

Evaluate Risk-Based Asset Management Systems (AMS): BrM Implementation

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**Washington State
Department of Transportation**

Evaluate Risk-Based Asset Management Systems (AMS)

BrM Implementation Strategy

April 2018

Washington State Department of Transportation
Asset Management System
BrM Implementation Strategy
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Washington State Department of Transportation

Asset Management System

BrM Implementation Strategy



I. Introduction

The Washington Department of Transportation (WSDOT) engaged Dye Management Group, Inc. (DMG) to evaluate risk-based asset management processes and systems for potential implementation at WSDOT. DMG used WSDOT's existing process and system documentation as the foundation for this project. We further augmented our understanding with information provided by WSDOT staff through stakeholder interviews. DMG summarized WSDOT's existing asset management-related processes, systems, and data in the *Current State Report*.

DMG identified four main asset management challenges for WSDOT:

- **Education** – Not all stakeholders and decisions makers understand the benefits of life-cycle asset management.
- **Leadership** – There is no single owner or champion for this effort at the enterprise level.
- **Data** – Outside pavement and bridge management, asset inventories are not sufficient. Either the inventory or condition data is incomplete or insufficient to meet the need.
- **Resources** – Compiling inventories and assessing asset condition is a time-consuming task. Priorities must be realigned to allow for this work to be completed by current staff.

WSDOT has already begun to address some of these challenges. Under the Practical Solutions initiative, WSDOT has developed a Statewide Transportation Asset Management Plan (STAMP), which provides a framework for making investment decisions across the full range of transportation assets. Also, the Highway Asset Management Technical Advisory Group (HAMTAG) was established as part of the Practical Solutions initiative and is charged with developing highway asset management proposals for Executive Steering Committee consideration.

Accurate asset inventory and condition data are critical to the success of an asset management program. Our research and interviews noted the following regarding asset condition and inventory at WSDOT:

- **Pavement** – WSDOT's pavement management process, system, and data are very mature, and considered by many to be world class. A recent Joint Legislative Audit and Review Committee (JLARC) study cited WSDOT's pavement management program as an approach to be emulated for other assets.

- **Bridge and structures** – WSDOT employs a strong bridge and structures management program, which is evolving. Each bridge is inspected every two years under the National Bridge Investment Analysis System (NBIAS). However, the bridge and structures management program lacks forecasting capability on the level of WSDOT’s pavement management program.
- **Other assets** – WSDOT’s inventory and condition data for other assets varies by asset and depends on stakeholder opinion. Facilities, ferries, terminals, and signs all have good inventory and condition data. Guardrail has good inventory but incomplete or non-existent condition data. Culverts and walls have incomplete or non-existent inventory and condition data.

Taking into consideration WSDOT’s current asset management state and the asset management-related goals of WSDOT and its stakeholders, DMG developed a baseline set of functional and technical requirements against which potential asset management systems (AMS) were evaluated. This approach helped ensure that any future AMS will be able to support both WSDOT’s existing and future best practices. The primary focus of the evaluated systems is bridges, although some requirements dealt with broader asset management functions. DMG conducted outreach to determine which software systems best met the requirements.

Vendors responded with an assessment of their current software capabilities measured against the requirements and an estimated cost for implementation, which included any necessary customization. For each of the seven vendor-provided solutions, DMG assessed the following:

- Ability to meet WSDOT requirements, including the strengths and weaknesses of each solution
- Implementation and integration approach and capabilities, including training
- Seven-year total cost of ownership (TCO) estimate

DMG summarized the results of our assessment in the *AMS Assessment Report*. Based on our review, we recommended that WSDOT consider the AASHTOWare BrM/Decision Lens combined solution for the following reasons:

- WSDOT currently owns site licenses for both products, which decreases the short-term implementation costs and eliminates the need for a costly and lengthy procurement process.
- The seven-year TCO is the lowest of the evaluated solutions.
- The BrM solution is the most widely used BMS – indicated by forty-one of fifty states licensing it to manage their bridges.
- Decision Lens provides a highly configurable tradeoff analysis engine that can be configured to WSDOT’s exact needs.

This *BrM Implementation Strategy* report summarizes the steps and processes necessary to implement the AASHTOWare BrM solution.

II. Solution Overview

The AASHTOWare Bridge Management software (BrM), formerly known as Pontis, was developed in the early 1990s as part of a National Cooperative Highway Research Program (NCHRP) project. The latest official release of BrM is 5.3, which was released in September 2017. BrM is licensed by forty-one state DOTs and four additional non-DOT agencies throughout the United States.

