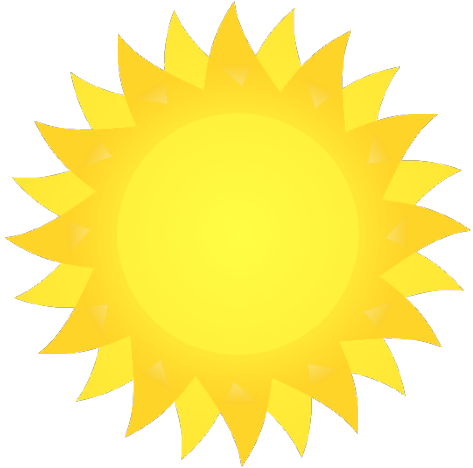


# Northeastern States Materials Engineers Association

## Managing, Analyzing, and Tracking Materials through LIMMS

Richard Mulcahy, Megi Martini, Alana Geary

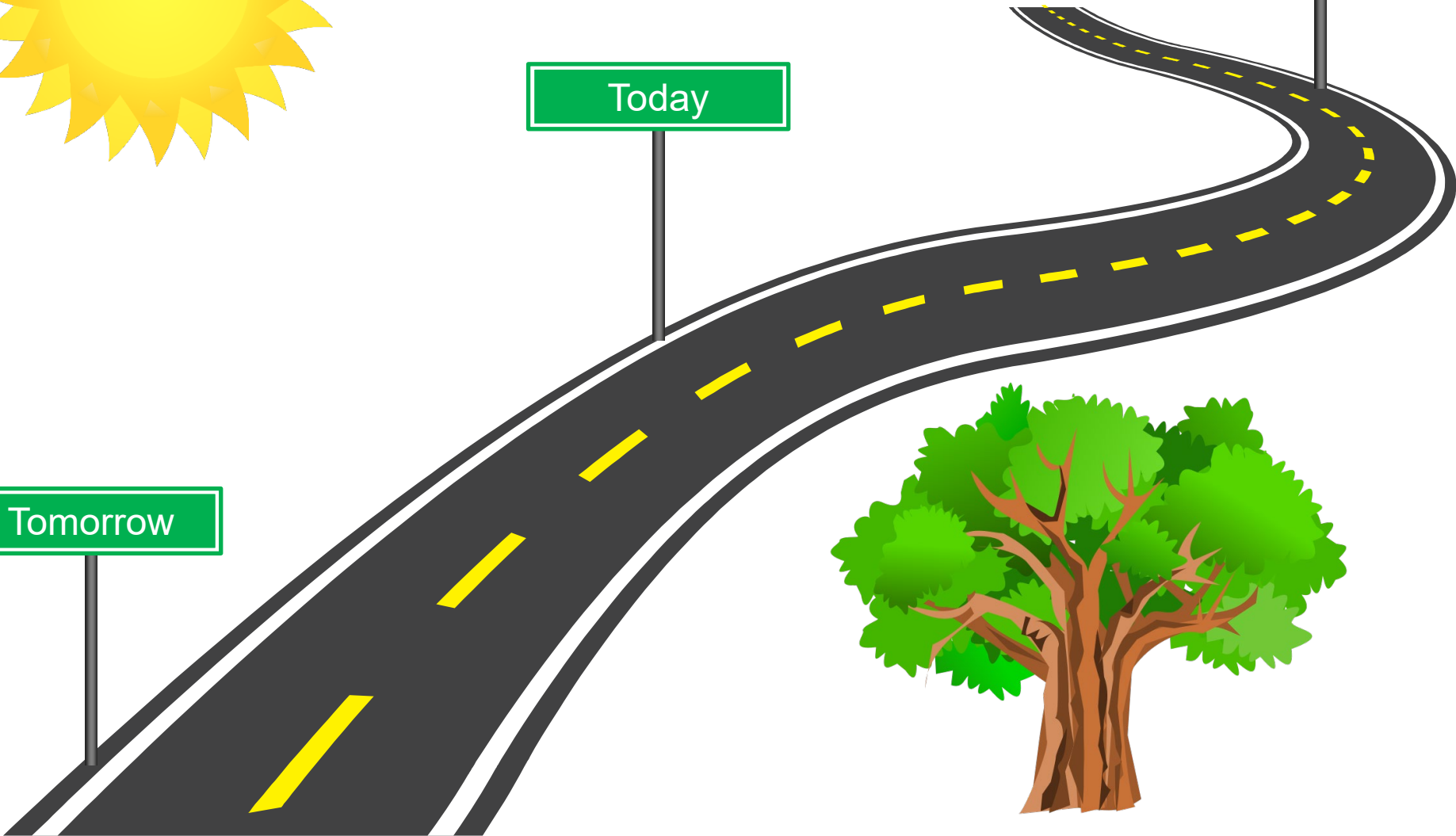
October 27, 2020

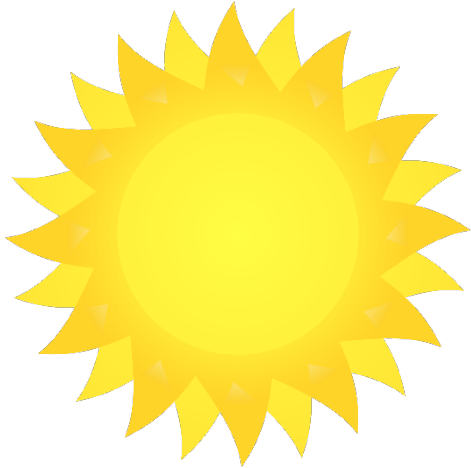


Yesterday

Today

Tomorrow





MassDOT  
Selects Vendor  
and Begins  
Development

MassDOT  
Generates  
LIMMS  
RFP

Brainstorming  
Session at the  
Innovation  
Conference, Fort  
Devens, MA

Medical  
Industry

RMS  
Investigates  
LIMMS  
Functionality

1980

2009

2013

2016

2018

2020

LIMMS  
“Go-Live”  
Launch



# The Problem

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*For decades, MassDOT has relied on an antiquated system of paper, hand-written test report forms, redundant data entry, and numerous decentralized databases to perform its daily functions, resulting in such inefficiencies as immense paper consumption, misfiling of documentation, delayed contract certification, misidentification, and lack of test data analytics.*

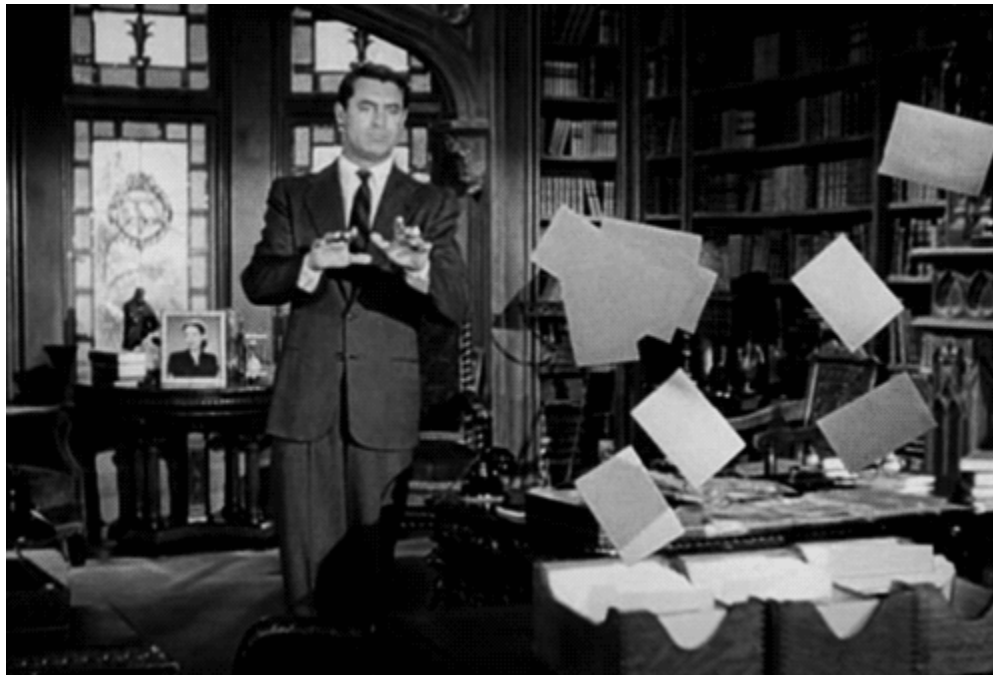
