JOINT TRANSPORTATION RESEARCH PROGRAM
INDIANA DEPARTMENT OF TRANSPORTATION AND PURDUE UNIVERSITY

Central HMA Acceptance Lab Process Improvement Project

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16. Abstract

The Indiana Department of Transportation (INDOT) Central Hot Mix Asphalt (HMA) Acceptance Lab was opened on March 29, 2018, at the Office of Materials Management (OMM) facility in Indianapolis. The state-of-the-art lab conducts acceptance testing on HMA samples from INDOT's Crawfordsville and Greenfield districts, as well as testing of appeals samples from the other four INDOT districts. Each HMA sample undergoes multiple sequences acceptance testing processes. INDOT's standard metric is for these tests to be completed and reported in six days. Overall average performance in 2018 met this target (4.66 days for Crawfordsville, 4.99 days for Greenfield), however, turnaround time exceeding this target during months of peak demand. The goal of this project was to improve organization, flow of work and efficiency in the central region HMA Acceptance Lab for all tests done, with implementation leading to reduction of turnaround time from 6 days to 4 days. Note that the scope of this project only included the samples from the Crawfordsville and Greenfield districts. It did not include appeals or other special testing that the lab may conduct.

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EXECUTIVE SUMMARY

CENTRAL HMA ACCEPTANCE LAB PROCESS IMPROVEMENT PROJECT

Introduction

The Indiana Department of Transportation (INDOT) Central Hot Mix Asphalt (HMA) Acceptance Lab was opened on March 29, 2018, at the Office of Materials Management (OMM) facility in Indianapolis. This state-of-the-art lab conducts acceptance testing on HMA samples from INDOT's Crawfordsville and Greenfield districts, as well as testing of appeals samples from the other four INDOT districts. Each HMA sample undergoes multiple sequences acceptance testing processes. The goal of this project was to improve organization, flow of work, and efficiency in the central region HMA Acceptance Lab for all tests done, with implementation leading to reduction of turnaround time from 6 days to 4 days.

Findings

Four fundamental issues inhibit the performance of the HMA Acceptance Lab Turnaround Time.

1. Lack of structured sample scheduling system, based on capacity.
2. Lack of capacity to meet peak demand.
3. Lack of focus on maximizing throughput at the bottleneck Extraction operation.
4. Not reporting results on the day the testing is completed.

While numerous actions have been recommended, and some piloted, those with the highest impact will be those that address these four fundamental issues.

The Future State Value Stream Map developed in this project has a *designed* average turnaround time of 2.25 days (reduced from 3.25 days). Implementing all of the identified action plans for the Future State VSM should provide the controls to be able to consistently perform at the designed state.

Implementation

Continuous improvement concepts and tools were used as the fundamental methodology for this project. The overall approach was to identify a Current State of the HMA Lab process, analyze the Current State to identify opportunities for improvement, and then develop a desired Future State and associated recommendations for actions to move toward the Future State.

Working with INDOT employees who work in the HMA Lab, a Current State process flow diagram was developed using a process called Value Stream Mapping (VSM). Lean Manufacturing concepts were then used to identify opportunities for improvement. The HMA Lab's actual testing protocols are required to adhere to strict standards/guidelines, so the actual testing methodologies were not within the scope for improvement. The focus was to identify improvements to the overall operational flow of the samples through the testing sequences, treating it as a manufacturing process flow.

The Current State VSM was analyzed extensively, yielding numerous opportunities for improvement, including those listed above. Recommended actions were developed, and select key actions were implemented on a pilot basis. Prototype Excel models were developed to enable the analysis and pilot implementation, thus simulating the desired outcomes in the Future State VSM.

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1. INTRODUCTION

The Indiana Department of Transportation (INDOT) Central Hot Mix Asphalt (HMA) Acceptance Lab was opened on March 29, 2018, at the Office of Materials Management (OMM) facility in Indianapolis. The state-of-the-art lab conducts acceptance testing on HMA samples from INDOT's Crawfordsville and Greenfield districts, as well as testing of appeals samples from the other four INDOT districts. Each HMA sample undergoes multiple sequences acceptance testing processes. INDOT's standard metric is for these tests to be completed and reported in 6 days. Overall average performance in 2018 met this target (4.66 days for Crawfordsville, 4.99 days for Greenfield); however, turnaround time exceeded this target during months of peak demand. The goal of this project was to improve organization, flow of work, and efficiency in the central region HMA Acceptance Lab for all tests done, with implementation leading to reduction of turnaround time from 6 days to 4 days. Note that the scope of this project only included the samples from the Crawfordsville and Greenfield districts. It did not include appeals or other special testing that the lab may conduct.

