the next two years; however, the possibility does exist.</td>
<td></td>
</tr>
<tr>
<td>Impact Rating: M</td>
<td>The impact would be somewhat significant. ALDOT could lose its federal funding until they become compliant.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating: 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>RID#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory: CoRe rating system is mandated within the next two years</td>
<td>If the CoRe elemental rating system is mandated by the federal government anytime before completion of the transition to a CoRe system, ALDOT will not be in compliance with the federal mandate.</td>
<td>3.007</td>
</tr>
<tr>
<td>Likelihood Rating: L</td>
<td>The FHWA has not yet mandated the use of CoRe element level data. However, it is presumed that the federal government will eventually require this of all state DOTs. It is not very likely that it will be mandated in the next two years; however, the possibility does exist.</td>
<td></td>
</tr>
<tr>
<td>Impact Rating: M</td>
<td>The impact would be somewhat significant. ALDOT could lose its federal funding until they become compliant.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating: 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>RID#</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>System doesn’t interface with CPMS and/or ABIMS</td>
<td>If Pontis™ does not interface properly with CPMS, financial data transfer is not possible disabling some functionality.</td>
<td>4.001</td>
</tr>
<tr>
<td>Description</td>
<td>4.001</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>On most attempts, Pontis™ has been successfully interfaced with other state DOT project management systems.</td>
<td>L</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>Pontis™ cannot be supplied with cost information resulting in inappropriate recommendations.</td>
<td>H</td>
</tr>
<tr>
<td>Mitigate</td>
<td>The data being exported from CPMS could be transferred into Pontis™ via an intermediary capable of interfacing with both applications.</td>
<td></td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Risk of inappropriate allocation of funds</td>
<td>4.002</td>
</tr>
<tr>
<td>Description</td>
<td>It has never been proven that Pontis™ appropriately allocates funding toward bridge projects that would result in the greatest cost/benefit.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>Inaccurate deterioration and cost models resulting from RID 4.001 could cause funds to be inappropriately allocated. Also, since it is not known if Pontis™ makes recommendations on the allocation of funds towards bridge projects that result in the greatest cost/benefit, the likelihood of occurrence is increased.</td>
<td>M</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>The impact of this risk would result in the inappropriate allocation of funds.</td>
<td>M</td>
</tr>
<tr>
<td>Mitigate</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Regulatory: CoRe rating system is mandated within the next two years</td>
<td>4.003</td>
</tr>
<tr>
<td>Description</td>
<td>If the CoRe elemental rating system is mandated by the federal government anytime before completion of the transition to a CoRe system, ALDOT will not be in compliance with the federal mandate.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>The FHWA has not yet mandated the use of CoRe element level data. However, it is presumed that the federal government will eventually require this of all state DOTs. It is not very likely that it will be mandated in the next two years; however, the possibility does exist.</td>
<td>L</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>The impact would be somewhat significant. ALDOT could lose its federal funding until they become compliant.</td>
<td>M</td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Results: Inaccuracy due to lack of data</td>
<td>4.004</td>
</tr>
<tr>
<td>Description</td>
<td>The elements used in this approach would only consist of Deck, Substructure &amp; Superstructure. This would result in a loss of granularity as a detailed analysis would require the use of all CoRe Elements.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>The likelihood of this risk is reduced since ALDOT will actually be retaining their historical data. Additionally, expert elicitations will be used. However, the possibility does still exist that inaccuracy will be a problem.</td>
<td>L</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>Inaccurate deterioration and cost models would result making a significant impact on the system’s ability to make reliable recommendations.</td>
<td>M</td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>People: Limited access to needed resources; difficult to obtain</td>
<td>4.005</td>
</tr>
<tr>
<td>Description</td>
<td>As with most all projects, there is a risk that the vendor will not be given sufficient access to critical resources</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>We see this chance as low and feel that ALDOT will cooperate in-full due to their overwhelming need for a new BMS.</td>
<td>L</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>If sufficient access to critical resources was not granted to the vendor, this could impact the implementation of the system. We view this as a medium-level threat to the successful implementation of the system</td>
<td>M</td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Training: System is difficult to use</td>
<td>4.006</td>
</tr>
<tr>
<td>Description</td>
<td>Pontis™ has a complex user interface. Additionally, some of the modules can be confusing and difficult to understand, especially for first-time users.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>According to the benchmarking report, many states have found Pontis™ difficult to use.</td>
<td>M</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>Additional training may be required in order to better verse the users of Pontis™.</td>
<td>L</td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
### Table 10: NBI-Based Transition Solution (NTPS) Risk Analysis, continued

<table>
<thead>
<tr>
<th>Name:</th>
<th>Training: Rating system is difficult to use</th>
<th>RID#: 4.007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Pontis™ uses the CoRe element-level rating system. ALDOT is currently only collecting NBI data. The two rating systems are quite different.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>M</td>
<td>According to the benchmarking report, bridge inspectors in other states have found the rating system somewhat difficult to use.</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>L</td>
<td>More time may be required to gather the first batch of CoRe data. Additionally, more training may be required.</td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>Network response time is high</th>
<th>RID#: 4.008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>By the fact of the Pontis™ system architecture employing the use of a &quot;FAT&quot; client, there have been cases of Pontis™ causing the local network to be less responsive.</td>
<td></td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>L</td>
<td>According to Mike Johnson of AASHTO, Pontis™ fat client architecture is capable of slowing down a network. However, he noted that the likelihood of this occurrence is not common.</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>L</td>
<td>Since this isn’t going to occur on a daily basis, the impact on ALDOT’s overall network response time would be less significant.</td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
### Table 11: Custom Solution Risk Analysis

<table>
<thead>
<tr>
<th>Name: Budget overrun due to inaccurate forecasting</th>
<th>RID#: 5.001</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>There would be no basis for budget estimation since there are not many vendors who have ever designed a system such as this before. This may result in an inaccurate estimate of time and budget needed to complete this project.</td>
</tr>
<tr>
<td><strong>Likelihood Rating:</strong></td>
<td><strong>H</strong> (High) - The possibility of inaccurate forecasting is high in this situation as there are not many vendors who have ever designed a system like this would be – therefore they may have no real basis for their budget forecasting.</td>
</tr>
<tr>
<td><strong>Impact Rating:</strong></td>
<td><strong>H</strong> (High) - This could possibly cause the project to fail if ALDOT doesn’t have the funding needed to complete the implementation of the system.</td>
</tr>
<tr>
<td><strong>Mitigate:</strong></td>
<td>Extensive expert elicitation and benchmarking should be conducted to provide sufficient visibility into the costs of the project.</td>
</tr>
<tr>
<td><strong>Priority Rating:</strong></td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Results: Infeasible requirements</th>
<th>RID#: 5.002</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>The chances that the requirements defined for the custom solution are impossible or infeasible due to time or budget constraints.</td>
</tr>
<tr>
<td><strong>Likelihood Rating:</strong></td>
<td><strong>H</strong> (High) - There is a high likelihood that the requirements set forth for this custom solution will not be viable</td>
</tr>
<tr>
<td><strong>Impact Rating:</strong></td>
<td><strong>H</strong> (High) - High, for this system to deliver value to ALDOT, it must adhere to their requirements.</td>
</tr>
<tr>
<td><strong>Mitigate:</strong></td>
<td>Not available</td>
</tr>
<tr>
<td><strong>Priority Rating:</strong></td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Vendor Management: Undelivered requirements</th>
<th>RID#: 5.003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Vendor is unable to perform to the requirements of the contractual arrangements, resulting in substandard components or delayed delivery.</td>
</tr>
<tr>
<td><strong>Likelihood Rating:</strong></td>
<td><strong>H</strong> (High) - The likelihood of the risk occurring is high as the vendor has most likely never implemented a system such as this before.</td>
</tr>
<tr>
<td><strong>Impact Rating:</strong></td>
<td><strong>H</strong> (High) - High, for this system to deliver value to ALDOT, it must adhere to their requirements.</td>
</tr>
<tr>
<td><strong>Mitigate:</strong></td>
<td>Specifications and requirements should be clearly stated in the vendor contract. Stringent management of this contract is essential.</td>
</tr>
<tr>
<td><strong>Priority Rating:</strong></td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Regulatory: Federal Mandate of CoRe</th>
<th>RID#: 5.004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>If the CoRe elemental rating system is mandated by the federal government to a CoRe system, ALDOT will not be in compliance with the federal mandate.</td>
</tr>
<tr>
<td><strong>Likelihood Rating:</strong></td>
<td><strong>H</strong> (High) - The FHWA has not yet mandated the use of CoRe element level data. However, it is presumed that the federal government will eventually require this of all state DOTs. It is not very likely that it will be mandated before the system is implemented; however, the possibility does exist.</td>
</tr>
<tr>
<td><strong>Impact Rating:</strong></td>
<td><strong>M</strong> (Moderate) - The impact would be somewhat significant. ALDOT could lose its federal funding until they become compliant.</td>
</tr>
<tr>
<td><strong>Mitigate:</strong></td>
<td>This solution could be modified to include the collection of CoRe data.</td>
</tr>
<tr>
<td><strong>Priority Rating:</strong></td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Vendor Management: Process for managing &amp; monitoring vendors are not effective</th>
<th>RID#: 5.005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Appropriate vendor management policies and procedures are not in place, not enforced, and/or fail.</td>
</tr>
<tr>
<td><strong>Likelihood Rating:</strong></td>
<td><strong>L</strong> (Low) - According to the benchmarking report, most other states have not had many problems with management of the vendor. However, some states, such as Florida, did report problems of budget overrun, undelivered requirements, etc.</td>
</tr>
<tr>
<td><strong>Impact Rating:</strong></td>
<td><strong>M</strong> (Moderate) - This could significantly impact the success of the project</td>
</tr>
<tr>
<td><strong>Priority Rating:</strong></td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name: Vendor Management: Failure to meet expectations</th>
<th>RID#: 5.006</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Vendor meets all aspects of the contract, yet fails to deliver a system meeting ALDOT’s expectations</td>
</tr>
<tr>
<td><strong>Likelihood Rating:</strong></td>
<td><strong>L</strong> (Low) - The vendor has had a good deal of experience implementing Pontis™ in other states. However, other states’ expectations are not always met in full.</td>
</tr>
<tr>
<td><strong>Impact Rating:</strong></td>
<td><strong>M</strong> (Moderate) - If the system does not meet ALDOT’s expectations, more work, such as more customization, might be required in order to meet ALDOT’s expectations.</td>
</tr>
<tr>
<td><strong>Priority Rating:</strong></td>
<td>3</td>
</tr>
<tr>
<td>Name:</td>
<td>People: Limited access to needed resources; difficult to obtain</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>RID#:</td>
<td>5.007</td>
</tr>
<tr>
<td>Description:</td>
<td>There is always a risk that the vendor will not be given sufficient access to critical resources</td>
</tr>
<tr>
<td>Likelihood Rating:</td>
<td>L</td>
</tr>
<tr>
<td>Impact Rating:</td>
<td>M</td>
</tr>
<tr>
<td>Priority Rating:</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix A.1: AASHTO Recommended BMS Capabilities

According to AASHTO, “A Bridge Management System (BMS) should help transportation agencies evaluate current and future conditions and needs and determine the best mix of maintenance and improvement work on a road network over time with and without budget limitations.” This guidance leads to the following recommended capabilities for a BMS:

- **Collecting, processing, and updating data:**
  The system’s database needs to have the capability to contain, edit, and update inventory, inspection, and appraisal data as well as complete historical information and codes. It needs to contain NBI data as well as detailed elemental data.

- **Predicting deterioration:**
  The system’s deterioration models should project the future condition of structural and other key elements and the overall condition of each type of bridge, both with and without intervening actions. These models should predict the nature, extent, and severity of deterioration of each element, reflect environmental conditions, such as location in a marine environment, and have an updating process to take into account new data.

  The system needs to be capable of predicting deterioration of bridges on a network level as well as a bridge level. It should be able to predict deterioration in five year increments. The deterioration should be based on a logarithmic curve that is created from the decay rates of individual elements. It should also allow visibility of the overall condition of an element at the network level. The system should be able to forecast the condition of the entire network of bridges given a hypothetical action such as painting and show the effects by not taking a given action.

- **Identifying alternative actions:**
  Given the condition of a bridge’s elements, BMS software should identify alternative strategies for those elements consistent with overall bridge maintenance and preservation of investment.

  The system should be able to suggest more than one action on a given element or bridge. These actions include all forms of rehabilitation, replacement, and preventive maintenance. The system should then show the forecasted costs and benefits from each identified action allowing the user to select the best alternative or series of actions.

- **Predicting costs (agency):**
  In order to achieve cost estimation, the system should contain procedures for estimating costs of any action ranging from maintenance of individual elements to full bridge replacement. Cost estimates should be derived from historical data files and/or engineering judgment.
The system should contain cost models that are able to predict costs based on historical data. The cost models will allow the system to identify the financial magnitude of different budgeting scenarios.

- **Determining optimal policies:**
  Every state-level BMS needs a program planning tool that economically optimizes the selection and scheduling of projects and the allocation of funding at the network level. A manual, judgmental approach to project selection and scheduling is unacceptable. It should be capable of minimizing the agency and user costs of bridge policy.

  The system should be able to determine the optimal mix of maintenance and improvement projects over time given budget constraints. A BMS needs to be able to combine work on different elements of a structure into a single project when it is appropriate and make bridge-by-bridge maintenance recommendations. However, maintenance actions should not be scheduled if replacement or other work is imminent.

- **Performing short- and long-term budget forecasting:**
  The system should have the ability to accept budget constraints for each budget period over the planning horizon. The system should also be able to forecast the effect on the network of bridges given a time period and budget. A short-term budget forecast would project one year. A long-term budget forecast should be created for a user-specified time period.

- **Recommending programs and schedules for implementation within policy and budget constraints:**
  The system should be capable of preventive maintenance, rehab, and replacement programs and scheduling. It should set priorities to reflect the optimization results of the analytical model.
Appendix A.2: Required Functional Capabilities

The following functions detail the major required algorithms the bridge maintenance management system must perform in order to generate the reports detailed in Appendix A: Requirements section.

Function I. Predicting Deterioration (For a given time frame):

Object
- Network
- Project (i.e. Multiple Bridges)
- Bridge
- Element

Historical Data of Object

Location Related Data of Object
- AADT
- Environmental Type

Decay Rates of Element(s) that Make Up the Object

Objects with similar external attributes
Find the object’s decay curve by modeling the historical data of the object and objects with similar external attributes. Smooth the curve using decay rates of the object. Find the future data by projecting the object’s decay curve over the given time frame. Display the object’s projected deterioration over the time frame.

Function II. Determine Alternative Actions (for a given object):

Object
- Network
- Project (i.e. Multiple Bridges)
- Bridge
- Element

Current State of Network

Alternative Actions
- Rehabilitation
- Replacement
- Preventative Maintenance
Projected Effects of Alternative Actions

- On Object
- On Network

Minimum acceptable overall state

- Sufficiency
- Deficiency

Proposed Cost of Alternative Actions (Function III)

After looking up the effects of an action on the object and network, simulate the effect of each alternative action on the specified object and on the network. Compare the effect on the object and the effect on the network with the simulated results and proposed costs.

Function III. Predicting Costs (for a given action on a specified object):

- Object
  - Network
  - Project (i.e. Multiple Bridges)
  - Bridge
  - Element
- Action to be Performed
- Materials in Object Affected by Action
- Quantity of Materials Needed to Perform Specified Action
- Cost for Performing Action
  - Cost of Affected Materials
  - Estimated Labor Costs

Look up the materials that make up the given object. Eliminate the materials not affected by the proposed action. Sum the amount of materials needed to perform the specified action. This gives the quantity of materials affected. Look up the material costs associated with the quantity of materials affected. Find the total material cost by multiplying the materials’ cost by the quantity of materials affected. Find the total cost of performing a given action by adding the labor costs associated with performing an action with the total material cost. Return best option that proves to have the highest sufficiency or lowest deficiency rating while staying within budget constraints.

Function IV. Determining Optimal Policies on Network

- Current State of Network
- Allocated Budget
- Available Actions (Function II)

For every bridge in the network, gather a list of alternative actions. Compare the effects of every sequence of actions on the network given budget constraints. Choose the sequence that provides greatest benefit to the network based on sufficiency or deficiency rating.
Function V. Perform Budget Forecasting

- Time Frame
- Budget for Each Year of Time Frame
- Specified List of Projects or Data from Optimal Policies List (Function IV) for each year
- Current State of Network

Assign projects for year from list given budget as a constraint. Schedule specified projects for year. Simulate effects on network. Create new project list. Repeat for every year in time frame.
Appendix A.3: Conversion-Based Transitional Implementation Timeline

Structural Implementation Transition Timeline

Stage 0
- Data is supplied by ABIMS and CPMS
- Reports are generated and George makes project related decisions


Stage 1
- Data is routed into Pontis after data conversion and formatting
- Reports are generated from Pontis and ABIMS
- Data definitions are being created
- Cost and Data models are being developed
- Training and change management activities play a dominant role

Stage 2
- Initial collection cycle of multi-state data has occurred
- Analysis for quality control is a predominate activity
- Training and customization continues
- Pontis reporting capabilities are fully implemented

Stage 3
- Additional collections of multi-state data have occurred
- Analysis and comparison of data is conducted
- Adjustments are made based on data comparison
- Target condition state functionality is implemented
- Pontis will no longer rely on converted ABIMS data

Stage 4
- Evaluate success of Pontis in regards to funding optimization
- ABIMS will no longer provide functionality

Figure 3: Structural implementation transition timeline
Appendix A.4: Conversion-Based Transitional Implementation Structure

Figure 4: Structural Implementation Transition Diagram Stage 0
Structural Implementation Transition Diagram Stage 1

- **ABIMS**
  - ALDOT Inspection Data
  - ALDOT User costs
  - Deficiency/Sufficiency Info

- **Data Conversion**
  - Converted data
  - ALDOT Inspection Data
  - ALDOT User costs

- **Pontis**
  - Project Costs Assigned To A Given Project

- **Data Translation**
  - Raw Project Cost Data
  - Raw Project Data
  - CPMS Project Data

- **CPMS**
  - Pontis Project Data

**User Input:**
- Budget
- Time Frame

Takes in ALDOT inspection Data, user cost data and CoRe data, then maps the inspection data together and assigns percentage values. Also determines what additional data should be defined.

**Figure 5: Structural Implementation Transition Diagram Stage 1**
Initial collection cycle of multi-state data has been completed. Pontis will no longer rely as heavily on cost data.

User Input: 
- Budget 
- Time Frame

ALDOT Deficiency/Sufficiency Info

Data Translation

Raw Project Cost Data

CPMS

CPMS Project Data

Translated CPMS Project Cost Data

Pontis

Pontis Project Data

Pontis Project Cost Data

Multi-State, Suff./Def. Data

QC Suff./Def. Data, QC Cost Data and QC Multi-State Data

Quality Control

Converted Data

Takes in both Pontis and ALDOT data. It then fine tunes the Pontis data based on the given ALDOT data by making comparisons.

ALDOT User costs

Takes in ALDOT inspection Data, user cost data and CoRe data, then maps the inspection data together and assigns percentage values. Also determines what additional data should be defined.

ALDOT Inspection Data

Figure 2.2

Figure 6: Structural implementation transition diagram stage 2
Additional collection of multi-state data has been completed. Pontis will no longer rely on cost and inspection data. Pontis now only references ABIMS for sufficiency and deficiency ratings due to the unreliable nature of Pontis’ rating system.

User Input:
• Budget
• Time Frame
• Target Condition State

ALDOT Deficiency/Sufficiency Data

Pontis

Data Translation

CPMS

Additional collection of multi-state data has been completed. Pontis will no longer rely on cost and inspection data. Pontis now only references ABIMS for sufficiency and deficiency ratings due to the unreliable nature of Pontis’ rating system.

User Input:
• Budget
• Time Frame
• Target Condition State

ALDOT Deficiency/Sufficiency Data

Pontis

Data Translation

CPMS

Converted Project Data

Raw Project Cost Data

Raw Project Data

Translated CPMS Project Cost Data

Pontis Project Data

CPMS Project Data

Pontis Project Cost Data

Takes in only Pontis inspection data. It then fine tunes the Pontis data based on the previous collection cycles by making comparisons. CPMS data and sufficiency/deficiency data still require QC.

Figure 7: Structural implementation transition diagram stage 3
Pontis no longer relies on ABIMS for functionality of any kind. All data is directly input into Pontis. CPMS is still used to store project data due to other departments reliance on this system, although it is no longer used to gather cost data from. Pontis now processes its own cost data.

