

NCDOT's Bridge Management System and Executive Trade-off Analysis

**Jim Edgerton
AgileAssets Inc.**

September 30, 2009

- ❖ More than 14,000 people work for NCDOT in a variety of positions, which range from transportation workers and engineers to archaeologists and ferry captains.

- ❖ NCDOT maintains about 80,000 miles of highway statewide. Texas is the only other state in the country that maintains more mileage.

- ❖ North Carolina maintains 12,712 bridges across North Carolina, ranking the state as 13th in the nation for the highest number of state-maintained bridges

❖ Past

❖ Present

❖ Future



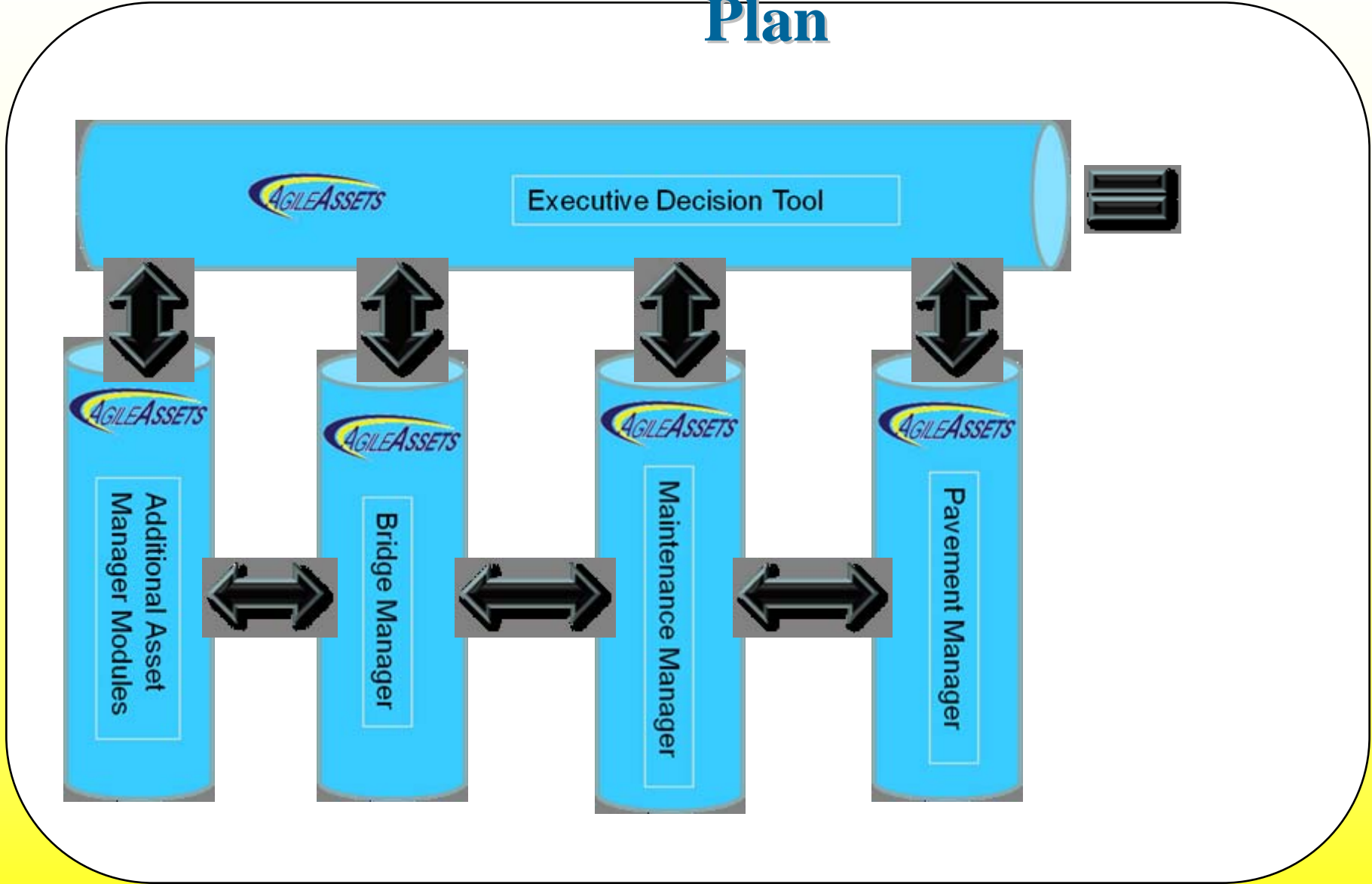
Existing

- **MMS** – Maintenance Management System
- **PMS** – Pavement Management System

New Project

- **BMS** – Bridge Management System
- **ATOA** – Asset Trade-off Analysis System

NC's Asset Management Plan



ORACLE DATABASE
ORACLE DATABASE

Inventory
(SIA)



WIGINS



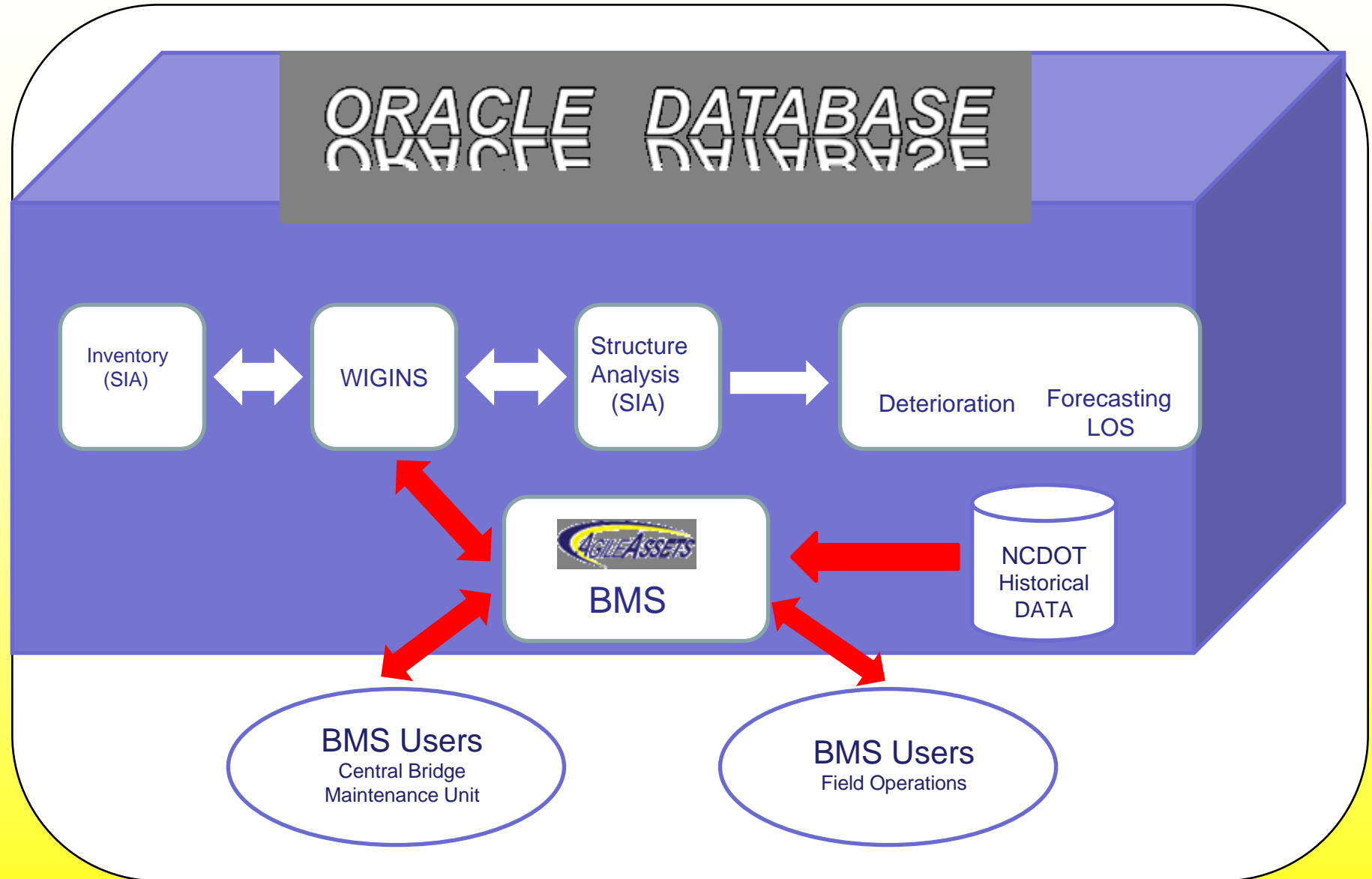
Structure
Analysis
(SIA)