2. METHODOLOGY

Continuous improvement concepts and tools were used as the fundamental methodology for this project. The overall approach was to identify a Current State of the HMA Lab process, analyze the Current State to identify opportunities for improvement, and then develop a desired Future State and associated recommendations for actions to move toward the Future State.

Working with INDOT employees who work in the HMA Lab, a Current State process flow diagram was developed using a process called Value Stream Mapping (VSM). Lean Manufacturing concepts were then used to identify opportunities for improvement. The HMA Lab's actual testing protocols are required to adhere to strict standards/guidelines, so the actual testing methodologies were not within scope for improvement. The focus was identifying improvements to the overall operational flow of the samples through the testing sequences, treating it as a manufacturing process flow. Figure 2.1 depicts the overall project methodology.

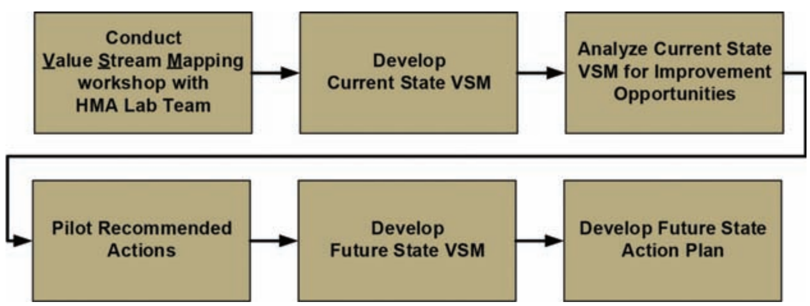

Figure 2.1 Flow diagram of the project methodology.

3. RESULTS / ACTIVITY SUMMARY

3.1 Conduct VSM Workshop (Figure 3.1)

All of the HMA Lab Technicians, along with the Lab Supervisor and Lab Manager, participated in a Value Stream Mapping Workshop. The Workshop, which spanned three half-day sessions, included:

- An overview VSM methodology and Lean Manufacturing principles.
- Development of a preliminary Value Stream Map using sticky notes and markers, capturing the team's knowledge and understanding of the overall process flow.
- A tour of the lab, validating the preliminary map, and capturing known problems and improvement opportunities.
- Identification of basic process parameters such as process times, delay times, capacities, and number of technicians for each process step.

3.2 Develop Current State VSM (Figure 3.2)

The preliminary VSM developed during the VSM Workshop was used to create a computerized version of the Current State VSM. As this Current State VSM was detailed, additional observations, assessments, time studies, interviews, and data collection were conducted to yield as accurate of a depiction of the process as possible. (Appendix A displays the completed Current State VSM.)

Significant aspects of the Current State VSM include the following:

- Five primary Work Flows/Paths were identified, representing the five tests common to all or most HMA samples.
  - T84/T85 Tests (T84/T85 Path).
  - Extraction/Gradation Tests (Gradation Path).
  - Maximum Specific Gravity Test (Max SG Path).
  - Bulk Specific Gravity Test on Pills (Pills Path).
  - Bulk Specific Gravity Test on Cores (Cores Path).
- Greenfield District samples are now delivered to the HMA Lab, while lab personnel must pick up samples from the Crawfordsville District Hub.
- Multiple tests require samples to dwell/rest for long periods of time at certain process steps (e.g., heating in ovens for hours, soaking overnight, cooling overnight, etc.). For this reason, the process flow essentially involves "daily batches," where samples are processed each day to the next "resting point."

3.3 Analyze Current State VSM for Improvement Opportunities (Figure 3.3)

Analysis of the Current State VSM included the following:

- Analysis of 2018 demand and turnaround time performance (see Figure 3.4).
  - Demand is seasonal, and highly variable within the season, depending on number of paving projects in process, weather, and other factors.
  - Highest monthly demand was 281 samples (approximately *70 samples per week*), with daily spikes as high as 53 in 2018. (Note that 88 samples were received on July 3, 2019, due to weather delays earlier in the season and extensive paving on Interstates I-65 and I-465.)