**Figure 8: Structural implementation transition diagram stage 4**
References


ALDOT Bridge Optimization Project Benchmarking Report


Appendix B: BMS Benchmarking Report

Executive Summary

This appendix provides a summary of the current state of BMS implemented and a summary of the utilization of these systems from a select sample of state Department of Transportation. Emphasis was placed on support provided for network level bridge condition optimization while evaluating funding scenarios. This summary allows the Alabama Department of Transportation’s Bridge Maintenance section to assess their current practices and the available options for enhancing their bridge maintenance management practices.

The benchmarking report contains a summary of:

- the major trends in the application of information systems to the management of bridge maintenance condition assessment and funding,
- the motivation for changing bridge maintenance management procedures for a select group of state Departments of Transportation,
- descriptions of the leading practices employed by several states and,
- descriptions of the variance in bridge maintenance management practices across interviewed states.

Supporting materials includes a synopsis of the information gleaned from primary data collected by phone interviews with 17 Department of Transportation personnel as well as secondary research from a review of relevant literature. The report also contains raw data of the transcripts from recorded calls to bridge maintenance management personnel at the state DOTs and contact information of the personnel contacted during current practices benchmarking.

Background

The purpose of this research effort is to evaluate the state of the current practice among the nation’s state Departments of Transportation with an emphasis on the utilization of automated budget optimization features associated with each state’s respective bridge maintenance management systems [Table 1]. After an initial review of research literature related to the adoption and utilization of BMS and a review of state Department of Transportation websites (Appendix B.3), an interview instrument was developed (Appendix B.1) to aid in structuring questions for a phone interview. The phone interview sample was selected to include Department of Transportation bridge maintenance management officials primarily from the southeastern region of the United States and from states identified as having leading practices with respect to the utilization of their BMS based on published literature. The interview respondents were required to be familiar with the use of their BMS and in a number of cases a second individual familiar with the implementation of the BMS was interviewed.
Over the course of four months (October 2003-February 2004), numerous state DOTs and officials from the FHWA were contacted to gain information about the use of their rating systems and bridge management systems. From the interviews, it was determined that each state is using their BMS to fit a specific bridge maintenance management need. These needs range from simple data collection and reporting to deterioration forecasting and budget analysis. The needs and resulting utilization of their BMS varies greatly from state to state. Additionally, states that have not fully implemented their BMS are working towards implementing additional tools available in their BMS. The following chart identifies the BMS used by the 17 states responding to the phone interview and purpose(s) for which the state is using it. See Appendix B.2 for a detailed description of each state’s BMS utilization.

Table 12: State BMS Type and Utilization

<table>
<thead>
<tr>
<th>State</th>
<th>Bridge Management System</th>
<th>Areas of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>Pontis™ and Custom Application</td>
<td>Data Collection</td>
</tr>
<tr>
<td>California</td>
<td>Pontis™</td>
<td>Data Collection and Network Condition Forecasting</td>
</tr>
<tr>
<td>Florida</td>
<td>Pontis™</td>
<td>Data Collection</td>
</tr>
<tr>
<td>Georgia</td>
<td>In-house custom system</td>
<td>Data Storage</td>
</tr>
<tr>
<td>Kentucky</td>
<td>TRDI</td>
<td>Developing Forecasting Module</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Pontis™</td>
<td>Budget and Decay Forecasting</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Pontis™</td>
<td>Data Collection and Reporting</td>
</tr>
<tr>
<td>Montana</td>
<td>Pontis™</td>
<td>Budgeting and Needs Assessment</td>
</tr>
<tr>
<td>New York</td>
<td>In-house custom system</td>
<td>Data Collection and Condition Analysis</td>
</tr>
<tr>
<td>Ohio</td>
<td>In-house custom system</td>
<td>Budget and Decay Forecasting</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>Pontis™</td>
<td>Preservation and Preventative Maintenance</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>In-house custom system</td>
<td>Data Collection and Condition Analysis</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Pontis™</td>
<td>Maintenance and Budgeting</td>
</tr>
<tr>
<td>Texas</td>
<td>Pontis™</td>
<td>Developing Maintenance Program</td>
</tr>
<tr>
<td>Virginia</td>
<td>Pontis™</td>
<td>Budgeting and Project Prioritization</td>
</tr>
<tr>
<td>Washington State</td>
<td>Bridgit</td>
<td>Budget Forecasting</td>
</tr>
<tr>
<td>West Virginia</td>
<td>No system</td>
<td>Project Selection</td>
</tr>
</tbody>
</table>

Summary of Current Practice Results

**Purpose of adopting Pontis™**

The primary driver for the adoption of Pontis™ is to provide a uniform method for data collection, analysis and reporting. There were no states that bought Pontis™ to facilitate funding optimization explicitly.

**Bridge Rating Types**

Of the 17 states responding to the phone interview, 12 states are collecting CoRe element data for bridge inspections. Of the 12 states collecting CoRE element data using a multi-state rating process, only Oklahoma is translating the CoRe element multi-state ratings to produce FHWA NBI ratings. The remaining states are performing dual collections with separate data sets to support their NBI-reported ratings and data to support their bridge
maintenance management systems [Final Requirements, Federal Guidelines, Collecting, Processing and Updating]. Important to note is that only South Carolina and Mississippi perform full dual inspections - others are taking multi-state CoRe element ratings and performing a scaled-back NBI rating collection for FHWA reporting.

Pontis™ Utilization

- Thirteen of the 17 states interviewed have a license for Pontis™. The remaining four states and their current BMS include: Kentucky (TRDI’s Bridge Management System), West Virginia (nothing), Washington State (Bridgit), and Ohio (custom in-house). New York and Pennsylvania have a license for Pontis™ for evaluation purposes, but use a custom-developed BMS application. Neither state actively uses Pontis™ for any type of bridge maintenance management activity. Additionally, all 15 the states with a Pontis™ license adopted the software system on or before 1995 with the exception of Florida which adopted the software system in 1997.
- Ten states have Pontis™ installed for some type of activity related to bridge maintenance management ranging from simple data collection and storage to condition state forecasting.
- Only four states at this time are using the Pontis™ deterioration and forecasting models. However, all states interviewed noted that they are planning to employ additional Pontis™ functionality at some point.
- Four states have fully implemented Pontis™ in the sense of it being used for bridge selection and funding optimization.

Training

With respect to training cost and effort, most states noted this was not a major issue to switch over to a multi-state, CoRe element rating system. According to bridge maintenance engineers in several states, training of bridge inspectors can differ depending on the method and number of individuals, but most states completed an initial round of training within a short period of time (3 or 4 days).

Evolution of Pontis™

Pontis™ had an initial reputation of being difficult to use and implement. However, most states believe Pontis™ has recently become easier to implement and use. Most state representatives noted that the software is acceptable to the majority of users. Implementation was easier with a qualified database administrator rather than an end user working with the software and data. Customization of Pontis™ reporting capabilities or the addition of functions often required the use of consultants and was described as expensive.

Challenges with Pontis™

- A major cost factor in converting from a traditional NBI bridge rating process to a multi-state CoRe element-based rating process used by Pontis™ is the need to have an inventory of each element on each bridge, each element containing multiple sub-
components that must also be inventoried. This level of detail is required for cost estimation purposes required for specific types of maintenance actions such as rehabilitation, replacement and preventative maintenance. This inventory and maintenance cost estimates are required for the utilization of the budget optimization functions within Pontis™.

- With respect to the utilization of Pontis™’ capabilities, a number of states noted issues or problems primarily centered on the implementation of the cost and deterioration models and with assessing the validity of these models. However, many felt these would come with time and heavy use of the optimization modules.

- It takes several cycles of bridge inspections to have enough data to validate the quality of the multi-state data rating process. One state performs a full NBI inspection and full multi-state element inspection and uses the translator in Pontis™ to assess the relationship between the multi-state ratings and NBI ratings for common elements. However, we did not find evidence of a state that had conducted an analysis of the resultant bridge eligibility and the rehabilitation and/or replacement decisions resulting from the CoRe element rating process versus the NBI rating process. Louisiana is beginning to perform this analysis [Appendix B.2; LA]

- Bridge maintenance policies must be codified within Pontis™ to invoke specific maintenance actions based on the results of the multi-state rating process for CoRe and non-CoRe bridge elements. Improper specification of these policies may result in a bias towards rehabilitation work for bridges not reaching the replacement threshold. If a state has a bias towards bridge replacement versus rehabilitation work, these bridge maintenance management policies must be carefully implemented within Pontis™.

**Cost/Benefits**

Few states have stated they have realized a significant benefit by using Pontis™ to offset the initial implementation costs. This is attributed to the fact that few states are using the optimization capabilities. Only Florida stated they feel there has been a decrease in their project backlog as a result of having adopted Pontis™.
Bridge Maintenance Management System Trends

Rating Types

Twelve of the 17 states responding to the phone interview are currently collecting CoRe elemental (Appendix B.4) data. Of these 12 states Oklahoma is the only state using the Pontis™ translator to produce the FHWA-required NBI ratings [Appendix B.2; Oklahoma]. The remaining 11 states are collecting both NBI and CoRe elemental ratings. Although Oklahoma is using the rating translator, they are currently phasing out the use of the translator [Appendix B.2; Oklahoma] due to the variance of the translated ratings. It should be noted that of the states performing dual inspections to obtain both NBI ratings along with multi-state CoRe element ratings, the NBI ratings are produced using only 3 or 4 overall major condition codes such as deck, superstructure and substructure. Mississippi and South Carolina stood out as the only states interviewed that actually take full inspection for both NBI and multi-state CoRe element rating schemes [Appendix B.2; MS, SC]. Additionally, South Carolina employs the translator in Pontis™ to check the accuracy of the inspectors’ results to make sure they are meeting the FHWA +/- 1 guideline for NBI rating changes [Appendix B.4; Appendix B.2, South Carolina].

Rating Type Comparison

NBI Rating Scheme

- Used to rate a particular element of a structure
- Single state rating given to each element (0-9 scale)

Elemental Rating Scheme

- Used to view how a particular element is affecting the inventory of bridges
- A multi-state rating is given for each of the CoRe elements and a percentage assigned for each of the states represented
- Used as a management tool to observe how a particular element is affecting the network as a whole
- California uses elemental data to produce a health index rating
- Creating a NBI rating from elemental data is technically the job of the translator but it is not widely used

The developers of Pontis™ assert that there are fundamental shortcomings in the NBI rating system [Appendix B.4]. We asked two individuals from FHWA about the NBI rating system shortcomings and received two different answers [Appendix B.2; FHWA]. They both agreed that multi-state elemental ratings provide a clearer, more detailed picture of a bridge’s condition than NBI ratings. The NBI ratings only provide for an overall idea of a bridge’s condition. However, one FHWA official stated that this does not mean that the NBI rating system is lacking in any way, and that although multi-state elemental data does give more detail, “…at a national level that amount of detail is not necessary to ensure
safety” [Appendix B.2; FHWA]. On the other hand, another FHWA official stated that he feels there are fundamental shortcomings in the NBI ratings because with the addition of more detailed data, more accurate analysis of the entire network of bridges can be conducted, resulting in better identification of what actions need to be taken to improve the bridge network [Appendix B.2; FHWA]. In summary, the FHWA does not require this multi-state elemental data at the moment, but they do believe that it is better than the current NBI rating system and are moving towards requiring a certain degree of elemental data at some point in the future [Appendix B.2; FHWA].

The traditional FHWA and AASHTO CoRe elements are assigned a rating based on five condition states, as defined by Richard Shepard (California DOT) and Paul Thompson (Consultant), to reflect the severity of the deterioration on a bridge element based on the most common processes of deterioration and the effect of deterioration on serviceability [Appendix B.4]. The five condition states associated with the multi-state CoRe element rating process used by Pontis™ include:

1. Protected – The element’s protective materials or systems are sound and functioning as intended to prevent deterioration
2. Exposed – The element protective materials or systems have partially or completely failed leaving the element vulnerable to deterioration
3. Attacked – The element is experiencing active attack by physical or chemical processes, but is not yet damaged
4. Damaged – The element has lost important amounts of material such that its serviceability is suspect
5. Failed – The element no longer serves its intended function

During a bridge inspection, the total quantity of each element is allocated among the condition states to denote the extent of the deterioration upon the total volume of a bridge element. The elements used in bridge ratings will include a number of standard bridge components (CoRe), but each state DOT may define additional non-CoRe elements that may be unique to that state’s bridge maintenance management process [Appendix B.4]. CoRe elements included in Pontis™ are comprised of the CoRe and state-defined non-CoRe bridge elements. In addition, other forms of deterioration such as scour, fatigue and settlement may be identified and their impact upon specific bridge elements may be defined through the use of “smart flags.”

**Time of Ownership vs. Time of Actual Use**

With elemental data being used on a network level and 12 of the states interviewed collecting elemental data, the ownership of the elementally-based bridge management system Pontis™ was predominant throughout the states interviewed. All states interviewed, except Kentucky, West Virginia, Washington, and Ohio, currently have the license for the Pontis™ system. Of the states with the Pontis™ license, only Florida has had the license since 1995 or before [Appendix B.4]. One of the states without the Pontis™ license, West
Virginia, previously had a Pontis™ license, but their implementation failed and they have aborted the system. [Appendix B.2; West Virginia]
Additionally, Georgia has the license for Pontis™ but has never tried to implement it [Appendix B.2; Georgia].

**Current Uses of Bridge Management Systems**

States that are currently using Pontis™ are divided into the following three tiers based on the extent to which the system’s functional features are used:
- Establishing initial data set and inventory (Lower Tier, two states – TX, VA)
- Full collection and use of data for decision making (Middle Tier, four states – AR, FL, MT, MS)
- Extended decay and budget forecasting modules that make up network optimization (Upper Tier, four states – CA, OK, SC, LA)

Louisiana has recently made the transition to using Pontis™ for decay and budget forecasting and is performing budget optimization. This provides Louisiana the ability to view different funding options over given time periods and selecting the most appealing budget/bridge maintenance management scenario. The quality of these forecasted results have been best when they first applied reconstruction and then rehab to the same structure [Appendix B.2; Louisiana]. States, such as Mississippi and Arkansas, are in the second tier and starting to look into developing practices to move into the upper tier. Montana is collecting data, but they have also written a custom web application to populate their database with inspection data. Additionally, Montana is using this data to help with smoothing out their rehabilitation and replacement needs [Appendix B.2; Montana]. Although Washington is using Bridgit [See Bi-Modal Results Section], they have discovered that without the presence of user costs, maintenance always seems to win over replacement. Once user costs are entered, it drives decisions more toward preservation and ultimately justifies replacement. Although they have discovered the importance of user costs, they also stressed the difficulty and excessive cost versus the benefits required to establish these accurate user costs. [Appendix B.2; Washington]. In order for the states in the upper tier to produce forecast modules they had to derive user costs and use expert elicitation to implement the modules.

**Future System Uses**

Only four states, Oklahoma, South Carolina, California, and Louisiana actually have the deterioration module of Pontis™ online. These same states are also using the optimization components of Pontis™. The rest of the states using the Pontis™ system are either in the planning stage or customization stage related to the deterioration and optimization modules. The states that are still customizing and implementing the deterioration and optimization components are only using Pontis™ for data collection and analysis. Furthermore, when asked, all states stated that they plan to further develop additional components of Pontis™ and eventually have an optimization tool that that can facilitate forecasting through the use of a budget, as related to the network of bridges. However,
even though all states using Pontis™ stated they planned to further advance the use of Pontis™ in the future, no state could provide any sort of timeline for upgrades.

**Pontis™ Evaluation Examples**

Two states, New York and Pennsylvania, are currently conducting an evaluation of Pontis™. These two states have developed opposite opinions pertaining to the adoption of Pontis™. Pennsylvania hired Bearing Point and Cambridge Systematics to conduct an evaluation of available software packages suitable for a BMS\(^1\). Their findings outline the requirements defined by Pennsylvania and how each application performs against these criteria. PENN-DOT has selected Pontis™ and is currently developing an implementation plan [AppendixB.5]. The timing and extent of implementation is contingent on budget constraints.

The two states’ evaluation process and criteria differed dramatically. Pennsylvania required the proposed BMS to be an implemented system capable of performing specific operations. Pennsylvania developed a list of requirements\(^1\) and scored Pontis™’ functionality against their BMS requirements using the following five point evaluation scores:

1. Meets the requirement with standard install and defaults.
2. Meets the requirement with configuration (no code changes).
3. Meets the requirement with customization (code changes).
4. Meets the requirement with a future release of Pontis™ within 12 months.
5. Does not meet the requirement and will need custom code or an additional product.

The requirements were then partitioned into two groups with the 1’s and 2’s in a group representing requirements Pontis™ could meet using standard defaults and through system configurations. The remaining scores constitute the requirements where customizations, future releases, or other products will be needed\(^1\). Pennsylvania has been evaluating Pontis™ since 1995 and has completed the reengineering of their business processes, the conceptual design phases, and currently working on an implementation plan.

New York’s evaluation of Pontis™ differed from Pennsylvania in that their evaluation requirements were based not only on meeting their current and future needs but, more importantly, on being capable of working with their current business processes. New York evaluated Pontis™ for three years and determined that it added no value to their current bridge maintenance management processes.

Pennsylvania’s current system does not provide cost and decay modeling; therefore Pontis™ is a good fit for them. New York’s current BMS does provide decay and cost modeling. New York will also be bringing their preventative maintenance module online during the middle of 2004.

New York decided that Pontis™ does not fit their needs and the maintenance management rules used in Pontis™ do not parallel their bridge management rules. Pennsylvania will
implement parts of Pontis™ in the upcoming years. New York will go ahead with their preventative maintenance module and re-evaluate Pontis™ if its business processes move closer to those New York employs.

Data Quality

The model accuracy and eventual ability to obtain business value from the use of Pontis™ is highly correlated with the quality of data input into the Pontis™ system. The most time-consuming and largest stepping stone in transitioning to Pontis™ is the collection of the elemental data and developing an inventory of the elements for each bridge in the network. In addition, the deterioration models and maintenance action costs should provide a reasonable approximation of the rate of movement from one state to another for specific elements as well as accurate cost estimates for specific maintenance actions. Obviously, without the presence of accurate and complete data the recommendations made by Pontis™ will be erroneous and ultimately useless. For example, Virginia lost all data from 1995-1999 due to rolling over to Pontis™ version 2.0, which did not store historical data [Appendix B.2; Virginia]. Additionally, Arkansas collected data from 1995 through 1999, but the useful data did not start until 1999 due to poor collection methods, thus causing inaccurate data to be collected [Appendix B.2; Arkansas]. Also, South Carolina stated that the most time-consuming part of the entire conversion process was the collection of initial data. Furthermore, South Carolina bridge maintenance management officials stressed that although the initial design of baseline and cost models was not very difficult, the usefulness of these models was highly dependent on the accuracy of the data collected [Appendix A.2; South Carolina].

Implementation and Training

The extent and timing of implementation varies from state to state. For example, Mississippi, who has had Pontis™ for ten years, is still implementing Pontis™, whereas Florida fully implemented it in two years [Appendix B.2]. Even though Mississippi has had Pontis™ for such a lengthy time, they have waited until just recently to look into budget optimization for the following reasons:

- Only recently began to feel comfortable and confident about collected data
- Waited on more advanced version of Pontis™ with a more intuitive user interface
- Complexity, time required to set up cost models and learning curve associated with modules

During the two-year implementation process for Florida, they stated to have experienced the following difficulties:

- Network response time
- Modifications to CoRe elements
- 2000 field character limit for notes in Oracle
- Reliability of client-server technology
Florida was able to provide for and solve their specific implementation problems because they established an implementation plan prior to implementing Pontis™. Other states, such as Arkansas, are just implementing a small piece at a time, depending on their annual budget. Therefore, agencies are reacting to implementation issues, rather than being able to proactively manage the implementation process. Key training remarks derived from the discussions with state DOT staff varied.

The training of inspectors is a relatively easy process with the use of the NHI training course [Appendix B.2; California]. Additionally, according to California DOT officials, the use of elemental ratings is easier for inspectors to grasp and provides more accountability. Furthermore, by utilizing the support offered by Cambridge Systematics, the technical training for implementation issues was a smooth process for personnel in the Arkansas DOT [Appendix B.2; Arkansas]. Training varies from state to state, depending on the training method and the number of individuals to train. Florida was able to train inspectors and maintenance employees in two separate four-day courses [Appendix B.2; Florida]. South Carolina trained all inspectors in-house by hosting a bridge inspection training school to enable quicker learning and knowledge transfer. [Appendix B.2; South Carolina].