Deterioration Forecasting
LOS



BMS Users
Central Bridge
Maintenance Unit



- Totally Integrated Software
- Proven Software
- Proven Implementation Methodology
- Web based Software
- Experienced staff



Targets Of The Bridge System



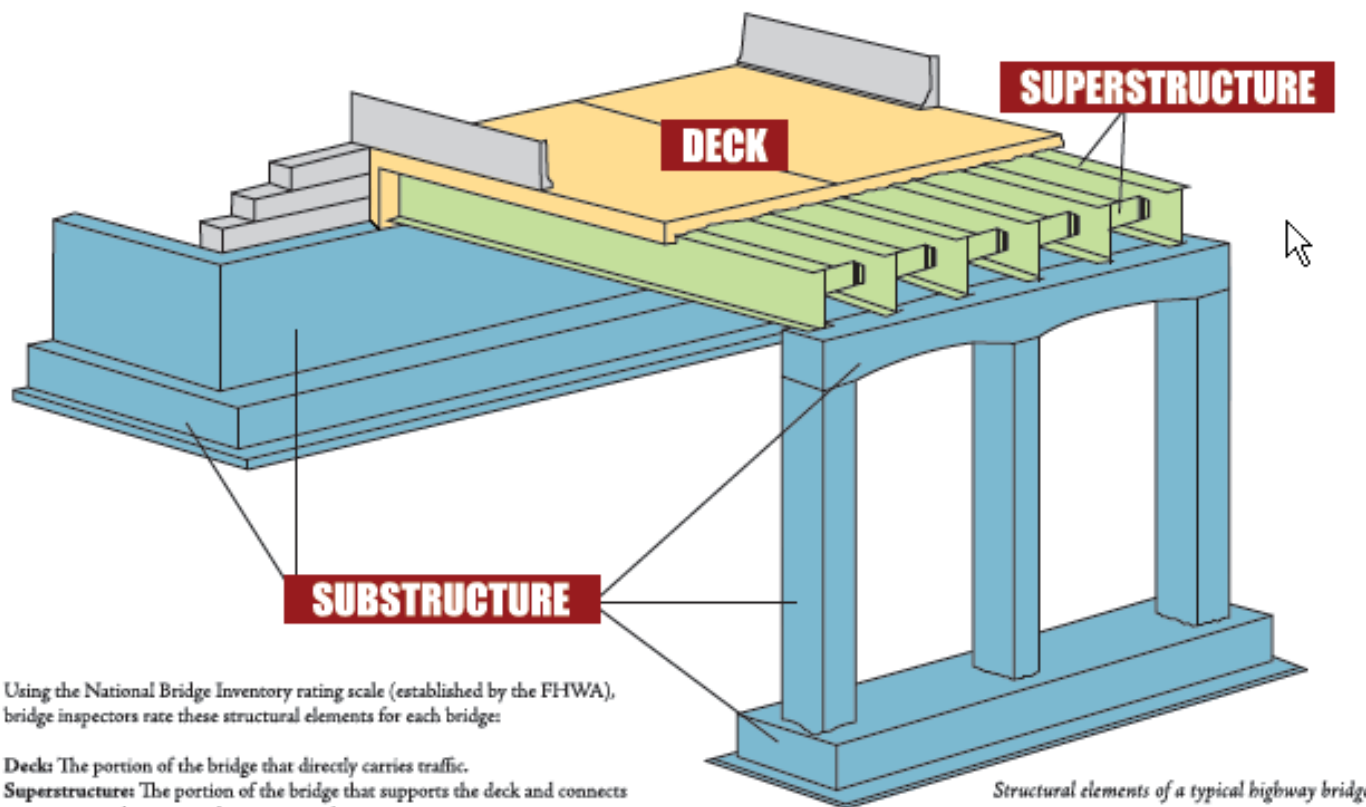
- Management of the infrastructure inventory.
- Definition and management of survey policies.
- Definition and management of condition and performance indices.
- Definition and management of deterioration models for condition indices.
- Definition and management of treatments (preventive maintenance and rehabilitation) and their costs.
- Definition and management of decision tree models for treatments.
- Definition and management of economic models which create prioritization.
- Produce annual and multi-annual work plans.
- Provide maintenance related documentation management (reports).
- Provide capabilities to present the infrastructure data and condition by using GIS & PHOTOLOG which simplifying and clarifying decision making.