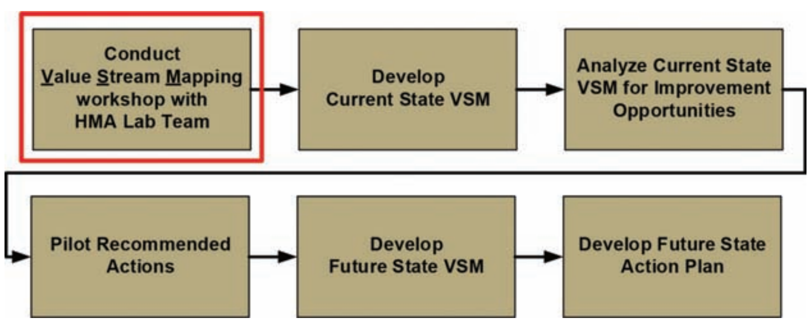

Figure 3.1 First step in project methodology was to conduct VSM Workshop.

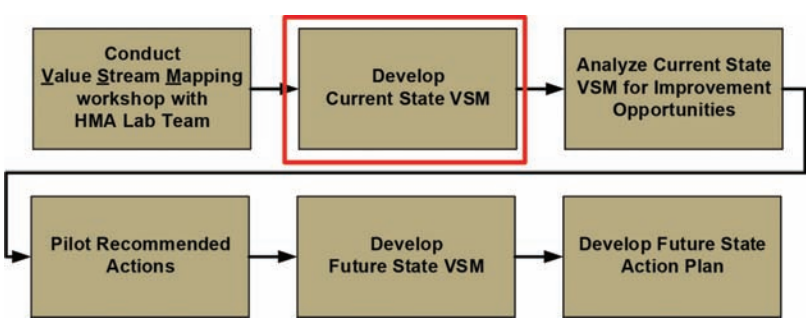

Figure 3.2 Second step in project methodology was to develop the Current State VSM.

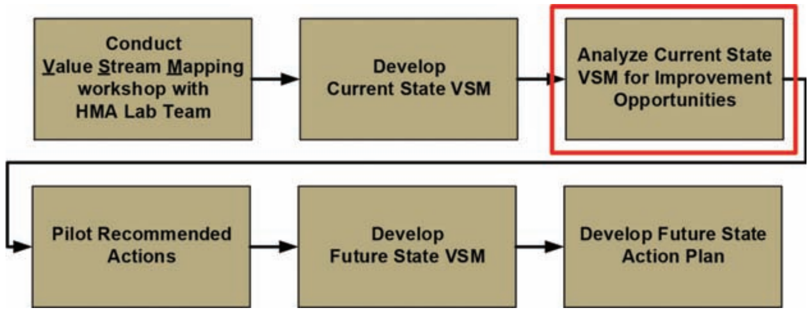

Figure 3.3 Third step in project methodology was to analyze the Current State VSM.

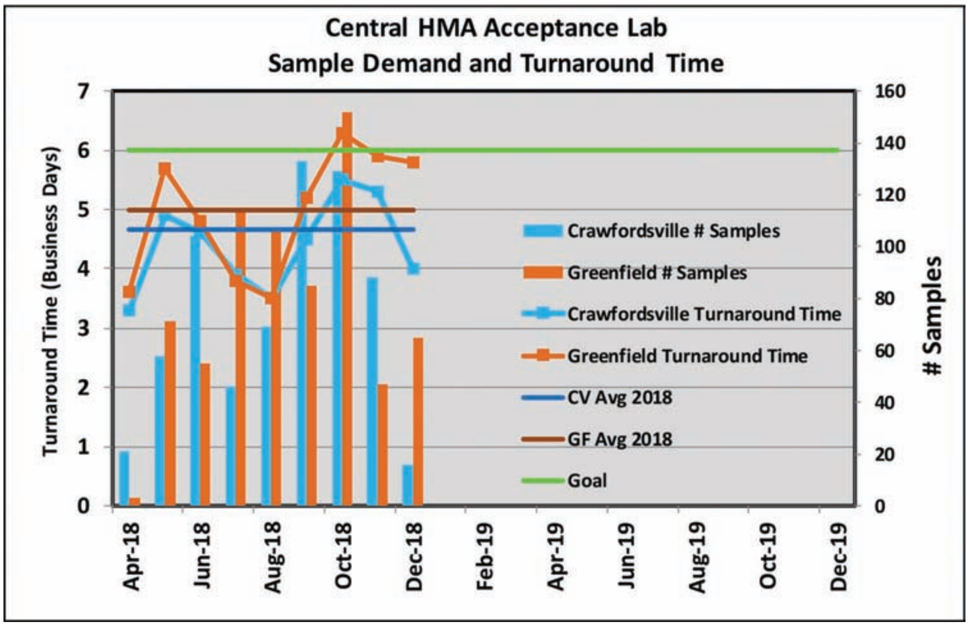

Figure 3.4 Analysis of 2018 demand and performance data.

