

LIMMS FOR ENHANCED TRANSPORTATION INFRASTRUCTURE: A COMPARATIVE ANALYSIS AND FUTURE ROADMAP

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Team:

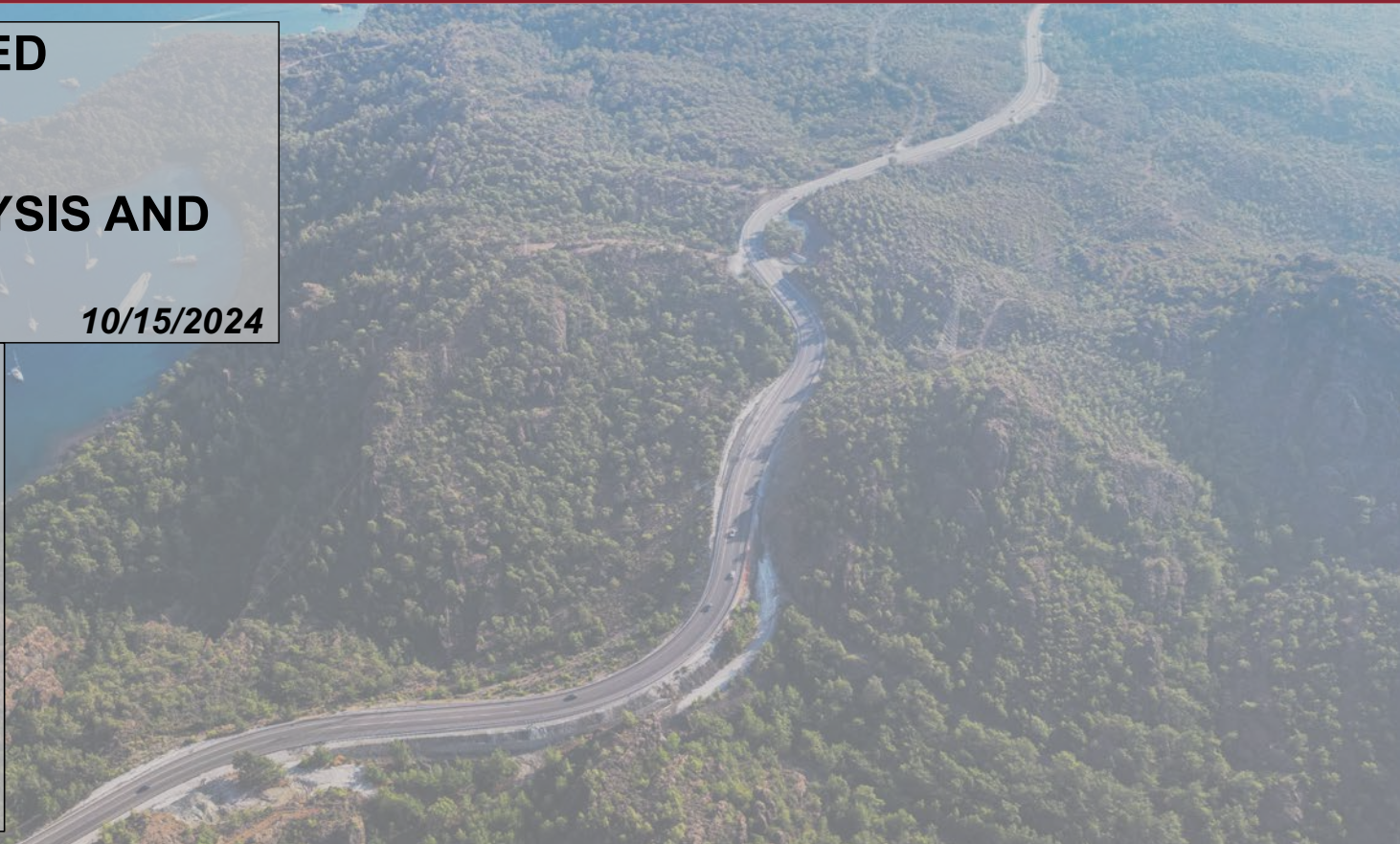
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Before I Begin

- This presentation summarizes the findings of “*Laboratory Information Materials Management System (LIMMS) Development Planning*”
- We would like to thank MassDOT, Office of Transportation Planning and USDOT for their support.
- Through this presentation, you will see that this was a collaborative effort between MassDOT and UMass. We would like to thank MassDOT for their time, help and feedback.



