

Appendix A: Questionnaire and Detailed Summary of Local Government Survey

QUESTIONNAIRE FOR ASSET MANAGEMENT SYSTEM PERFORMANCE MODELS

Please answer each question by writing in the space provided. If you need additional space, please attach additional pages as necessary. Please return the survey in the enclosed envelope to Dr. Anil Misra, Professor of Civil Engineering, University of Missouri-Kansas City, 5100 Rockhill Road, 350H Flarsheim Hall, Kansas City, MO 64110.

1. Name _____
Title _____
Organization _____
Mailing Address _____
City _____
State _____ Zip _____
Fax _____
e-mail _____

Check here if you do not wish your/ your organization name to be in the final document.

2. Are you using an asset management system? YES _____ NO _____
If YES, please mark all the types of computer program that your agency uses.
Bridge _____ Pavement _____ Sign _____ Signal _____
Other _____

3. When did you start using the above computer program? _____

4. Is your system using performance models to select the most cost effective maintenance plan? YES _____ NO _____

Comments:

5. Do you know what type of performance models your system uses? YES _____ NO _____
If YES, please describe the model type.

7. How often does your agency collect condition data for:
Pavement _____ Sign _____ Signal _____
Bridge _____ Building _____

8. Type of pavement by road (in miles) in your jurisdiction.
Flexible _____ miles Chip seal _____ miles
Rigid _____ miles Gravel _____ miles

9. Are you willing to review the draft copy of our project to identify the project's strengths and weaknesses? YES _____ NO _____
10. How does your agency determine the level of service for your assets? What criteria does your agency use?

11. What process does your agency use to make decisions on asset management replacements/renewals?

12. Does your system take into account :
Risk Cost _____ Life cycles _____ Performance Prediction _____
Optimizing Decision Making _____
13. What standards does your agency use to measure asset performance?

14. How your systems monitor performance in relation to those standards?

15. What standards are used to determine asset's remaining service life?

16. What standards of software program are being used to predict asset's deterioration?

17. Please list items which you think we should cover in this project, in order to meet your needs regarding asset performance.
- a.
 - b.
 - c.
 - d.
 - e.
 - f.

Summary of the Survey

Item 2: Are you using asset management system?

Total respondent: 34 **Yes:** 24 **No:** 10

	<i>Using Computer Program</i>	<i>N/A</i>
Bridge	15	19
Pavement	24	10
Sign	8	26
Signal	3	31
Other	8	26

In the category of *Other*, it includes:

- Work order management, infrastructure management
- Maintenance management system
- Sidewalk curbing, drainage, street lights, traffic markings, trees
- Congestion
- Buildings
- Safety, mobility

Item 3: When did you start using the above computer program?

	<i>Data Available</i>	<i>N/A</i>
Bridge	12	22
Pavement	21	13
Sign	8	26
Signal	3	31
Other	6	28

The data can be generated in a following table:

	70	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01
Bridge		/							/		/	///		//		//		/	/				
Pavement				/	//				/	///		/	//		/	/	//	/	//	/	/	/	/
Sign	/													/		/		/		//	//		
Signal														/	/		/						
Other		/												/		/	/		/	/			

Item 4: Is your system using performance models to select the most cost effective maintenance plan?

***Total respondent:** 34 **Yes:** 19 **No:** 14 **N/A:** 3

* Some respondent's answer may apply in both categories based on different projects such as bridge, pavement, etc.

Item 5: Do you know what type of performance models your system uses?

***Total respondent:** 34 **Yes:** 15 **No:** 14 **N/A:** 6

There are many model types used by the respondents such as:

- Rating procedure for streets developed by U.S. Army Corps Engineers
- Algorithm
- Deighton; Paser
- Pavement deterioration, rehabilitation relationship and maintenance and repair strategies
- Performance curves based on life expectancy and cost effectiveness
- Pavement quality, pavement distress, ride quality
- Deterministic
- Carte graph
- HPM (Highway Pavement Management Analysis), PONTIS
- Empirical models for distress (cracking, patching, etc), IRI
- Markov Chain Model
- Pavement Condition Index

Item 7: How often does your agency collect condition data?