AGILEASSETS Bridge Management System



- Inventory
 - Bridges
 - Culverts & Pipes
 - Overhead Sign Structures
- Inspection Manager
- Oversized, Overweight Loads
- Analysis
- Work Programs
- Reporting

Bridge Structural Elements Diagram



Using the National Bridge Inventory rating scale (established by the FHWA), bridge inspectors rate these structural elements for each bridge:

Decks: The portion of the bridge that directly carries traffic.

Superstructures: The portion of the bridge that supports the deck and connects one substructure element to another.

Substructures: The portion of the bridge that supports the superstructure and distributes all bridge loads to below-ground bridge footings.

Culverts: (Not pictured) A pipe or small structure used for drainage under a road, railroad or other embankment. A culvert with a span length greater than 20 feet is included in the National Bridge Inventory and receives a rating using the NBI scale.

Structural elements of a typical highway bridge



Bridge Inventory



Bridge 1 Go >> 6 pages (55 rows)

Bridge	01.01 Structure
6 - I-25-10.78-ABF	S-BRG-00000
I-25-.97-AAC	S-BRG-00091
I-25-100.13-AEY	S-BRG-00010
I-25-117.47-CZJ	S-CLV-002557
I-25-125.52-CZS	S-CLV-002652
I-25-135.47-AFQ	S-BRG-20011
I-25-17.24-ABQ	S-BRG-00001
I-25-19.26-ABR	S-BRG-00001
I-25-197.52-AIW	S-BRG-00012
I-25-197.52-AIX	S-BRG-00012

1. Bridge Inventory

Remarks 0 pages (0 rows)

Column Label	Re
--------------	----

General | Service | Geometric Data | Classifications | Loads/Infra./Hydr. | PI'S / Inspec. | Misc

1 Go >> 1 pages (1 rows)

01.01 Structure No.	S-BRG-00000800
* 01.02 Structure name	6 - I-25-10.78-ABF
01.03 Structure Identification Mark	0001-S-BRG-00000800
01.04 General Description	
01.05 Region	Central
Route	ML1118
Start MP	10.780
End MP	10.780
Att.	
01.10 Ordinate - N	655533
01.11 Ordinate - E	187713
Comments	262373
User Update	PASCAL
Date Update	5/29/2009
02.01 Primary Classification	BRG

2. For Each Bridge - Information Presented in a Structured Manner


Attach Number of Pictures, Files, Drawings

General | Service | Geometric Data | Classifications | Loads/Infra./Hydr. | PIS / Inspec. | Misc

<< < 1 Go > >> 1 pages (1 rows)

01.01 Structure No.	S-BRG-00000800	
* 01.02 Structure name	6 - I-25-10.78-ABF	
01.03 Structure Identification Mark	0001-S-BRG-00000800	
01.04 General Description	<input type="text"/>	
01.05 Region	Central	
Route	ML1118	
Start MP	<input type="text"/>	10.780
End MP	<input type="text"/>	10.780
Att.		
01.10 Ordinate - N	<input type="text"/>	655533
01.11 Ordinate - E	<input type="text"/>	187713
Comments	262373	

Work With Attachments [X]



Change order... Add...