**Drivers for Adoption of Pontis™**

**AASHTO Guidelines**

The American Association of State Highway and Transportation Officials (AASHTO) published guidelines to help agencies understand and evaluate current and future needs for their transportation infrastructure. AASHTO also published guidelines detailing the major capabilities of a Bridge Management System. These capabilities include:

1. Collecting, processing, and updating data
2. Predicting deterioration
3. Identifying alternative actions
4. Predicting costs (agency)
5. Determining optimal policies
6. Performing short- and long-term budget forecasting
7. Recommending programs and schedules for implementation within policy and budget constraints

Our research has shown that there is currently no commercial software product that meets all seven of the AASHTO guidelines. The guideline not met by a commercial product is the ability to recommend programs to meet particular target conditions given specified user constraints. The developers of Pontis™ are addressing this issue with the modifications to their product scheduled for an August 2004 release date. However, further interviews conducted with Cambridge Systematics show that additional customization will be required to Pontis™ to fully comply with the federal guidelines.

**State-Specific Needs**
Obviously, states have a variety of different reasons for choosing to implement Pontis™. For example, states such as South Carolina, California, and Washington State helped in development of the Pontis™ system, which enabled easier implementation and use of the system. Although states have different circumstances for obtaining the BMS they currently use, their expectations of a BMS are similar. The main objective of a BMS is to provide uniform methods for data collection and analysis [Appendix B.4]. For example, Arkansas’ specific reason was the need to transition to an electronic system of collection for bridge inspection data and to provide this data collection in a paperless way [Appendix B.2; Arkansas]. Some states have more specific and complex requirements of a BMS, but all states require that their BMS have the ability to hold and collect data in an organized and efficient way.

Table 13: Pontis™ Adoption Rationale

<table>
<thead>
<tr>
<th>State</th>
<th>Reason for adopting Pontis™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>Provide electronic system of inspection and collection</td>
</tr>
<tr>
<td>Florida</td>
<td>Share the cost of developing BMS among states</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Felt it would be mandated by FHWA</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Could not develop anything comparable</td>
</tr>
<tr>
<td>Montana</td>
<td>Off-the-shelf product the suited BMS needs and fulfilled FHWA requirements</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Pontis™ was sponsored by FHWA and AASHTO</td>
</tr>
</tbody>
</table>

**Pontis™ Evolution**

**User Adoption**

As Pontis™ has transitioned from its initial version to its current version 4.3, the opinions on and perceived values of Pontis™ have changed. For example, in 1991 Pontis™ did not have the same capabilities that it does today due to the evolution of the product [Appendix B.2; California]. Bridge maintenance management personnel from the Louisiana DOT stated the following about the change in Pontis™:

“It’s (Pontis™) gone from being an essentially unusable, user abusive, wretched piece of work to being a very productive, user-friendly piece of work.”

Louisiana has also employed outside sources to facilitate their adoption of Pontis™. Specifically, the Louisiana DOT is retraining their bridge inspectors through the use of the consulting firm, Huvall and Associates [Appendix B.2; Louisiana]. Other states are taking a similar approach for both the training of bridge inspectors and personnel to operate Pontis™. For example, Texas is outsourcing a large percentage of its bridge inspections [Appendix B.2; Texas] and Florida is using outside firms for training both bridge inspection in the new bridge inspection process as well as the use of Pontis™ [Appendix B.2; Florida]. As Pontis™ has evolved and added more features and become more user-friendly, the ability to use Pontis™ in an efficient and effective manner has dramatically increased.
IT Implementation

Benchmarking of other states revealed that the major hurdle for Pontis™ adoption and implementation is network administration issues such as security and distribution. In addition, customization of the current functional capabilities of Pontis™ or the addition of new capabilities is difficult. However, the consensus across states is that purchasing service units from Cambridge Systematics makes the initial implementation and customization easier. Mississippi used Cambridge Systematics to customize and implement one module of Pontis™ and used this module as a template for the rest of the system for its personnel to implement [Appendix B.2; Mississippi]. Florida is now making extensive use of Pontis™; however, they have made a number of customizations to both the functional and reporting capabilities. They noted these custom enhancements used both internal personnel and consultants and described the enhancements as expensive [Appendix B.2; Florida].

Pontis™ Reporting Capabilities

Pontis™ has two options for report generation. There is a built-in report simulator that must be customized specifically for each desired report. The consensus opinion by state DOTs on this simulator was that the customization was time-consuming and difficult [Appendix B.2]. The second reporting option is a software tool currently provided with Pontis™ called Infomaker. Infomaker operates outside of the Pontis™ environment but allows for front-end access to the Pontis™ database. The overall opinion on Infomaker of people interviewed was very positive. For example, the primary Pontis™ operator in Mississippi, stated the following regarding Infomaker:

“It will query anything anyway imaginable. Infomaker, which is a database querying tool, is provided with Pontis™ and you can do most any query through Pontis™ but you can use Infomaker outside of Pontis™ to build reports, queries, forms, whatever you need that can run externally into Pontis™ or can be incorporated into Pontis™. It has a lot of flexibility.” [Appendix B.2; Mississippi]

Furthermore, a bridge maintenance engineer from South Carolina felt that Infomaker was the best report simulator he had ever seen. He went on to explain how Infomaker has the ability to create self-supporting executable files from the reports and forms it creates. These executables only need a few DLL [Dynamic Link Libraries] files to run and do not need the Pontis™ software.
Leading Practices for Pontis™ Use

We found that the most progressive use of Pontis™ is in California, South Carolina, Oklahoma, and Louisiana. These states have Pontis™ fully implemented and are utilizing its capabilities involving deterioration, condition optimization and budget forecasting modules. However, as both California and South Carolina were involved in the design and testing of Pontis™, they were in a position to fully exploit the capabilities of Pontis™ and obtain the benefits from full use. The following is a description of the evolution of the utilization of Pontis™ in these two test states.

California

California has been collecting elemental data since 1991. It took them two work-years to collect their initial batch of elemental data for 24,000 bridges. Their goal for Pontis™ was to be able to determine the optimal condition to keep their network of bridges in given certain budget constraints. Similarly, they wanted to able to quantify the cost to get their bridge inventory at a steady state condition and allow comparisons between the inspectors’ suggestions and the recommendations created by Pontis™. To date, California has met all of its stated Pontis™ goals. Additionally, California generates a Bridge Health Index that is based on NBI data. Furthermore, California has implemented Pontis™ using an Oracle database. California is using Pontis™ in conjunction with a web-enabled data collection system that allows inspectors to enter their data through an Internet connection. California used the FHWA training course to train their inspectors to take elemental data and asserted that the training process was relatively painless. So far, California claims to have experienced better data capturing, more accurate decay forecasting, better reporting, and easier development of funding proposals through the use of Pontis™ [Appendix B.2; California].

South Carolina

South Carolina has been collecting elemental data since 1993. Their initial goal for Pontis™ was to provide maintenance and budget recommendations, and it is currently facilitating this goal through their use of Pontis™. They have recently converted over to an Oracle database. In order to make this conversion, they hired Cambridge Systematics to convert and migrate the data. It took South Carolina 3 years to implement Pontis™. Additionally, it took four months to train inspectors how to collect elemental data. The training method used was in-house classes taught by their own personnel. Currently, South Carolina claims to have experienced better data capturing, more accurate decay forecasting, better reporting and better funding proposals through the use of Pontis™. Mr. Floyd stated, “Since 1999, we have already seen our bridge system network improving condition-wise as a whole… I don’t feel that the trouble and costs it would be to develop and maintain your own system would even compare to the benefits you can obtain from Pontis™.” [Ron Hudson and Mr. Floyd; Appendix B.2; South Carolina].
Pontis™ Implementation Cost Findings

The consensus of all the states that have implemented Pontis™ was that the most expensive and time-consuming part of implementation is the gathering of the first set of elemental data. On average, it took approximately 2 years for states to train inspectors and gather the first set of elemental data. This process was time-consuming because states would have to define the elements in Pontis™, train inspectors on how to inspect these elements, and then collect the condition of these elements for the bridges in their inventories. Another problem that arose was determining the cost data that goes along with the elements. It has been discovered that many states do not have accurate unit cost data that Pontis™ needs in order to provide accurate optimization [DAGS Report; Appendix B.3]. This unit cost data can be determined by historical and current state cost data, historical and current cost data provided by contractors, and expert elicitation.

Overall, states would not or could not provide a quantified cost associated with the implementation of Pontis™. Florida provided information that in-house customization with a consultant, training, and the actual transition were the major costs, but they did not provide any specific numbers regarding costs [Appendix B.2; Florida]. Louisiana had customization costs of several million dollars and noted that the most expensive part of the process was the initial data collection [Appendix B.2; Louisiana]. During our interview stage of benchmarking, questions were asked relating to the cost of implementation and customization of the Pontis™ system. Specifically, we tried to derive the cost ranges related to the adoption and utilization of a new system. We were able to obtain information relating to where costs were incurred, either through the use of consultants or in-house expenses. However, most states were not able to provide the cumulative costs for a full implementation. Thus, no one felt comfortable providing a reasonable cost estimate for the adoption and implementation of a new Bridge Management System.

BMS Discrepancies

With most states adopting Pontis™ either using or working towards using Pontis™ for similar tasks, the results were fairly uniform across the states interviewed. However, Kentucky, West Virginia, and Washington emerged as outliers. Kentucky was the only state using TRDI’s BMS product. They have had the software for over two years and the decision trees detailing their bridge management rules for the optimization modules are still not customized. Their reason for choosing TRDI’s BMS was their ability to acquire it in a package deal with operation and pavement management systems also produced by TRDI [Appendix B.2; Kentucky].

West Virginia was the only state to stop using Pontis™. West Virginia has migrated to a manual system to collect and store all of their data and then generate reports from the data to make project decisions. However, one district in West Virginia does use the Bridgeview software. When West Virginia digressed back to a manual system, they left software decisions up to the individual districts. When asked how they would handle a mandate by
the FHWA to collect elemental data, a bridge maintenance management official stated “We will cross that bridge when we come to it.” [Appendix B.2; West Virginia].

Washington is unique in that they were a beta test state for Pontis™ but decided to implement Bridgit instead of Pontis™ [Appendix BA.2; Washington State]. Washington was on the original six-state task group that worked from 1988-1992 in the development of Pontis™. They also participated in the development of the CoRe elements. Although they were involved in the alpha and beta testing of Pontis™, they still implemented Bridgit as their BMS. However, they did state that even though they chose Bridgit, they did not feel that there was anything wrong with Pontis™. They gave several reasons for this choice:

- Easier to customize than Pontis™
- Addressed combined elements in a more useful way to them
- Having access to the source code allowed implementation with less manpower
- Preferred how Bridgit generated cost effective indexes. [Appendix B.2, Washington State]

Of all the states interviewed, Florida is the only state that specifically noted they had experienced a decrease in backlogged projects through the use of Pontis™. However, Florida is not using the deterioration, optimization, or budget modules of Pontis™. The goals Florida stated they had for Pontis™ were a uniform collection method, inspection scheduling, and coordination with other FDOT systems. They also stated that although their goals were met, a lot of expensive customization was required in order for that to successfully happen.
Appendix B.1 – Phone Questionnaire

---------------------------------------------------------------------------------------

Intro to call:
Hi, my name is (name), and I am calling in connection with a research study that is being jointly conducted by the Alabama Department of Transportation and the MIS department at the University of Alabama. This study is to assess the adoption and utilization of bridge management systems. Are you the correct person that I could talk to? If so, could I have a few minutes of your time to ask you some questions? If not, could you please direct me to the appropriate person within your organization?

---------------------------------------------------------------------------------------

Pontis™
Questions for department actively using Pontis™ for bridge management:

Background Info

(1) When did you buy the Pontis™ System?
(2) What were the major reasons for purchasing Pontis™?
(3) Are you currently using the Pontis™ system? (If no skip to 5)
(4) What version of Pontis™ are you currently using?

Ratings

(5) Did you use the NBI system prior to purchasing Pontis™?
(6) What rating system do you use now—Pontis™ or NBI translated to Pontis™?
   a. If Pontis™, How do you find it in comparison to NBI?
(7) What attributes of the Pontis™ rating system do you like? Which do you dislike?
(8) What attributes of the NBI rating system do you like? Which do you dislike?

BMS

(9) What Bridge Management Systems are you currently using?
(10) If not Pontis™, do you plan on switching to Pontis™?
   a. If yes
      i. Have you started to plan this switch?
      ii. When do you plan on switching over to Pontis™ BMS?
   b. If no
      i. What are the reasons you have shelved Pontis™?
(11) Did you develop a set of evaluation criteria for choosing a BMS?

---------------------------------------------------------------------------------------
a. If yes, what other systems did you consider?
b. What attributes of these systems did you find beneficial to your organization?

(12) What attributes of Pontis™ made it a better fit for your organization?

Implementation. *IF NOT CURRENTLY USING Pontis™, SKIP THIS TO BUSINESS USE SECTION*

(13) What tools that Pontis™ provides are you utilizing?
   a. NBI edit checking
      • If yes, what do you like about the edit checker?
      • What do you not like about the edit checker?
      • How has this option been helpful?
   b. Deterioration model
      • If yes, what do you like about the deterioration option?
      • What do you not like about the deterioration option?
      • How has this option been helpful?

(14) How long was the transition period to switch to the full use of the Pontis™ system?
   a. What issues did you face during the transition period?

(15) What challenges did you have in implementing Pontis™?
   a. How did you deal with those challenges?

(16) Were there any other unexpected issues or difficulties that arose in the implementation and/or maintenance of Pontis™?
   a. If yes, please explain the difficulties.

(17) Did you populate Pontis™ with past data?
   a. If no, what is the status of your old data? Is it being used?
   b. If no, how did you develop your decay probabilities?
   c. Did you bring in experts to help with decay curve probabilities?
      i. If yes, would you mind telling us who were the experts?
      ii. Did you find these experts helpful?
   d. If yes, did you use the Translator?
      i. If yes, did you find the Translator useful?
      ii. What did you like about the translator?
      iii. What did you not like about the translator?

(18) Did you have to customize the Pontis™ system? (If no, skip to bulleted question c)
   a. If yes, what types of customization did you have done?
   b. Would you say that this customization was needed and is still useful?
   c. Is there any customization that you now see you would have liked to have?
   d. Did you do the customization in-house?
   e. If no, who did the customization?

(19) From your experience, is there anything else about Pontis™ that would be helpful to know?
Training – Bridge Maintenance Employees

(20) How long did it take to train bridge maintenance personnel in-house to use Pontis™?
(21) What training methods did you use (one-on-one, classes, etc)?
(22) Were there any major difficulties you had with training?
(23) Did you train in-house or did an outside firm come in and assist in the training?
   a. If outside firm would you mind telling us which one?
   b. Did you find their training techniques beneficial?
(24) Looking back, is there anything that could have improved the training process?

Training – Bridge Inspectors

(25) How long did it take to train bridge inspectors to use the Pontis™ rating system?
(26) What training methods did you use (one-on-one, classes, etc)?
(27) What major difficulties you had with training?
(28) Did you train in-house or did an outside firm come in and assist in the training?
   a. If outside firm, which one?
   b. Did you find their training techniques beneficial?
(29) Looking back, is there anything that could have improved the training process?

Cost Analysis

(30) Besides purchase price, were there any other major costs of implementing this system?
   a. If yes what were the major costs?
   b. Are there other hidden costs that we should be aware of?

Business Uses

(31) Did you perform any type of forecasting for condition deterioration, funding optimization, or future projects before purchasing Pontis™?
   a. If yes what tools/methods did you use to forecast?

IF NOT USING Pontis™ SKIP TO GOALS

(32) Are you using the BMS for forecasting:
   a. Bridge condition data? (Decay Curve)
      i. If yes, what kind of forecasting or deterioration reports and models are you using?
   b. Future Bridge Projects?
      i. If yes how effective has the funding forecasting tool been to you?
      ii. Has it played an important role in which bridge projects you choose?
c. Optimization?
   i. If yes, how accurate is this and how satisfied are you with Pontis™ results?

(33) What features of the new system have been most useful?
(34) Are there any additional features that you wished Pontis™ had?
(35) Is there any feature or performance factor of Pontis™ that you are disappointed in or unsatisfied with?

**Goals**

(36) Did you have any goals set that you wanted Pontis™ to facilitate?
   a. If yes what were these goals?
   b. How did you go about setting these goals?
   c. How exactly are you going to measure the success or failure of these goals?
   d. What actions will you take if Pontis™ does not meet your preset goals?

**Benefits. IF NOT USING Pontis™ SKIP THIS SECTION**

(37) What benefits have you experienced since implementing Pontis™?
   a. Cost benefits?
   b. Better capturing of data?
   c. More accurate decay forecasting?
   d. Better reporting?
   e. Decreased backlog?
   f. Easier development of funding proposal?
(38) Do you think that the benefits have outweighed the cost? By how much? (May need to provide ballpark figure)

**TRDI’s BMS. Questions for department actively using TRDI’s BMS for bridge management**

(39) When did you buy the TRDI system?
(40) What rating scale did you use prior to adopting TRDI? What rating system do you use now—NBI or TRDI’s Pontis™ rating capabilities?
(41) What sort of bridge management systems or processes did you have or had you used before TRDI? (Steps of the full bridge project selection process, funding, etc.)
(42) What other bridge management systems were considered before you decided to purchase TRDI?
   a. Did you consider Pontis™?
(43) What rating system do you use now—NBI or TRDI’s Pontis™ rating capabilities?
(44) Was there any sort of transition period to switch to the full use of TRDI’s system?
(45) What challenges did you have in implementing this new system? (Possibly data conversion, loss of historical data, training, any employee resistance, etc)
(46) Were there any other unexpected issues or difficulties that arose in the implementation and/or maintenance of TRDI’s BMS?
(47) How long did it take to train employees (managers, inspectors, etc) to use this system?

(48) What major difficulties did you have with training?

(49) What training methods did you use (one-on-one, classes, etc)?

(50) Looking back, is there anything that could have improved the training process?

(51) What cost-related benefits have you experienced since implementing TRDI’s BMS?

(52) Besides purchase price, were there any other major costs of implementing this system?

(53) Are there any hidden costs that we should be aware of?

(54) How much would you say that the benefits of this system outweigh the costs?

(55) What were the major influencing factors and/or restrictions you had in choosing a bridge management system?

(56) Did you develop a set of evaluation criteria for choosing a BMS?
   a. If yes, could we get an email copy of those or list?

(57) Are you using the BMS for forecasting:
   a. Bridge condition data?
   b. Cost to maintain bridges?
   c. Optimization?
   d. Project vs. Network level?
   e. How accurate is this, how satisfied are you with system results?

(58) How did you back populate the system?
   a. Could previous data be used?

(59) If you had to convert, what conversion problems did you encounter?

(60) How much customization, if any, did you have?
   a. Would you say that this customization was needed and is still useful?

(61) Is there any customization that you now see you would have liked to have?

(62) What kind of forecasting or deterioration reports and models are you using?

(63) What features of the new system have been most useful?

(64) How effective has the funding forecasting tool been to you?
   a. Has it played an important role in which bridge projects you choose?

**Goals**

(65) Did you have any goals set that you wanted purchasing this system to facilitate?
   a. If yes, what were these goals?
   b. How did you go about setting these goals?
   c. How exactly are you going to measure the success or failure of these goals?

(66) What actions will you take if TRDI’s BMS does not meet your preset goals?

(67) From your experience, is there any other information that you think we would find useful?
# Appendix B.2 – Call Transcripts

## Contact List

<table>
<thead>
<tr>
<th>DOT/Org</th>
<th>Name, Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>David Ball, Inventory Rating Manager</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Mr. Hart, Technical</td>
</tr>
<tr>
<td>California</td>
<td>Richard Shepard</td>
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<tr>
<td>Florida</td>
<td>Lisa Gilbert</td>
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<td>Georgia</td>
<td>Bill Deval</td>
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<td>Kentucky</td>
<td>Ken Watson</td>
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<tr>
<td>Louisiana</td>
<td>Gil Gautreau</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Jason Chapman, State Supervisor over Bridge Maintenance</td>
</tr>
<tr>
<td>New York</td>
<td>Pete Wycamp</td>
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<tr>
<td>Mississippi</td>
<td>Jerry Smith, Pontis™ Operator</td>
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<tr>
<td>Montana</td>
<td>Paul Jansen, Bridge Bureau</td>
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<tr>
<td>Ohio</td>
<td>Ahmjad Waheed</td>
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<td>Oklahoma</td>
<td>Mike Johnson</td>
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<tr>
<td>Pennsylvania</td>
<td>Hal</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Ron Hudson, State Bridge Maintenance Engineer</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Mr. Floyd, Technical</td>
</tr>
<tr>
<td>Texas</td>
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Arkansas Transcript

David Ball – 501-569-2397
Inventory Rating Manager

Q. What current BMS system are you using?
A: In the midst of two systems we have had a mainframe based system that we have tracked the info for several years we are transitioning to Pontis™, and eventually that will be our inspection tool and we will use that DB.