	<i>Data Available</i>	<i>N/A</i>
Pavement	25	9
Sign	7	27
Signal	4	30
Bridge	19	15
Building	2	32

The data can be categorized in following table:

	Daily	Monthly	Every 3 month	Every 4 month	Every 6 month	Every 8 month	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	7 yr	8 yr	9 yr	10 yr
Pavement		/	/		//		////	////	///	/	/	/				
Sign	/			/	/		/		//							/
Signal	/					/			/		/					
Bridge		/			/		////	////	////	////						
Building							/		/							

Item 8: Type of pavement by road (in miles) in your jurisdiction

	<i>Data Available</i>	<i>N/A</i>
Flexible	24	10
Rigid	20	14
Chip Seal	8	26
Gravel	10	24

The data can be categorized in following table:

	0-100 Miles	101-1000 Miles	1001-5000 Miles	5001-10,000 Miles	10,001 Miles Up	Average Miles
Flexible	/	//// /	////	///	//// /	7408
Rigid	//// /	//// //// /	///			816
Chip Seal	/	//	////			4315
Gravel	//// //	/	/	/		1117

Item 9: Are you willing to review the draft copy of our project to identify the project’s strength and weakness?

Total respondent: 34 **Yes:** 24 **No:** 10

Item 10: How does you agency determine the level of service for your assets? What criteria does your agency use?

Total respondent: 34 **Data Available:** 27 **N/A:** 7

In order to determine the level of service for the assets, there are many criteria that the agencies of respondents use, for example

- Available funding and asset rating system (//// //)
- PCI – Pavement Condition Index (///)
- PSR – Pavement Serviceability Ride Rating
- Visual inspection (///)
- FHWA Highway System Monitoring System, Bridge Sufficiency
- Conditions of pavement based on several distress factors (///)
- Paser rating method
- Safety evaluation based on available resources (//)
- Grading system (A-F) based on established standard
- Accepted principles found in AASHTO Highway Capacity Manual and other standard references
- Regional thoroughfare plan, traffic volume
- Pavement – IRI (//)
- Pavement Management System

Item 11: What process does your agency use to make decisions on asset management replacement/ renewals?

Total respondent: 34 **Data Available:** 30 **N/A:** 4

Many different processes used by respondents’ agencies to make decisions on asset management replacement/renewals are shown as follow,

- Asset rating, City Council priorities, evaluation rating (///)
- Screening process factoring in volume versus capacity, road condition, municipal support while also reviewing prospective signalization of intersections
- City Commission input (//)

- Projection during budget process
- Pavement age, condition, traffic volume, and traffic loads (//)
- Visual site inspection, field management suggestions (///// /)
- Life cycle costing, rate of deterioration (///// /)
- Public Works director's recommendation
- Budget limit, available funding (////)
- Safety (//)
- Replacement when damaged or vandalized
- Consultant evaluation (///)
- Pavement management administration program (////)
- Fixed asset system
- Service request system (//)
- Future performance predicted by using past performance and lowest life cycle cost concepts are used to select optimum time for rehabilitation
- Available resources

Item 12: Does your system take into account of these factors?

	<i>Data Available</i>	<i>N/A</i>
Risk Cost	2	32
Life Cycles	21	13
Performance Prediction	22	12
Optimization Decision Making	12	22

Item 13: What standard does your agency use to measure asset performance?

Total respondent: 34

Data Available: 22

N/A: 12

The followings are the variety of standards used by respondents' agencies to measure asset performance:

- PCI – ASTM (///)
- PSR – FHWA (//)
- Life cycle
- Deterioration curve
- Pavement rating (///// //)
- Deighton Pavement Management Software
- Establish standards based on the past history (///)
- Field observation (/////)
- Manufacturer recommended life
- Evaluation by consultant
- Ride score, congestion, level of service (//)
- IRI, rutting (//)
- Longevity
- Pavement distress index, pavement serviceability index

Item 14: How your systems monitor performance in relation to those standards?

Total respondent: 34

Data Available: 18

N/A: 16

In relation to those standards, the respondents' agencies monitor the performance by,

- Targets a range for different maintenance strategies based on selected standards
- Update data such as PCI, IRI (//)
- Condition assessments survey, historical data (//// /)
- Pavement rating
- Field observation (//)
- Numerical values
- Measured level of service
- Mobility

Item 15: What standards are used to determine asset's remaining service life?

Total respondent: 34

Data Available: 17

N/A: 17

The different standards are used to determine asset's remaining service life as shown,

- PCI
- PSR
- Performance prediction model (//)
- Historical basis of pavement based on current condition (////)
- Pavement condition rating (//)
- Deterioration curve (//)
- Field inventory and observation (//)
- Initial quality and quantity of usage of asset
- Threshold value such as PSC, IRI, rutting
- FHWA, other state's information
- Consultant recommendation
- Available data

Item 16: What standards of software program are being used to predict asset's deterioration?