For Each Bridge –

Select Elements from Element Dictionary



* Element	Element No.	↑ Importance Level	Measurement Unit	Sub units
01.01 Arch - Solid Spandrel	01.01	Very High	SM - Sq Meter	
01.02 Arch - Open/Braced Spandrel	01.02	Very High	SM - Sq Meter	
01.03 Arch - Tied	01.03	Very High	M - Meter	
01.04 primary beam/girder	01.04	Very High	M - Meter	Meter - Perimeter
01.05 Box girder (ext+int)	01.05	Very High	SM - Sq Meter	
01.06 Beam/Girder - Half through	01.06	Very High	M - Meter	Meter - Perimeter
01.07 Beam/Girder - Filler Beams	01.07	Very High	M - Meter	Meter - Perimeter
01.08 Truss - Underslung truss	01.08	Very High	M - Meter	
01.09 Truss - Half through truss	01.09	Very High	M - Meter	
01.10 Truss - Full Trough truss	01.10	Very High	M - Meter	
01.11 Slab - Solid	01.11	Very High	SM - Sq Meter	
01.12 Slab - Voided	01.12	Very High	SM - Sq Meter	
01.13 Culvert/Pipe/Subway - Circular/Oval	01.13	Very High	M - Meter	Meter - Perimeter
01.14 Culvert/Pipe/Subway - Box sec. top	01.14	Very High	SM - Sq Meter	
02 Transverse beams	02	Very High	M - Meter	Meter - Perimeter
03.02 Arch - Open/Braced Spandrel - deck	03.02	Very High	SM - Sq Meter	
03.03 Arch - Tied - deck slab	03.03	Very High	SM - Sq Meter	
03.04 Deck slab	03.04	Very High	SM - Sq Meter	
03.05 Deck slab	03.05	Very High	SM - Sq Meter	

September 30, 2009

Bridge Inventory – Record Number of Elements by Type & Span

For Each Bridge

Bridge Elements

<< < 1 Go > >> 28 pages (55 rows)

Bridge	01.01 Structure No.	Structure Type	04.01 Number of Spans	Route
6 - I-25-10.78-ABF	S-BRG-00000800	04 - Beam/Girder - At/Below Deck Surface	4	ML1118
I-25-.97-AAC	S-BRG-00091400	04 - Beam/Girder - At/Below Deck Surface	4	ML1310

Number of Elements & Details about Quantity for Each

Element totals | Element Quantities

<< < 1 Go > >> 11 pages (184 rows)

Span	Element	Measurement Unit	# Sub Elements	Importance Level	Quantity	Att.	Comments
01	01.04 primary beam/girder	M - Meter	5	Very High	46.15		
01	02 Transverse beams	M - Meter	2	Very High	20.5		
01	03.04 Deck slab	SM - Sq Meter	1	Very High	110.29		
01	04 Half joints	M - Meter		Very High			
01	05 Tie beam / rod / deck bracing	M - Meter		Very High			
01	06 Parapet beam or cantilever	SM - Sq Meter		Very High			
01	07 Shear Keys	EA - EACH	2	High	18.46		
01	08 Foundations	SM - Sq Meter		High			
01	09 Abutments	SM - Sq Meter	1	High	24.36		
01	10 Spandrel wall/head wall	SM - Sq Meter					
01	11 Pier/column	SM - Sq Meter					
01	12 Cross-head/capping beam	M - Meter					



**Example
Number of Primary Beam
Girders in Span 1 → 5**



Bridge Inventory –



Record Detailed Information about each Sub-Element

Bridge Elements

<< < 1 Go > >> 55 pages (55 rows)