Q. What where your reasons for attempting to transition to Pontis™?
A. We had been playing with Pontis™ and tracking/collecting element condition data and the biggest reason was an attempt to transition to an electronic system of inspection for collecting data in a paperless way. We looked at several different software deals and we felt that we had been collecting this type of data for a significant amount of type, and it has the capabilities of submitting NBI data, so they decided to go along with Pontis™.

Q. You are currently taking complete elemental data and not NBI modified data?
A. We are collecting the elemental data; we are not using the converted (NOT USING THE TRANSLTOR). We are still using the inspector’s information the way they see it.

Q. Have you had any problems in transitions regarding Pontis™?
A. The toughest thing is that some folks are computer savvy and some are not. We find out with the older inspectors that have been on the job for a while, sometimes the helper is more computer savvy and helps them out with the computer part of it and this can and does cause problems.

Q. Did you develop evaluation criteria for choosing Pontis™ and additionally what was your reason for selecting it?
A. I did not establish criteria but we have executed some modification so that it will adapt to our inspections (have made modifications to specifically fit needs)

Q. How long have you been collecting elemental data?
A. Well, we have been collecting it since 1995, but the first useful data started in 1999. The first few years’ data is not valuable at all.

Q. What tools are you wanting to utilize that Pontis™ offers? (deterioration, decay)
A. Of course we want to get the biggest bang for our buck, so hopefully we will get the investment we are putting into it. Maybe we can maintain this a little longer and not have to replace it. You know, just the normal things it’s supposed to do.

Q. So you want to optimize on preventive maintenance and replacement in regards to optimizing to the budget?
A. We really haven’t done much to try to use it as far as trying to optimize things and that sort of stuff. We want to make sure and get the data recorded correctly.
Q. How long did it take to train your maintenance personnel for the inspections?
A. We pretty much did it ourselves. We had a three or four day session. Everyone brought their laptops and sat around and worked on it. Of course, we’ve had updates to the system. Initially, we had a big session where we trained our own people. Then an FHWA person came in and he helped train.

Q. Are you happy so far with your Pontis™ experience?
A.
- So far, so good. Like you said on the front end of it, we still have our mainframe database (Dealing with both systems together). Any kind of reporting and data querying I’m still doing off of the mainframe system. We do our submittal through the mainframe system. (They are not actually using queries yet for DB queries). It’ll be interesting to see the results when we do a mainframe submittal and also do data queries and report generation. I think it will be a learning experience for sure.
- So for now, we’re just using it for a collection tool, building towards the future, taking small steps at a time.

Mr. Hart (technical)

Q. How difficult has it been to implement Pontis™? What kind of DB are you using on the backend?
A. The database is NASA DB which Pontis™ supports. With the support of Cambridge Systematics it makes the technical stuff easy. It is not that difficult and I learned a lot of things. So I would consider it not hard but not easy.

Q. Have you had any major stepping stones you have had to overcome in implementing Pontis™?
A. No not really. Once you get it on the inspectors’ laptop it becomes pretty easy on the technical side. The hardest thing is keeping the data flowing back and forth. Right now we only have it flowing in and not flowing back. In order to keep the Laptops and system updated, we must send data from the office. We haven’t reached that point yet.

Q. How are you back populating data into your new system?
A. We have 2 technicians that get the paper for the inspectors and update the mainframe. The inspectors update Pontis™ in their laptop, make export files, and send them to me. It is then copied over into a server. The new version of Pontis™ that we just received has the edit checks in it. We are looking to use Pontis™ as the database.

Q. Once you get enough elemental data are you going to quit taking NBI ratings?
A. We do both. We do not use the elements to tell us what the NBI should be. We have been taking both all along.

Q. Can you put NBI data into Pontis™?
A. Yes, we have been doing that since version 2.0.
Q. Before you helped develop Pontis™, did you use the NBI ratings?
A. Yes

Q. How smooth of a transition has it been to switch from NBI ratings to Pontis™ ratings?
A. Positive:
   • Changing inspectors over was relatively easy and painless. FHWA has been putting on the NHI training for a long time now.
   • The elemental inspections module was much easier for training purposes.
   • It’s easier for inspectors to grasp the elemental ratings than the NBI ratings.
   • Not only is it easier for the inspectors, but it provides for more accountability.
A. Negative:
   • The hardest and costliest part of the transition was getting the initial elemental data that is needed for the Pontis™ system, but in subsequent inspections it was much easier, easier than the NBI method.

Q. Is there anyway to convert that past NBI data to elemental data?
A.
   • The initial deterioration curves for Pontis™ were generated using experts that gave their input on how long it would take elements to decay.
   • They found that after using Pontis™, the experts had over-estimated the rate at which the elements would decay.

Q. How long have you been collecting elemental data?
A. Since 1991

Q. What were the costs of collecting the data that first year?
A. With 24,000 bridges in California, it cost us two person years. For 12,000 bridges, it costs one person per year. You could prorate that to your own inventory. After that it was probably cheaper than NBI collection.

Q. What were the costs of customization?
A. That’s hard to say. We have a sophisticated data collection system that Pontis™ is only a small part of. That’s because Pontis™, in 1991, wasn’t capable of what it is now. If we were switching to Pontis™ now, we would probably take Pontis™ the way it is right out of the box because it has evolved so much. Now, it is able to generate all kinds of reports. You can also add tables, data fields within tables, etc. This tool allows reports to be accessible from within Pontis™, and also allows data to be input from within Pontis™.

Q. Will the Pontis™ deterioration curve work with NBI data?
A. Yes, you can create an element within Pontis™. The five condition ratings are 0-3, 4, 5, 6, 7-9. Put these directly into the element matrix and generate a curve from those NBI numbers.

Q. What were your main goals that you wanted Pontis™ to accomplish?
A. We wanted it to allow them to know the optimal condition to keep their network in. It allowed us to quantify how much it would cost them to get their inventory at a steady state condition. It allowed them to compare what the engineering trained inspectors’ recommendations to Pontis™ recommendations were for optimization. They were very similar.

Q. What are you using on the backend?
A. Oracle and a web enabled data collection system. Their management has access to Pontis™.
Florida Transcript

Background Info

Q. When did you buy the Pontis™ System?
A. 1997

Q. What were the major reasons for purchasing Pontis™?
A. To share the cost of developing the Bridge Management System among States.

Q. Are you currently using the Pontis™ system? (If no skip to 5)
A. Yes

Q. What version of Pontis™ are you currently using?
A. 4.2

Ratings

Q. Did you use the NBI system prior to purchasing Pontis™?
A. Yes

Q. What rating system do you use now—Pontis™ or NBI translated to Pontis™?
A. The element condition state rating is used. In addition, our inspectors continue to assign NBI ratings to deck, superstructure, substructure, culvert, etc.

Q. (If Pontis™), How do you find it in comparison to NBI?
A. Loosely compares.

Q. What attributes of the Pontis™ rating system do you like? Which do you dislike?
A. We like the fact that it provides more detail. A little more complex.

Q. What attributes of the NBI rating system do you like? Which do you dislike?
A. NBI is simple, but provides lack of detail.

BMS

Q. What Bridge Management Systems are you currently using?
A. Pontis™

Q. Did you develop a set of evaluation criteria for choosing a BMS? If yes, could we get an email copy of those or list?
A. No

Q. Did you consider other bridge management systems? (If no skip to 12)
A. Yes  
Q. If yes what other systems did you consider?  
A. Considered in-house development

Q. What attributes of these systems did you find beneficial to your organization?  
A. N/A

Q. What attributes of Pontis™ made it a better fit for your organization?  
A. It met a good percentage of our needs without having to be developed.

**Implementation**

Q. How long was the transition period to switch to the full use of the Pontis™ system?  
A. 2 years

Q. What issues did you face during the transition period?  
A. Existing consultant contracts, finishing existing inspections before starting in Pontis™.

Q. What challenges did you have in implementing Pontis™?  
A. Network response and reliability of Client Server technology. Ad-hoc reporting, Oracle database issues, security of data, modifying Core elements, customization (i.e. Reporting).

Q. How did you deal with those challenges?  
A. One at a time and patiently!

Q. Were there any other unexpected issues or difficulties that arose in the implementation and/or maintenance of Pontis™?  
A. Yes.

Q. If yes, please explain the difficulties.  

Q. Did you populate Pontis™ with past data?  
A. Yes

Q. Did you bring in experts to help with decay curve probabilities?  
A. No

Q. Did you use the Translator? If yes, did you find the Translator useful?  
A. We advise using the FHWA translator with skepticism.

Q. What did you like about the translator?  
A. Not much
Q. What did you not like about the translator?
A. Translator does not adequately reflect substructure deterioration.

Q. Did you have to customize the Pontis™ system?
A. YES!

Q. If yes, what types of customization did you have done?
A. Reporting additional data, customized tables, work order generation, deficient bridge list, additional inspectors, and supervisors and reviewing Engineers. Spell Checking (should be eliminated in 4.3.)

Q. Would you say that this customization was needed and is still useful?
A. Yes

Q. Is there any customization that you would have liked to have?
A. No

Q. Did you do the customization in-house?
A. In-house

Q. If no, who did the customization?
A. N/A

Q. From your experience, is there anything else about Pontis™ that would be helpful to know? A. Develop a good working relationship with Cambridge!

**Training – Bridge Maintenance Employees**

Q. How long did it take to train bridge maintenance personnel in-house to use Pontis™?
A. Pilot program. Each District was represented. 4 days spent conducting inspections and inputting data.

Q. What training methods did you use (one-on-one, classes, etc)?
A. Classes and field exercises

Q. Were there any major difficulties you had with training?
A. No

Q. Did you train in-house or did an outside firm come in and assist in the training?
A. NHI course on condition state inspections and additional in-house training was provided.

Q. If outside firm, would you mind telling us which one?
A. NHI
Q. Did you find their training techniques beneficial?
A. Yes

Q. Looking back, is there anything that could have improved the training process?
A. We did a great job!

**Training – Bridge Inspectors**

Q. How long did it take to train bridge inspectors to use the Pontis™ rating system?
A. 4 days

Q. What training methods did you use (one-on-one, classes, etc)?
A. Classes and field exercises

Q. What major difficulties you had with training?
A. None

Q. Did you train in-house or did an outside firm come in and assist in the training?
A. Yes

Q. If outside firm which one?
A. NHI

Q. Did you find their training techniques beneficial?
A. Yes

Q. Looking back, is there anything that could have improved the training process?
A. No

**Cost Analysis**

Q. Besides purchase price, were there any other major costs of implementing this system?
A. Yes

Q. If yes what were the major costs?
A. In-house customization and transition and training.

Q. Are there other hidden costs that we should be aware of?
A. Can not do enough training!
Business Uses

Q. Did you perform any type of forecasting for condition deterioration, funding optimization, or future projects before purchasing Pontis™?
A. Yes

Q. If yes what tools/methods did you use to forecast?
A. Pretty unsophisticated methods.

Goals.

Q. Did you have any goals set that you wanted Pontis™ to facilitate?
A. Yes

Q. If yes what were these goals?
A. Uniform method of collecting data, scheduling inspections, coordinating with other FDOT systems.

Q. How did you go about setting these goals?
A. Committee of Central Office Staff and District representation.

Q. How exactly are you going to measure the success or failure of these goals?
A. Feedback from users.

Q. What actions will you take if Pontis™ does not meet your preset goals?
A. They have been met.
Georgia Transcript

Bill Deval

Q. What system are you currently using?
A. We are licensed for Pontis™ but we do not use it. We have never implemented it, but we do collect Pontis™ data inside our system, which is called BIMS. It is comprised of the data collection system (active data, drawing, photos, inspection info., waterways) and the archival side that any report is stored electronically along with all associated reports and bridges.

Q. You are collecting elemental ratings?
A. Yes

Q. How long have you been collecting elemental data?
A. At least six years, I have no idea, we do keep current data.

Q. Did adding elemental data to BIMS cause any problems?
A. BIMS was developed back in 1985. Elemental is just one table inside of BIMS. Not anything major.

Q. How many tables does BIMS have?
A. Around 15 or so.

Q. How are you handling optimization and maintenance in regards to budget forecasting?
A. We are not using automatic means. We have element and condition data and we use that to make decisions.

Q. Have there been any problems related to inspection due to taking both NBI and elemental data?
A. No, it is all the same. It is easy to collect elemental data. We only collect only data on state routes.
Kentucky Transcript
Ken Watson

Q. How long have you had TRDI?
A. 2 – 3 years. Just got it installed this past year. The decision trees still aren’t customized. Their new forecast tools don’t meet their current ones. UK is helping them customize systems and validate data.

Q. What systems are you using? NBI – no problems w/ data conversion?
A. What tools or validation for data deterioration models are you using? Not sure. It’s been too long ago since he’s looked at them. Had inspectors and engineers come up w/ decision trees and formulas when they first got it. Their forecasting tools haven’t been fed real data. Pretty much using on a conceptual basis.

Q. What system was in place before TRDI?
A. No system before TRDI

Q. When choosing TRDI, what made you think TRDI would be a good strategic fit for you?
A. “We didn’t like Pontis™.” They conceptually liked TRDI’s formulas plus they were already using TRDI’s Operation Management System and their Pavement Management System (package deal).

Q. What didn’t you like about Pontis™?
A. Can’t remember. It’s been to long ago. One problem was that they were concerned about the change to core elements.

Q. Can you compare routines between the two systems?
A. “I can’t intelligently answer this question.”

Q. Any additional training cost with TRDI?
A. No. They are looking to get someone in place to work on the BMS. They are trying to get this system to give the exact same result as their old system (mainframe).

Q. Are you going to use TRDI for optimization?
A. Yes. A team of about 8 individuals is getting together in October to test the optimization formulas.

Q. How are you going to train?
A. We had a class for those interested when they first got it to go over routines. In the future they will only train 1 or 2 people (the main users).

Q. Were there any specific goals for choosing TRDI?
A. We didn’t like Pontis™ and they already had to other products from TRDI.
Louisiana Transcript

Gil Gautreau
225-379-1552
Jason Chapman

Q. Are you currently using Pontis™?
A. In a manner of speaking. We’re still attempting to collect data. We used it with NBI originally. We just got finished collecting our first batch of elemental data. Now we have to collect condition data. Our biggest problem has been collecting condition data. Cambridge is now doing a palm-based data collection for us.

Q. How long have you had Pontis™?
A. 10 years.

Q. What is the reason you purchased it.
A. We were strong-armed by the FHWA in a meeting.

Q. Did you use NBI before Pontis™?
A. Yes, we still do. We have lots of NBI data that we are trying to use in Pontis™.

Q. What do you like about Pontis™?
A. I like the quantitative approach.

Q. Compare NBI and Pontis™:
A. NBI’s rating system is only 10 numbers which is way too few. I really don’t like it.

Q. What Pontis™ tools are you utilizing?
A. Repair priorities, replacement priorities. What decisions to make about particular bridges, particular routes, help for optimizing funds.

Q. Are you using the deterioration models?
A. Yes.

Q. Are you doing any budget forecasting?
A. Yes, but it is with NBI data, and have used to budget requests.

Q. Are you tying the budget in with the forecasting and decay curves?
A. Yes. For example, we apply constraints and see how our budget will look in twenty years. It’s consistently shown that if you do reconstruction at first and then apply rehab, then you have the best result.

Q. How has training gone?
A. We will start training inspectors again in about a year.
Q. What methods will you use to train?
A. We are going to have classes for inspectors. We will be bringing consultants in to train.

Q. Who are these consultants?
A. Huvall and Associates (Inventory and training)

Q. Did you have any goals set for Pontis™?
A. To make the best of the use of our limited budget.

Q. What is your opinion on Pontis™?
A. It’s gone from being an essentially unusable, user abusive, wretched piece of work to being a very productive, user-friendly piece of work. It’s always had more emphasis on analyzing data than collecting data.

Q. Could you discuss some of the costs with the conversion?
A. Probably several millions of dollars in the conversion, but not necessarily additional costs. The major costs come up in getting the inventory for the new ratings.
Mississippi Transcript

John Taylor
Jerry Smith

Q. What BMS are you currently using?
A. Pontis™

Q. When did you purchase the Pontis™ system?
A. Probably 1992-1993

Q. What kind of rating were you taking before you purchased Pontis™? Were you using NBI and switched to elemental?
A. We were taking NBI ratings now we are taking both NBI and elemental.

Q. How do you handle storing two sets of ratings?
A. All ratings go into one database.

Q. What database are you using on the backend?
A. Adaptive Server.

Q. What were your states major reasons for purchasing Pontis™?
A. It was purchased because we did not feel we could produce anything in-house to meet our needs at anywhere near a reasonable cost and keep it updated.

Q. What activities do you want Pontis™ to facilitate?
A. We have done extensive customization for use with data collection. All of our bridge inspection data is collected in Pontis™. We have added routines that collects are state data so that we do not have to use anything but Pontis™. Now that we have a couple cycles of elemental data, we are beginning to look into models and predictions.

Q. So you have not really got into deterioration forecasting?
A. Not really, we started collecting data in 1996 full time. It took a while to get all of our bridges and elements into the system. So we are just now getting to a point where we feel comfortable with our data to look into forecasting. Additionally, a lot of improvements were made to Pontis™ so we put of our efforts until the new version was rolled out.

Q. What kinds of costs are associated with upgrading to a new version of Pontis™?
A. Basically only my time. It is not that significant of an undertaking. The Pontis™ people provide scripts to update the database so it really only consists of me running a script on the machines using Pontis™.

Q. What role does the NBI data you are collecting play?
A. We use it to report our bridge data to the FHWA.
Q. Do you use the translator?
A. We use it some to check that all elements look okay but we have not made a decision to stop collecting NBI and fully utilize the translator.

Q. What kind of cost and effort has been associated in requiring the inspectors to take two types of ratings?
A. We had some FHWA people come in and give a training course. Additionally, some people on my staff spot check different data and address problems that might occur.

Q. Did you handle the technical implementation and the customization of the program?
A. We did. We hired the Pontis™ contractor to do one piece to use as a template and the rest we have done in-house.

Q. From the technical side has implementation and customization been smooth?
A. I’m not a database person, I am an engineer and I figured it out. So it was not that difficult.

Q. How difficult has the process of training office personnel to use Pontis™?
A. I run the database. The inspectors connect to the database over an intranet. We have had to help a few people learn how to navigate the system but for inspection data it is not hard to use.

Q. What goals do you have associated with Pontis™ on a network level vs. bridge level?
A. Currently it is contains all of our information regarding a bridge. Whether or not we are looking for information on a specific bridge or if we are running a query both things are handled through Pontis™.

Q. Can you run a query to provide all the bridges on a particular route?
A. It will query anything anyway imaginable. Infomaker, which is a database querying tool, is provided with Pontis™ and you can do most any query through Pontis™. You can use Infomaker outside of Pontis™ to build reports, queries, forms, whatever you need that can run externally into Pontis™ or can be incorporated into Pontis™. It has a lot of flexibility.

Q. What type of system did the state use before Pontis™?
A. Originally we had paper forms that were key punched into a mainframe database. We then went to a single table in an access database, and finally to Pontis™.

Q. Has Pontis™ been helpful as a management tool?
A. As far as keeping up with information, keeping that information accurate, and being able to find out things it has been great.

Q. Currently you have not attempted to use Pontis™ to optimize by tying deterioration to the budget?
A. No, we have not done anything with that. We have finally collected what we think is enough element data that is our next step is to start attempting to optimize. A nice thing about this database is that once it is set up we have our GIS system that queries that database; we have information that are on dynamic web pages in that they query the database and update themselves. We have the central database and we have multiple things that use that database outside of database.

Q. Did you have any interface problems regarding outside use of Pontis™?
A. No.

Q. Did Pontis™ specify what database they wanted you to use on the backend?
A. They support Adaptive server, Oracle, and a few others. They are working on incorporating Sequel Server into their list of choice. I also believe they support access.

Q. In conclusion, you are fundamentally using Pontis™ as a querying tool?
A. Yes, it give you access to every piece of data.

Q. Were any other systems considered other that Pontis™?
A. Yes, Bridget was considered, but with the number of states using Pontis™ we thought it was a better supported system, and know that they are working towards allowing sharing between vertis (load rating), opis (bridge design), and Pontis™ which will make all three more useful. Therefore, when a designer puts in data about a bridge it gets transformed to the load rating function, and the data used for bridge management gets transferred also.

Q. Do you have any complaints about the way Pontis™ works?
A. The deterioration prediction components seem complicated but I have not been deep enough into it to know. I do know they have made it extremely flexible. You can set a lot of parameters. All the flexibility does make it somewhat cumbersome.