BrM allows state DOTs to take all the National Bridge Inventory (NBI) data, that the Federal Highway Administration (FHWA) mandates that they collect and add the AASHTO element-level data, and develop a bridge management program to identify risks and priorities and strategic ways to spend funds.

BrM includes capabilities to enable or perform the following:

- Planning
- Deterioration
- Risk
- Multi-objective analysis
- Lifecycle costs
- Project models
- Dashboards
- Corridor planning

III. Implementation Approach

Bentley Systems, Inc. (Bentley) is the contract developer for BrM. In that role, Bentley is the provider for implementation services and modifications for the software. BrM is a web-based bridge management tool, and AASHTO offers the option to have the software hosted by Bentley.

Bentley offers initial set-up of BrM. This is an “out-of-the-box” set up of BrM and does not include training or system customization. Additional fees apply for importing inventory or historical inspection data into BrM. These services must be paid for using Service Units through AASHTO. This is further explained in Section V (Cost) of this report.

Both Bentley and other independent contractors offer BrM training programs, deterioration modeling, and tradeoff analysis services. We also understand that WSDOT is planning to hire internal technical resources to facilitate the BrM implementation, which will be critical to the success of this multi-year implementation. Based on our experience assisting the implementation of BrM at other agencies, we recommend that WSDOT designate a project manager to serve as a point-of-contact for the implementation effort. We anticipate that the implementation team for BrM will comprise internal WSDOT resources, Bentley, and other consultants.

DMG has developed an implementation project work plan and schedule to help WSDOT plan for its BrM implementation. The work plan comprises six phases and an additional post-implementation support phase for the ninety days following go-live.

DMG estimates a full statewide implementation of BrM will take three years. However, it is important to recognize that key functionality within BrM will be available before that three-year mark. We have developed a project schedule that allows for concurrent activities. This shortens the overall project timeline without affecting critical project activities.

The project phases, and estimated duration for each, are provided in Exhibit 1. Each phase is discussed in more detail in the next section. The full project schedule and Gantt chart is provided in Appendix A.

Exhibit 1: Project Phases and Duration

Project Phase	Duration, in working days
Acquisition	45
Design	120
Installation/Configuration	220
Development	240
Integration and Testing	200
Implementation	105
Post-Implementation Support	65
Total Project Duration	775

IV. Implementation Work Plan

A. Acquisition Phase

The acquisition phase of this effort includes the tasks necessary to procure the BrM software, implementation and integration services, project support, and training. We understand that WSDOT currently has an annual commitment to license the BrM software. To move forward with the implementation of BrM, WSDOT must purchase AASHTO Service Units to support the implementation scope defined in this project phase. AASHTO Service Units would be used specifically for Bentley's effort relating to installing, configuring, and integrating the BrM solution.

WSDOT has the option to leverage other contractors and consultants for non-Bentley specific activities. These include project management support, developing and delivering customized training, developing WSDOT-specific cost and deterioration models, and independent quality assurance of the installed solution.

The tasks and subtasks for the acquisition phase are shown in Exhibit 2.

Exhibit 2: Acquisition Phase Tasks

Acquisition Phase	45 days
Develop scope for AASHTO Service Units	20 days
Prepare draft scope	10 days
Provide draft scope to WSDOT for review	5 days
Finalize scope based on WSDOT comments	5 days
Support AASHTO Service Units Procurement	15 days
Purchase required Service Units from AASHTO	10 days
Support scope of work discussions with AASHTO BrM contractor as required	5 days

Develop Work Plan for AASHTOWare BrM Integration Tasks	25 days
Prepare draft work plan	15 days
Provide draft work plan to WSDOT for review	5 days
Finalize work plan based on WSDOT comments	5 days
Define Integration Support Tasks	25 days
Develop draft support task summary for non AASHTOWare-specific integration tasks	15 days
Provide draft support task summary to WSDOT for review	5 days
Finalize support task summary based on WSDOT comments	5 days

B. Design Phase

This phase of the effort includes the tasks necessary to conceptualize, define, and establish the design of WSDOT's bridge management system. The design phase begins with a kickoff meeting for the overall project. Following the kickoff, the project team will work to define enterprise and system designs.

Developing an enterprise design focuses on defining how BrM will exist in WSDOT's environment, including ensuring BrM's database and system configuration align with WSDOT's enterprise technology standards.