Background

- **A Laboratory Information Management Systems (LIMMS or LIMS) is an essential part of life-cycle tracking of materials used by DOTs**
- **A well executed LIMS software could simplify workflows, improve efficiency and save time.**
- **MassDOT needed additional flexibility and functionality from their LIMS system.**



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Project Tasks

Gap Analysis

- Understanding the state of art
- What are the available vendors?
- What are the available software suites?
- What do other states use?

Interviews

- Interviewing MassDOT employees to understand their needs
- Interviewing vendors to understand products

Workshop

- What are the ideal features in a LIMS system?
- How to adopt to MassDOT procedures from sampling to reporting

App Development

- Building a pilot system suitable for further development
- Demonstrating some desired capabilities

Gap Analysis

- **The team first searched for available LIMS products, focusing on transportation-based applications**
- **All LIMMS vendors use a cloud-based solution mainly powered by Amazon Web Services or Microsoft Azure**
- **Mobile and offline capabilities are crucial reported components of all LIMMS systems.**
- **All solutions provide various levels of access and security.**
- **Some solutions focus heavily on data visualizations and flow.**

Company	Architecture Highlights
AASHTOWare	Modules for estimation, preconstruction, bids, materials management
Autoscribe Informatics	Components include API, calibration system, configuration tools, data acquisition
Agile FrameWorks	Compliance verification, workload management, data communication
Aurigo	Cloud platform, materials specification, lab management
ExeVision iPD	Estimating, electronic bidding, construction management, civil rights compliance
ElmTree	Centralized database, sample management, certification, reporting capabilities
ForneyVault	Cloud database, automated data entry, customized reports, real-time data export
Haulhub	Uses AWS infrastructure, accessible via iOS, Android, Web
Headlight	Cloud-based, data analytics, sample management, mobile access
Quality Systems International	Microsoft ASP.NET architecture, multi-tiered system, SQL integration
SynapticSci	Utilizes Microsoft PowerBI, web and mobile application support
ThermoFisher	Multi-tier architecture, thin client, application server, database, mobile integration

Gap Analysis

- To understand the need and usage of LIMS systems, the team investigated transportation asset management plans of almost all states.
- We further searched each states publicly available information for the latest LIMS system that they use.
- We were able to find public information on 33 states.

Software	Suite	States
AASHTOWare	Project Construction & Materials	Alaska, Connecticut, Kansas, Michigan, Minnesota, Missouri, Montana, Nevada, New Jersey, New York, Ohio, Oklahoma, Oregon, South Carolina, Tennessee, Wisconsin
AASHTOWare	SiteManager	Colorado, Georgia, Nebraska, West Virginia
Others		Florida, Illinois, Indiana, Iowa, Louisiana, Maine, Maryland, Massachusetts, Pennsylvania, Rhode Island, Utah, Vermont

State	System
Alabama	CAMMS
Alaska	AASHTOWare
Colorado	AASHTOWare
Connecticut	AASHTOWare
Florida	Citrix & LIMS
Georgia	AASHTOWare
Illinois	ExeVision
Indiana	MIS
Iowa	SIIMS
Kansas	AASHTOWare
Louisiana	Headlight
Maine	TIMS
Maryland	MMS
Massachusetts	N/A
Michigan	AASHTOWare
Minnesota	AASHTOWare
Missouri	AASHTOWare
Montana	AASHTOWare
Nebraska	AASHTOWare
Nevada	AASHTOWare
New Jersey	AASHTOWare
New York	AASHTOWare
Ohio	AASHTOWare
Oklahoma	AASHTOWare
Oregon	AASHTOWare
Pennsylvania	eCAMMS
Rhode Island	Microsoft Access
South Carolina	AASHTOWare
Tennessee	AASHTOWare
Utah	Aurigo
Vermont	CMS
West Virginia	AASHTOWare
Wisconsin	AASHTOWare