Total respondent: 34

Data Available: 17

N/A: 17

The diversity of standards of software program are being used to predict asset's deterioration such as,

- Use historical and current information to develop performance curve (//)
- Internal software developed on empirical evidence of pavement deterioration (//)
- Pavement management system
- Industry standards
- RSMS computer software
- Performance prediction model
- Oracle based platform
- Relational and field database (//)
- dRoad, dTIMS
- Pontis BMS
- IRI data
- PONTIS, NBI data for bridges

- Micro Paver
- IBM mainframe FORTRAN program

Item 17: Please list items which you think we should cover in this project, in order to meet your needs regarding asset performance.

Total respondent: 34

Data Available: 16

N/A: 18

The followings are the items that would meet the respondents' needs regarding to asset performance, and they are expected to cover in the project:

- Life cycle analysis (///)
- Cost model analysis (///)
- Comprehensive study on roughness
- Proved successful program to be used
- Development of regional performance models for different maintenance strategies
- Cost effectiveness of maintenance strategies
- "Repair or Replace as needed" to increase service life (//)
- Asset condition standards
- Deterioration curve for each type of asset (//)
- Methodology for calculating composite present value
- Methodology for determining historical original value
- A uniform standard data collection procedure
- A uniform rating and evaluation method
- Windows based software that is easy to manipulate (//)
- Standards maintenance treatment with standard results of these treatments
- Survey of commercial products
- For small cities, how can RMSs be made affordable and user-friendly enough to justify their use
- Level of service determinations (///)
- Integration of asset management tools
- Standard Performance Models (///)
- Linkage of GPS system and GIS systems with the program
- Applicable in many area such as pavement, bridges, signs
- Better data integration performance models setting level of services
- Complete FHWA price index
- Timing and value of chip seals
- Performance model based on actual condition information
- Examples of why preventive maintenance is cost effective with defer & rebuild
- Optimizing decision making

Geographical Distribution of survey respondents



Appendix B: Forms for Data Collection

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FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Road Name: _____ Location: _____ From: _____ To: _____

Survey Date: _____ Beginning Milepost: _____ Length: _____ End Milepost: _____ Width: _____

Width of Right of Way: _____ Average Daily Traffic (ADT): _____ Surface Thickness: _____ Base Thickness: _____

Surface Type B: Bituminous, C: Cold Mix
 S: Chip Seal, G: Gravel, O: Others

Subgrade Type: _____ Subgrade Strength: _____

Classification A1: Major Arterial, A2: Minor Arterial, C1: Major Collector
 C2: Minor Collector, L†: Local, S†: Cul-de-sac

Year of Last Survey: _____ Year of Next Survey: _____

Traffic Direction B: Both Directions, N: North Bound
 E: East Bound, S: South Bound, W: West

Year of Last Maintenance: _____ Year of Last Rehabilitation: _____

Base Type B: Bituminous, G: Gravel, A: Aggregate, R: Rolled Stone, L: Lime Stabilized, C: Cement
 F: Fly Ash Stabilized, Z: Pozzo-Pac, U: Built-up (Oil and Aggregate), O: Others, N: No Base

Year of Next Action: _____

Type of Next Action: _____

Distress Type		Severity-Quantity			Density (%)			Deduct Value			Sum of Deduct	Severity			Extent Level
		L	M	H	L	M	H	L	M	H		L	M	H	
1	Alligator Cracking											Width < 1/8"	1/8" < Width < 1/4"	Width > 1/4"	Area in SQ. Ft.
2	Bleeding											Thin Film of Bituminous	Thick Film of Bituminous	Extensive Film of Bituminous	Area in SQ. Ft.
3	Block Cracking											Width < 1/8"	1/8" < Width < 1/4"	Width > 1/4"	Area in SQ. Ft.
4	Corrugation											Depth < 1/2"	1/2" < Depth < 1 1/2"	Depth > 1 1/2"	Area in SQ. Ft.
5	Distortion											Depth < 1"	1" < Depth < 2"	Depth > 2"	Area in SQ. Ft.
6	Longitudinal Cracking											Width < 1/8"	1/8" < Width < 1/4"	Width > 1/4"	Area in SQ. Ft.
7	Polish Aggregate											Slight Friction	Very Smooth Friction	No Friction	Area in SQ. Ft.
8	Potholes											Depth < 1/2" Area < 1 ft ²	1/2" < Depth < 2" 1 ft ² < Area < 3 ft ²	Depth > 2" Area > 3 ft ²	Area in SQ. Ft.
9	Raveling and Weathering											Surface Texture Slightly Rough	Moderately Rough	Severely Rough	Area in SQ. Ft.
10	Rutting											Depth < 1/2"	1/2" < Depth < 1 1/2"	Depth > 1 1/2"	Area in SQ. Ft.
11	Surface Deterioration											Noticeable Loss	Moderate Loss	Severe Loss	Area in SQ. Ft.
12	Transverse Cracking											Width < 1/8"	1/8" < Width < 1/4"	Width > 1/4"	Area in SQ. Ft.