Work Center	Process Time (min)	# People	Per person Capacity	# Stations	Per Station Capacity	Per Shift Capacity	Comments
Paperwork generation	10	0.5	45			23	
Splitting	20	2.0	22.5	4		45	
Counter	17.5	1.5	26	2		39	5 min for Bulk, 30 min for Max
Extraction	90	2	9	4	4	17	Person can run 2 stations simultaneously
Gradation	35	1.5	13			19	
Cores (Cutting/Labeling)	10	0.5	45			23	Based on overnight oven drying, not Core Dryer
T84/85	150	0.5	3			2	3/shift Based on SME knowledge/experience
Results entry/reporting	20	1	23			23	Range 15 - 25 min, avg 20
		9.5					
Hours per shift:	7.5						
Extraction Process Time for SMA adds 45 min							

Figure 3.5 Capacity modeling for each Work Center.

- Identification, validation, and modeling of capacities for each process step (see Figure 3.5).
  - Figure 3.5 depicts an Excel model that allows input of hours per week, number of people per Work Center, and number of stations, and calculates capacity for each Work Center.
  - This analysis determined that *Extraction is the bottleneck process step*. This analysis was validated empirically by observation of inventory buildup at Extraction and lack of inventory buildup and the subsequent gradation process. The analysis also determined that Extraction capacity is equipment-limited.

- ◦ Because Stone Matrix Asphalt (SMA) requires additional process time in Extraction, the Extraction bottleneck is exacerbated when SMA samples are being tested (i.e., Extraction capacity is cut in half). (Note also that SMA samples do not require Bulk SG for Pills, so Slitting and Counter Work Centers are less loaded with SMA.)

- Modeling of resource loading vs. demand (see Figure 3.6).
  - ◦ Figure 3.6 depicts an Excel model that allows input of the weekly demand, hours per shift, and other variables, and calculates resource requirements to support the demand, with automatic color coding for resource overloading.
  - ◦ Use of this model indicates that, at current staffing levels, without overtime, lab *capacity is approximately 50 samples per week*. During non-peak demand, this capacity is sufficient. During peak demand, daily and weekly spikes exceed this capacity, requiring overtime, or resulting in longer Turnaround Time.

- Detailing Process Times, Delay Times, and Lead Times for each process step.
  - ◦ On the VSM (Appendix A), see the lower portion of each process box, as well as the summary along the bottom of the VSM.
  - ◦ Based on the "daily batching," when there is not Work-In-Process inventory causing processes delays, the Work Flow Lead Times are the following:
    - ▪ T84/T85 Path: 5 days.
    - ▪ Gradation Path: 3 days.
    - ▪ Max SG Path: 3 days.
    - ▪ Pills Path: 3 days.
    - ▪ Cores Path: 3 days.
  - ◦ During peak demand, current practices generate extensive Work-In-Process inventory, which inherently adds Delay Time and increases Work Flow Lead Times (and thereby increases Lab Turnaround Time).
  - ◦ T84/T85 tests are not required on all samples (required on approximately 13% of samples year-to-date), while all of the other tests/Work Flows are required for all samples (except Cores, which is 90% year-to-date).
  - ◦ Based on this, *designed* Turnaround Time, when operating within capacity (i.e., not at peak demand), is approximately 3.25 days.

- Identification of issues and problem areas (represented on the VSM in Appendix A by yellow "Kaizen Bursts"). These included the following:
  - ◦ Delays during the sample pickup from Crawfordsville can result in the samples not arriving before the noon cutoff to start their Day 1 processing, so the sample isn't started till the next day, thereby adding 1 day to the sample's Turnaround Time.
  - ◦ Multiple redundant manual logs are maintained.
  - ◦ There is no scheduling process for lab tests. In VSM terminology, it is strictly a "Push" system, where everything just gets pushed through as quickly as possible.
  - ◦ There is limited/manual identification of the routing of samples for tests (no work order or routing system).
  - ◦ There is no system for knowing the capacity utilization status (i.e., available capacity) when a sample arrives.
  - ◦ Since multiple samples arrive at the same time, there is inherently a queue for getting paperwork generated to enable starting the samples.
  - ◦ Technicians and staff are constantly having to determine priorities and what to work on "today."
  - ◦ Technicians manually record test results onto paper at each testing step.
  - ◦ Since multiple test results at same time, have a queue for reporting results. Influx of test results at end of shift causes reporting to be delayed to next day, causing Turnaround Time to increase by 1 day.