System design centers on formally defining the configuration of BrM, and its interfaces, necessary to meet WSDOT's requirements. The system design includes developing definitions for all customizations, interfaces, data loads, screen designs, and report layouts.

The results of the design phase findings will be compiled in a system design document. The system design document will serve as a project reference artifact, against which the installation and configuration of the system will be measured.

The final task in the design phase is developing a formal knowledge transfer plan. The knowledge transfer plan will define a strategy for capturing critical functional and technical information from the project team to ensure WSDOT has the capacity to maintain and operate the BrM implementation after implementation with minimal reliance on Bentley or other contractors.

The tasks and subtasks for the design phase are shown in Exhibit 3.

Exhibit 3: Design Phase Tasks

Design Phase	120 days
Conduct BrM Implementation Project Kickoff Meeting	10 days
Schedule and prepare for kickoff meeting	5 days
Conduct kickoff meeting; document results	5 days
Perform Enterprise Design	50 days
Establish development environment	10 days
Develop initial design configuration	15 days
Schedule and conduct design workshops	15 days
Update configuration based on workshops	10 days
Finalize System Design	70 days

Identify gaps	20 days
Identify inventory of customizations	20 days
Identify inventory of interfaces	20 days
Identify inventory of initial data loads	20 days
Create any required screen designs	15 days
Create any required report layouts	15 days
Document System Design	15 days
Provide System Design document to WSDOT to review	10 days
Finalize System Design document based on WSDOT input	10 days
Establish formal knowledge transfer plan to WSDOT	30 days
Develop draft of knowledge transfer plan	20 days
Provide draft plan to WSDOT for review	5 days
Finalize knowledge transfer plan based on WSDOT feedback	5 days
Manage Design Phase	120 days
Monitor and update project work plan	120 days
Prepare monthly progress reports	120 days
Conduct project status meetings	120 days
Conduct periodic Steering Committee meetings	120 days

C. Installation/Configuration Phase

This phase includes the tasks necessary to conduct an initial installation and configuration of the BrM solution. Bentley will perform a lead role on most of the tasks and subtask in this phase with one key exception: developing WSDOT-specific deterioration and cost models.

During our review of possible bridge asset management solutions for WSDOT, DMG noted two requirements that would require additional data review and analysis to be enabled in BrM. The first was requirement 3.1:

3.1	Ability to forecast asset condition, including leveraging current and future WSDOT-defined deterioration models/curves.
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BrM has this capability, but the agency must provide the quantitative parameters, specifically transition times between condition states, for it to function. Agencies define these models in either or both of two ways: (1) Using the judgment of a panel of in-house experts (experienced inspectors), sometimes informed by existing agency models using other types of condition data if the agency has performed such research previously; or (2) Statistical analysis of historical inspection data.

The second requirement:

3.3	Ability to determine the impact of natural disaster and/or third-party damage on expected bridge life and risk of collapse.
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BrM also has a feature to help WSDOT implement this type of model. However, WSDOT research is required to establish metrics for the likelihood of extreme events and the likelihood that such events would disrupt service on given classes of structures.

We have included a task in this phase to develop these models so that they can be enabled in BrM during the development phase. It is important to understand that this task is not considered to be on the critical path (noted in maroon on the project task list and schedule) for the project and can be enabled at any time during the implementation, including earlier in the design phase if resources are available. WSDOT would have full use of existing BrM models in the software until the WSDOT-specific models are enabled.

The tasks and subtasks for the installation/configuration phase are shown in Exhibit 4.

Exhibit 4: Installation/Configuration Phase Tasks

Installation/Configuration Phase	220 days
Perform Installation Activities	45 days
Acquire, install, and test hardware environment	15 days
Install BrM software	5 days
Perform BrM configuration	5 days
Expand the BrM database to include all WSDOT-specific inventory and inspection items	10 days
Develop customizations of inspection planning form of BrM	10 days
Configure BrM to capture work recommendations	10 days
Convert WSDOT reports to BrM-ready format	20 days
Create additional standard reports.	20 days
Design test inspection process	30 days
Develop and document bridge risk assessment process	15 days
Revise inspection documentation and procedures	5 days
Pilot testing of the inspection process	10 days
Develop deterioration and cost models	180 days
Develop WSDOT-specific deterioration model	150 days
Develop WSDOT-specific cost model	180 days
Setup Element List	45 days
Enter and configure non-CoRe and sub-elements in BrM	15 days
Create element lists from drawings - state bridges	15 days
Feed scour data into BrM risk assessment	15 days
Manage Installation/Configuration Phase	95 days
Monitor and update project work plan	95 days
Prepare monthly progress reports	95 days
Conduct project status meetings	95 days
Conduct periodic Steering Committee meetings	95 days

D. Development Phase

This phase includes the tasks necessary to customize and fully configure BrM for WSDOT's environment. This phase begins with the development of a data conversion plan that will specify the process for moving WSDOT's existing bridge data into BrM. To accomplish the data conversion, the project team will create a detailed design document for all required interfaces, initial data loads, and software customizations.