Driving Factors

1. Compatibility with existing systems

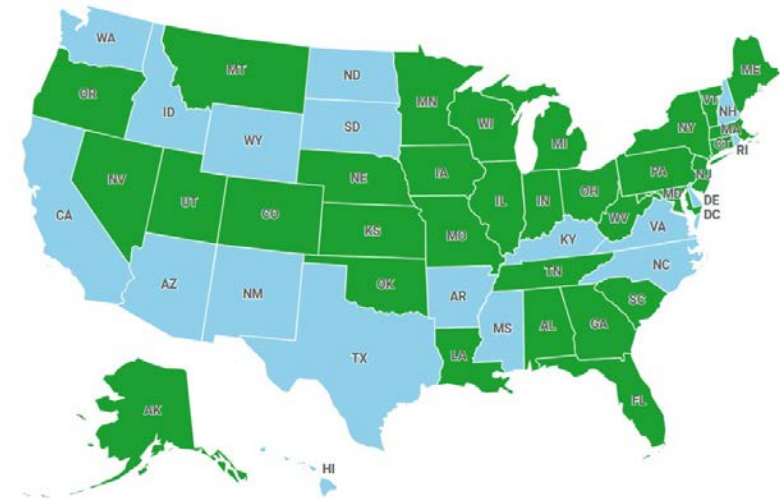
- *Many DOT's use AASHTOWare because they are already using many other AASHTOWare products which integrates into LIMMS.*

2. Ability to implement features quickly

- *Most states prefer being able to implement features as quickly as possible without vendor involvement.*
- *AASHTOWare allows users to form “Joint Development” groups to share subroutines.*
- *Some states circumvent this altogether by developing their own systems.*

3. Training and ease of use

- *Wide adoption results in many training resources for DOT's and shortens the learning period.*



States with public information about their LIMS systems

MassDOT Interviews

- **Following initial survey of available systems, the team met with:**
 - Steering committee (March 2023),
 - Materials and District Quality Engineers (May 2023)
 - Technicians (May 2023) and
 - Client administration personnel (June 2023).
- **Additionally, a survey was sent to MassDOT employees to understand their LIMMS experience in the past and LIMMS usage.**
- **After going over interviews about experience, desired features from a new system were organized after 8 subheadings.**

Administrative

User Experience

Reporting

Test Methods

Inspect/Sample

Non-compliance

Security

Other/General

MassDOT Interviews

Administrative

- **Clearly defined administrative rights**
- **Contractor Access**
- Ability to make changes to different groups of users easily
- Better training and user manual

User Experience

- Fast data access times
- **Easy to use interface**
- Mobile device integration
- **Webpage customization**

Reporting

- Shorter reports with crucial information placed in identifiable locations
- Excel integration
- **Reporting based on user-selectable categories user queries**

Test Methods

- Ability to add required tests using plug-ins
- Ability to populate a sample with the results from another sample
- **Linking testing at multiple locations**

Inspect/Sample

- Supporting multiple contracts with the same sample
- Quick sample log in with minimal preparation time
- **Data dashboards and query support for samples**

Non-compliance

- **Ability to integrate NCR forms directly with the system**
- Ability to flag/assign tasks for outstanding materials in the system.

Security

- **Multi-Factor Authentication**
- Secure communication
- Clear chain of custody
- Geoblocking
- **ADA compliance**
- Ability to patch quickly

Other/General

- Being able to make small changes without admin privileges
- **Software modularity/connectivity to other suites (RMS 360, SAM, CMS)**
- Ability to modify screens based on user preference

Vendor Interviews

- Interviewed 6 vendors and some DOT's using their products
- Based on MassDOT requirements, the companies were evaluated

Features	Headlight	SynapticSci	Aurigo	AASHTOWare	ExeVision	Thermo Fisher
DOT Usage	✓ (RI, LA)	✓ (ME)	✓ (UT)	✓ (Many)	✓ (NH, IL)	Limited
Cloud-Based	✓ (AWS)	✓ (Azure)	✓ (AWS)	✓ (Infotech)	✓ (Azure)	✓ (AWS)
Mobile Application	✓	✓	✓	✓	✓	✓
Supports Offline Data Entry	✓	Limited	Limited	✓	Limited	Limited
Supports NCR	✓	✓	✓	✓	✓	Limited
Customizable Dashboards/Reports	✓	✓	Limited	✓	✓	Limited
Supports Contractor Access	Limited	✓	✓	✓	×	Limited
Integration with Microsoft Products	✓	✓	Limited	✓	Limited	Limited

Limited may mean not available or not suitable for MassDOT needs

Vendor Interviews

- **Interviews revealed that all products are**
 - Cloud-based and
 - Offer mobile applications
- **While many vendors address most DOT needs, they may be lacking in certain areas such as customizability, response time and flexibility**
- **For certain companies, it could take months for a requested feature to be implemented.**
- **For certain companies DOTs are encouraged to code the changes themselves in the system.**



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Workshop

- At the end, MassDOT and the team decided that the best path forward was an in-house developed solution
- The main objective:
 - What do you need in a LIMS system?
 - What are the short/medium/long term features?
 - What are the crucial components?