Sum of Deduct Value: _____ Corrected Deduct Value: _____ PCI = 100 – CDV: _____

CHIP SEAL PAVEMENT CONDITION EVALUATION FORM

Road Name: _____ Location: _____ From: _____ To: _____

Survey Date: _____ Beginning Milepost: _____ Length: _____ End Milepost: _____ Width: _____

Width of Right of Way: _____ Average Daily Traffic (ADT): _____ Surface Thickness: _____ Base Thickness: _____

Surface Type B: Bituminous, C: Cold Mix
 S: Chip Seal, G: Gravel, O: Others
 Subgrade Type: _____ Subgrade Strength: _____

Classification A1: Major Arterial, A2: Minor Arterial, C1: Major Collector
 C2: Minor Collector, L1: Local, S1: Cul-de-sac
 Year of Last Survey: _____ Year of Next Survey: _____

Traffic Direction B: Both Directions, N: North Bound
 E: East Bound, S: South Bound, W: West
 Year of Last Maintenance: _____ Year of Last Rehabilitation: _____

Base Type B: Bituminous, G: Gravel, A: Aggregate, R: Rolled Stone, L: Lime Stabilized, C: Cement
 F: Fly Ash Stabilized, Z: Pozzo-Pac, U: Built-up (Oil and Aggregate), O: Others, N: No Base
 Year of Next Action: _____
 Type of Next Action: _____

Distress Type		Severity-Quantity			Density (%)			Deduct Value			Sum of Deduct	Severity			Extent Level
		L	M	H	L	M	H	L	M	H		L	M	H	
1	Bleeding											Thin Film of Bituminous	Thick Film of Bituminous	Extensive Film of Bituminous	Area in SQ. Ft.
2	Corrugation											Depth < 1"	1" < Depth < 2"	Depth > 2"	Area in SQ. Ft.
3	Distortion											Depth < 1/2"	1/2" < Depth < 2"	Depth > 2"	Area in SQ. Ft.
4	Loose Chips											Minimal Amount < 10% of Surface	10% < Moderate Amount < 30% of Surface	> 30% of Surface	
5	Potholes											Depth < 1" Area < 3 ft ²	1" < Depth < 2" 3 ft ² < Area < 6 ft ²	Depth > 2" Area > 6 ft ²	Area in SQ. Ft.
6	Rutting											Depth < 1/2"	1/2" < Depth < 2"	Depth > 2"	Area in SQ. Ft.
7	Surface Deterioration											Noticeable Loss of Surface Integrity	Moderate Loss of Surface Integrity	Severe Loss of Surface Integrity	Area in SQ. Ft.

Sum of Deduct Value: _____ Corrected Deduct Value: _____ PCI = 100 - CDV: _____

COLD MIX PAVEMENT CONDITION EVALUATION FORM

Road Name: _____ Location: _____ From: _____ To: _____

Survey Date: _____ Beginning Milepost: _____ Length: _____ End Milepost: _____ Width: _____

Width of Right of Way: _____ Average Daily Traffic (ADT): _____ Surface Thickness: _____ Base Thickness: _____

Surface Type B: Bituminous, C: Cold Mix
 S: Chip Seal, G: Gravel, O: Others
 Subgrade Type: _____ Subgrade Strength: _____

Classification A1: Major Arterial, A2: Minor Arterial, C1: Major Collector
 C2: Minor Collector, L1: Local, S1: Cul-de-sac
 Year of Last Survey: _____ Year of Next Survey: _____

Traffic Direction B: Both Directions, N: North Bound
 E: East Bound, S: South Bound, W: West
 Year of Last Maintenance: _____ Year of Last Rehabilitation: _____

