Federal Contract # DTFH61-17D00001 – Task Order #2

LONG-TERM BRIDGE PERFORMANCE PROGRAM

PROGRESS REPORT NO. 6

Report Period: March 1, 2018 – March 31, 2018

Prepared For:

Federal Highway Administration

Prepared By:

A. Account of work performed in this period

1. Coordination and Meetings Between the Contractor and FHWA LTBP Team

The Rutgers team attended a meeting at FHWA Turner Fairbank on 3/6. The purpose of the meeting was to meet with the HDR team and help FHWA and the HDR team to prepare for the data collection contract.

Staff Engineer: 16 hours

2. Develop LTBP Program bridge performance strategic research matrix

March 2018 work consisted of developing the final proposed framework for the Strategic Research Matrices. This work included developing review process and protocols (Task 2.2.3), graphical representation (Task 2.2.4), SRM functional requirements (Task 2.2.1), topic refinement and keyword development (Task 2.2.2) for automated search. Returning to earlier subtasks in the workflow was necessary due to changes in scope to better align the project with FHWA priorities based on the February meeting at Turner-Fairbank. Work in March also began to cover ground that was to be found under the objective in Task 2.3. Test research extraction programs were undertaken with prototype software (Task 2.3.1) in order to refine the SRM framework. More details about each task can be found later in this section.

Task 2.2.1 - Identification of Review Objectives: Functional requirements for the SRMs were detailed as part of this subtask. This process was iterated with work on other subtasks. Details of the findings of this task will be found in the Task 2.2 report, due end of April 2018.

Task 2.2.2 - Development of Strategic Research Matrices Framework: An initial list of keywords to be used by the research extraction software with the domain knowledge experts at NJIT. The initial basis for these topics was the conceptual framework of Bridge Performance; this was developed first via the Data Gap Analysis task, under LTBP Task Order 2. The bridge performance categories, inputs, and attributes were then subdivided into research topics, such predicting freeze-thaw behavior, or concrete mix design. Work is ongoing to develop a comprehensive list of keywords, context keywords, and other terms useful for automating web searches for research.

Task 2.2.3 - Development of Review Protocol: Further work was performed to develop a comprehensive framework for software search of research. Constraints were developed for research sources. An investigation was undertaken to discover the availability of funding information for state DOT-based research. Work was undertaken to determine the best underlaying technologies for the development of a web-based SRM.

Task 2.2.4 - Development of Initial Visualization Concepts: Graphical mockups were developed for the SRMs. Whiteboarding sessions allowed the research team to refine these concepts. A sample of the concepts developed during this stage can be found in Appendix A.

Co-PI: 8.5 hours

Project Engineer: 200.5 hours

Staff Engineer: 165 hours

Technician: 38.74

Project Support: 17 hours

3. Conduct training for all field personnel on LTBP Protocols

No work was performed for this task.

4. Development of data collection protocols and RABIT-CE operations manual

Task 4.2.1. Instrumentation Protocols – After the submission of review comments to the Pennoni, the Rutgers team continued working on some of the very important protocols (mainly instrumentation design protocols). Meanwhile, the Pennoni team continued working on the revisions and submitted the completed parts in multiple steps.

Task 4.2.2. Legacy Data Mining Protocols – After discussion during the February 23rd meeting at the FHWA- TFHRC office, the Rutgers team finalized a list of several issues (beyond the scope of the current contract) to be corrected at the final drafts (see Appendix B). To that extent, the Rutgers team focused working on that additional task and analyzed the data extracted from the 1200 bridge documents, which has been completed through the last contract. Through this analysis, it was possible to locate the protocols fields which have been rarely or never filled up.

Task 4.2.3. RABIT-CE Operations Manual - After the submission of review comments to Infratek, the Rutgers team continued working on the contents of the proposed Validation Plan. Multiple discussions were also made with the Infratek (as they have more experience) to complete the Validation Plan. At the last days of March, the Rutgers team received the review responses from the Infratek.

Co-PI: 3.5 hours

Subject Matter Expert: 13 hours

Staff Engineer: 165 hours

Senior Engineer: 68 hours

Project Engineer: 33 hours

Technician: 23.52

Project Support: 12 hours

5. Legacy Data Mining data extraction

The Rutgers team accomplished the following during the month of February:

- Data extraction were performed throughout the month for the bridge plans provided. It should be noted that these data extraction being performed by everyone in the LDM group will take up the majority of the groups effort to complete.
- Continued to work on extracting the BLOB (Binary Large Object) files for implementation into Bridge Portal. A large portion of the team's efforts will lay in the data extraction for the immediate future.
- Quality control and quality assurance was provided for the data extraction performed this month and last month by reviewing the data collected by the students on the data extraction excel input sheet.
- Cataloguing of all bridge documentation collected that is currently being used for LDM as well as the analysis of statistics found from this such as percentage collected/missing.
- Maintenance records from the bridges in each state in which bridge documentation was collected for LDM were carefully reviewed in order to look more precisely as to exactly what kind of detailed items were included in these reports, what important items were missing, and the overall quality of the documentation provided to us from each state.
- In addition to providing charts/data/graphs of all of the bridge documentation and maintenance records analyzed, a written portion of the explaining the results found from this study were also provided.