Following the documentation of the detailed design, Bentley will code and test the interfaces, data loads, and custom software components. Bentley will also work with WSDOT and their project support consultant, to prepare for the data conversion by performing dry runs of the conversion process. Bentley will then revise the processes based on the results of the dry run to ensure the data is ready for system cutover in the implementation phase.

The tasks and subtasks for the development phase are shown in Exhibit 5.

Exhibit 5: Development Phase Tasks

Development Phase	240 days
Plan Data Conversion	45 days
Develop detailed data conversion plan	30 days
Provide detailed conversion plan to WSDOT for review	10 days
Finalize detailed conversion plan based on WSDOT input	5 days
Perform detail design for interfaces, initial data loads, and custom components	65 days
Prepare functional specifications	50 days
Obtain WSDOT sign-off on functional specifications	15 days
Prepare technical specification	50 days
Obtain WSDOT sign-off on technical specifications	15 days
Code and unit test interfaces, initial data loads, and custom components	105 days
Code assigned program units	60 days
Develop unit test plans	40 days
Test assigned program units	20 days
Obtain WSDOT sign-offs	5 days
Prepare for Data Conversion	25 days
Conduct dry runs of conversion processes	10 days
Make conversion program updates as needed	5 days
Perform necessary data clean-up	5 days
Develop procedures for manual conversion	5 days
Manage Development Phase	240 days
Monitor and update project work plan	240 days
Prepare monthly progress reports	240 days
Conduct project status meetings	240 days
Conduct periodic Steering Committee meetings	240 days

E. Testing Phase

This phase includes the tasks necessary to test the BrM solution prior to implementation in WSDOT's environment. The successful completion of the tasks in this phase will ensure that the customized and configured BrM software is ready for implementation at WSDOT. The testing phase is the final step prior to system go-live.

To start this phase, Bentley will work with WSDOT, and their project support consultant, to define a load testing plan and a system testing plan. The load testing plan will detail the process that will ensure WSDOT's installation of BrM can handle the expected amount of bridge-related data and anticipated number of users. The system test plan focuses on defining the processes for testing all components of the software holistically. This includes testing the installed software and all custom components to ensure they meet the test acceptance criteria. Bentley will have a lead role on conducting the system test, with support from WSDOT and their project support consultant. Bentley will then revise any system components that didn't meet acceptance criteria and retest them for compliance.

Once the system and load testing have been successfully completed, WSDOT will be ready for user acceptance testing (UAT). UAT is the last phase of the software testing process, where expected software users test the software to make sure it can handle required tasks in real-world scenarios, according to specifications and acceptance criteria.

The UAT test plan will be designed jointly by Bentley and WSDOT's project support consultant, and the consultant will lead the UAT process. The consultant will then report the UAT results to Bentley. Bentley will then correct any issues or software bugs observed during UAT and submit for retesting by WSDOT.

The tasks and subtasks for the testing phase are shown in Exhibit 6.

Exhibit 6: Testing Phase Tasks

Testing Phase	200 days
Prepare Load Testing Plan	35 days
Develop detailed Load Testing Plan	20 days
Provide Load Testing Plan to WSDOT for review	10 days
Finalize Load Testing Plan based on WSDOT input	5 days
Prepare System Test Plan	65 days
Develop draft system test plan	30 days
Provide system test plan to WSDOT for review	10 days
Finalize system test plan based on WSDOT review	5 days
Develop draft of system test scripts	20 days
Provide system test scripts to WSDOT for review	10 days
Finalize system test scripts based on WSDOT input	5 days
Conduct System Test	65 days
Set-up system test environment (hardware & software)	10 days
Configure system test instance of application software	10 days
Install/migrate custom programs	10 days
Perform initial data loads	5 days
Conduct system testing	10 days
Make program fixes	10 days
Update application software configuration based on system testing	10 days
User Acceptance Testing	95 days
Prepare user acceptance test plan	15 days
Create user acceptance test scripts	15 days
Establish user acceptance testing environment (hardware and software)	10 days
Configure user acceptance test version of application software	5 days
Install/migrate custom programs	10 days
Perform data loads	10 days
Perform manual conversions	10 days
Execute user acceptance test	20 days
Make program fixes based on user acceptance testing	10 days
Update application software configuration based on user acceptance testing	10 days
Perform load test	5 days