Bridge	01.01 Structure No.	Structure Type	04.01 Number of Spans	Route
6 - I-25-10.78-ABF	S-BRG-00000800	04 - Beam/Girder - At/Below Deck Surface		4 ML1118

Element totals | Element Quantities

<< < 1 Go > >> 14 pages (174 rows)

Span	Element	Sub Elem Num	Sub Elem Name	Quantity	Measurement Unit	Sub-unit Quantity	Sub units	Att.
01	01.04 primary beam/girder	1	1-43-1	9.23	M - Meter	3.58	Meter - Perimeter	
01	01.04 primary beam/girder	2	1-43-2	9.23	M - Meter	3.58	Meter - Perimeter	
01	01.04 primary beam/girder	3	1-43-3	9.23	M - Meter	3.58	Meter - Perimeter	
01	01.04 primary beam/girder	4	1-43-4	9.23	M - Meter	3.58	Meter - Perimeter	
01	01.04 primary beam/girder	5	1-43-5	9.23	M - Meter	3.58	Meter - Perimeter	
01	02 Transverse beams	1	1-2-1					
01	02 Transverse beams	2	1-2-2					
01	03.04 Deck slab	1	1-58-1					
01	07 Shear Keys	1	1-7-1					
01	07 Shear Keys	2	1-7-2					
01	09 Abutments	1	1-9-1					
01	13 Bearings	1	1-13-1					
01	13 Bearings	2	1-13-2		1 EA - EACH			

Example:
Condition & Dimensions of
each of the 5 Primary Beam
Girders in Span 1

AGILEASSETS Bridge Condition Inspection



For Each Element / Sub-Element,
Record

- Type of **Defect**
- **Severity** of Defect
- **Extent** of Severity

OR, Record

NBI Condition Ratings

Defects

<< < 1 > >> 6 pages (109 rows)

* ILB DEFECTS NAME	† ILB F	ILB DEFECT SEV 1 TXT	ILB DEFECT SEV 2 TXT	ILB DEFECT SEV 3 TXT	ILB DEFECT SEV 4 TXT	ILB DEFECT SEV 5 TXT
01.01 Corrosion, pitting	1	No sign of rust or	Slight surface rust	Pitting, local	Pitting, perforation,	Disintegrated due to
01.02 Reduced cross-section (section loss)	1	No loss of cross-section	minor loss of	moderate loss of	Severe loss of	Collapse
01.03 Connecting elements	1	No signs of rusting	Non structural bolts	Non structural	Structural bolts	Failure of element
01.04 Welding	1	No corrosion or	Slight corrosion of	Crack at toe of	Longitudinally	Weld connection
01.05 Cracking	1	No signs of	Fine cracks not in	Fine cracks in areas	Cracks penetrate	Failure of element
01.06 Fire	1	Signs of soot with		Signs of damage.		Loss of stability and
01.07 Poor workmanship	1	No sign	Fillet weld			
01.08 Algae, mould, bacteria	1	Very slight surface	The element is			
01.09 grout under base plates	1	No sign of				loss of stability as a
02.01 Spalls	2	No spalling	Slight, but clear,	Large, discrete spalling	Deep, conjoined spalling	The element is
02.02 Delamination	2	No Delamination.	Early signs of	Delamination in regions	Delamination in regions	Failure as a result of
02.03 Cracks in reinforced concrete affecting	2	No sign of	Hairline cracks less	Cracks between 0.3-1.0	Wide cracks 1.0 - 4.9	Cracks wider
02.04 Cracks in Reinforced Concrete not	2	No signs of	Hairline cracks 0.3-	Wide cracks – 2.0 – 4.9	Cracks more than 5 mm	The element
02.05 Cracks at prestressed concrete	2	Random hairline	Hairline cracks 0.05 -	Cracks between 0.1 –	Wide cracks 0.3 – 1.0	Cracks
02.06 Stressing cables/rods	2	No signs of	Defects in the grouting	Cracking along the length	Exposure of the	Failure of the
02.07 Efflorescence: white deposits of	2	Powdery white	White efflorescence of	White efflorescence of		
02.08 Chlorides Sulphates Acids (structures	2	No sign of attack	steel bars have surface	steel bars are rusted up	Loss of 50-75% area	Failure of the
02.09 Freeze\ thaw	2	No signs of	Slight cracking caused	Moderate freeze-thaw	Major freeze-thaw	Failure due
02.10 Concrete Forms deficiencies	2	Tie-wires and/or	Rough concrete surfaces			