CO-PI: 4.5 hours

Staff Engineer: 149 hours

Technician: 25 hours

Project Support: 6 hours

6. Organize, conduct, and participate in LTBP workshops and meetings

No work was performed for this task.

7. Publications, website, communications, and technical assistance

The Rutgers team prepared the electronic version of the monthly progress report and submitted it to FHWA. Moreover, the Rutgers team developed a MS Project file showing the project milestone and submitted it to FHWA.

Moreover, the Bridge Intelligence team replied to numerous FHWA's requests. The detail is in the subcontract section.

Co-PI: 31.5

Project Support: 20 hours

B. Work to be accomplished during the next period

1. Coordination and Meetings Between the Contractor and FHWA LTBP Team

The Rutgers team will reach out to the FHWA team to set up a monthly meeting.

2. Develop LTBP Program bridge performance strategic research matrix

The Rutgers team will continue the formalization of the SRM framework. The Task 2.2 report will be developed and delivered to COR in April.

3. Conduct training for all field personnel on LTBP Protocols

No work is planned under this task for the next reporting period as of now. However, FHWA might ask the Rutgers team to do a round of training for the HDR team in March.

4. Development of data collection protocols and RABIT-CE operations manual

Task 4.2.1. Instrumentation Protocols – the Rutgers team will receive all the remaining items from Pennoni and will finalize the protocols. The completed drafts will be submitted to the COR by April 25.

Task 4.2.2. Legacy Data Mining Protocols – the Rutgers team will finalize all the remaining items from the last task, which was additionally assigned during the February 23rd meeting at the FHWA- TFHRC office. The completed drafts will be submitted to the COR by April 25.

Task 4.2.3. RABIT-CE Operations Manual – the Infratek and Rutgers teams will work collaboratively to finalize the manual. The completed manual will be submitted to the COR by April 25.

5. Legacy Data Mining data extraction

The Rutgers team will continue with the data extraction from bridge documentations for the bridges that are assigned by FHWA. In addition, the team will perform QA/QC to make sure that the content being recorded in the main excel file is of high quality. The team will continue to update the main excel sheet with minor improvements in order to increase efficiency.

6. Organize, conduct, and participate in LTBP workshops and meetings

No work is planned under this task for the next reporting period.

7. Publications, website, communications, and technical assistance

The Rutgers team will prepare the electronic version of the monthly progress report and will submit it to FHWA. Moreover, the Rutgers team will submit the updated MS Project file to FHWA.

The Rutgers team will work on the tasks related to Bridge Portal as they are requested by FHWA.

C. Problems/Recommended Solutions

No problems encountered during this period.

D. How the results of the work performed supports one or more of the FHWA, DOT and LTBP Goals

The following is a summary of how the work performed on the primary tasks of this task order contribute to meeting the FHWA, DOT, and LTBP program goals.

Task 2 - Develop LTBP Program bridge performance strategic research matrix

Fundamentally, the SRMs aim to link the LTBP program to the larger research community. By placing the LTBP efforts in this larger context, the program will be able to identify potential synergies and collaborative opportunities as well as any overlaps that may exist. This will both increase the cost effectiveness of the program as well as the program's impact on bridge engineering practice through clearly showing how the LTBP program contributes to the overall bridge performance research landscape.

Task 3 - Conduct training for all field personnel on LTBP Protocols

At the heart of the LTBP program's data collection effort is the requirement that data be obtained in a consistent and reliable manner across the breadth of the program. Variations in collection techniques or unreliable practices would pollute the data streams and greatly limit the ability of the program to meets its goal of improving our understanding of long-term bridge performance. Activities under this task aim to ensure that the data collection efforts of the LTBP program are executed by teams with the required expertise to obtain consistent and reliable data.

Task 4 - Development of data collection protocols and RABIT-CE operations manual

Similar to the training work being conducted under Task 3, this task is also involved in ensuring consistent and reliable data collection throughout the program. Specifically, this task will develop additional protocols and operations manuals that specify best-practice approaches for data collection.

Task 5 - Legacy Data Mining data extraction

In addition to ensuring consistent and reliable data collection efforts, the overarching goal of the program is also dependent upon the completeness of the data collection efforts. This task contributes to this through the collection of available legacy data. This data not only provides a means to ensure field data collection efforts are carried out efficiently (i.e. on bridges best suited to meeting the program's goals) but also provides context to the data to help explain observed trends and correlations (and thus further our understanding of long-term bridge performance).

E. Purchases and Rentals

Nothing was purchased during this period.

F. Travel Details for Reporting Period

None.