Incoming samples per week: 51 | 224 # Samples per month | 10.2 Average # Samples received per day

		Work Center Samples/Week*							Work Center Hours/Week						
Sample Type	Weekly Demand	Admin	Splitting	Counter	Cores	Extraction	Gradation	T84/T85	Admin	Splitting	Counter	Cores	Extraction	Gradation	T84/T85
Paperwork generation	51	51	0	0	0	0	0	0	12.8	0	0	0	0	0	0
A1	51	0	102	51	0	51	51	0	0	34.0	25.5	0	76.5	29.8	0
A2	51	0	102	51	0	0	0	0	0	34.0	4.3	0	0	0	0
Cores	45.9	0	0	45.9	45.9	0	0	0	0	0	4	7.7	0	0	0
A3 (T84/T85)	7.7	0	15.3	0	0	15.3	15.3	7.65	0	5.1	0	0	23.0	8.9	19.1
Results entry/reporting	51	51	0	0	0	0	0	0	17.0	0	0	0	0	0	0
	Weekly Demand:	102.0	219.3	147.9	45.9	66.3	66.3	7.7	29.8	73.1	33.6	7.7	99.5	38.7	19.1
	Monthly Demand:	448.8	964.92	650.76	201.96	291.72	291.72	33.66	131	322	148	34	438	170	84
	Daily Demand:	20.4	43.9	29.6	9.2	13.3	13.3	1.5	6.0	14.6	6.7	1.5	19.9	7.7	3.8
								# People:	0.8	1.9	0.9	0.2	2.7	1.0	0.5
									Admin	Lab Techs					

* For each sample received:
4 Splittings (2 A1 & 2 A2)(or 6 if T84/T85)
2 Counters (Max & Bulk) (3 if Cores)
1 Extraction (3 if T84/T85)
1 Gradation (3 if T84/T85)

Assumptions:

90%	% of Samples with Cores
15%	% of Samples with T84/T85
7.5	Hours per shift
8	Current # Lab Techs
90%	Lab Tech Load Factor
0%	% SMA Samples

Process Times:

Admin Paperwork gen:	15	
Splitting/Crumble A1:	20	
Splitting/Pill A2:	20	
Splitting/Crumble A3:	20	
Counter Max:	30	
Counter Bulk:	5	
Cores (Cut/Label):	10	Based on overnight oven drying, not Core Dryers
Extraction:	90	
Gradation:	35	
T84/T85:	150	

Total Lab Techs: 7.2
Total w/ Admin: 8.0
Total Lab Techs w/ Load Factor: 8.0

Figure 3.6 Resource modeling vs. demand for each Work Center.

- Reporting of results involves extensive manual data entry from hard copy test reports.
- Reporting of results requires extensive, time consuming file/data/database manipulation.
- There is no ability to report/track timing of completion of individual steps/tests.

Recommended Actions

Moreover, the analysis concluded that the sample flow through the lab could and should be highly predictable and schedulable.

Recommended actions are summarized in Table 3.1.

Note that the option of adding a 2nd shift in Extraction to increase capacity was considered, but was not recommended due to expressed concerns over Technician safety concerns when dealing with hazardous chemicals in the Extraction process. If these concerns could be mitigated, and staffing could be effectively managed, adding a 2nd shift in Extraction during peak demand periods would be a viable and valuable option.

3.4 Pilot Recommended Actions (Figure 3.7)

For pilot implementation of a structured scheduling method, an Excel model was developed/prototyped for providing visibility of available Extraction capacity, and scheduling sample test dates accordingly (see Figure 3.8 and Figure 3.9).