# The Problem

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# The Problem

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# The Solution

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**L**aboratory  
**I**nformation  
**M**aterials  
**M**anagement  
**S**ystem

# The Solution

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*Today, we live in a “data-driven” society, compelled by data, rather than by intuition or anecdotal evidence, which should be no different for MassDOT. To resolve these inefficiencies and to bring MassDOT into the “Digital Age”, MassDOT required a much-needed upgrade to its existing system, which is accomplished through the implementation of a newly developed Laboratory Information Materials Management System (LIMMS).*



# What is LIMMS?

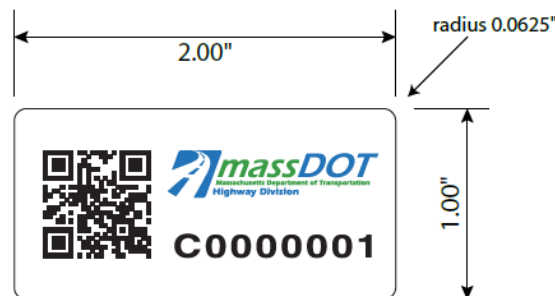
---

*Laboratory Information Materials Management System (LIMMS) is a highly efficient software ecosystem, which uses a system of computers, electronic identification tags, and cloud servers to manage, analyze, and track materials.*