G. Current and Cumulative Expenditures (cost shown includes benefits and overhead)

Institution	Current Expenditures 2/1/2018 – 2/28/2018	Cumulative Expenditures 10/1/2017 – 2/28/2018
Rutgers, the State University of New Jersey	$ 73,417.44	$ 288,780.44
Bridge Intelligence LLC	$ 6,048.00	$ 24,983.55
Pennoni Associates	$ 11,839.00	$ 33,138.00
Infratek Solutions	$ 7,000.00	$ 25,244.00
New Jersey Institute of Technology	$ 4,171.42	$ 4,171.42

H. Subcontractor's Progress Report

Sub-recipient Name: Bridge Intelligence LLC
Subaward No: 00000286
Principal Investigator: Hooman Parvardeh

LTBP TSSC
Federal Contract # DTFH61-17-D00001

PROGRESS REPORT NO. 3
For the Period from 3/1/2018 through 3/31/2018

A. Accomplishments/Work Performed

The following is a complete account of all accomplishments and work performed on each task during this reporting period.

Task 1: (Coordination and Meetings between the Rutgers and FHWA LTBP Team)

During this period, Mr. Parvardeh was invited to a meeting at FHWA TFHRC on 3/6. The purpose of the meeting was to help the FHWA and HDR team to prepare for the data collection efforts.

Number of hours during this period: 0 hour

This task is approximately 25% complete.

Task 2: (Develop LTBP Program Bridge Performance Strategic Research Matrix)

During this period Mr. Parvardeh met with Dr. Masceri two times to discuss the progress of the Strategic Research Matrix task and to develop a framework for the SRM visualization. This work is under progress.

Number of hours during this period: 8.5 hours

This task is approximately 22% complete.

Task 3: (Conduct Training on Proper Use and Application of LTBP Field Assessment Protocols)

Nothing was done during this period.

Number of hours during this period: 0 hours

This task is approximately 12% complete.

Task 4: (Development and Refinement of Data Collection Protocols)

During this period, Mr. Parvardeh assisted Dr. Babanejad with a few tasks related to Long and Short-Term instrumentation protocols.

Number of hours during this period: 3.5 hours

This task is approximately 60% complete.

Task 5: (Legacy Data Mining Data Extraction and Upload)

During this period, Mr. Parvardeh continued working on the Binary Large Object (BLOB) file storage and upload for the Legacy Data Mining Task. Mr. Parvardeh also met with Mr. Mott to discuss the progress of the data extraction work.

Number of hours during this period: 4.5 hours

This task is approximately 20% complete.

Task 6: (Organize, Conduct, and Participate in LTBP Workshops and Meetings)

Nothing was done during this period.

Number of hours during this period: 0 hours

This task is approximately 10% complete.

Task 7: (Publication, Website, Communication, and Technical Assistance)

During this period, the Bridge Intelligence team performed the following tasks:

- Prepared and submitted monthly progress report for March including updated MS project
- Performed functionality test on the Info Bridge Site twice and provided a detailed report
- Prepared the LDM related documents for FHWA and provided a download link to Dr. Zobel
- Review of the NDT metadata document which was sent by FHWA
- Provided answers and comments for the NDT metadata documents which was sent by FHWA
- Conference call with FHWA regarding the NDT metadata
- Provided time and cost estimation for developing documentations for Bridge Portal to FHWA
- Created user accounts for the HDR and Alta Vista personnel on the Bridge Portal

Number of hours during this period: 31.5 hours

This task is approximately 28% complete.

BRIDGE INTELLIGENCE

B. Work Anticipated During the Next Period

For the next period, the Bridge Intelligence team will work with the Rutgers team to satisfy the FHWA requirements.

C. Changes /Problems

None.

D. Participants & charged Level of Efforts

Personnel Name	**Role/Contribution**	**Total Hours**	**Billed Cost**
Hooman Parvardeh	Principal	48	$ 6,240.00

Below is a breakdown of level of effort per task:

Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Total
0	8.5 hrs	0	3.5 hr	4.5 hr	0	31.5 hrs	48 hrs

E. Travel

None.

PROJECT PROGRESS REPORT
March 27, 2018

Project: 005 –New Content Development, Modification and Formatting for RABIT-CE User Manual as per Rutgers University's Request and Proposed Guidelines

Progress Report #:	2 - Final
Project ID:	820631
Grant Period:	1/2/2018 to 3/25/2018
Report Period:	3/1/2018 to 3/25/2018
Rutgers Subcontract #:	0345
Rutgers Purchase Order #:	745226

Infratek Solutions Inc.
50 Washington Road, Princeton Junction, NJ 08550
Tel: 609.269.8123 www.InfratekSolutions.com

Infratek SOLUTIONS

Summary of Work Performed During This Period 3/1/2018 to 3/25/2018

- Conducted meetings with Rutgers University to review Rutger's feedbacks on the the interim delivery of the manual.
- Developed new content, formatted and added remaining chapters
- Made new figures, designs, and images and added to the document
- Reformatted existing figures, designs, and images to match the proposed outline by Rutgers University
- Took additional pictures, edited and added to the document
- Submitted the final report to Rutgers University for feedback, comments and project conclusion

Changes and Problems

There were no changes or problems during this period.

Level of Effort

NAME	Hourly Rate	Hours	Billable
Ali Asmari	$134.00	17.00	$2,278.00
Andrew Morrero	$97.00	15.00	$1,455.00
Max Meng	$100.00	18.00	$1,800.00
		Total for This Period	**$5,533.00**

Sub-recipient Name: Pennoni Associates Inc.
Subaward No: 00000285
Principal Investigator: Jeffrey E. Purdy, P.E.