Q. What benefits do you think Pontis™ has provided?
A. The ability to view/query data from many angles and the quality of our data is better. Additionally, I can use querying to error check for bad data by querying for things that I know should not exist. The querying and ability to tie that in with other systems has been the most beneficial.
Summary of Interview:

Pontis™:

Initial solicitation of Pontis™, 3.0 ok

Because it was an off the shelf product that suited the vms needs and fulfilled the fhwa requirements

Needed more detail in their rating system, on top of that, they wanted to project over time the elements (decay, deterioration). Right now they are using it to smooth out the rehab and replacement needs.

They did back populate the data from 1980. problems: did not use Pontis™ to import previous data, they are using oracle and they hashed the 432, 428 data files? hashed them into tables, then went record by record to resolve differences and realign the bridge IDs.

Wrote a third party application using the internet (intranet) to populate the database with inspection data, been working on that since then. Have an internet site that allows for population of inspector data.

Using Pontis™ for analysis, it's doing pretty good. Had a few enhancements made for projects that were intended to be removed, (things too short for federal request of information), they have option to drop bridge at certain point in time.

Customization:

He did all of it reporting, querying, done on database directly, outside of Pontis™. Would not have been as successful without robust, enterprise level database.

Training:

The training went really well, didn't lose their core people. Every year they have an inspection seminar (done in-house)
**Cost:**

Two people did all of it

**Main goal:**

Taking a long term approach and system level approach to developing budgets and needs for projects beyond the normal 5 year step.
New York Transcript

Pete Wycamp

Q. Current System?
A. Custom built system. Does have decay and cost models. It’s not based on elemental data. Currently have logic, data, and rules for preventative maintenance module and working on platform to bring online in the next couple of months.

Q. Pontis™ Evaluation?
A. Have been evaluating for three years using their current and future needs as evaluation criteria. Feels it doesn’t add anything to their current methods since they already have modeling, funding, selection, modules. They are comfortable with the way they do things, how their modules work and Pontis™ is a confusing mess. Pontis™ would be a big change to their in regards to their business rules. However, with Pontis™ theoretically having the support of 49 other states and the federal government if its modules became more acceptable to NY business rules they would consider adopting modules. Their benchmarking showed that states are only using certain modules of Pontis™ and use varies from state to state. They currently have no plans of adopting Pontis™.
Ohio Transcript

Ahmad Waheed

Q. What BMS are you using?
A. We developed one through a contractor in the early 1990’s

Q. What was the name of the contractor?
A. Miguel Institute

Q. What were the goals you set for your BMS to accomplish?
A. We had list of objectives, including electronic data collection tools. Additionally, tools to help manage the bridges and run queries about bridges health which provide forecasting of bridge needs and ability to plan for forecasted needs.

Q. Are you running deterioration curves?
A. No, it was planned initially but we do not currently have them.

Q. What type of ratings do you collect?
A. We collect NBI ratings.

Q. When in the future do you plan to implement deterioration curves?
A. We are currently working on it.

Q. What was the creation time of your system?
A. It took a long time.

Q. What costs were associated with the development of your BMS system?
A. We based it on the cost of bridge projects.

Q. On your preventive maintenance website you have costs associated with repairs and time frames for the length a repair will last. How did you derive these numbers?
A. Yes, that is our online manual. The costs are to provide guidelines. We are actually using our costs on them.

Q. Are there algorithms to derive at costs and lifetime numbers?
A. No, they are rough costs and historical costs.

Q. Are you doing budget forecasting with your BMS?
A. No.

Q. How do you use NBI ratings to deal with network level decisions?
A. We have developed some in-house spreadsheets, and we normally run the queries and dump the data into a spreadsheet.
Q. Since you are not collecting elemental level what attributes do you look at to make network decisions?
A. We monitor four OPI’s (Organizational Performance Indices) and those are the four attributes we monitor on the bridge, and that is how we determine the health of the bridge on a network level. The four OPI’s are general appraisal (based on NBI ratings), deck condition, surface, and paint.

Q. Did you back populate historical data into your BMS?
A. We had the data in several formats and we made efforts to get all the data since 1985 into the system.

Q. What type of database is on the backend of your system?
A. We have a developed DB not a commercial product.

Q. Do you feel the BMS is meeting the needs set for it when it was developed?
A. No, we have had to supplement it with additional work.

Q. Have you ever considered moving to a Pontis™ or TRDI system?
A. We have looked into Pontis™ and are still reviewing it. We evaluated Pontis™ for a while and initially rejected it. We have again looked at version 4.0 of Pontis™ and have not decided to obtain it.
**Oklahoma Transcript**

Mike Johnson

**Interview Summary**

Back population of data into Pontis™: 1995, elemental inspection 95 until now.
Used expert elicitation process then updated to the 95-2000 data

Oracle database software for the entire DOT, bought the inspectors laptop...did in-house training to handle all of that.

Using Pontis™ for decay curves for both the replace and repair.
Came up with preservation plan on the 8 years

Pontis™ is used to determine which bridges to update/repair.

Benefits have outweighed the cost

Problem with translator was when they upgraded from Pontis™ 4 to 4.1, the translator that came with it did not work correctly... 4.22 solved this problem.

Using it for budget forecasting, idea of what budget is

Conversion to elemental rating -> NHI training course is recommended, Cambridge or FHWA can tell about the training courses

If your bridge management system identifies preservation needs, then you can use the bridge reconstruction(?) funds for those needs

Q. Did you back populate the old NBI ratings into the Pontis™ system?
A. We’ve been doing elemental inspections since 1995.

Q. How did you develop your deterioration curves?
A. We used the expert elicitation process and the updated with our ’95-‘00 data.

Q. Besides the purchase price, were there any other major costs with the implementation of the system?
A. We switched to an Oracle database and bought the inspectors laptop computers.
Q. What kind of forecasting and deterioration models are you using?
A. We’ve used it for an eight-year preservation plan.

Q. Have the benefits outweighed the cost?
A. Yes, we can see some pretty good potential with this.

Q. Have you had problems with the translator?
A. The problems with the translator occurred when we upgraded.

Q. Are you using this for budget forecasting as well?
A. Yes, you can run all kinds of scenarios with your allotted budget.

Q. Is five years of elemental data long enough to come up with valid forecasts?
A. Well, we’ve used the actual data in conjunction with the expert elicitations. You’ll find that you’ll have to tweak your models a bit.

Q. What were some problems with training?
A. I would definitely buy the NHI training course.

Q. Could you give us a summary of the preservation plan?
A. It looks at decks, beams, and joints.

Q. Are there funds available for these preservation plans?
A. Yes, if you have a BMS that is capable of generating a preservation plan, then funds are available.
Pennsylvania Transcript

Q. Current BMS?
A.
- Custom built system that they installed in 1986.
- Does not provide deterioration/cost modeling.
- Paper written describing current system by John Oravec.

Q. Evaluation of Pontis™?
A.
- First looked at in 1995.
- Completed reengineering phase, currently in the conceptual design phase.
- Interested in CoRe element level data to feed deterioration models.
- Pontis™ implementation dependent on funding.
- Consider them an AASHTO state.
- Deciding to go along with Pontis™ since no one else is following their efforts.
- Pontis™ is only elemental (CoRe) system.

Q. Criteria for evaluation?
A.
- Must be an up and running system.
- Must be “Made in the U.S.A.”

Q. Overall opinion of Pontis™?
A.
- Until we use it with our bridges, we cannot fully evaluate Pontis™.
- Have a major concern with the accuracy of using elemental (CoRe) data.
  - Their quality assurance gives them 95% accuracy.
  - Question the consistency of the smart flags.
  - Does not think the FHWA, Pontis™ material is consistent enough.
  - “Does feel it can become consistent enough.”

Q. How do you define success?
A.
- Set performance measures that will either improve or hold backlog.
- Federal funding does define success for most.

Q. Migration path?
A.
- Currently developing an implementation plan.
- Will not release cost information.
- Data conversion (25,000 state, 7,000 county bridges) - $2 million, 2 man years.
South Carolina Transcript

Ron Hudson
State Bridge Maintenance Engineer

Q. What BMS system are you currently using?
A. Pontis™

Q. When did you purchase Pontis™?
A. We were a beta test state and helped to develop the system?

Q. What were your reasons for helping in the beta testing of Pontis™?
A. Mandated to obtain a BMS, Pontis™ was on the market jointly sponsored by FHWA and AASHTO and we felt it was a good piece of software.

Q. Are you using the complete elemental ratings?
A. Yes

Q. Did you use NBI before the roll over to Pontis™?
A. Yes, we used NBI and we still use NBI. We run a parallel system where we report NBI data separately from Pontis™ data, and we will continue to do this until the federal highway administration chooses to accept Pontis™ data.

Q. Are you doing dual inspections?
A. No, we only do one inspection and produce two reports. There is no such thing as a Pontis™ inspection vs. NBI inspection its more quantitative vs. qualitative. If you are rating a superstructure under NBI you have to take into account the condition of the beams, bearings, and the deck. Whereas Pontis™ would put you into a percentage of beams. You have to jointly consider all of it to get any rating period.

Q. Do you have a preference as to which rating type to use?
A. Pontis™ is more of a management tool that tells you where you need to be looking and why. If you have a lot of timber piles you can go and tell what percentage of the timber piles are bad what percentage of my steel streamers are in a particular category same way with paint system etc. throughout the entire bridge inventory. If you were just looking at an individual bridge NBI rating, it could tell you what the condition of any individual bridge is. It does not tell why unless you go and read the individual report. Both ratings are more than numbers on a piece of paper. An element report will not show me a whole lot of information about a particular bridge, but instead helps me manage a particular bridge in regards to my entire inventory.
Q. What tools that Pontis™ provides are you utilizing?
A. We utilize deterioration models. We utilize the projection curve. We have a four or five year history in Pontis™ so we can run deterioration curves we feel comfortable with. We use it as a tool for need studies and projection analysis.

Q. Did you use deterioration models before you implemented Pontis™? Do you have any way to verify you current models?
A. Not quantitatively, only subjectively through experience.

Q. What kind of challenges have you faced in implementing Pontis™ and more specifically in customizing tools?
A. You would need to ask my assistant. I do know that we did not use a soft download. We actually loaded our data as far as getting baseline data. We ran a dual system for probably a year or two. We actually loaded the data through inspections we did not try to do a soft conversion.

Q. What kind of costs was associated with implementation and customization?
A. Hard to place costs specifically on Pontis™. At the same time as implementation we were going to laptop conversions for inspectors. So it’s hard to arrive at what costs were Pontis™ based. We are having all our forms on the laptops and the laptops are used in the field to enter the data from the inspection.

Q. How difficult was the training of not only inspectors but on the office users to use the Pontis™ system?
A. We trained our inspectors in-house. We also hosted a bridge inspection training school where we made part of the training in elemental data collection along the same lines of the bridge inspection school to allow crossover of knowledge and procedures. Everything is managed out of a central office, therefore no one out of our office required training. We have seven districts but they only do what they are instructed to do by us.

Q. Are your deterioration curves tied to the budget to try and optimize a plan to get the most effect out of your budgeted dollars?
A. I would like to say yes, but we have so much trouble overcoming gravity I do not know if we will ever get into a purely preventive mode. As far as budget allocation, we use Pontis™ as a prediction module but not so much as a management module in the strictest form for preventive use. We do not have enough funding to facilitate all that Pontis™ tells us to do. Not that we would not do it. I am not questioning the data but if you do not have the funding it is an exercise in futility. We look at what Pontis™ says to do and on a percentage basis and we are pretty close in a given year. But if Pontis™ tells us we need 100 million in bridges, well we only get 190 million each year and that is for everything therefore the number it would spit out would be meaningless. We would more likely kick in an amount based on our maintenance management system that tracks repairs. We then compare on the back end to make sure our percentages on maintenance are in the same ball bark as what Pontis™ suggested. We are usually pretty close but in any given year we
could and have been skewed in one direction or the other. Ideally we would like to
everything Pontis™ suggests but we do not have the funding to do that.

Q. On a network vs. bridge level how are you using deterioration tools on both levels?
A. We use it on both, but you would rarely do it on an individual bridge. We have a very
small percentage of big bridges and big bridges are where you would use management tool
on an individual bridge. It is not productive only a smaller bridge. Pontis™ is more of a
management tool to get an idea on the shape of the entire inventory throughout the state.
Any management system will only work well on individual level where you have a very
big structure. For example, the golden gate bridge where you have a lot of elements and a
lot of areas of the bridge to manage so that in turn that bridge becomes a mini network.

Q. What were your pre-established goals that you wanted Pontis™ to facilitate before you
implemented Pontis™?
A. Yes, we wanted a management tool that could manage on the network level mainly to
give us data in regards to the entire inventory. More specifically, we wanted to be able to
look at a particular element such as timber piles condition throughout the entire inventory
as a whole. We also wanted projection analysis of needs for 5, 10, and 15 year time frames.
We also wanted instantaneous need studies and what if scenarios, and if we had this, what
could we do with it. We can take 100 million dollars and split in any number of ways and
float it into the inventory and project what the effects are going to be. It can then rank the
bridges and tell you where you need to spend and why. It is an extremely powerful and
useful for what if scenarios. We do use it to manage our paint system, and we ran an
analysis to see how many bridges we had that were a 3 or less in paint deterioration. So
based on Pontis™ prediction we have established a paint program. We have plotted curves
based on this program and we are gaining ground.

South Carolina – technical questions Transcript

Mr. Floyd

Q. How difficult was it to implement Pontis™ from a technical standpoint?
A. Overall, it was fairly easy. The most time-consuming aspect was developing the initial
baseline and cost models from a technical standpoint. Obviously, the gathering of initial
data was the most overall time-consuming aspect.

Q. Did you bring in consultants or handle implementation in-house?
A. We have done 98% in-house. Back in the early 1990’s, we did have a professor at
Clemson who did some basic research on Pontis™ for us. He concluded that it was a good
system to build on. Additionally, they helped us develop an in-house data collection tool
that we are still using today but we are planning to switch to the collection module inside of
Pontis™. We have been collecting elemental data since 1993. Another problem he helped
with was to conduct an interview in mid 1990’s dealing with maintenance cost issues
dealing with particular action on particular elements. One of the problems in any BMS is
you must have good condition data and good cost data because that is the core that your
recommendations will be built off of. One thing we found was different states collected different types of data differently. Some states collected more, some less. We even found differences in the units of measure in collecting cost data. We found a large range in cost pertaining to the same action on the same element. The findings were regionalized, even though they developed a software tool to statistically analyze your data and compare your data against other states. We did develop our baseline deterioration model in-house, and using that software tool we built our baseline cost mode. On the deterioration model there are two approaches. I chose to make my initial deterioration model a little on the aggressive side so I could let my real data slow it down as I brought it in.

Q. Did you have any problems in developing that initial deterioration model?
A. Nothing other than it was time-consuming.

Q. Do you have any validation practices in place to verify your results?
A. Yes, some data we had cost on and some I had to estimate on. The most common verification technique is in how it has helped us pick replacement projects in regards to how we used to pick projects. And in that respect we have been very successful. So in that regard our models are working very well. Additionally, I conducted a paint study in the late 1990’s and was able to convince management to budget 5M a year to painting. And since 1999 we have already seen our bridge system network improving condition-wise as a whole. The biggest impact Pontis™ has made has been the replacement process by applying our judgment to what Pontis™ suggests and making a decision.

Q. Are you tying deterioration to the budget in order to optimize?
A. The deterioration and cost models are not dependant on a budget. The way the budget comes in is when you develop a time based scenario in Pontis™. This way your models run against this budget over the time frame due to its yearly recommendations where the money is used up year to year and the effects of the money adjust the curves accordingly.

Q. What types of reports did you customize Pontis™ to produce?
A. Pontis™ had a built in report simulator. We are now using Infomaker and it is the best report generator I have ever seen. We have had a lot of benefit using Infomaker outside of Pontis™ by using its ability to create self supporting executable files from the reports and forms it creates. Additionally, you can design custom forms and import them into Pontis™ and key in your specific data.

Q. What type of upgrade costs have you experienced with Pontis™?
A. It is 25K for a super site license which can be but on your network server and as many people as your system can handle can access the database. Additionally, you can use federal BR money to pay the 25K so in essence you are only paying 20% in state funds. I don’t feel that the trouble and costs it would be to develop and maintain your own system would even compare to the benefits you can obtain from Pontis™.
Texas Transcript

Keith Ramsey
Texas DOT Employee

Q. What BMS are you currently using?
A. We are in the process of implementing a BMS right now. That system is Pontis™. We have not decided whether we are going to be entering everything through Pontis™, which would require a lot of customization, or whether we are going to have Pontis™ drawing data that is converted into federal format.

Q. What are you currently using?
A. All our information is presently maintained on an Oracle database. We do use a Texas developed program with TTI, Texas Transportation Inst, to prioritize our bridge rehab and replacement called Texas Eligible Bridge Selection System. It uses the info out of the mainframe. So, we are currently converting to the Oracle database to where we can store and retrieve a lot more information.

Q. Are you using the NBI rating system?
A. We are doing dual inspections. We are collecting NBI data as well as elemental data since 1996. In order to make Pontis™ work we have to have the elemental data.

Q. Are you using deterioration curves?
A. Right now, Texas does not have a bridge maintenance program per se. Districts have them. We are trying to implement a statewide bridge maintenance program and use Pontis™ for that.

Q. How was training the inspectors to do the elemental ratings accomplished?
A. Our inspectors are contracted 90% of the time. The firms we contract with, we trained them. It wasn’t that big of a deal. It probably adds an additional 15 minutes to each inspection.

Q. Do you mind giving a couple names of the firms you outsource inspectors from?

Q. How are you going to train office staff?
A. We are going to have some sort of formal training, probably a combination of in office and through the NHI.

Q. Are you going to do the customization in-house?
A. We are working on customizing now. However, we are not sure if we are going to go with that because when Pontis™ upgrades, we will have to do the customizations again.

Q. What kind of costs are you budgeting for implementation?
A. We are not budgeting for a lot. We originally budgeted for quite a lot. Last year we budgeted for $60,000-$100,000. I don’t think we spent that.
Virginia Transcript

Tom Lester
804 786 2851

Q. What BMS system are you currently using?
A. Pontis™.

Q. How long have you been using Pontis™?
A. We got in on the ground floor in 1992. We have been using since version 1.0.

Q. How expensive is a rollover to a new Pontis™ version?
A. The yearly subscription is 25K any additional cost would be man hours and the cost of any other software purchase to work with it.

Q. When did you start taking elemental ratings?
A. 1995

Q. Are you using the translator or are you still taking NBI ratings?
A. We are still inputting NBI ratings. There is discussion of using the translator, but we have not implemented in replacement of inspectors ratings.

Q. Are your inspectors taking both ratings during a single inspection?
A. Yes

Q. Do your inspectors have a preference as to which rating process they prefer?
A. There is an interview currently out there that shows inspectors predominately like the elemental level data.

Q. What were your goals for implementing Pontis™ on a management level?
A. What we used to do and still do to some extent is we would list out our bridges from lowest NBI level to highest in an MR (maintenance replacement) list. Which means you can replace elements in kind without really improving the bridge. That list would be condensed to a short list and pull inspection reports for all bridges on the list. The list would then be revamped into maintenance categories. So our goal was to get enough detail during an inspection to be able to automate the process and have Pontis™ create the final list and skip the first three steps. We have a need based budgeting plan but we are not currently tying optimization to budget. Additionally, we plan to tie this to preventative maintenance which Pontis™ is not a big help on.

Q. Pontis™ does not help in preventative maintenance?
A. No, Pontis™ does not care about preventive maintenance because you can’t model it. What it can do is over a long period of time you can slow down deterioration based on maintenance. Pontis™ is not interested in preventive maintenance in place that will
influence the deterioration matrix. You could put in elements in the database and give budget figures but it will not model preventive maintenance.

Q. What database are you using on the backend?
A. Oracle

Q. How easy is it to produce queries through Pontis™?
A. Through Pontis™ it is moderately difficult because you have to write reports for Pontis™ to do that. Pontis™ can not do ad hoc queries they must be actual reports that are written for what you want. It is not the same as Infomaker, which can query anything you want as long as you understand how the tables are set up. Infomaker is very powerful in querying, but Pontis™ must have a report to produce a query.

Q. Have there been any major problems in training inspectors to take elemental ratings and office staff in using Pontis™?
A. Only problems with inspectors was a timeframe problem on the emphasis of collecting data that they thought was not being used. It is difficult to teach old dogs new tricks.

Q. How many years have you been taking elemental data?
A. Since 1995, but we lost a lot of it in rolling over to version 2.0. We did not realize that the new version did not history the data.

Q. What were the major goals you wanted Pontis™ to facilitate?
A. To identify needs and provide data collection to any level of management in order to provide comprehensive rollup to the detail up to macro overview and to give more detail to backup decision process. Additionally, to provide a uniform way statewide to handle maintenance.