# Radio-Frequency Identification (RFID)



QR = C0000001  
Programming: Custom

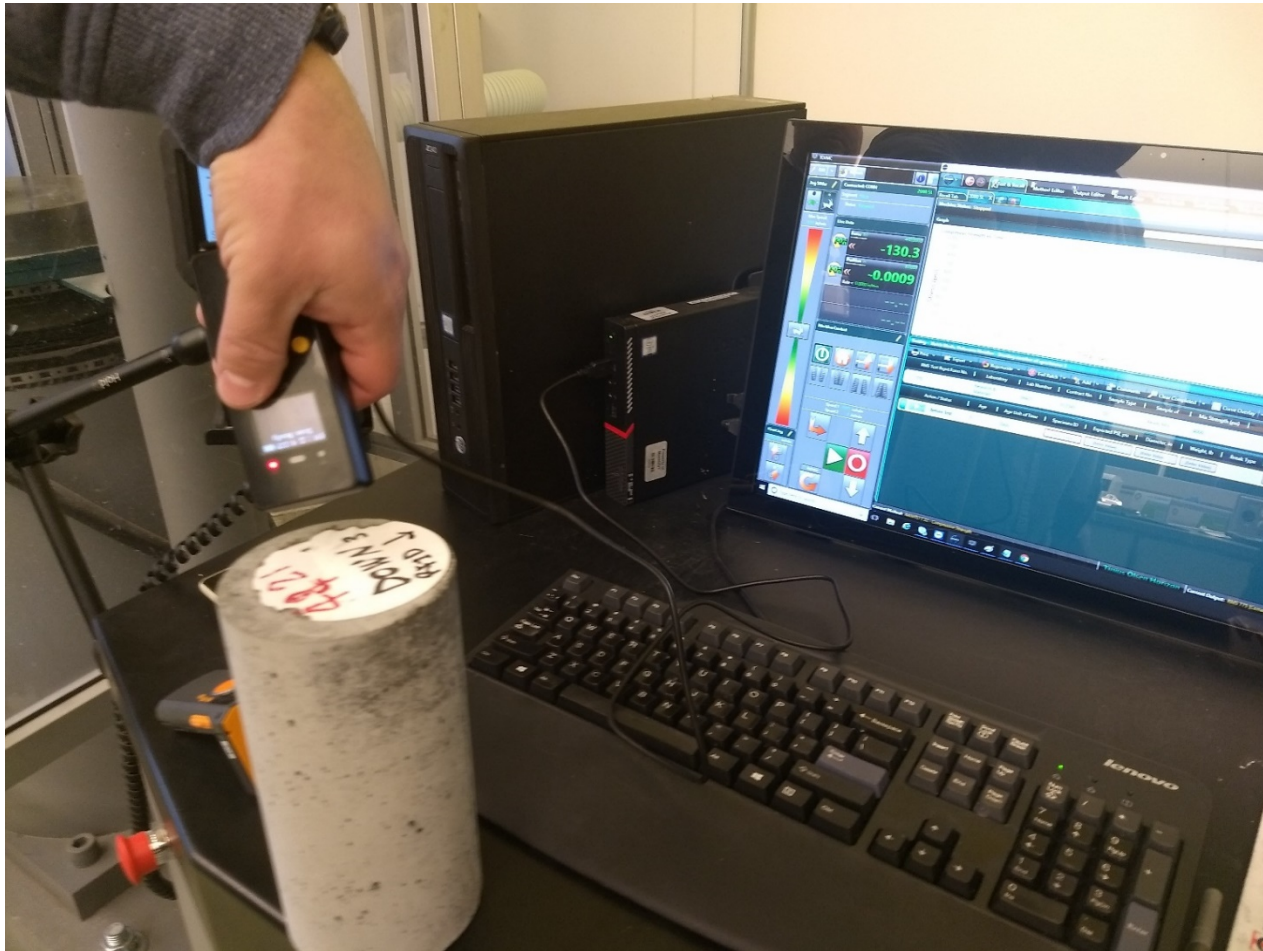


QR = C0000001  
epc = C0000001  
8 characters



# Radio-Frequency Identification (RFID)

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# LIMMS Benefits

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- ☐ Ability to perform data analytics to make informed decisions
- ☐ Chain of Custody and Tracking of Materials
- ☐ Elimination of Redundancy
- ☐ Reduction in Paper
- ☐ Electronic Tagging of Samples and Construction Assets
- ☐ Statewide Sharing of Data
- ☐ Automatic Documentation Filing System
- ☐ Time and Cost Savings to MassDOT