LTBP TSSC
Federal Contract # DTFH61-17-D00001

PROGRESS REPORT NO. 3
For the Period from 3/5/2018 through 3/31/2018

A. Accomplishments/Work Performed

The following is a complete account of all accomplishments and work performed on each task during this reporting period.

Task 4.2: Long Term Instrumentation of Untreated and Treated Decks, Bridge Bearings, and Bridge Joints

This task is broken into four subtasks including the following:

- Identification of Performance Metrics for Treated and Untreated Concrete Decks, Bridge Bearings, and Bridge Joints
- Sensors, Data Acquisition, Installation, and Data Validation
- Protocol Development
- Development of Generalized Instrumentation Plan

During this period Pennoni staff completed addressing the review comments from Rutgers and resubmitted the protocols and generalized instrumentation plan to Rutgers.

Number of hours during this period: 64 hours

This task is approximately 66% complete.

B. Work Anticipated During the Next Period

Pennoni anticipates there will be further comments to be addressed from FHWA. These comments may or may not be addressed during the next billing cycle depending on when they are received.

C. Changes /Problems

Pennoni will require a no cost contract extension to complete assigned work (if any) during the next period. The contract end date was 3/25/2018.

D. Participants & charged Level of Efforts

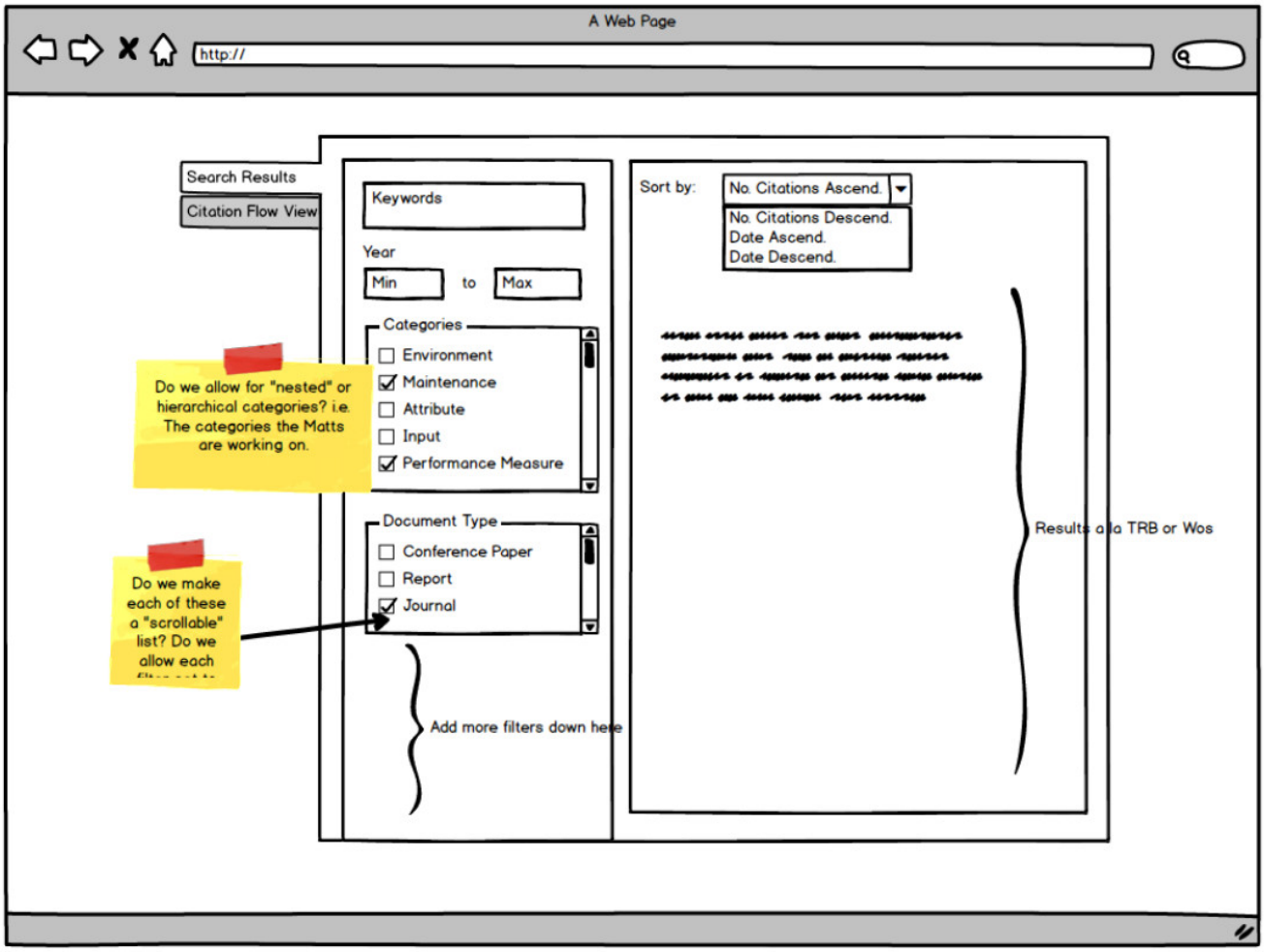
Personnel Name	Role/Contribution	Total Hours	Billed Cost
Jeffrey E. Purdy	Project management and protocol review	13	$ 3,016.00
John Blair Prader	Revision of draft instrumentation protocols	51	$ 8,823.00