- The model in Figure 3.8 allows the administrator to see Extraction capacity (the red line) by day, 90% capacity loading (the yellow line), and Overtime capacity (the dashed red line). The administrator adds Test Order numbers by day to allocate/fill the available capacity.
- The model shown in Figure 3.9 features the following:
  - The Administrator enters the Sample Number, Date Received, whether cores are included, and the targeted

TABLE 3.1
Summary of Recommended Actions

Item #	Recommended Action	Pilot Implementation?
1*	Minimize delays in pickup of samples from Crawfordsville.	—
2	Establish a structured scheduling method: A specific schedule is assigned to each test for each sample. The schedule is based on the date planned for bottleneck Extraction operation. Dates are scheduled for Extraction based on the available capacity at Extraction. All other processes/tests are scheduled based on the planned Extraction date. Do not load schedule to 100% of capacity, allowing time for reruns, appeals, etc.	Yes
3	Establish a Work Order (“Test Order”) routing system to communicate scheduled dates and to provide visual identification and control of the flow samples in the lab.	Yes
4	Increase capacity in Extraction, to provide sufficient capacity for peak demands.	—
5*	Focus on the Extraction process…make sure it is fully staffed and running at all times.	—
6	Use the Resource vs. Demand model to facilitate/trigger planning of overtime.	Yes
7	Assign staff according to Work Groups rather than Work Centers, providing more flexible resource allocation and utilization.	—
8	When running high percentage of SMA, move staff from Splitting to Extraction.	—
9*	Adjust/stagger schedules of Lab Management/Administration staff to provide resources at end-of-shift for reporting test results.	Yes
10	Establish and communicate a performance metric for schedule compliance (i.e., compliance to the specific schedules for each sample).	—
11	(Long Term) Implement a Laboratory Information Management System (LIMS) to eliminate manual/paper test reporting, minimize data entry duplication, and facilitate faster, easier, more efficient, and more accurate reporting of results.	—

*These items have the greatest short-term impact on reducing average Turnaround Time.

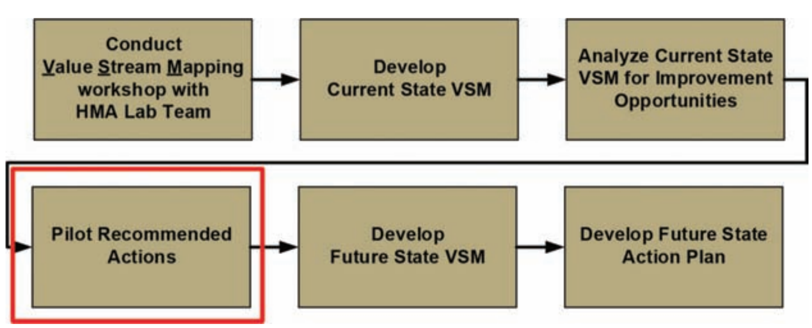

Figure 3.7 Fourth step in project methodology was to pilot recommended actions.

Day of Month:	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
Test Orders:																															
1	C46-1	G74-1																													
2	C46-3	G74-3																													
3	C47-1	G75-1																													
4	C48-1	G76-1																													
5	C49-1																														
6	C50-1																														
7	C50-3																														
8	G66-1																														
9	G67-1																														
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Figure 3.8 Excel model for visibility of Extraction process capacity loading.

Enter Data HERE to Schedule Sample					Planned Turnaround Time	Split A1			Split A2			Split A3			Max SG		
Sample #	Date Received	Cores?	Extraction A1 Schedule Date	Extraction A3 Schedule Date		Split A1	Split A1 Actual	Days past Target	Split/Pill A2	Split/Pill A2 Actual	Days past Target	Split A3	Split A3 Actual	Days past Target	Max SG	Max SG Actual	Days past Target
C82	7/1/19	Yes	7/1/19		3	7/1/19	7/1/19	0	7/1/19	7/1/19	0				7/1/19	7/4/19	3
C83	7/1/19	Yes	7/2/19		2	7/2/19			7/2/19						7/2/19		
C84	7/1/19	Yes	7/3/19		3	7/3/19			7/3/19						7/3/19		
C85	7/1/19	Yes	7/4/19		4	7/4/19			7/4/19						7/4/19		
C86	7/1/19	Yes	7/5/19		5	7/5/19			7/5/19						7/5/19		
C87	7/1/19	Yes	7/6/19		6	7/6/19			7/6/19						7/6/19		
C88	7/1/19	Yes	7/7/19		7	7/7/19			7/7/19						7/7/19		
C89	7/1/19	Yes	7/8/19		8	7/8/19			7/8/19						7/8/19		
C90	7/1/19	Yes	7/1/19	7/1/19	3	7/1/19			7/1/19			7/1/19			7/1/19		
C91	7/1/19	No	7/3/19	7/3/19	5	7/3/19			7/3/19			7/3/19			7/3/19		

Figure 3.9 Excel model for Master Scheduling of samples (not all columns show).