Workshop Stations

RMS360

- RMS360, CMS and SAM integration
- User friendly forms with defined acronyms
- Easy links between bid items and specifications
- Comparison between completed/remaining, estimated/actual
- Documented change tracking and notifications of completion

Documentation

- Comprehensive document management for all users to support scanning
- Syncretization across modules
- Dashboard displaying important information for actionable items
- Faster deployment of features for NCR, project to-do lists, automated workflow processes

Sampling

- Intuitive interface resembling forms
- Mobile scanning/logging
- System integration for sample entry, ability to quickly match
- Full chain-of-custody tracking and time-based alerts
- Integration of workflow processes within the system and development of training materials

Reporting

- In depth and customizable reports, specific to sample type
- Automatically calculating key metrics and subsequent actions
- Report compliance with FHWA and other regulations
- Single page report for project summary, visualizations and action items

Testing

- Streamlined interface with minimal clicks
- Being able to link and sort samples/organizations and critical time constraints
- Implementation of batch approval and better handling of failed test comments
- Automated assignment of tests
- Flexible status tracking, allowing re-tests

Interface

- Customizable landing page based on user
- Flexible filtering and auto-scaling for all devices
- Similar interfaces across modules
- Real time sync with robust user roles
- Allowing users to customize most aspects that is important for them

Workshop Summary

- **Integration with existing Software**
- **Customizable based on user**
- **Supporting mobile use including data entry**
- **Ability to easily filter, search, build visualizations**
- **Clearly defined user-roles with contractor access**
- **Notifications and alerts for important action items**
- **Support for NCR and regulations**



App Development

- Based on the workshop, Dr. Jeremy Gummesson started a pilot app development using Power BI platform

LIMMS Sample Test Card Entry

Project Information	
Town/City	CANTON, NORWOOD, WESTWOOD
Contractor	SPS NEW ENGLAND INC
Report to District	6
Resident Engineer	Roderick Connelly III
Federal Aid Number	NHP(IM)-002S(797);CM-002S(797);NHP(NHS)-002S(797);NHP(on-syst.brg)-002S(797);STP-002S(797)
Cost Account Number	P606146C12; P606146C22; P606146C32; P606146C42; P606146C52
District Material Engineer	

Contractual
 Non-Contractual

Contract Number
90726

Material Type
HMA

Next

App Development

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Concrete Material Information Entry

Material Information

Bid Item:	100.	Specification Number:	M9.11.0
Bid Item Description:	SCHEDULE OF OPERATIONS - FIXED PRICE \$ _____	Date to be Used:	
Sub-Item Description:	Sub Item Description	Producer Mix ID Number:	
Bid Item Quantity:		Town/City, State:	ALKALI SILICA REACTION TESTING
MassDOT Concrete Mix ID Number	00-00-00-00-00-00	Max Aggregate Size	
Produced By:	ALKALI SILICA REACTION TESTING	Mix Design Type	ASR
Design Strength:		Additional Information:	
Total Cementitious (lbs)			
Proposed Use:			

[Back to Material Selection](#) [Enter Test Data](#)

App Development

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Double click to edit text HMA Sample Record

Material Information

Bid Item:	100. <input type="text"/>	▼	
Bid Item Description:	SCHEDULE OF OPERATIONS - FIXED PRICE		Specification Number: <input type="text"/>
Sub-Item Description:	\$ _____		
	Sub Item Description	▼	
Bid Item Quantity:	<input type="text"/>		
Produced By:	WHITE BROS.	▼	Date to be Used: <input type="text"/>
Town/City, State:	OAK BLUFFS, MA	▼	Paved By: <input type="text"/>
Mix ID Number	<input type="text"/>	▼	
Binder Supplier:	<input type="text"/>		Binder Grade: <input type="text"/>
Binder Lot:	<input type="text"/>		Binder Specific Gravity: <input type="text"/>
Additional Information:	<input type="text"/>		

Back to Material SelectionNext

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Thank you!

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