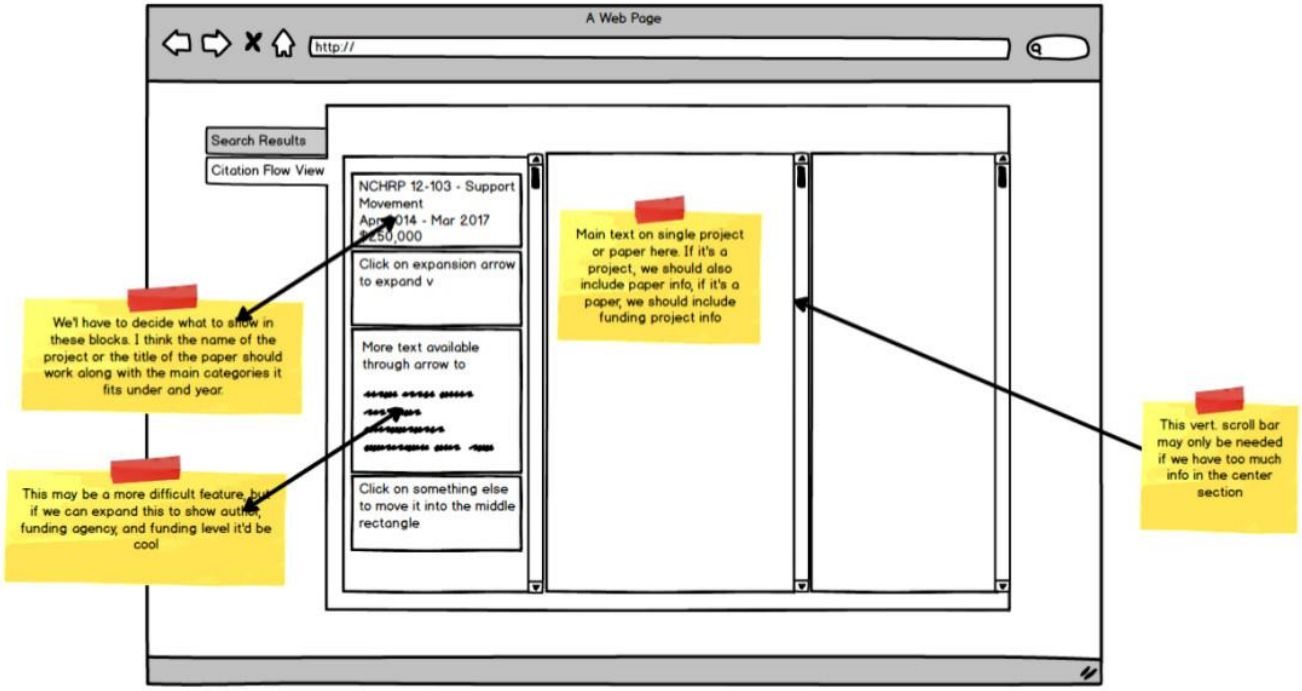
E. Travel

None.

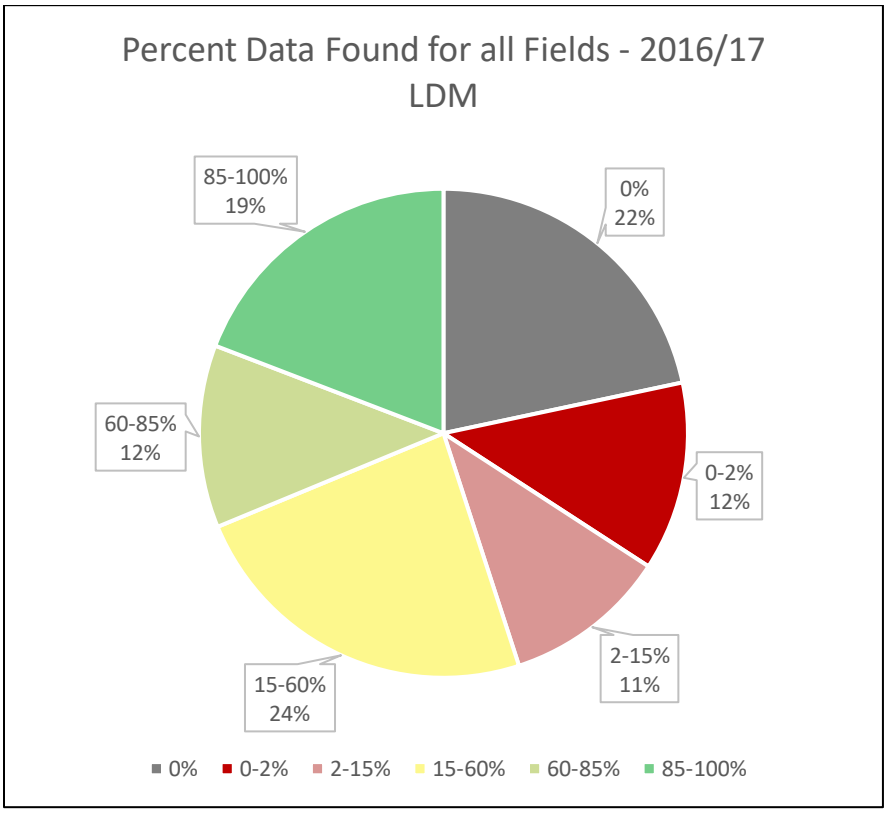
I. Appendices

Appendix A – SRM mockups





Appendix B – Analyzed statistics for the data collection task- 1200 bridges (from the previous contract)