Base Type B: Bituminous, G: Gravel, A: Aggregate, R: Rolled Stone, L: Lime Stabilized, C: Cement
 F: Fly Ash Stabilized, Z: Pozzo-Pac, U: Built-up (Oil and Aggregate), O: Others, N: No Base
 Year of Next Action: _____
 Type of Next Action: _____

Distress Type		Severity-Quantity			Density (%)			Deduct Value			Sum of Deduct	Severity			Extent Level
		L	M	H	L	M	H	L	M	H		L	M	H	
1	Alligator Cracking											Width < 1/4"	1/4" < Width < 1/2"	Width > 1/2"	Area in SQ. Ft.
2	Bleeding											Thin Film of Bituminous	Thick Film of Bituminous	Extensive Film of Bituminous	Area in SQ. Ft.
3	Corrugation											Depth < 1/2"	1/2" < Depth < 1 1/2"	Depth > 1 1/2"	Area in SQ. Ft.
4	Distortion											Depth < 1"	1" < Depth < 2"	Depth > 2"	Area in SQ. Ft.
5	Linear Cracking											Width < 1/4"	1/4" < Width < 1/2"	Width > 1/2"	Area in SQ. Ft.
6	Potholes											Depth < 1/2" Area < 1 ft ²	1/2" < Depth < 2" 1 ft ² < Area < 3 ft ²	Depth > 2" Area > 3 ft ²	Area in SQ. Ft.
7	Rutting											Depth < 1/2"	1/2" < Depth < 1 1/2"	Depth > 1 1/2"	Area in SQ. Ft.
8	Surface Deterioration											Noticeable Loss of Surface Integrity	Moderate Loss of Surface Integrity	Severe Loss of Surface Integrity	Area in SQ. Ft.

Sum of Deduct Value: _____ Corrected Deduct Value: _____ PCI = 100 – CDV: _____

GRAVEL PAVEMENT CONDITION EVALUATION FORM

Road Name: _____ Location: _____ From: _____ To: _____

Survey Date: _____ Beginning Milepost: _____ Length: _____ End Milepost: _____ Width: _____

Width of Right of Way: _____ Average Daily Traffic (ADT): _____ Surface Thickness: _____ Base Thickness: _____

Surface Type B: Bituminous, C: Cold Mix
 S: Chip Seal, G: Gravel, O: Others

Subgrade Type: _____ Subgrade Strength: _____

Classification A1: Major Arterial, A2: Minor Arterial, C1: Major Collector
 C2: Minor Collector, L1: Local, S1: Cul-de-sac

Year of Last Survey: _____ Year of Next Survey: _____

Traffic Direction B: Both Directions, N: North Bound
 E: East Bound, S: South Bound, W: West

Year of Last Maintenance: _____ Year of Last Rehabilitation: _____

Base Type B: Bituminous, G: Gravel, A: Aggregate, R: Rolled Stone, L: Lime Stabilized, C: Cement
 F: Fly Ash Stabilized, Z: Pozzo-Pac, U: Built-up (Oil and Aggregate), O: Others, N: No Base

Year of Next Action: _____

Type of Next Action: _____

Distress Type	Severity-Quantity			Density (%)			Deduct Value			Sum of Deduct	Severity			Extent Level
	L	M	H	L	M	H	L	M	H		L	M	H	
1	Corrugation										Depth < 1/2"	1/2" < Depth < 1 1/2"	Depth > 1 1/2"	Area in SQ. Ft.
2	Distortion										Depth < 1"	1" < Depth < 2"	Depth > 2"	Area in SQ. Ft.
3	Dusting										< 2' High Dust Cloud	Intensive Dust Cloud	Thick Dust Cloud	
4	Loose Aggregate										Depth < 1"	1" < Depth < 2"	Depth > 2"	Area in SQ. Ft.
5	Potholes										Depth < 1/2" Area < 1 ft ²	1/2" < Depth < 2" 1 ft ² < Area < 3 ft ²	Depth > 2" Area > 3 ft ²	Area in SQ. Ft.
6	Rutting										Depth < 1/2"	1/2" < Depth < 1 1/2"	Depth > 1 1/2"	Area in SQ. Ft.
7	Surface Deterioration										Noticeable Loss	Moderate Loss	Severe Loss	Area in SQ. Ft.

Sum of Deduct Value: _____ Corrected Deduct Value: _____ PCI = 100 - CDV: _____