**Technical Questions**

Doug Horton

Q. How difficult was it to implement and customize Pontis™?
A. The first time through we did not have a whole lot of trouble. We had to jump through some hoops, but everything ran smooth. This second time we had some problems in regards to the database. Sometimes the instructions are not exactly accurate. We have had some difficult times and other times things have worked just fine. It is pretty much like it is with any major program.

Q. Are you problems population or configuration problems in regards to the data?
A. We are setting it up and it did not have district level security in it so we had to add it as an applet to allow write protection to the proper individual. A lot of the problems we ran into were methodology issues in the way we wanted to use the product.
Q. Have you begun in any customization for deterioration models?
A. Yes, we have been working to go ahead and make the proper modifications and derive the costs that are in accordance with what Virginia needs.

Q. How difficult has this customization been?
A. We have not had a chance to validate the deterioration data but we have a lot of data and supposedly the models are supposed to take care of themselves.

Q. How long has the implementation and transition process taken?
A. We implemented the first version in 1999. The transition has not been bad in regards to inspectors. It definitely took 6-9 months for people to get comfortable using the new program after it was up and running.

Q. What cost have been associated with implementation other than the licensing fee?
A. We have done everything in-house staff and no outside consultants. The only major cost was the server to run Pontis™ on.

Q. Was customization done in-house also and were there any costs associated with customization?
A. We do use service units and had Cambridge come in and train them on the models. But we consider these not to be extreme costs.
Washington State Transcript

Ed Henley

Q. Did you use NBI prior to purchasing Pontis™?
A. We’ve all used NBI ratings since the seventies, but when we began to implement a BMS we started collecting the element level data around ’92 or ’93. So, when we were beta testing that on Pontis™ and later on when we started evaluating Bridgit software, we were basically using the BMS element level data. We never used NBI data to operate our BMS. We did not use any of the conversion methods that were developed at CO State.

Q. Are you talking about the conversion from NBI to elemental?  
A. Yes, that is the work that Herns at CO State put together in ’96 ’97 for FHWA. But we didn’t have to use it since we had been collecting element level data prior.

Q. Did you set up evaluation criteria when deciding between Bridgit and Pontis™?  
A. No we did not. We had participated in alpha and beta testing with Pontis™ using sample data sets that were provided. We were on a couple of different committees that were evaluating the good, bad, and ugly of Pontis™ for several years. We initiated our evaluation of Bridgit because we had seen it demonstrated at a PCI conference Seattle in ’96. It was much easier for us to create new elements in the BMS. It was much easier to customize the BMS to suit our needs and we didn’t have to go through a consultant like with Pontis™, so if you wanted to do some customization you pretty much have to go through Cambridge Systematics and we didn’t care for that. That was just one of the things. We certainly did like the way Bridgit handled the combined elements such as painted steel. It treats them separately rather than as a single item. It was kind of a technical attraction based on three things. 1. We could customize it with very little effort. 2. It could handle some of the elements in a way that we agreed with more, such as the separating of the combined elements. 3. We thought we would have to staff up if we went with Pontis™. It requires more manpower to operate than Pontis™.

Q. How long was the transition period?  
A. It probably took three years of inspection cycles before inspectors were all pretty well trained for the BMS portion of the inspections. One of the challenges of BMS in the future is how do you make the decision of whether to paint more steel bridges or whether to go out and do more deck rehab and protective overlays. And that will come into your cost effective index considerations. Bridgit generates a cost effective index. Some people would argue that it is not as rigorous of an optimization routine as Pontis™, but we find it adequate for our purpose.

Q. Does Bridgit produce decay curves and deterioration models?  
A. Yes, it has that capability.
Q. As far as that optimization tools, you said you’re satisfied with those, but could you elaborate on that a little bit?
A. We’re satisfied with the methodology. What we’re not satisfied with is being able to get the appropriate cost information into the model. And that is when you have all of these feasible actions, its like replace steel beam, well there’s a steel beam that is 6 inches and a steel beam that is 72 inches. So, getting reasonably accurate cost estimates for the different feasible actions is very difficult. There have been several national projects; I think one in Virginia to tackle it. But we know to have it produce reliable outputs; we have a lot of work to do in getting better cost estimation into it. It isn’t the effectiveness of these two systems that is the problem, it is getting that correct cost estimations in there that is the difficult part. The inspection side of it is not that difficult to get accurate even if your inspectors are having to estimate some of the quantities in the different condition states in the field, its still reasonable and your not going to be to far off. But when it comes to those damn costs, that’s where the main amount of work is for a given state for a given state to make sure that they are getting reasonable cost information in there for the various feasible actions. I haven’t done the research in the last five years to find out what is going on at a national level to come up with these default cost values, whether those have been adjusted for regional. We look at our own state and we see that the cost to do certain types of work varies a great deal between a state, a city, and a county. So, if we have that kind of variation within our own state even though we use the same contractors maybe we’re not so interested in what they are doing back on the east coast or down in the south. We would like to keep the cost information as it relates to doing that type of work in our region, in our state. So, the other piece of the cost that is certainly subjective is that of the owner costs. You know it will calculate the cost of a lane of traffic being down for a day, week, month, etc. and it will calculate the cost whatever it shows in your NBI data for a given detour. It’ll calculate the cost of having one lane or the entire route out of service for a time. It’ll also factor in things like accident costs. The catch is that with all of those owner costs comes with it a judgment. There’s almost a paradox in it that an agency has finite budgets and they have to deal with specific preservation and deterioration issues on their bridge population. By using owner costs, it helps you to move away from a maintenance mentality more towards a preservation mentality. If you don’t consider user costs, maintenance always seems to win out. You factor in some of these user costs and it drives you towards preservation and then ultimately it justifies replacement. But getting the right information according to how it’s laid out in these BMSs for the owner cost part of it, again, it’s not that simple because you have to look at the rules for generating those numbers and judge whether those software rules really are accurate to your area.

Q. So, Bridgit does a good job of using those numbers?
A. It does a reasonable job in how it handles the numbers we put in. We’re just simply in a political reality where funding has been cut so much that we don’t have a choice to do all the right things so we basically have moved from replacing bridges, preservation was a big issue with us for fifteen years and we’ve done a lot of that. And we’ve also done a lot of replacing of older bridges that are usually functionally obsolete, but when you get into constrained and unconstrained budgets when we make our BMS run right now we don’t get anywhere close to the unconstrained budget. We’re getting down in a very low element
level of the constrained budget which basically pushes you back towards maintenance. It allows preservation, don’t get me wrong, but in a perfect world a BMS would show you the best way to spend your money. If you have an unconstrained budget, you can really come up with the most cost effective and beneficial to society. But as soon as you get down to constraining those budgets then it really constricts the usefulness of your BMS to you.

Q. Do you have the contact info for Bridgit?
A. That’s a good question because those of us who were still paying a fee to AASHTO Ware a couple of years ago when they decided they weren’t going to carry Bridgit anymore we received free of charge so that we could basically own it ourselves from now on. Now, Delcan Co. that developed it for NCHRP project is out of CA. Delcan might have some kind of rights of distribution after it was dropped AHSSTO Ware.
Frank Liss

Q. What BMS system are you using?
A. We really do not have a system per se; we kept using Pontis™ in 1996.

Q. What were your reasons to stop using Pontis™?
A. We were not satisfied with the results we were getting and when it became optional, management decided to stop using it.

Q. What are you using in place of Pontis™?
A. We have 10 districts in the state and one of our districts got the Bridgeview software. There is no statewide usage of any particular software. It is basically left up to the district. Of the 10 districts, 2 of them are fluent with Bridgeview. The other 8 have no system in place, just crude paperwork and notes.

Q. Has there been any consideration in going back to Pontis™?
A. No, Pontis™ is a four letter word in our department.

Q. Are you collecting elemental data?
A. No, just NBI.

Q. If the FHWA starts requiring elemental data how will you handle that type of stipulation?
A. We will cross that bridge when we come to it.
Q. The developers of Pontis™ reported they found fundamental shortcomings in the NBI rating system. Do you agree with their findings?
A. No

Q. If yes, what are NBI’s deficiencies?
A. The Pontis™ database collects element level data. It is far more detailed than the NBI condition ratings. The NBI is moving towards collection of some element data; however, at a National level that amount of detail is not necessary to ensure safety. We do not feel that this is a shortcoming of the NBI. The system was created to ensure safety and we feel that we are meeting that requirement and we continue to improve our data and data quality.

Q. What are the strengths of the NBI rating system?
A. The NBI rating system provides a good general overall condition rating for the deck, superstructure or substructure. These condition ratings adequately address the need to track the general trend of bridge conditions as well as being able to distribute funds equitably to states.

Q. Did the FHWA play a role in the development of Pontis™?
A. Yes.

Q. If yes, what type of role did the FHWA facilitate?
A. The FHWA sponsored a contract that was awarded to Cambridge Systematics, Inc. and Optima, Inc on August 1, 1989, to develop the Pontis™ system. California DOT, in cooperation with FHWA, administered the contract. The first two versions (DOS) of Pontis™ resulted from this effort. During 1993-94, it was decided that Pontis™ would move to the AASHTOWare program to provide necessary support and future enhancements.

Q. Does FHWA have a preference which Bridge Management System is used by DOT’s? If yes, which system and why?
A. Yes. The FHWA prefers the Pontis™ BMS, however, we do not require it. We do promote its use among the States because of the many advantages of this system, such as over 40 highway agencies using Pontis™, it can thoroughly analyze bridge inspection data, and it helps the user establish bridge preservation policies, assists in developing bridge improvement projects, and can produce an array of high quality reports for management purposes.

Q. The developers of Pontis™ reported they found fundamental shortcomings in the NBI rating system. Do you agree with their report?
A. Yes.

Q. If yes, what are the shortcomings?
A. The description of the condition of the individual bridge components is more detailed than the NBI ratings and the Pontis™ program can analyze all the related data with respect to the entire network of bridges in a State. Under the NBI inspection program, bridge components or items are coded from 0 (worst) to 9 (best). The inspector rates an element or component applying an overall characterization of the general condition of the entire component, not a localized portion of the element. Pontis™ allows the inspector to code the element into the various condition states that exist, including the quantity of element in each condition state. In Pontis™, a feasible action goes with each condition state of an element, ranging from "do nothing" in the best state to "replacement" in the worst state. This allows the Pontis™ models to analyze all bridge needs, i.e., preservation, repair, or replacement. It takes a great deal more effort to analyze all needs using the very subjective NBI ratings.

Q. Does the Pontis™ rating system overcome these shortcomings?
A. Yes.

**RATING REQUIREMENTS**

Raymond McCormick
Raymond.McCormick@fhwa.dot.gov

Q. Is there any movement by the FHWA to mandate DOT’s nationwide conversion to the Pontis™ system?
A. There is absolutely no plan to require the States to use Pontis™ as their BMS. The FHWA believes that Pontis™ is a good system, but, it is not the only system. Our primary interest is for States to implement bridge management systems that work for their particular situation. We will be moving toward the use of some element level data in the future, so that we can increase the overall accuracy of the data. But we will not mandate any system.
Appendix B.3 – Inspector Interview

The following is a transcript of 24 interviews conducted by a bridge maintenance engineer from a northeastern state. The purpose of the phone interviews was to assess the transition from and NBI-based bridge condition rating system to the collection of multi-state CoRe condition data.

**CoRe Element (Pontis) Data Collection Costs**

I polled Pontis users and asked the following:

1. Do your inspectors find that collecting CoRe element data is a significant burden?
2. For your typical garden variety bridge, how long does collecting CoRe element data take?

The responses are shown in this table below:

<table>
<thead>
<tr>
<th>Answer Question 1</th>
<th>Answer Question 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>We do dual inspections. The inspections take longer than they did before but not much longer and they are much better. The inspectors do not feel it is a significant burden.</td>
<td>It usually takes a few hours to complete a typical bridge.</td>
</tr>
<tr>
<td>No, after the initial calculation of quantities and initial inspection our inspectors find there is no significant time increase. They are supposed to look at the entire bridge anyway so recording the quantity increase is not that bad. With that said there is still the time involved in calculating the quantities the first time and then the data entry. What we have found is the time saved completing in house BCR for you run of the mill bridge rehabs, which then can be done utilizing the Pontis inspection information.</td>
<td>This depends on whether it is the first inspection of an older bridge or a repeat inspection. I have seen an inspection take 4 hours if the bridge is over water and fairly tall abutments and piers requiring ladders to inspect the bearings and a boat to look into scour. I have also seen an inspection take 30 minutes if it is a fairly new bridge that you can see everything without a ladder and boat.</td>
</tr>
<tr>
<td>After our inspectors got used to CoRe Element Inspection, they did not find it a significant burden.</td>
<td>As for extra time we never did any surveys on this, but we have not experienced any significant increases in time to conduct an inspection.</td>
</tr>
<tr>
<td>Yes it is burdensome. Yet the inspectors are using the information for minor rehabilitation repairs under our price agreement and for major rehabilitation where specific structural designs (bidding/contracts). The information allows for better communication with our District Engineer and Bridge Design Staff.</td>
<td>Time required varies. I understand that at the initial set up of Pontis data element inspections, our District Inspectors on a typical simply supported bridge, single/multiple span, look about 2-4 hours. This did not include traffic control, equipment to access the abutments or the piers and travel time to and from the bridge. The subsequent inspections are reduced to about 1/2 the time.</td>
</tr>
<tr>
<td>The majority of our inspections are carried out by consultant forces but the response that I get from them is that it does not significantly add to the inspection. This is especially true once all the elements for a bridge have been collected for the first time. Don't get me wrong it does add time to the inspection, but I would not classify it as significant.</td>
<td>The inspectors indicate that it will add anywhere from 15 to 30 additional minutes in the field to collect the necessary data. What they have found is that they can do the elemental and NBI inspections at the same time. For each inspection you are looking at the same areas. The biggest difference is the collection of condition state quantities.</td>
</tr>
<tr>
<td>No, not at this time</td>
<td>The state has been doing CoRe element inspections for some time now so our time is simply spend updating the data - say, 10-15</td>
</tr>
<tr>
<td>On a new structure the elements are entered in the office from the plans then the inspectors will verify the dimensions when they inspect it so the initial inspection will take longer but after that there is no significant time difference</td>
<td>minutes max. It takes around 45 minutes to an hour to inspect the bridge and update the CoRe elements on a laptop.</td>
</tr>
</tbody>
</table>
| Element level inspection (at least the way we do it) does not have to be cumbersome or burdensome. Our inspectors use their "best judgment" estimate as to the quantity of distressed areas as opposed to measuring down to the nearest millimeter | Our best estimate is that it does not add more than a couple of minutes to the average inspection. That being said, I offer some of the experience we have gained. 
1) When we started, we decided that we needed to re-invent the wheel. We made up and used all of our own elements. We have since determined that while we don't think CoRe is the end all be all, it is better than what we came up with and works a lot better with the Pontis Program. 
2) There is a significant amount of time that needs to be invested up front in getting ready for element level inspections. This time is used to assign the elements which belong to each bridge and to determine what agency specific elements or sub-elements are needed. We estimate that it took about ½ man year to do our 1700 plus structures. 
3) We feel that the element level inspection is a much better indicator of the overall "Health" of the structure. |
| No. We have been collecting CoRe element data for 8 years. It is just part of the job. We try to capture as much data on new structures from plan and then field verify. The one change we started making this last year was to add better location details in the notes to reduce time looking for deterioration. | We can typically inspect, photograph, and enter data in Pontis in 1.5 to 2 hours for a bridge up to 150 to 200 feet. Inspection of our long bridges of the Salt River take 8 hours with extra people (additional time is for snooter inspection). This year we are trying a schedule of 4 hours per bridge, however, all notes photos etc will be completed in field and final report will be ready for printing. |
| No, not now. (There is always resistance to change at first) | The first CoRe inspection takes some time. But after that it doesn't significantly add to the overall inspection time ( maybe 15 – 20 minutes). |
| No response | Initially, it may take up to half a day to collect CoRe Elements for a mid size concrete bridge. After that, during each consecutive inspection, we need only up to half an hour to update the data. |
| No our inspectors do not find it a burden. We find that evaluating core element conditions requires the inspector to look closer and quantifies the deterioration in the different members thus a better job is done. We follow the same procedure of creating the initial inspections in the office from plans the inspector also verifies that the elements are correct. | The extra time is spent updating the element conditions which varies depending on the structure but typically might add 30 minutes to an inspection. |
| For our inspectors it is not a significant burden when utilizing information available from the bridge | Again, if all the elements are there and relatively the same it doesn't |
| **No. not now.** | The first CoRe inspection takes some time. But after that it doesn't significantly add to the overall inspection time (maybe 20 – 25 minutes). |
| **No. Initial identification and coding of CoRe elements will take varying amounts of time depending on bridge size. Once this is completed updating the CoRe elements in the field goes quickly.** | Initial: 15-30 minutes depending on bridge size. Updating: 10-15 minutes depending on bridge size. |
| **This state has been collecting CoRe element data for about 10 years. We initially code the forms from the plans so the inspectors only have to verify in the field. The first inspection takes more time. I have only been on board for 3 years so the initial inspections were done before I was here. I haven’t heard that there was much opposition other on the bridges without plans where all information had to be field measured and coded. Some of our inspectors like doing the CoRe element inspections as they believe that they get a better description of actual conditions of more items than the generalized NBI ratings.** | I don't think the CoRe element data collection requires much more than ¼ to ½ hour to verify each cycle in the field. (depending on the bridge size.) We code the results into the computer in the office. |
| **I asked one of our inspectors he said that it is not a significant burden to do the Pontis inspections.** | He said that the initial Pontis inspection may take about 1.5 hours in addition to the NBI bridge inspection. After the initial Pontis inspection, he said it takes about 0.5 hour additional time to do the Pontis inspection. |
| **I asked one of our new Engineers who spent some time in a bridge inspection office. We have observed that our inspectors do not like to collect CoRe elements. However, it does make them take a better look at the bridge.** | It probably adds 30 minutes to a regular inspection. An initial Pontis inspection could take twice or three times that long. |
| **NO. I would say that for typical bridge it might add 5-10 minutes to the inspection once the elements have been initially defined. For larger complex structures it could take longer.** | 5-10 minutes more on the inspection. |
| **We began in Fall 1993. Of course at first it took some time to get off the learning curve, but our inspectors like it because they feel they are collecting very useful data. So no, they do not consider it a burden.** | 1 to 1.5 hours. |
| **This is an integral part of our Bridge Inspection Duties, significant or not, it is definitely not a burden.>> We love it.** | Assuming one year’s worth of deteriorations, an hour is a safe guess for our City Bridges with about twice as much on the average for initials. |
| **No. This county inspects about 1300 non-state owned NBI bridges within the County under contract to the state. This includes local bridges in sixty-eight cities. Our inspectors use the State Element List which is an expanded version of the Commonly Recognized Elements list that is customized to the bridge types in this state. We have been collecting Element Level Data since 1996.** | Thirty to forty-five minutes. About thirty percent of the NBI bridges in our inventory require more time and/or specialized equipment to complete an inspection in accordance with the AASHTO standards. |
| **No** | Initially it might take up to an hour to identify the elements depending on plan availability but with |
a little experience in the CoRe Elements and with a set of plans it really only takes minutes to identify the elements and quantities. We haven't really seen any increase in inspection time (or had complaints from our inspectors about additional time). They are still inspecting the same bridge in the same way, only reporting their findings in a more objective way.

PS - We don't do NBI inspection coding for Deck, Super and Sub - we use the FHWA NBI Translator for this.

| This is a matter of differing opinion, some do consider it burdensome, many do not. | It does not seem to take more than one hour per bridge, often less than that. |
Appendix B.4 – DOT Contact Information

State Departments of Transportation

**Alabama**
- Main: [http://www.dot.state.al.us](http://www.dot.state.al.us)
- Bridges: [http://www.dot.state.al.us/Bureau/Maintenance/bridge/bridge.htm](http://www.dot.state.al.us/Bureau/Maintenance/bridge/bridge.htm)
- Website Notes: Has several PDF files of different bridge rating data sheets.

**Alaska**
- Main: [http://www.dot.state.ak.us](http://www.dot.state.ak.us)
- Bridges: Select “Bridge Design” from the “Inside the DOT&PF” dropdown box
- Website Notes:

**Arizona**
- Main: [http://www.dot.state.az.us](http://www.dot.state.az.us)
- Bridges: [http://www.dot.state.az.us/ROADS/bridge/index.htm](http://www.dot.state.az.us/ROADS/bridge/index.htm)
- Website Notes:

**Arkansas**
- Main: [http://www.ahtd.state.ar.us](http://www.ahtd.state.ar.us)
- Bridges:
- Website Notes: No useful bridge maintenance information.