Appendix C – Bridge documentation statistical information

Bridge Documentation Collection Statistics

State	Bridges Requested	Design Plans	As-built Plans	Either Plans	Rehab Plans	Shop Drawings	Load Ratings	Inspection History	Design Manual
CT	3	100%	0%	100%	0%	0%	100%	100%	33%
DE	57	68%	33%	102%	5%	23%	98%	100%	2%
ME	1	0%	100%	100%	0%	100%	100%	100%	0%
MD	35	89%	14%	103%	14%	3%	100%	100%	0%
MA	19	95%	5%	100%	16%	11%	100%	100%	11%
NH	2	100%	0%	100%	50%	0%	100%	100%	100%
NJ	50	40%	60%	100%	8%	0%	100%	100%	100%
NY	40	38%	75%	113%	3%	55%	100%	100%	30%
OH	16	100%	0%	100%	0%	31%	100%	100%	100%
PA	90	89%	13%	102%	19%	58%	100%	100%	78%
RI	11	100%	0%	100%	18%	0%	100%	100%	0%
VT	5	20%	80%	100%	0%	80%	100%	100%	0%
VA	49	8%	92%	100%	4%	78%	100%	100%	0%
WV	53	87%	19%	106%	6%	13%	100%	100%	17%
TOTAL:	431								

On average, each state provided XX% of this document

66.6%	35.1%	101.8%	10.2%	32.2%	99.9%	100.0%	33.6%

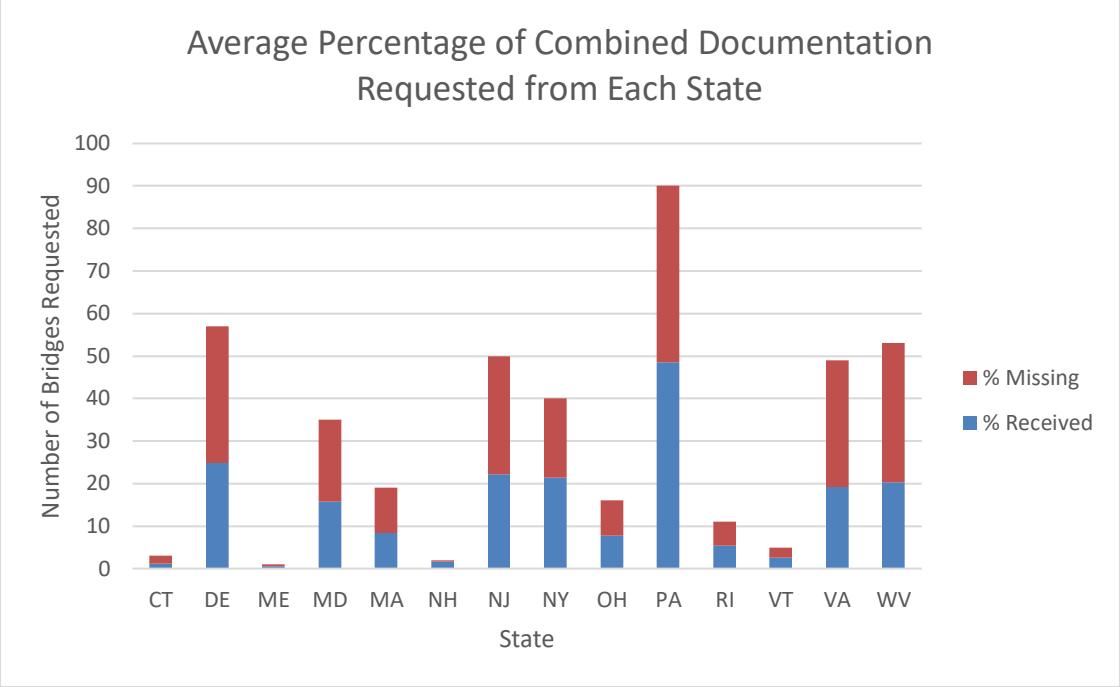
Percent chance documentation will be provided for bridge