Treatment Assignment At Sub-Element Level

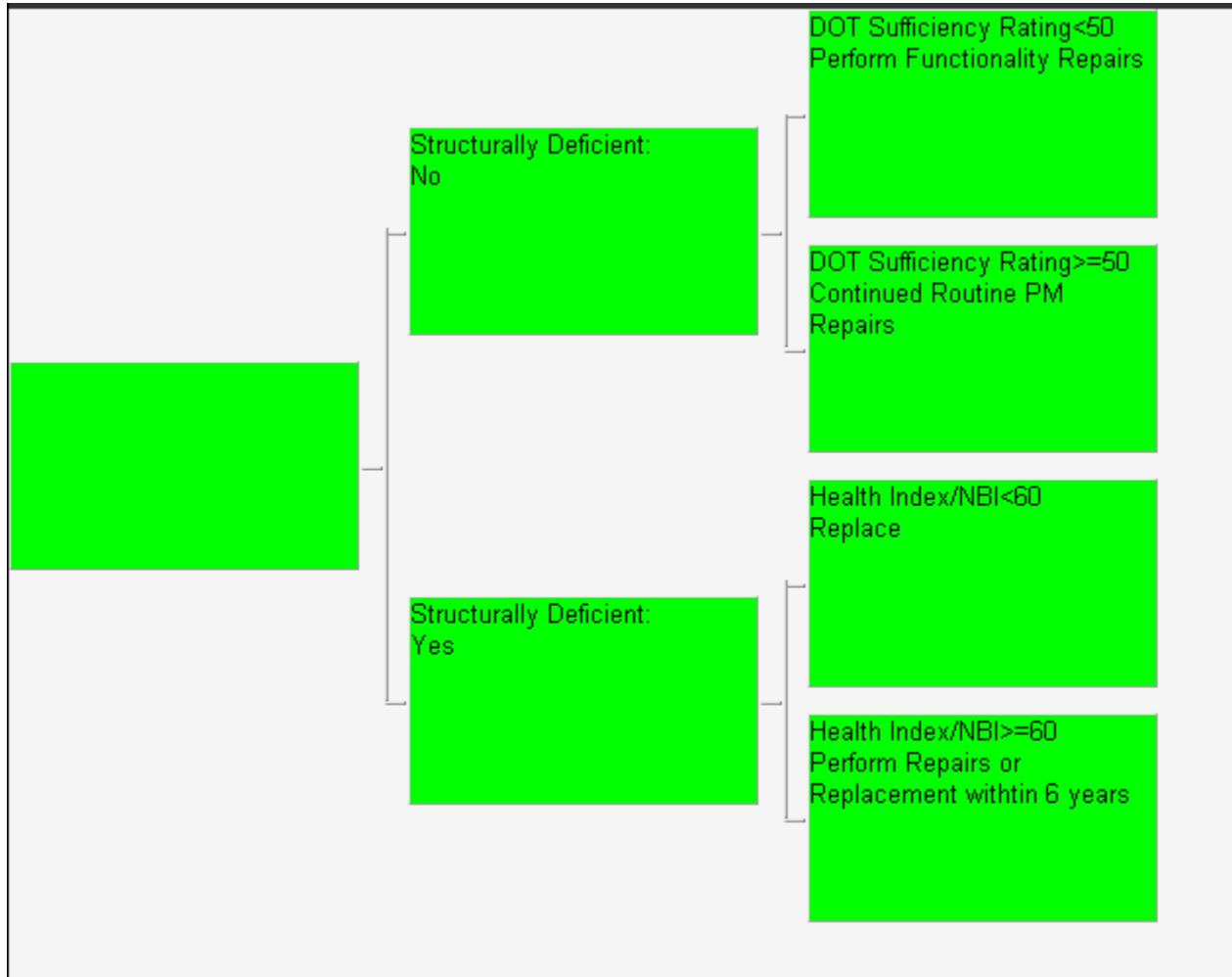


Based on Recorded Defect + Severity + Extent

TRT No (1, Defects)	Element	Extent	Severity	Treatment	
1	14.01 Impact damage	03.04 Deck slab	B	2	1 Replace/Design
1	14.01 Impact damage	03.04 Deck slab	D	5	1 Replace/Design
1	14.01 Impact damage	03.04 Deck slab	E	5	1 Replace/Design
2	05.01 Paintwork and	03.04 Deck slab	E	3	PT4
2	05.03 Galvanizing	03.04 Deck slab	B	1	GV1
2	05.03 Galvanizing	03.04 Deck slab	C	1	GV1
2	09.02 Staining	03.04 Deck slab	D	2	ST3
3	09.02 Staining	03.04 Deck slab	D	2	ST4
2	09.02 Staining	03.04 Deck slab	E	2	ST3
3	09.02 Staining	03.04 Deck slab	E	2	ST4
1	06.01 Structural damage from	03.04 Deck slab	D	3	VT4
2	05.03 Galvanizing	03.04 Deck slab	D	1	GV1
2	05.03 Galvanizing	03.04 Deck slab	E	1	GV1
2	05.03 Galvanizing	03.04 Deck slab	B	2	GV1
3	05.03 Galvanizing	03.04 Deck slab	B	2	GV2
2	09.02 Staining	03.04 Deck slab	B	2	ST3
3	09.02 Staining	03.04 Deck slab	B	2	ST4
2	09.02 Staining	03.04 Deck slab	C	2	ST3
3	09.02 Staining	03.04 Deck slab	C	2	ST4

Treatment Assignment

Decision Trees Based on NBI Ratings





For Each Bridge –

Compose Projects from Recommended Treatments