Obtain user sign-off on system	5 days
Manage Integration and Test Phase	200 days
Monitor and update project work plan	200 days
Prepare monthly progress reports	200 days
Conduct project status meetings	200 days
Conduct periodic Steering Committee meetings	200 days

F. Implementation Phase

This implementation phase includes the tasks necessary for WSDOT to go live in their new BrM system environment. This phase begins with preparing for and conducting user training on BrM. We anticipate that user training will comprise an “administrator” training component for users that will maintain the software and data; and a user training component for inspectors and other users of BrM. Bentley will prepare all necessary training materials using the basic BrM training material as a foundation. Bentley will then work with WSDOT’s project support consultant to schedule and conduct the training.

Within this phase, WSDOT and Bentley will develop a cutover plan that describes the steps for decommissioning existing systems and utilizing BrM from that point forward. The cutover plan will align with the scheduled user training dates to ensure all training is complete prior to cutover.

The tasks and subtasks for the development phase are shown in Exhibit 7.

Exhibit 7: Implementation Phase Tasks

Implementation Phase	105 days
Plan and prepare for user training	65 days
Prepare draft Training Plan	20 days
Provide Training Plan to WSDOT for review	10 days
Finalize Training Plan	5 days
Prepare draft training materials	15 days
Provide training materials to WSDOT for review	10 days
Finalize training materials based on WSDOT review	5 days
Schedule training classes	10 days
Establish training environment (hardware and software)	10 days
Configure application software in training environment	10 days
Prepare Cutover Plan	30 days
Develop draft of cutover plan	15 days
Provide draft of cutover plan to WSDOT for review	10 days
Finalize cutover plan based on WSDOT review	5 days
WSDOT State Level Rollout	40 days
Conduct administrator training	10 days
Conduct end-user training	15 days
Conduct lessons learned meeting	5 days
Document lessons learned	5 days

Revise training materials based on feedback	5 days
Execute System Cutover Plan	5 days
Manage Implementation Phase	105 days
Monitor and update project work plan	105 days
Prepare monthly progress reports	105 days
Conduct project status meetings	105 days
Conduct periodic Steering Committee meetings	105 days

G. Post-Implementation Support

This phase focuses on providing ninety days of support for WSDOT after BrM go-live. During this phase, WSDOT's project support consultant will monitor BrM performance and usability to ensure it continues to meet WSDOT's requirements. If necessary, follow-up training will be provided during this period. The consultant will also provide status updates on post-implementation activities.

V. Cost

WSDOT has a super site license, which "allows for use of AASHTOWare BrM within the agency. The license permits WSDOT to use the software on specified structures within the bounds of the licensing agency's inspection and management responsibilities." Licensing costs for BrM are \$36,000 per year, which provides licenses for the following users:

- Bridge Asset Management (users that would perform lifecycle cost analyses, risk analyses, replacement candidate analyses, etc.): **three users**
- Bridge Operations (inventory and inspection data entry, etc.): **ten users**

Additional implementation costs are as follows:

- A single service unit from AASHTO costs \$13,500. After administration fees, \$12,200 from each Service Unit is available for services. We estimate that WSDOT will require approximately fifteen (15) service units to complete the installation and integration of BrM. That total cost is \$202,500.
- To meet requirement 3.1, we estimate WSDOT will spend \$100,000.
- To meet requirement 3.3, we estimate WSDOT will spend \$200,000.
- We anticipate WSDOT needing consultant project support for the project, which would cost approximately \$250,000 for the three-year implementation. Project support would include assistance with developing technical and functional specifications, supporting the software testing process, project management support, and customizing the training program.
- Hardware costs are not included in this estimate. Those costs will be determined during the design phase of the project.

Exhibit 8 summarizes WSDOT's estimated BrM implementation costs.

Exhibit 8: WSDOT BrM Estimated Implementation Costs

AASHTO Service Units	\$202,500
WSDOT-Specific Bridge Deterioration Modeling	\$100,000
WSDOT Risk Forecasting for Condition and Collapse	\$200,000
Consultant Project Support	\$250,000
Hardware	TBD
Contingency (15%)	\$112,875
Total	\$865,375

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