66.4%	36.4%	102.8%	9.5%	33.6%	99.8%	100.0%	37.8%

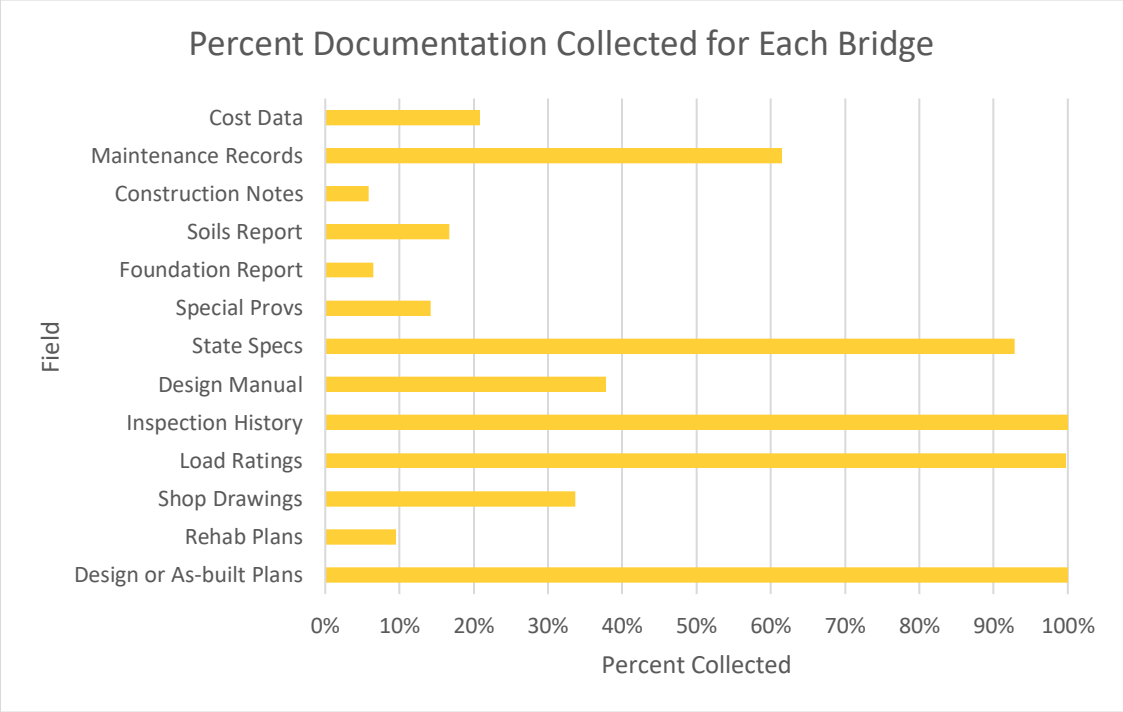
State Specs	Special Provs	Foundation Report	Soils Report	Construction Notes	Maintenance Records	Cost Data	Total % Collected
100%	0%	0%	0%	0%	100%	0%	41%
86%	12%	0%	2%	18%	100%	19%	44%
0%	0%	0%	100%	100%	0%	0%	46%
100%	69%	11%	0%	6%	66%	14%	45%
53%	42%	47%	58%	0%	0%	37%	44%
100%	100%	100%	100%	100%	100%	0%	81%
96%	0%	0%	0%	0%	74%	0%	44%
85%	8%	0%	90%	5%	100%	8%	53%
100%	13%	0%	44%	0%	13%	25%	48%
98%	0%	8%	8%	7%	77%	47%	54%
82%	64%	55%	55%	0%	9%	64%	50%
80%	100%	0%	0%	0%	0%	100%	51%
100%	4%	0%	2%	0%	14%	8%	39%
100%	2%	0%	0%	4%	45%	4%	38%

84.2%	29.5%	15.8%	32.7%	17.0%	49.8%	23.2%	48.5%

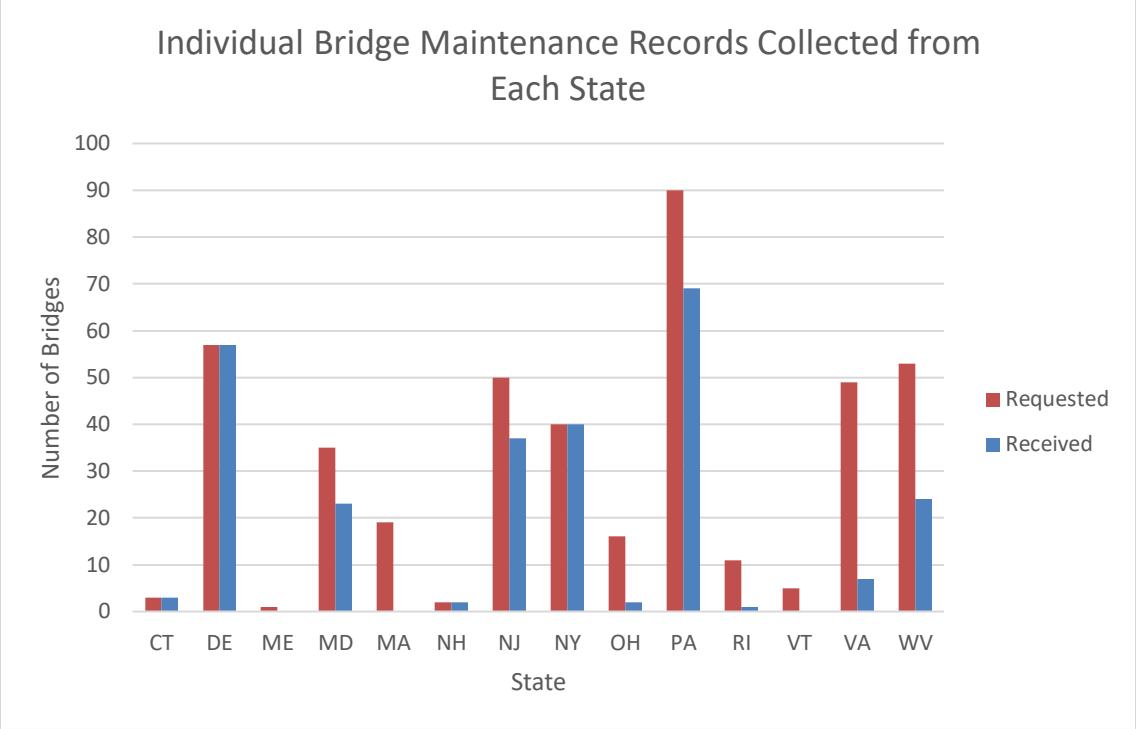
92.8%	14.2%	6.5%	16.7%	5.8%	61.5%	20.9%	46.3%