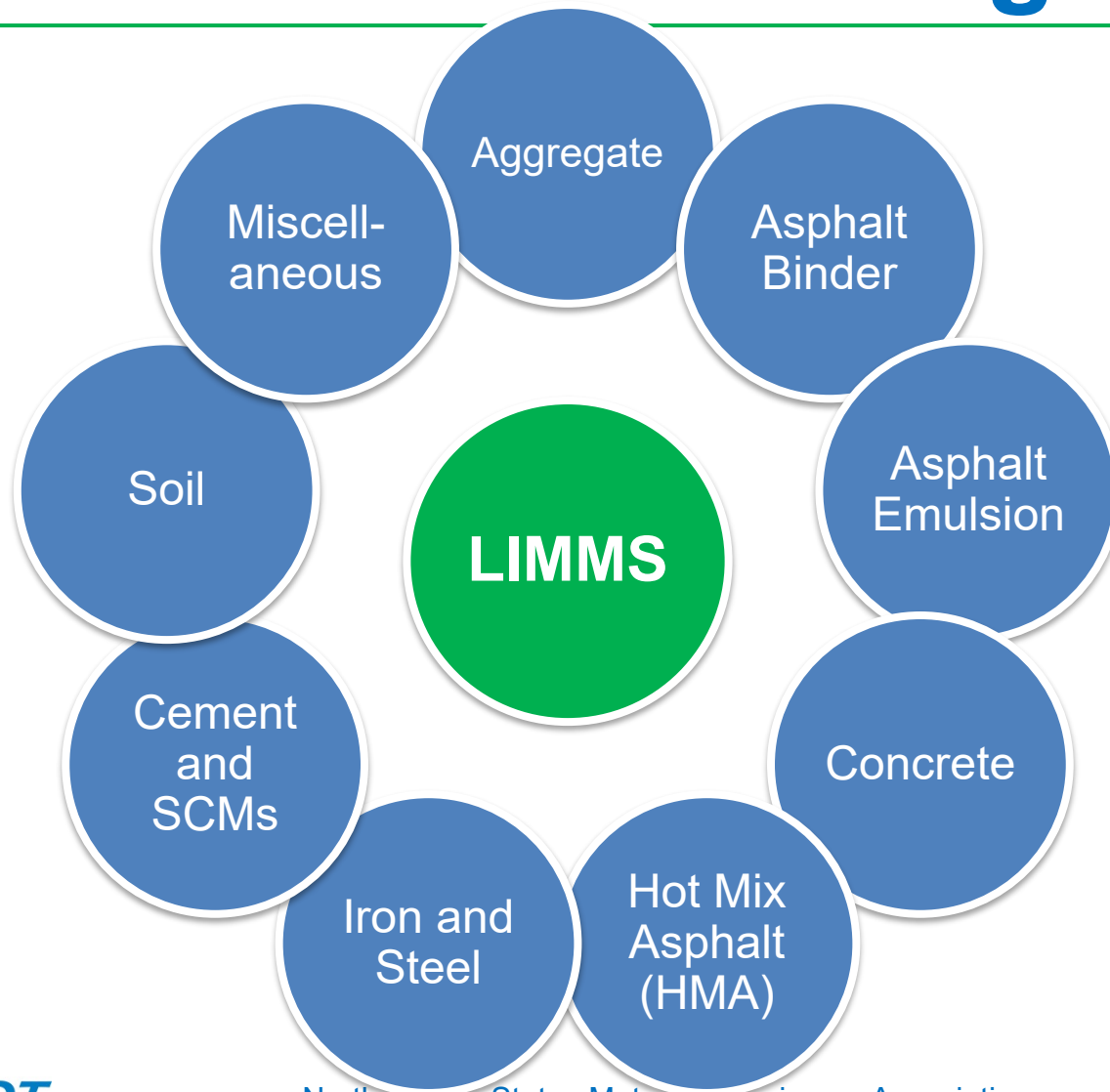
A vibrant display of fireworks in various colors (yellow, green, purple, red) exploding against a dark night sky, framing the central calendar.