Extraction Dates (obtained using the Model in Figure 3.8).
- The model automatically generates scheduled dates for each Work Center for each test to be completed on the sample, as well as a planned completion date for the entire sample (not shown here).
- The model calculates Planned Turnaround Time, with conditional formatting to color code the Planned Turnaround Time. This provides immediate feedback to the administrator if there is a need to reconsider the Extraction schedule/priorities.
- When actual dates are record for each scheduled activity, the model calculates a schedule compliance ("Days past Target"), which can be used for performance monitoring/reporting.

For pilot implementation of a Work Order ("Test Order") routing system, an Excel model was developed/prototyped to enable generation of Test Orders using the same algorithms used in the Master Scheduling model (see Figure 3.10 and Figure 3.11).

- The model shown in Figure 3.10 features the following:
  - The Administrator enters the Sample Number, Date Received, whether cores are included, whether T84/T85 are required, and the targeted Extraction Dates (obtained using the Model in Figure 3.8).
  - The model automatically generates scheduled dates for each Work Center for each test to be completed on the sample, as well as a planned completion date for the entire sample ("Report Results" date).
  - The model calculates Planned Turnaround Time, with conditional formatting to color code the Planned Turnaround Time. This provides immediate feedback to the administrator if there is a need to reconsider the Extraction schedule/priorities.
- The model then automatically generates the full set of Test Orders shown in Figure 3.11.
  - Test Orders are color coded by the Test Type.
  - Each Test Order lists the Activities and Work Centers required for that Test (for Routing).
  - For each activity, the Target Date is listed, providing a means for organizing work in each Work Center by Target Date.
  - For each activity, the actual completion date is recorded (for entry into the Master Schedule in Figure 3.9), along with the initials of the person who completed the activity.
- Test Orders are printed and travel with the samples in color coded Work Order folders, along with associated test report forms for the tests to be conducted, and any other special instructions for the sample.

For piloting the use of the resource vs. demand model to facilitate/trigger planning of overtime, the Excel file for the model was provided to HMA Lab Management on 7/3/19.

Piloting of adjusted/staggered schedules of Lab Management/Administration staff to provide resource at end-of-shift for reporting test results has been left up to the staff to administer. During peak season, when the team and staff are working extensive overtime hours,

Test Order Master Data Entry Sheet

Sample #:	C234	Date Received:	7/15/2019
Cores?	Yes	Lab start date:	7/16/2019
T84/T85?	Yes	Planned Turn Time:	4

Activity	Work Center	Target Date
Split/Pill A2	Splitting	16-Jul
Split A1	Splitting	16-Jul
Split A3	Splitting	16-Jul
Max SG	Counter	16-Jul
Bulk SG Pill	Counter	17-Jul
Cut Cores	Cores	16-Jul
Weigh Cores	Cores	17-Jul
Bulk SG Cores	Counter	17-Jul
Extraction A1	Extraction	16-Jul
Extraction A3	Extraction	16-Jul
Gradation A1	Gradation	17-Jul
Gradation A3	Gradation	17-Jul
T84/T85	T84/T85	19-Jul
Report Results	Office	19-Jul

Figure 3.10 Test Order master entry screen.

this may be challenging to implement. However, it is important to reiterate that delaying reporting till the day after tests are completed “costs” an extra day on the Turnaround Time, greatly driving up the overall overage Turnaround Time. This is the greatest opportunity to improve Turnaround Time performance immediately and significantly.

3.5 Develop Future State VSM (Figure 3.12)

The Future State Value Stream Map is shown in Appendix B.

Highlights of the Future State VSM:

- Depicts the scheduling system which schedules based on Extraction, with a Pull system prior to Extraction and FIFO flow after Extraction.
- Reflects the 1-day improvement in Turnaround Time by getting results reported same-day.
- Depicts the use of color coded Test Orders.
- Depicts the implementation of a LIMS system, thus eliminating/reducing manual recording of data and redundant data entry, and improving the efficiency of reporting of results.
- Reflects increase in Extraction capacity.
- Reflects elimination of Work-In-Process inventory and associated throughput delays.
- Based on this, *designed* Turnaround Time, is approximately 2.25 days (reduced from 3.25 days).

Based on the Future State VSM, the designed Work Flow Lead Times are the following:

- T84/T85 Path: 4 days (reduced from 5 days).
- Gradation Path: 2 days (reduced from 3 days).
- Max SG Path: 2 days (reduced from 3 days).
- Pills Path: 2 days (reduced from 3 days).
- Cores Path: 2 days (reduced from 3 days).