Average Percentage of Combined Documentation Requested from Each State



Percent Documentation Collected for Each Bridge



Individual Bridge Maintenance Records Collected from Each State

PROJECT 170-1270/1278 BRIDGE #00190

SHEET 25 OF 31

MAINTENANCE SUMMARY

1. Repair/patch HA's @ top of deck @ joint of P-2. Total 1 SF.
2. Repair/patch SSSp w/exp. rebar @ deck u-side. Total 3 SF.
3. Clean sand build-up @ deck exp. joint o/P-1.
4. Repair/replace missing portions of asbestos utility pipes @ south abutment and @ P-2. Total 9 LF.
5. Seal deck joints over both abutments - total 92 LF.
6. Replace heavily rusted and/or missing anchor bolt washers @ B2-7, B2-6, B2-5 bearings over P-1 -total = 4 anchor bolts.
7. Repair tilted anchor bolt @ bearing of B2-7, Span 2 and all anchor bolts @ south abutment - total = 8 anchor bolts.
8. Clean and paint all lightly rusted bearings as needed.
9. Repair/patch SSSp 1 SF @ north abutment backwall.
10. Remove vegetation from exp. joint of NW WW.
11. Seal all vt. cracks in south abutment stem as required (app. 30 L.F.).

Example of a Poor Quality Maintenance Record

Structure No.: 0429-150 Route: I-295 Cycle No.: 18
Name: Warwick Road (CR 669) over I-295 Insp. Date: 12/03/2013

WORK DONE HISTORICAL DATA

CYCLE NO.	YEAR	WORK DONE SUMMARY
18	2013	Work done on the East span, East abutment deck joint and East approach on the WB lane where previous cycle reported settlement up to 2 ½"; that area is patched up.
17	2011	None.
16	2009	Missing anchor bolts have been installed at the left sign support attached to the north fascia. Previously reported deck spalls at west span and east abutment header have been repaired. New sections have been installed at southeast and southwest approach sidewalks.
15	2007	U-bolt has been installed at the top chord of the sign attached to the south fascia over the NB roadway. New asphalt patching at the eastbound lane of the west approach.

Example of an Average Quality Maintenance Record

Monday, October 27, 2014

Status Key:
A-Active Design, AI-Active Inspection
UC-Under Construction, C-Construction and billing completed

Bridge Inspection and Remedial Engineering
Engineer's Worklist

Construction Key:
97-DBMC year, PT- to be given to Phil to assign for construction
MN-assigned to District Maintenance, AD-individual advertised contract

1

Job Number	Structure Number	Description	Work Required	Team Leader	Suspense Date	Status	Constr. Contract	Permit Type	Class Stream	Permit Restrictions	Engineer's Estimate	Construction Assign Date	Constr. Priority	Completion Date	Final Cost	Remarks
16248	0300100	US 1 over LITTLE GUNPOWDER FALLS	Remove plaque from structure # 0300100 per request of Joe Navarra in New Design.	ND		C	JP	N/A		- -	$2,500	07/16/2008	B	08/07/2008	$1,846.45	5/11/09, CWK - Notice to Proceed awarded on 5/6/09 for the replacement of the bridge (contract BA3285180)
15274	0300100	US 1 over LITTLE GUNPOWDER FALLS	Deck puncture (full depth) through sidewalk due to deterioration.			C	M			- -				10/22/2007	$14,828.21	
13278	0300100	US 1 over LITTLE GUNPOWDER FALLS	Repair deck punctures in 3 side walk areas due to deterioration.	D4		C	M			- -				09/19/2006	$7,229.20	Information obtained from District Maintenance Repair Memo per Steve Marciszewski.
13010	0300100	US 1 over LITTLE GUNPOWDER FALLS	deck punctures full depth and sidewalk puncture repairs	D4		C	M			- -				01/01/2004	$3,344.00	information taken from district memo

Example of a High-Quality Maintenance Record