# March 2020

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

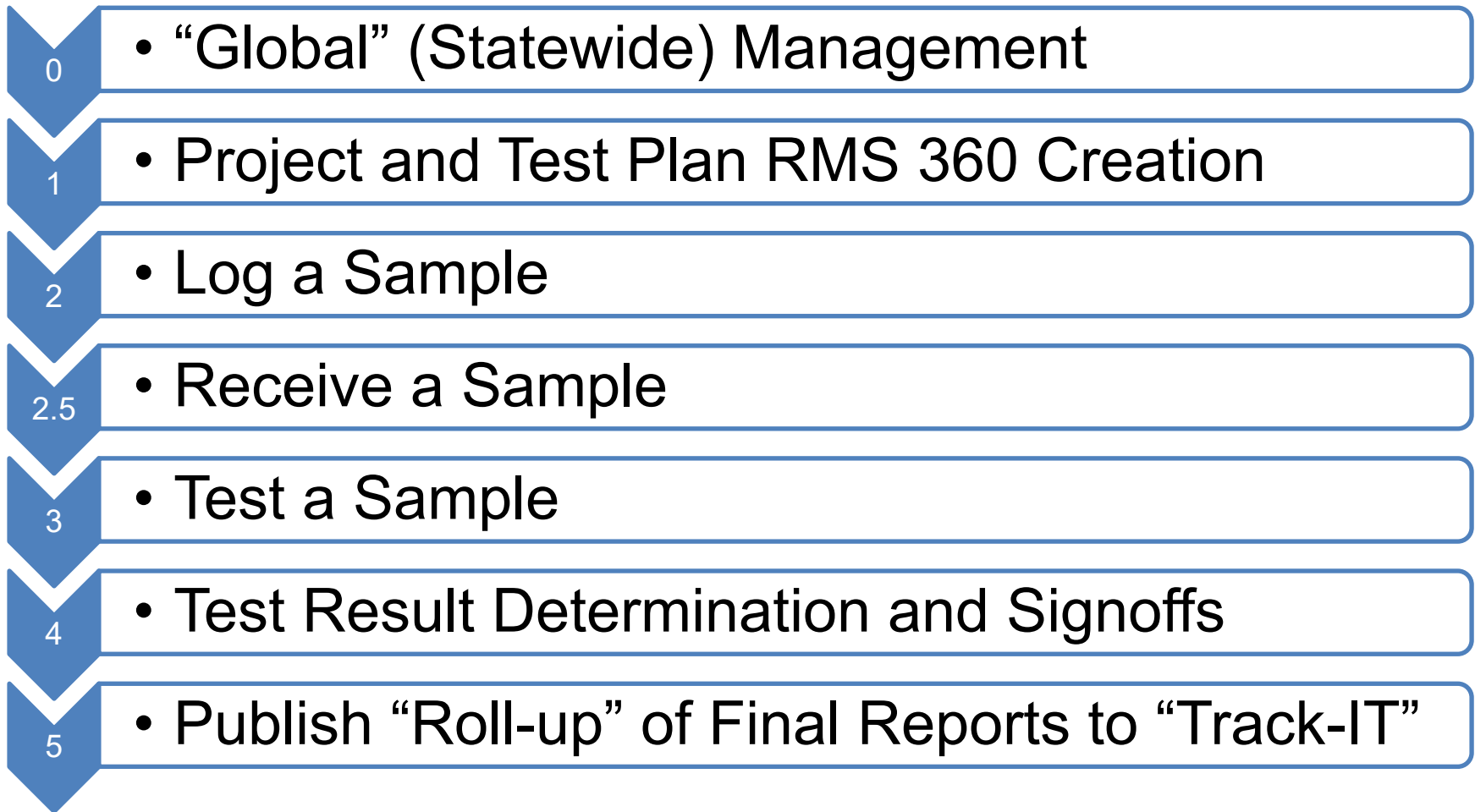
# LIMMS Materials Categories

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# LIMMS Process Flow

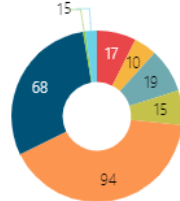
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# Reporting

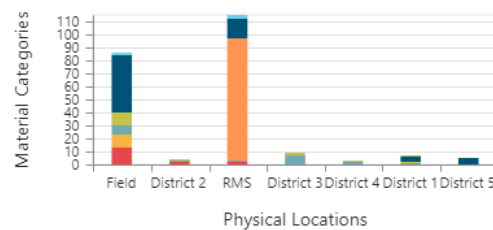
## Receiving Dashboard

Samples by Material Categories



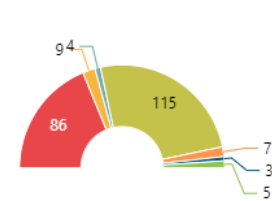
Concrete Asphalt Emulsion Soil Aggregate  
Iron and Steel Hot Mix Asphalt (HMA) Asphalt Binder

Material Categories by Physical Locations



Concrete Asphalt Emulsion Soil Aggregate  
Iron and Steel Hot Mix Asphalt (HMA) Asphalt Binder

Samples by Physical Locations (In quantity values)



Field District 3 District 2 RMS District 1  
District 4 District 5



# Reporting

## HMA Tracking Log

Contract No.: 108457 Lot: ALL MixDesign: CA-9.5-SSC-75G-1 By Date: Range StartDate: 05-05-2020 EndDate: 09-02-2020

Page 1 of 1

Status: ALL

Search:

Q Search

Export

Print

SampleNo	Date / Type	Lot / SubLot	Producer / MixDesign	T308 %Pb	T166 T331 T275 Gmb	T209 Gmm	R35							T30 Percent Passing													T269		D3549 Avg Thick. in
							Air Voids %	VMA	VFA	Gse	Pba %	Pbe %	Dust Bind Ratio	2 (50)	1 1/2 (37.5)	1 (25)	3/4 (19)	1/2 (12.5)	3/8 (9.5)	#4 (4.75)	#8 (2.36)	#16 (1.18)	#30 (0.6)	#50 (0.3)	#100 (0.15)	#200 (0.075)	Comp. of Gmm %	Voids in Place Pa%	
2020-000922	08/25/20 ACC	1 /11	Century A... CA-9.5-SS...	6.03	2.431	2.535	4.1	15.1	72.8	2.797	1.5	4.6	0.7					99	94	63	38	27	19	12	7	3.2			
2020-000920	08/24/20 ACC	1 /9	Century A... CA-9.5-SS...	6.02	2.43	2.522	3.6	15.1	75.8	2.78	1.2	4.9	0.7					99	96	66	41	28	20	13	7	3.2			
2020-000916	08/24/20 ACC	1 /10	Century A... CA-9.5-SS...	6.09	2.438	2.519	3.2	14.9	78.4	2.78	1.2	5	0.7					99	96	71	46	32	22	14	7	3.3			
2020-000910	08/21/20 ACC	1 /9	Century A... CA-9.5-SS...		2.331																						92.9	7.1	1.9
2020-000909	08/21/20 ACC	1 /8	Century A... CA-9.5-SS...		2.403																						95.7	4.3	1.7
2020-000908	08/21/20 ACC	1 /7	Century A... CA-9.5-SS...		2.345																						93.5	6.5	1.71
2020-000891	08/20/20 ACC	1 /8	Century A... CA-9.5-SS...	6.32	2.433	2.512	3.1	15.3	79.4	2.782	1.3	5.1	0.7					99	96	68	41	28	20	13	7	3.5			
2020-000886	08/19/20 ACC	1 /7	Century A... CA-9.5-SS...	6.33	2.428	2.509	3.2	15.5	79.1	2.779	1.2	5.2	0.6					100	99	68	41	28	20	12	7	3.3			
2020-000379	06/10/20 ACC	1 /6	Century A... CA-9.5-SS...		2.335																						92.5	7.5	1.75
2020-000377	06/10/20 ACC	1 /5	Century A... CA-9.5-SS...		2.416																						95.7	4.3	1.8
2020-000372	06/09/20 ACC	1 /4	Century A... CA-9.5-SS...		2.412																						95.7	4.3	1.45
2020-000371	06/10/20 ACC	1 /6	Century A... CA-9.5-SS...	6.11	2.405	2.525	4.8	16.1	70.4	2.788	1.3	4.9	0.6					100	97	69	41	28	20	12	6	3			
2020-000370	06/09/20 ACC	1 /5	Century A... CA-9.5-SS...	6.07	2.416	2.525	4.3	15.6	72.4	2.786	1.3	4.8	0.8					100	96	71	43	29	21	14	7	3.7			
2020-000357	06/08/20 ACC	1 /4	Century A... CA-9.5-SS...	6.14	2.401	2.521	4.8	16.2	70.7	2.785	1.3	4.9	0.6					100	96	71	44	30	21	13	6	3			

Record Count : 17 Of 25

# Reporting

## Binder Tracking Log

Contract No.: 108457 Lot: ALL PG Binder Grade: ALL By Date: Range StartDate: 05-05-2020 EndDate: 09-02-2020

Page 1 of 1

Status: ALL

Search:

Search

Export

Print

SampleNo	Date / Type	Lot	Produser / PG Binder Grade/ Additive	T315 Original Binder (Unaged)			T315 Rolling Thin Film Oven Residue			T315 Pressure Aging Vessel Reside			T316		T240	T313			T350						
				G*/sin (kPa)	Test Temp. (C)	Phase Angle (d)	G*/sin (kPa)	Test Temp. (C)	Phase Angle (d)	G*/sin (kPa)	Test Temp. (C)	Phase Angle (d)	Visc., Rot. 135C (Pa*s)	Visc., Rot. 165C (Pa*s)	Mass Change (%)	Creep Stiffness (mPa)	m-value	Low Grade Temp. (C)	Avg % Recovery at 0.1 kPa, R0.1	Avg % Recovery at 3.2 kPa, R3.2	% Diff. Noncover. Creep Comp. between 0.1 and 3.2 kPa, Rdiff	Average Noncov. Creep Comp. at 0.1 kPa, Jnr0.1	Average Noncov. Creep Comp. at 3.2 kPa, Jnr3.2	Percent Difference of Non-recover. Creep Comp., Jnr-diff	
2020-000322	06/01/20 ACC	1	Century A... PG 64-28 N/A	1.09	64	84.2	2.76	64	78	2195	22	49	0.375	0.1	-0.268	185	0.354	-18							
2020-000265	05/06/20 ACC	24 - PG...	Century A... PG 64-28 evotherm	1.21	64	83.9	2.88	64	78	2573	22	47.8	0.388	0.11	-0.298	196	0.34	-18							

Record Count : 1 Of 2

# Reporting

## Global Non Conformity Report (NCR) Log

Project:  Lab:  Category:  By Date:  StartDate:  EndDate:

Page:  NCR Type:  NCR Status:  Search:

Tracking	Project	NCR No	NCR Date	Lab No.	Non-Conformance	Initiated By(District)	Initiated By(RMS)	Proposed By	Accepted By	Review By	NCR Status	Photo	Version
	Lab	Doc. Control No	Target Closing Date	NCR Type	Proposed Corrective Action	Date	Date	Date	Date	Date			
000083	VER-CON-2...		08/20/2020	2020-000602(...		Timothy Will...					Open	No	v 2
	RMS(VER)	00017				08/20/2020 ...							
000082	VER-CON-2...		08/20/2020	2020-000456(...	3/8 sieve 5% passing	Timothy Will...					Open	No	v 3
	RMS(VER)	00016		Lab		08/20/2020 ...							
000081	109677	3	08/17/2020	2020-000623(...	3880 psi @ 28 Days Air Content = ...	John Blanco					Open	No	v 6
	District 1(AC...	00003	09/18/2020	Field		08/17/2020 ...							
000080	109466	00002	08/17/2020	2020-000805(...	90.9%	Thomas Kwla...					Open	No	v 3
	District 3(AC...	00002		Lab		08/17/2020 ...							
000079	VER-CON-2...		08/14/2020	2020-000457(...	3.0% passing 75u	Timothy Will...					Open	No	v 3
	RMS(VER)	00015		Lab		08/14/2020 ...							
000078	VER-CON-2...		08/14/2020	2020-000547(...	2.6% passing 75u	Timothy Will...					Open	No	v 3
	RMS(VER)	00014		Lab		08/14/2020 ...							
000077	VER-CON-2...		08/14/2020	2020-000560(...	2.3% passing 75u	Timothy Will...					Open	No	v 3
	RMS(VER)	00013		Lab		08/14/2020 ...							
000076	VER-CON-2...		08/14/2020	2020-000559(...	2.1% passing 75u	Timothy Will...					Open	No	v 5