3.6 Develop Future State Action Plan (Figure 3.13)

The action plan to achieve the Future State VSM is essentially a subset of the recommended actions detailed in Table 3.1 above (see Table 3.2). These actions require implementation of tools and systems based on those prototyped in this project, as well as potential capital expenditures.

Figure 3.11 Test Orders for each test.

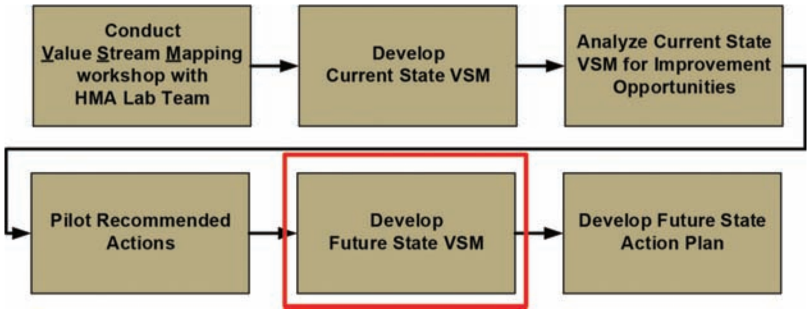

Figure 3.12 Fifth step in project methodology was to develop a Future State VSM.

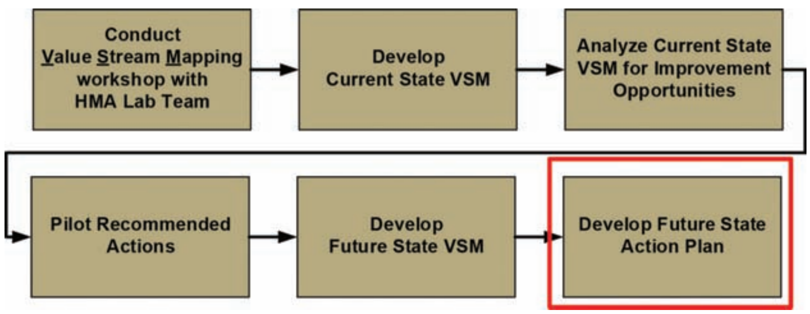

Figure 3.13 Final step in project methodology was to develop a Future State Action Plan.

TABLE 3.2
Future State VSM Action Plans

Item #	Recommended Action
1	Establish a structured scheduling method: A specific schedule is assigned to each test for each sample. The schedule is based on the date planned for bottleneck Extraction operation. Dates are scheduled for Extraction based on the available capacity at Extraction. All other processes/tests are scheduled based on the planned Extraction date. Do not load schedule to 100% of capacity, allowing time for reruns, appeals, etc.
2	Establish a Work Order (“Test Order”) routing system to communicate scheduled dates and to provide visual identification and control of the flow samples in the lab.
3	Increase capacity in Extraction, to provide sufficient capacity for peak demands.
4	Adjust/stagger schedules of Lab Management/Administration staff to provide resources at end-of-shift for reporting test results.
5	Establish and communicate a performance metric for schedule compliance (i.e., compliance to the specific schedules for each sample).
6	Implement a Laboratory Information Management System (LIMS) to eliminate manual/paper test reporting, minimize data entry duplication, and facilitate faster, easier, more efficient, and more accurate reporting of results.

4. CONCLUSIONS

Moreover, the analysis concluded that the sample flow through the lab could and should be highly structured and schedulable, with very predictable Turnaround Times.

Four fundamental issues inhibit the performance of the HMA Acceptance Lab Turnaround Time.

1. Lack of structured sample scheduling system, based on capacity.
2. Lack of capacity to meet peak demand.
3. Not focusing on maximizing throughput at the bottleneck Extraction operation.
4. Not getting results reported on the day the testing is completed.

While numerous actions have been recommended, and some piloted, those with the highest impact will be those that address these four fundamental issues.

The Future State VSM has a *designed* average Turnaround Time of 2.25 days (reduced from 3.25 days). Implementing all of the identified action plans for the Future State VSM should provide the controls to be able to consistently perform at the designed state.

APPENDICES

The Microsoft Visio file that contains the following appendices is available as a supplement to this report. It can be downloaded at https://doi.org/10.5703/1288284317078 and is viewable with Internet Explorer.

Appendix A.

Current State Value Stream Map (VSM)

Appendix B.

Future State Value Stream Map (VSM)

About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1—evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at http://docs.lib.purdue.edu/jtrp.

Further information about JTRP and its current research program is available at http://www.purdue.edu/jtrp.

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