**California**
- Main: [http://www.dot.ca.gov](http://www.dot.ca.gov)
- Bridges:
- Website Notes: No useful bridge maintenance information.

**Colorado**
- Main: [http://www.dot.state.co.us](http://www.dot.state.co.us)
- Bridges:
- Website Notes: Has online manual.

**Connecticut**
- Main: [http://www.dot.state.ct.us](http://www.dot.state.ct.us)
- Bridges: [http://www.dot.state.ct.us/bureau/eh/ehen/pconcept/Funding%20Pamphlet.htm#HBBR](http://www.dot.state.ct.us/bureau/eh/ehen/pconcept/Funding%20Pamphlet.htm#HBBR)
- Website Notes: Has good 100+ page online manual.

**Delaware**
- Main: [http://www.deldot.net](http://www.deldot.net)
• Bridges: http://http://www.deldot.net/static/WorkProgram2001/bridgepres.html
• Website Notes:

Florida
• Main: http://www.dot.state.fl.us
• Bridges:
• Website Notes: PDF FILES

Georgia
• Main: http://www.dot.state.ga.us
• Bridges: 
  http://www.dot.state.ga.us/dot/operations/maintenance/bridgemaintenance/index.shtml
• Website Notes: Main bridge maintenance and inventory page containing links to a list of all posted bridges, a posted bridge locator, and a link to download a copy of the NBIS Coding Guide

Hawaii
• Main: http://www.state.hi.us/dot
• Bridges:
• Website Notes:

Idaho
• Main: http://www2.state.id.us/itd
• Bridges:
• Website Notes: No useful information found.

Illinois
• Main: http://www.dot.state.il.us
• Bridges:
• Website Notes: Has report of project plan overview.

Indiana
• Main: http://www.in.gov/dot
• Bridges:
• Website Notes: PDF FILES

Iowa
• Main: http://www.dot.state.ia.us
• Bridges: 
  http://www.dot.state.ia.us/bridges.pdf
  http://www.dot.state.ia.us/bridge/index.htm
• Website Notes:
Kansas
- Main: http://www.ksdot.org
- Bridges: http://www.ksdot.org/burdesign/bridge/br_email.html
- Website Notes: Not much information, website has direct contact info.

Kentucky
- Main: http://www.kytc.state.ky.us
- Bridges:
- Website Notes: No useful info on bridge maintenance found.

Louisiana
- Main: http://www.dotd.state.la.us
- Bridges: http://www.dotd.state.la.us/highways/project_devel/design/bridge_design/
  http://www.dotd.state.la.us/highways/project_devel/design/bridge_design/bridge_design_directory.shtml
- Website Notes:

Maine
- Main: http://www.state.me.us/mdot
- Bridges:
- Website Notes: No useful info on bridge maintenance found.

Maryland
- Main: http://www.mdot.state.md.us
- Bridges: http://www.sha.state.md.us/keepingcurrent/roadsandbridges.asp?id=WD51+WD55
- Website Notes: More info on the specific bridges rather than the general info that we’re usually looking for.

Massachusetts
- Main: http://www.state.ma.us/mhd
- Bridges:
- Website Notes: No useful info on bridge maintenance found.

Michigan
- Main: http://www.mdot.state.mi.us
- Bridges:
- Website Notes: No useful info on bridge maintenance found.

Minnesota
- Main: http://www.dot.state.mn.us
- Bridges: http://www.dot.state.mn.us/bridge/index.html
  http://www.dot.state.mn.us/bridge/DocumentsFormsLinks/index.html
- Website Notes: Many useful links, documents, downloads, etc. Click on “People” for all contact info.

Mississippi
- Main: http://www.mdot.state.ms.us
- Bridges: http://www.mdot.state.ms.us/facts/divisions/bridge.htm
- Website Notes: Website just gives brief description of the bridge division and the process involved in bridge project selection.

Missouri
- Main: http://www.modot.state.mo.us
- Bridges: http://www.modot.state.mo.us/business/bridgestandards.htm
  http://www.modot.state.mo.us/business/bridgeinspectrating.htm

Montana
- Main: http://www.mdt.state.mt.us
- Bridges: http://www.mdt.state.mt.us/bridge/
- Website Notes: Main Bridge Bureau site. Many links.

Nebraska
- Main: http://www.dor.state.ne.us
- Bridges: http://www.nebraskatransportation.org/design/bridge/
- Website Notes: Bridge Design Department main page.

Nevada
- Main: http://www.nevadadot.com
- Bridges:
- Website Notes: No useful info on bridge maintenance was found, only bridge design stuff.

New Hampshire
- Main: http://www.state.nh.us/dot
- Bridges: http://webster.state.nh.us/dot/contactus.htm
  No useful bridge information
- Website Notes: Contact info

New Jersey
- Main: http://www.state.nj.us/transportation
- Bridges: http://www.state.nj.us/transportation/business/procurement/ProfServ/ConsulSelecti ons/ConSel97.htm
• Website Notes: PDF FILES, list of consultants by name who performed bridge inspection for DOT

**New Mexico**
• Main: [http://www.nmshtd.state.nm.us](http://www.nmshtd.state.nm.us)
• Bridges: [http://nmshtd.state.nm.us/general/depts/bridgemain/default.asp](http://nmshtd.state.nm.us/general/depts/bridgemain/default.asp)
• Website Notes: No useful information. Nothing is on bridge maintenance page.

**New York**
• Main: [http://www.dot.state.ny.us](http://www.dot.state.ny.us)
• Bridges: [http://www.dot.state.ny.us/structures/progeval/bippi/bippi_home.html](http://www.dot.state.ny.us/structures/progeval/bippi/bippi_home.html)
• Website Notes: Website for “Bridge Inspection Program – Pen Interface.”

**North Carolina**
• Main: [http://www.ncdot.org](http://www.ncdot.org)
• Bridges: [http://www.doh.dot.state.nc.us/operations/dp_chief_eng/maintenance/bridge/](http://www.doh.dot.state.nc.us/operations/dp_chief_eng/maintenance/bridge/)
• Website Notes: Main bridge page. Many links and information.

**North Dakota**
• Main: [http://www.state.nd.us/dot/](http://www.state.nd.us/dot/)
• Bridges: [http://www.state.nd.us/dot/materials/researchlistbridge.shtml](http://www.state.nd.us/dot/materials/researchlistbridge.shtml)
• Website Notes: List of specific bridge projects. Couldn’t find stuff on bridge maintenance.

**Ohio**
• Main: [http://www.dot.state.oh.us](http://www.dot.state.oh.us)
• Bridges: [http://www.dot.state.oh.us/ltap/](http://www.dot.state.oh.us/ltap/)
• Website Notes: PDF FILES, the Ohio Local Technical Assistance Program (LTAP) Center website

**Oklahoma**
• Main: [http://www.okladot.state.ok.us](http://www.okladot.state.ok.us)
• Bridges: [http://www.okladot.state.ok.us/telefon.htm](http://www.okladot.state.ok.us/telefon.htm)
• Website Notes: PDF FILES, contact Info

**Oregon**
• Main: [http://www.odot.state.or.us](http://www.odot.state.or.us)
• Bridges: [http://www.odot.state.or.us/tsbbridgepub/](http://www.odot.state.or.us/tsbbridgepub/)
  [http://www.odot.state.or.us/tsbbridgepub/brteamlist.htm#BridgeProgram](http://www.odot.state.or.us/tsbbridgepub/brteamlist.htm#BridgeProgram)
• Website Notes: Main bridges/bridge engineering page. Bridge Program Team contact info. This team is responsible for the development, implementation and operation of the Bridge Management System
Pennsylvania
- Main: http://www.dot.state.pa.us
- Bridges:
- Website Notes: More info on their historic bridges than general useful information.

Rhode Island
- Main: http://www.dot.state.ri.us
- Bridges: http://www.dot.state.ri.us/WebProj/maint.htm
- Website Notes: PDF FILES, Highway and Bridge Maintenance main website, but not much information besides contact info

South Carolina
- Main: http://www.dot.state.sc.us
- Bridges: http://www.cooperriverbridge.org/
- Website Notes: Cooper River Bridge Project – a current huge bridge project.

South Dakota
- Main: http://www.sddot.com
- Bridges: http://www.sddot.com/pe/bridge/index.htm
  http://www.sddot.com/pe/bridge/office.asp
  http://www.sddot.com/geninfo_facts.asp
- Website Notes: Bridge Design main website. Contact info for bridge people. Just says which department handles bridge maintenance. South Dakota has 5,905 bridges, with 1,793 of these on the state system, the rest are local.

Tennessee
- Main: http://www.tdot.state.tn.us
- Bridges:
  http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_operations/mainte~1/BridgeGrantProgram.htm
  http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_operations/mainte~1/MMS.htm
- Website Notes: Bridge Grant Program. Maintenance Management System.

Texas
- Main: http://www.dot.state.tx.us
- Bridges: http://www.dot.state.tx.us/hrd/tdp/catalog/mnt801.htm
  http://www.dot.state.tx.us/brg/default.htm
- Website Notes: Bridge Maintenance Training Course. Bridge Division – many links
Utah
- Main: http://www.dot.state.ut.us
- Bridges:  http://www.udot.utah.gov/str/operations/BridgeOperations.htm
- Website Notes: Bridge Operations main bridge division - Nothing but short description and contact info.

Vermont
- Main: http://www.aot.state.vt.us
- Bridges: http://www.aot.state.vt.us/maint/mainthome.htm
- Website Notes: Maintenance Page – no useful info

Virginia
- Main: http://www.virginiadotorg/default.asp
- Bridges: http://virginiadot.org/vtrc/main/online_reports/99-r4.htm
  http://www.virginiadot.org/business/bridge-default.asp
- Website Notes: Article on project level and network level stuff for Pontis™ and link to pdf file. Virginia’s Structure and Bridge Program.

Washington
- Main: http://www.wsdot.wa.gov
- Bridges: http://www.wsdot.wa.gov/eesc/bridge/index.cfm
- Website Notes: Bridge and Structures Office website – description. Bridge Structural Repair and Modification.

West Virginia
- Main: http://www.wvdot.com
- Bridges: http://www.wvdot.com/3%5FRoadways/3b4_bridges.htm
- Website Notes: Bridges page with WV numbers, stats, etc.

Wisconsin
- Main: http://www.dot.state.wi.us
- Bridges: http://www.dot.wisconsin.gov/library/research/reports/bridges.htm
- Website Notes: Website on both completed and current research on anything having to do with bridges conducted by Wisconsin DOT.

Wyoming
- Main: http://wydotweb.state.wy.us
- Bridges: http://dot.state.wy.us/web/brass/index.html
- Website Notes: WYDOT Bridge Program – BRASS – Bridge Rating and Analysis of Structural Systems – many links.
Others:

FHWA
- Main: http://www.fhwa.dot.gov/
- Website Notes: TEA bridge fact sheet.

AASHTO
- Main: http://www.transportation.org/aashto/home.nsf/FrontPage
- Website Notes:

References:

Appendix C: Bridge Deterioration Analysis

The primary goal of this portion of the project was to provide a more accurate and reliable means of forecasting the condition of bridges and bridge maintenance needs required for the optimization component of a bridge maintenance management system. The project proceeded by initially examining the historical and current bridge deterioration forecasting techniques.

Figure 14: Bridge condition forecasting techniques

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Rating Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolukbasi, Mohammadi &amp; Arditi</td>
<td>2004</td>
<td>Regression Analysis &amp; Condition Latency</td>
</tr>
<tr>
<td>Cesare, Santamaria, Turkstra &amp; VanMarcke</td>
<td>1992</td>
<td>Markov Chain Analysis</td>
</tr>
<tr>
<td>DeStefano and Grivas</td>
<td>1998</td>
<td>Markov Chain Analysis</td>
</tr>
<tr>
<td>Golabi, Thompson &amp; Hyman</td>
<td>1992</td>
<td>Markov Chain Analysis</td>
</tr>
<tr>
<td>Hawk</td>
<td>1995</td>
<td>Linear Regression</td>
</tr>
<tr>
<td>Jiang, Saito and Sinha</td>
<td>1988</td>
<td>Markov Chain Analysis</td>
</tr>
<tr>
<td>Sun, Wang &amp; Zhang</td>
<td>2003</td>
<td>Multiple Linear Regression Analysis</td>
</tr>
<tr>
<td>Zayed, Chang and Fricker</td>
<td>2002</td>
<td>Economic Analysis &amp; Markov Chain Analysis</td>
</tr>
</tbody>
</table>

The examination focused on the relationship between the purpose of the analysis (network versus project), the data types (single versus multi-state), the type of forecasting method applied to historical data (deterministic versus probabilistic). Due to variance in the analysis results, the source of model also became an issue when examining the reliability of empirically-derived historical data analysis versus expert elicitation.

An examination of ALDOT’s historical bridge condition data reveals biannual inspection data using an NBI-based rating process for core bridge elements consistently collected across all bridges for over five full inspection cycles. The ages of bridges in the inventory range from newly constructed to 80+ year old bridges in active service. The data was of a consistent format across the various inspection cycles and readily extractible from the bridge management system. The following attributes were available to facilitate an examination of influence of specific elements on the condition rating for a bridge or its major elements: age, structure type, location, route type, and traffic volume.

The analysis of the overall bridge rating, deck, superstructure and substructure for individual bridges revealed very little changes in deterioration over the course of a decade; however, the clustering of bridges based on various attributes did provide insights into the influence of specific factors or combinations of factors upon the condition ratings. Prior to data analysis, the bridge condition data sets were manipulated to categorize bridges as: belonging to a specific 5-year cluster; having a location of either coastal, central or northern bridges; having a traffic volume of AADT less than 5,000, between 5,000 and 10,000 or greater than 10,000; being constructed of either steel, concrete, prestressed concrete materials of a slab, stringer, beam or girder; and being associated with a route type of either Interstate or non-Interstate bridges. Bridges with sharply increasing condition ratings in its deck, superstructure or substructure were excluded from the analysis to avoid corrupting the data set with bridges having undergone replacement or rehabilitation. Once the bridge condition data set had been evaluated and cleaned, a series of multiple regression
analysis were performed on the data sets. An analysis of the resulting data set revealed the
influence of these factors upon the variance in condition factors for specific elements.

For additional details of this analysis, see UTCA Report number 03112, “Bridge Decay and
Maintenance Forecasting Integration,” which was funded through a University
Transportation Center for Alabama (UTCA) grant.

References

Bolukbasi, M., Mahammadi, J. and Arditi, D. “Estimating the Future Condition of
Highway Components Using National Bridge Inventory Data,” 2004, Practice
Periodical on Structural Design & Construction.

Cesare, M., Santamarina, C., Turkstra, C., and VanMarcke, E. H."Modeling bridge

DeStefano, P. and Grivas, D. "Method for estimating transition probability in bridge

Highway Administration, Washington, D.C.

Hawk, H. "BRIDGIT deterioration models." (1995) Transportation Research Record 1490,
Transportation Research Board, Washington, D.C.

Jiang, Y., Saito, M., and Sinha, K. C. "Bridge performance prediction model using the
Markov chain." (1988) Transportation Research Record. 1180, Transportation Research
Board, Washington, D.C.

Sun, S., Wang, R., and Zhang, Z. “Analysis of Past NBI Ratings to Determine Future
Department of Transportation and Development, Louisiana Transportation Research
Center.

Zayed, T. M., Chang, L. and Fricker, J. D. "Life-cycle cost analysis using deterministic and
Facilities.

Minimum System Requirements

Any system running this application should comply with the following requirements:

- 17 inch Monitor with a Minimum of 800x600 screen resolution or greater
- 15 inch monitor with a minimum of 1024x768 screen resolution or greater
- Pentium or greater processor
- 64 Megabytes of memory or greater
- Internet Explorer 5.0 or greater

Introduction

The Web Sufficiency Calculator (WSC) has been created by the University of Alabama Aging Infrastructure Systems Center of Excellence. This application is designed to aid in the training of both new and current bridge inspectors, with the intention of facilitating a better understanding of the calculation of a bridge’s sufficiency rating. With this application, a bridge inspector should be able to make more informed decisions.

This application was designed under the auspices of the Bridge Maintenance Section of the Alabama Department of Transportation, particularly George Conner. All efforts have been made to ensure that the materials included herein comply with existing federal and state regulations governing bridge inspections.
Web Sufficiency Calculator (WSC)

Getting started with the Web Sufficiency Calculator is as simple as opening a web browser and typing in the correct URL. After the URL has been entered, the program will begin running and will show the user this screen:

![Web sufficiency calculator startup screen](image)

**Figure 9: Web sufficiency calculator startup screen**

With the appearance of this startup screen, the option to either continue or to exit will be given.
When Continue has been selected, the first of 2 data entry screens will appear. On the initial screen, INPUT SCREENS 1A - 5B, the Bridge Identification Number (BIN) must be entered prior to continuing. The screens are organized in the same manner as the BI-6 form to aid for ease of data entry.

![Bridge Identification Number Entry](image)

**Figure 10:** Bridge identification number entry
Entering Values

Once a BIN has been entered, the user can change values for a proposed bridge. In all, there are 34 items that are used in the calculations. They are organized on the two input screens in the same order that they appear in the BI-6. The values can be selected either from the drop-down boxes provided or by entering the numbers into the text fields provided. The values that are available in the drop-down boxes are the only valid values for an item as listed in the federal and state codes that define that item.

Figure 11: Changing bridge item values for what-if analysis
Calculation Screen Features

The Calculations screen has a number of important functions. All of the fields are not editable. By clicking Calculate the fields on the following form are populated with the relevant data. The Print All Results button will print a single page report of the bridge identification number, all of the data that was used in the calculations, the sufficiency rating and its component values, and the values of the main elements that make up the component values.

Figure 12: Printing results
This application was designed to serve several purposes. A primary use will be to quickly determine the sufficiency rating and status of a bridge. The area highlighted by the dashed boxes list the Sufficiency Rating and Status of the bridge.

Figure 13: Sufficiency rating and bridge status
Another essential use for this application is as an analysis and training tool. The bridge’s rating is broken down into its components. By clicking on any of the “Analyze” buttons inside the dashed box, the user can drill down into the calculations that are involved in determining the overall rating.

Figure 14: Sufficiency rating component analysis selection
In addition to analyzing the overall rating, there are a number of calculated appraisal values that are part of the intermediate calculations. These are shown in the dashed box. These values are calculated according to the Federal Highway Administration guidelines.

![Figure 15: Detailed item analysis](image)
Analysis Tools

Once a sufficiency rating has been calculated, this application offers a number of options for the bridge inspectors to examine how the input values affect the sufficiency rating calculations. It is hoped that the information contained on these screens will facilitate a better understanding of the bridge rating process and aid in fostering a more uniform bridge rating system.

Each of the analysis screens is organized in a similar fashion. The overall component rating is listed on the top left corner with a description of the component and its maximum value across the top. The remainder of the page screen is divided into two halves. The right half shows the values that have been pulled from the main calculation.

Figure 16: Detailed analysis screen layout
The left half shows the formulas that were used in the calculations. In addition, there are a number of built-in suggestions as to how the individual rating components can be altered to adjust an overall score. Since changing a number may have a great effect or none at all, the application attempts to direct the user towards the items that will have the highest likelihood of producing the desired results.

Remember: The Web Sufficiency Calculator (WSC) application is designed to serve as a training tool for Bridge inspectors for the state of Alabama. Any changes to values entered into the WSC must be defensible and comply with all state and federal requirements. Results derived from the WSC should be confirmed by secondary means. All parties other than those operating the WSC shall be held harmless from misuse of the WSC. Further, by using the WSC the operator accepts all responsibility for all made changes.

Figure 17: Calculation details and suggestions
The following pages provide examples of each of the analysis screens. Four forms can be accessed directly from the **Calculations** screen:

- **S1**: Structural Adequacy and Safety
- **S2**: Serviceability and Functional Obsolescence
- **S3**: Essentiality for Public Use
- **S4**: Special Reductions.