Record Count : 8 Of 48

# Reporting

## Test Results Summary Report

Project No.: (109297) Intersection Improvements and Related Work (Including Signal) Status: ALL By Date: Range

Report: T 22/C39 Concrete Compressive Stre Lab: ALL Item No: ALL SubItem: ALL StartDate: 04/01/2018

Closed: ALL ShowInactive: No Equip: ALL Concrete MixDesignNo.: 20-01-07-13-21-42-03 Test Age(Days): ALL (Hours): ALL EndDate: 09-02-2020

Page 1 of 1 Test Control No.: Search Export Print

Sample-TestNo-SN	Lab Name	Equip.	Mixdesign No/ SpecimenNo.	BidItem/ SubBidItem	Date Of Test	Test Age Day/hr	Compressive Strength, psi	Mix Req. Strg.(psi)	Avg. Result	Spec. min/max	Pass/ Fail	Test Result Determ.	Discard	Closed	Status
2020-000593-42-02	RMS		20-01-07-13-... 00000996	812.16 :Light Sta... Sub:Cement Con...	07/24/2020	28 Day	6524	5000	6490	5000 min	Pass	For Informatio...	N	N	Sign Off
2020-000594-47-02	RMS		20-01-07-13-... 00000999	812.16 :Light Sta... Sub:Cement Con...	07/24/2020	28 Day	6255	5000	6290	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000592-37-01	RMS		20-01-07-13-... 00000992	812.16 :Light Sta... Sub:Cement Con...	07/22/2020	28 Day	5942	5000	5900	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000592-37-02	RMS		20-01-07-13-... 00000993	812.16 :Light Sta... Sub:Cement Con...	07/22/2020	28 Day	5777	5000	5900	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000592-37-03	RMS		20-01-07-13-... 00000994	812.16 :Light Sta... Sub:Cement Con...	07/22/2020	28 Day	5991	5000	5900	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000477-27-02	District 2		20-01-07-13-... 00000973	812.16 :Light Sta... Sub:Cement Con...	07/17/2020	28 Day	6199	5000	6380	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000477-27-03	District 2		20-01-07-13-... 00000974	812.16 :Light Sta... Sub:Cement Con...	07/17/2020	28 Day	6583	5000	6380	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000477-27-01	District 2		20-01-07-13-... 00000972	812.16 :Light Sta... Sub:Cement Con...	07/17/2020	28 Day	6354	5000	6380	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000476-21-01	District 2		20-01-07-13-... 00000969	812.16 :Light Sta... Sub:Cement Con...	07/16/2020	28 Day	7031	5000	7040	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000476-21-02	District 2		20-01-07-13-... 00000970	812.16 :Light Sta... Sub:Cement Con...	07/16/2020	28 Day	6996	5000	7040	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000476-21-01	District 2		20-01-07-13-... 00000971	812.16 :Light Sta... Sub:Cement Con...	07/16/2020	28 Day	7088	5000	7040	5000 min	Pass	Conforms wit...	N	N	Sign Off
2020-000475-15-01	District 2		20-01-07-13-... 00000963	812.16 :Light Sta... Sub:Cement Con...	07/15/2020	28 Day	7096	5000	6870	5000 min	Pass	Conforms wit...	N	N	Sign Off

Record Count : 42 Of 48

# Data Analysis

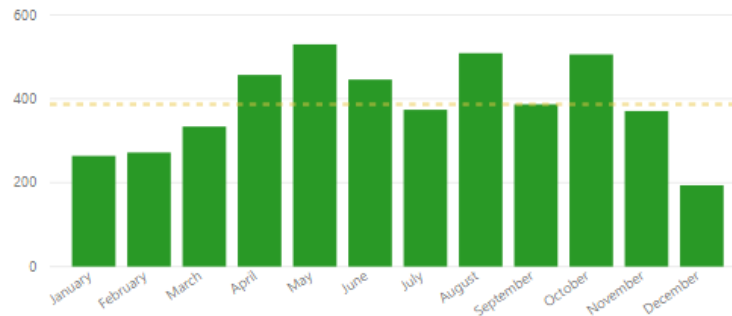
## Research & Materials Materials Received - Consolidated Calendar Year 2019