In addition to these forms, S2 has a number of subcomponents:

- **J**: Rating Reduction
- **G**: Width of Roadway Insufficiency (linked to H)
- **H**: Width of Roadway Insufficiency (linked to G)
- **I**: Vertical Clearance Insufficiency

![Figure 18: S1 structural adequacy and safety analysis screen](image-url)
Figure 19: S2 serviceability and functional obsolescence analysis screen
Figure 20: S3 essentiality for public use analysis screen
Figure 21: S4 special reductions analysis screen
**Figure 22: S2 J value analysis screen**

<table>
<thead>
<tr>
<th>S2 J: Rating Reductions</th>
<th>Minimum Value: 13%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S2 A:</strong> Deck Condition Reduction</td>
<td></td>
</tr>
<tr>
<td>Item 58 (Deck Condition): 4</td>
<td></td>
</tr>
<tr>
<td>S2 J A: 3.0</td>
<td></td>
</tr>
<tr>
<td><strong>S2 B:</strong> Structure Condition Reduction</td>
<td></td>
</tr>
<tr>
<td>Item 61 (Structural Evaluation): 2</td>
<td></td>
</tr>
<tr>
<td>S2 J B: 4.0</td>
<td></td>
</tr>
<tr>
<td><strong>S2 C:</strong> Deck Geometry Reduction</td>
<td></td>
</tr>
<tr>
<td>Item 62 (Deck Geometry): 2</td>
<td></td>
</tr>
<tr>
<td>S2 J C: 4.0</td>
<td></td>
</tr>
<tr>
<td><strong>S2 D:</strong> Underclearances Reduction</td>
<td></td>
</tr>
<tr>
<td>Item 64 (Underclearances, Vertical and Horizontal): 8</td>
<td></td>
</tr>
<tr>
<td>S2 J D: 8.0</td>
<td></td>
</tr>
<tr>
<td><strong>S2 E:</strong> Waterway Adequacy Reduction</td>
<td></td>
</tr>
<tr>
<td>Item 71 (Waterway Adequacy): 5</td>
<td></td>
</tr>
<tr>
<td>S2 J E: 5.0</td>
<td></td>
</tr>
<tr>
<td><strong>S2 F:</strong> Roadway Alignment Reduction</td>
<td></td>
</tr>
<tr>
<td>Item 72 (Approach Roadway Alignment): 4</td>
<td></td>
</tr>
<tr>
<td>S2 J F: 2.0</td>
<td></td>
</tr>
</tbody>
</table>

**Suggestions**
- Decreasing Item 58 will increase S2 A
- S2 B is at its highest possible value
- S2 C is at its highest possible value
- Item 61 is N, so S2 J B is 0
- Decreasing Item 71 will increase S2 E
- Decreasing Item 72 will increase S2 F

< Back
Figure 23: S2 G value analysis screen
Figure 24: S2 H value analysis screen
Figure 25: S2 I value analysis screen
Appendix E: Verification of the Process and Calculation of 2003 GASB 34 Condition Ratings

Bridge GASB 34 Reporting Process

The data required for GASB 34 reporting should be extracted from ABIMS so it may be imported into the GASB 34 Reporting application. Only active bridges should be used in this report. The criteria for extracting data from ABIMS, the data to be extracted and the format of the data files to be input into the Bridge GASB application are as follows.

*Note: The Item number listed by each field is for use in ABIMS. For Item number description refer to the Bridge Inspection Manual.*

**Extraction Criteria**
- Maintained By = 01 (Item 21, State)
- Type Service = 1 (Item 5A, On)

**Bridge File**
- BIN
- Nation Highway System (Item 104)
- Length (Item 49)
- Width (Item 52)
- Deck (Item 58)
- Superstructure (Item 59)
- Substructure (Item 60)
- Route Signing Prefix (Item 5B)

**Culvert File**
- BIN
- Nation Highway System (Item 104)
- Length (Item 49)
- Width (Item 233B)
- Culverts (Item 62)
- Route Signing Prefix (Item 5B)

For use in the GASB 34 Calculation program, the files are combined so that they adhere to the following format:

<table>
<thead>
<tr>
<th>Data</th>
<th>BIN</th>
<th>NHS</th>
<th>Length</th>
<th>Width</th>
<th>Rating</th>
<th>Deck</th>
<th>Superstructure</th>
<th>Substructure</th>
<th>Culvert</th>
<th>RSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“N”</td>
<td>“N”</td>
<td>“N”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culvert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“N”</td>
<td></td>
</tr>
</tbody>
</table>

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The GASB 34 Report is generated using the Bridge GASB Report Generator Application. The process for running the report is listed below:

**Process**
- Open the application
- Enter the path to the Bridge Data File or browse for that file
- Click on the Calculate button
- The application will import the Bridge Data File, calculate the GASB 34 numbers for each of the required areas using the report algorithms
- The new GASB 34 Report will be saved, using the filename of the import data file with an .xls extension.
- Example: Using an import data file named 2002gasb.dat with generate an GASB 34 report spreadsheet named 2002gasb.xls

**Report Categories**

Both Bridges and Culverts are broken out in the following categories:

- **INTERSTATE** (Item 5B) Route Signing Prefix = 1
- **Non-National Highway System** (Item 104) National Highway System = 0
- **National Highway System** (Item 104) National Highway System = 1

**Report Algorithms**

The following algorithms are used to generate the GASB 34 number in the categories listed above.

**Bridges**

Weight the Structure Types
- Deck (20%)
- Super structure (40%)
- Sub structure (40%)

Multiply by Total Deck Area (length * width) for the Structure
Sum these structures
Divide by total area of all bridges

Algorithm = Total Sum (Weighted Structure Type * Total Deck Area of Structure)/Total Area of all Bridges
**Culverts**

Weight the Structure Types
- Culvert (100%)
Multiply by Total Deck Area (Barrel length * width) for the Structure
Sum these structures
Divide by total area of all bridges

Algorithm = Total Sum (Weighted Structure Type * Total Deck Area of Structure)/Total Area of all Bridges

Although, Bridges and Culverts have different algorithms, the GASB 34 number for a specific area is calculated using both Bridges and Culverts.

If the Total Deck Area cannot be calculated due to missing length, width, or barrel length data the bridge or culvert is eliminated from the GASB 34 calculations and noted in the **Bridge Exception Report**. As new data is entered into ABIMS, the program will recognize when Total Deck Area can be calculated and include this bridge in the calculations.
## GASB34

### REPORT BRIDGE CONDITION

Report Generated: 12/29/2003

### Interstate Bridges and Culverts

<table>
<thead>
<tr>
<th>Number of Structures</th>
<th>Deck Area</th>
<th>Rating</th>
<th>GASB34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridges</td>
<td>882</td>
<td>28,676,234.23</td>
<td>180,912,656.40</td>
</tr>
<tr>
<td>Culverts</td>
<td>271</td>
<td>2,681,046.53</td>
<td>16,060,063.68</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1,153</strong></td>
<td><strong>31,359,280.76</strong></td>
<td><strong>196,972,720.08</strong></td>
</tr>
</tbody>
</table>

### National Bridges and Culverts

<table>
<thead>
<tr>
<th>Number of Structures</th>
<th>Deck Area</th>
<th>Rating</th>
<th>GASB34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridges</td>
<td>971</td>
<td>14,286,539.74</td>
<td>97,560,943.34</td>
</tr>
<tr>
<td>Culverts</td>
<td>555</td>
<td>3,116,010.49</td>
<td>20,252,346.77</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1,526</strong></td>
<td><strong>17,402,550.23</strong></td>
<td><strong>117,813,290.11</strong></td>
</tr>
</tbody>
</table>

### Non-National Bridges and Culverts

<table>
<thead>
<tr>
<th>Number of Structures</th>
<th>Deck Area</th>
<th>Rating</th>
<th>GASB34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridges</td>
<td>1671</td>
<td>22,753,513.86</td>
<td>155,750,394.68</td>
</tr>
<tr>
<td>Culverts</td>
<td>1233</td>
<td>3,199,276.23</td>
<td>21,017,238.60</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>2,904</strong></td>
<td><strong>25,952,790.09</strong></td>
<td><strong>176,767,633.28</strong></td>
</tr>
</tbody>
</table>

**Overall Rating**

Figure 26: 2003 GASB 34 bridge condition report
ALGORITHM Summaries

**GASB 34 Algorithm**
The GASB 34 rating for bridges in the state of Alabama is calculated using a weighted rating of the major structure components and the deck area of the structure. To obtain the GASB 34 rating for an individual rating category, the weighted ratings of all of the structures in that category are summed along with the deck areas of the all of those structures. The rating is then obtained using the following formula:

\[
\text{GASB 34} = \frac{\sum (\text{Individual Bridge Deck Area} \times \text{Weighted Rating})}{\sum (\text{Deck Areas})}
\]

**Deck Area & Weighted Rating**
The deck area for each structure are calculated by multiplying the structure length by the structure width. Due to the design differences between bridges and culverts, the weighted ratings are calculated differently. The weighted ratings for bridges is calculated using specific percentages of the condition rating for each of the major structural components of a bridge (deck, superstructure and substructure). The entire condition rating for a culvert is used as the "weighted" rating. The algorithms used to calculate deck area and the weighted ratings for both bridge and culverts are provided below.

- **Deck Area** = Structure Length x Structure Width
- **Bridge Weighted Rating** = (Deck Condition x 20%) + (Superstructure Condition x 40%) + (Substructure Condition x 40%)
- **Culvert Weighted Rating** = Culvert Condition x 100%

**Exception Data**
Calculation of the GASB 34 number is dependent on the availability of quality data. If the deck area or weighted rating for a specific structure can not be calculated due to the lack of data or the occurrence of invalid data, that structure's data is not included in the GASB 34 rating. The small percentage of invalid structures demonstrates that this missing or invalid data does not have a significant impact on the GASB rating.

**Figure 27:** 2003 bridge GASB report calculation algorithms
<table>
<thead>
<tr>
<th></th>
<th>Valid Structures</th>
<th>Invalid Structures</th>
<th>Totals</th>
<th>Percent Invalid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bridges</td>
<td>Structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interstate</td>
<td>881</td>
<td>1</td>
<td>882</td>
<td>0.11%</td>
</tr>
<tr>
<td></td>
<td>Culverts</td>
<td>266</td>
<td>5</td>
<td>1.85%</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>1147</td>
<td>5</td>
<td>0.52%</td>
</tr>
<tr>
<td>National</td>
<td>Bridges</td>
<td>970</td>
<td>1</td>
<td>0.10%</td>
</tr>
<tr>
<td></td>
<td>Culverts</td>
<td>538</td>
<td>17</td>
<td>3.06%</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>1508</td>
<td>18</td>
<td>1.18%</td>
</tr>
<tr>
<td>Non-National</td>
<td>Bridges</td>
<td>1671</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Culverts</td>
<td>1220</td>
<td>13</td>
<td>1.05%</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>2891</td>
<td>13</td>
<td>0.45%</td>
</tr>
</tbody>
</table>

Figure 28: Bridge GASB exception report
Figure 29: 2003 bridge GASB data reduction screen shot
Appendix E.1: 2003 State Auditors Notes

1. Describe the procedures, both automated and manual, by which transactions are initiated, recorded, processed, and reported from their occurrence to their inclusion in the financial statements. **BE SURE TO DESCRIBE THE EXTENT TO WHICH INFORMATION TECHNOLOGY (IT) IS USED.**

1) The Alabama Department of Transportation (DOT) has divided infrastructure into two networks, which consist of roads and bridges.
2) Road and bridge projects will only be capitalized when the project is complete and has been accepted by National Highway Administration (NHA). For the 2003 Fiscal Year DOT has chosen to capitalize the road and bridge projects that were closed out on Comprehensive Project Management System (CPMS) during FY 2003. All costs for these projects (some projects began prior to FY 2003) from beginning to end will be capitalized. In some cases projects can be finished but not closed out for many years due to problems with acceptance by NHA. Infrastructure assets that were completed prior to fiscal year 2003 will not be reported this year. Retroactive reporting of infrastructure will be done possibly for FY 2003 CAFR.
3) Infrastructure construction-in-progress will be reported to the Finance Department and will consist of road and bridge projects that have not been capitalized and are still open projects.
4) Infrastructure costs that result in an increase in capacity, an improvement in the efficiency, or a replacement of a portion of the infrastructure network are capitalized and added to the historical cost of the assets.
5) Costs that allow the infrastructure network to be used efficiently over the expected useful life of the assets are expensed as general maintenance costs.
6) Certain maintenance costs that extend the useful life of the assets but do not increase capacity or efficiency are classified as preservation costs.
7) DOT has established a measurement scale for the condition of its roads and bridges.
8) DOT has disclosed that the weighted average of all State maintained roadways shall be “Satisfactory” or better.
9) DOT has disclosed that the weighted average of all State maintained bridges and culverts shall be “Satisfactory” or better.

DOT has an asset management system that has an up-to-date inventory of eligible infrastructure assets. DOT performs condition assessments of the eligible infrastructure assets and summarizes the results using a measurement scale. DOT also estimates each year the annual amount to maintain and preserve the eligible infrastructure assets at the established condition level.
DOT’s asset management system consists of several component systems including the Comprehensive Project Management System (CPMS), Pavement Management System (PMS), Alabama Bridge Information Management System (ABIMS), and the GASB 34 reporting program developed and maintained by the University of Alabama. ABIMS and PMS provide the condition assessment data that the GASB 34 reporting program needs to produce the GASB 34 Road Condition Report and the GASB 34 Bridge Condition Report. These reports are the source of condition data reported in the Required Supplementary Information (RSI) section of the CAFR. CPMS’s project cost accounting data is used by Bill Flowers, Assistant Finance Director, to produce the annual preservation cost amount that is reported in the (RSI) section of the CAFR.

**Comprehensive Project Management System (CPMS)**

The main cost accounting system for DOT is the Comprehensive Project Management System (CPMS). CPMS contains data on all construction and maintenance projects that are contracted out by DOT. Construction and maintenance projects are assigned work codes by GASB category. Mr. Flowers has taken the total dollar amount that has been spent on maintenance projects from the GASB Expenditure Summary Report from CPMS and has averaged the last three years in order to determine the annual preservation cost to be reported in the RSI section of the CAFR.

**Pavement Management System (PMS)**

The Pavement Management System contains all of the condition assessment data for roads. Scott George, Acting Pavement Management Engineer, of the Materials and Test Bureau of ALDOT, has the responsibility of maintaining the Pavement Management System’s day-to-day operations. DOT has contracted with Roadware to collect road stress data. Roadware takes videos roadways across the state. Roadware collects condition assessment data on Alabama interstate highways once a year. Other National Highway System (NHS) and other state non-NHS roads are collected once every two years. After the road data is collected, Roadware provides DOT with copies of the data on DVD’s. These DVD’s contain road stress information as well as moving video of the road surface. DOT performs quality control checks of Roadware data by sending pavement management technicians out to take samples of road conditions to compare back to data received from Roadware. Access to the pavement management system is controlled by user login by password. Data access permission is assigned to each user login on a needs-only basis. Road condition data is provided to the University of Alabama for the GASB 34 reporting program on CD and by File Transfer Protocol (FTP) over the Internet.
**Alabama Bridge Information Management System (ABIMS)**

The Alabama Bridge Information Management System (ABIMS) contains all of the condition assessment data for all the state’s bridges. Each bridge in the state is assigned a bin number to separately identify it. Lesley J. Morrissette, Bridge Management Engineer/Management & Training, of the Maintenance Division of DOT is the administrator of the ABIMS system. ABIMS is located on a mainframe computer at the DOT central office in Montgomery. Ed Phillips, P.E., Assistant State Maintenance Engineer/Management & Training, is Mr. Morrissette’s immediate supervisor. George Conner, P.E., Assistant State Maintenance Engineer/Bridges, is responsible for compliance in the area of bridge inspections.

The state is divided into nine divisions with each division having a bridge inspection team. Bridge inspection teams have at least one Chief Inspector who has completed the requirements for becoming a Certified Bridge Inspector. The Chief Bridge Inspector of that particular team enters inspections completed by the inspection team into ABIMS. Bridge inspection teams from other DOT divisions do not have the ability to change data entered by other divisions. Access to the ABIMS system for entering inspection data is controlled by password login. Bridge condition data is provided to the University of Alabama for the GASB 34 reporting program on CD and by File Transfer Protocol (FTP) over the Internet.

**GASB 34 Reporting Program**

The Alabama Department of Transportation contracted with the Center for Economic & Business Research (CBER) at the University of Alabama in May 2001 to assist ALDOT in establishing an “asset management system” as the driver of its modified method for reporting infrastructure investments, modifications, and maintenance. This new system will integrate data from the Alabama Bridge Information Management System (ABIMS), ALBRIDGE, Comprehensive Project Management System (CPMS), Proposal Estimate System (PES), and Pavement Management System (PMS).

CBER receives data from DOT by downloading the files from the Internet using File Transfer Protocol (FTP). Once the data is downloaded it is copied to a CD and stored in a locked cabinet for backup purposes. The GASB 34 program is housed in a secured lab only accessible by card access with three security checkpoints. Faculty and students working on the project must sign a non-disclosure form. Data is backed up weekly and a backup copy is stored off-site. Backups are destroyed weekly after a new backup has been created. Each user accessing the program is assigned a specific level of access.
Only those with administrative privileges can enter changes to the program. There are three faculty members (all PhD’s) and one professional staff member working on the project. Detailed testing of the accuracy of the data and calculations is checked by graduate students of the University. CBER has performed black box and white box testing of the program. CBER has documented the program code and other information in a user’s manual and a developer’s manual.

CBER provides DOT with two reports on an annual basis. These reports are the GASB 34 Road Condition Report and the GASB 34 Bridge Condition Report. CBER does not perform the condition assessments of the roads and bridges. The GASB 34 reporting program takes the condition assessment data received from DOT for each segment of roadway and for each bridge and weights them to calculate an overall road condition rating and an overall bridge condition rating.

2. Describe the related accounting records, whether electronic or manual, supporting information, and specific accounts in the financial statements involved in initiating, recording, processing and reporting transactions.

The CPMS has various screens from which information about projects may be obtained. Some of these include:

- The general purpose inquiry – this captures data related to particular projects including a description of the project, GASB work codes, payment history, stage, etc.
- The payment by vendor history – lists all payment vouchers charged to a project.

The construction-in-progress and capitalized projects listings are kept on the CPMS. These are the reports from which the infrastructure is reported on the CAFR.

3. Describe how the information system captures any other events or conditions that are significant to the financial statements. (For example, commitments and contingencies, subsequent events, compliance with debt covenants, related party transactions, fair values of financial instruments, disclosures, etc.)

N/A

4. Describe any other procedures used to record recurring and nonrecurring adjustments to the financial statements. (For example, reclassifications, adjusting journal entries, etc.)

N/A
5. Describe the significant controls, both electronic and manual, which appear to exist. **BE SURE TO INCLUDE ANY IT RELATED CONTROLS.**

- Access to each component of ALDOT’s asset management system is controlled by user login by password.
- ALDOT performs quality control checks of Roadware data by sending pavement management technicians out to take samples of road conditions to compare back to data received from Roadware.
- Detailed testing of the accuracy of the data and calculations from the GASB reporting program is checked by graduate students as part of a senior class project.

6. List and describe any supporting documents that are used and/or generated in the process above, including any journal or subsidiary ledger used in the recording process.

A. Vouchers, material receipts, etc., are used when roads and bridges are constructed.

7. List and describe any computer reports or other input or output data that is used in the recording process.

- GASB Expenditure Summary Report – A CPMS report that details the total annual dollar amount of maintenance projects by GASB code.
- GASB Expenditure Detail Report – A CPMS report that is the detailed version of the GASB Expenditure Summary Report broken down by project.
- GASB Capital Project Detail Report – A CPMS report that summarizes the total dollar amount of capitalized infrastructure projects by GASB code.
- GASB Active Capital Project Summary Report – A CPMS report that summarizes the infrastructure projects that have not been capitalized and are still in Construction-in-progress.
- GASB 34 Road Condition Report – Report generated by the GASB 34 reporting program developed by the University of Alabama that is used to prepare the RSI section of the CAFR.
- GASB 34 Bridge Condition Report – Report generated by the GASB 34 reporting program developed by the University of Alabama that is used to prepare the RSI section of the CAFR.

8. Do the controls identified in No. 5 above appear to be effective? **Yes**
   If yes, are there efficiencies to be obtained from testing the controls? **No**

9. Will control risk be assessed below the maximum? **No**
   If yes, be sure and include the tests of controls which will be performed on the audit program(s) as well as indicate them on the **Summary of Internal Control and Control Risk Assessment** Form.
10. Based on the understanding gathered above, were any reportable conditions noted? If so, describe below as well as include on the *Summary of Internal Control and Control Risk Assessment* Form.

Based on our understanding of the internal control, there appear to be no reportable conditions.
Acknowledgments

THIS REPORT WAS PREPARED WITH COOPERATION AND ASSISTANCE OF REPRESENTATIVES OF THE FOLLOWING AGENCIES, ORGANIZATIONS, AND PEOPLE:

Alabama Department of Transportation, Federal Highway Administration- Alabama Division, Paul Thompson, Cambridge Systematic, American Association of State Highway and Transportation Officials, The University of Alabama’s Enterprise Integration Lab, Manufacturing Information Technology Research Center, Department of Civil, Construction, and Environmental Engineering, and the Area of Management Information Systems