Total Materials Received

**4644**

Total Materials 2019

Number of Materials Received by Month



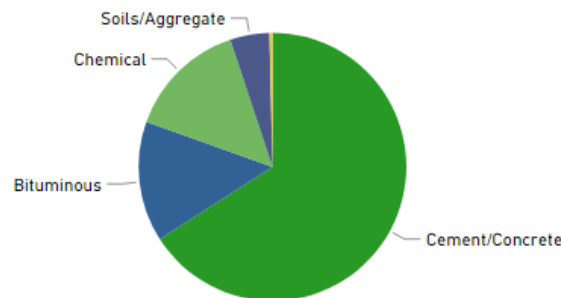
Top 10 Material Manufacturers

Manufacturer	Number of Materials Received
Oldcastle	308
Concrete System Inc.	296
Dauphinais Concrete	231
United Concrete	171
Michie Corporation	166
East Jordan Foundry	149
Fort Miller	135
Ennis Flint	123
Tri State Materials	115
Benevento	111
<b>Total</b>	<b>1805</b>

Materials Received by Lab

Lab Name	Total Materials 2019
Soils/Aggregate	220
QALab	17
Chemical	671
Cement/Concrete	3062
Bituminous	674
<b>Total</b>	<b>4644</b>

Materials Received by Lab



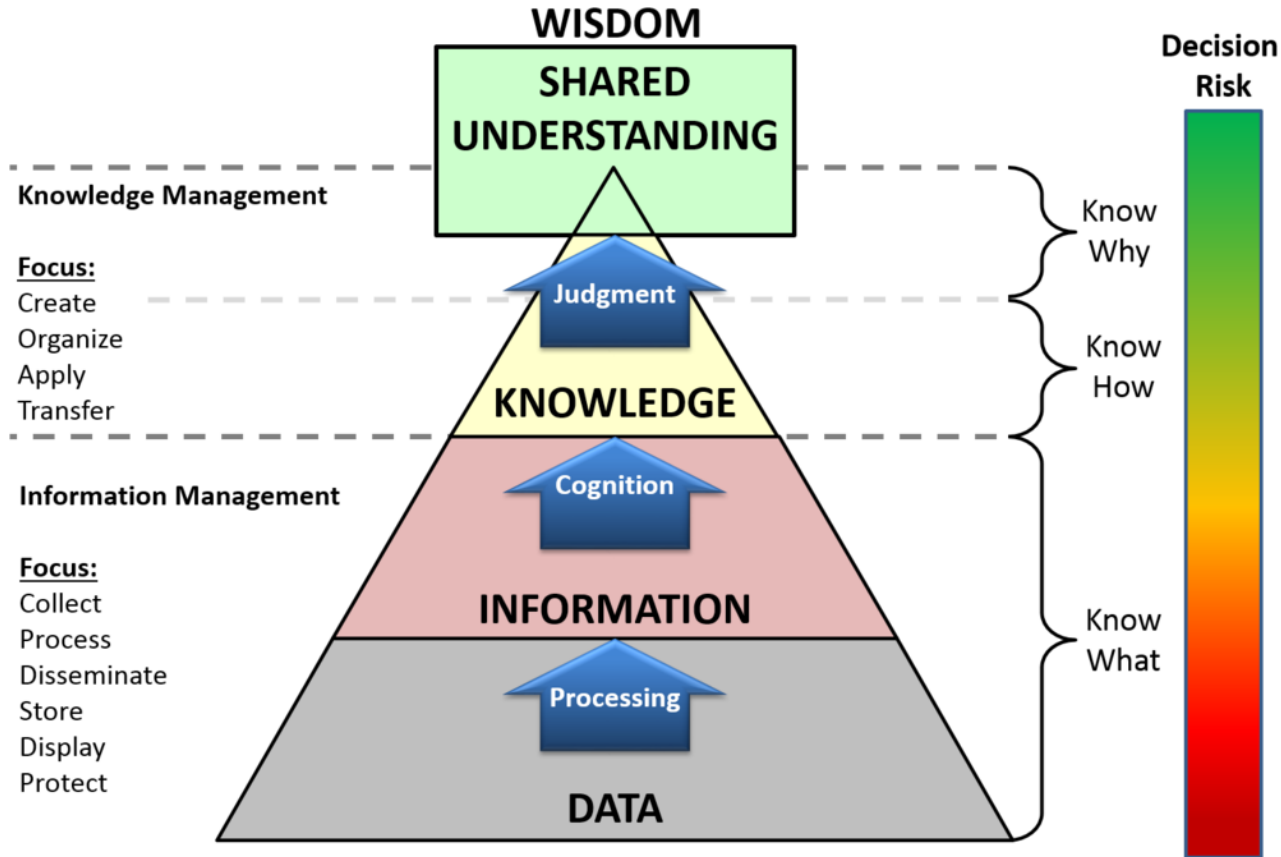
Number of Contracts R&M Contributed To

**275**

Total Contracts

# Moving Forward

## Knowledge Management Cognitive Pyramid



Source: Matthew.viel ([https://commons.wikimedia.org/wiki/File:KM\\_Pyramid\\_Adaptation.png](https://commons.wikimedia.org/wiki/File:KM_Pyramid_Adaptation.png)), <https://creativecommons.org/licenses/by-sa/4.0/legalcode>

# Questions?

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