- Treatments Recommended @ Element/Sub-Element Level
- Benefits & Costs Calculated for each Treatment

Bridge - Project Composition

1 87 pages (87 rows)

Bridge	↑ CPI Av	CPI Crit	Trt. Group	Def 11	Def 13	Def 14	090 INSPECTION DATE
1 - I-80-152.46-ARS	86.34	100.00	B	No	No	No	6/15/2008

Projects | Recommended Treatments

Projects

1 2 pages (3 rows)

Approved	Project Type	Improvement Project	CPI Av	CPI Crit	Project Cost	CE Factor	Project Benefits	Project
<input checked="" type="checkbox"/>	BMS Type 1	Project #263138	96.18	100.00	\$77,050.00	0.35	9.8383	
<input type="checkbox"/>	BMS Type 2	Project #263139	86.34	100.00	\$5,820.00	1.05	0	

Treatments

1 1 pages (6 rows)

Span	Element	Defects	Severity	Extent	Treatment	Quant. for Trt	Treatment Cost	Improved BCI	Benefit Cost R
0	08 Foundations	02.04 Cracks in Reinforced Concrete not affe	3	C	CN3	24	\$4,800.00	2.1	0.0002
0	08 Foundations	02.17 Abrasion (wearing away of the surfac	2	E	CN1	120	\$48,000.00	1.7	0
0	09 Abutments	02.04 Cracks in Reinforced Concrete not affe	2	D	CN3	38.8	\$7,760.00	1.3	0.0001
0	09 Abutments	02.04 Cracks in Reinforced Concrete not affe	2	D	CN3	38.8	\$7,760.00	1.3	0.0001
0	09 Abutments	02.07 Efflorescence: white deposits of calci	2	C	CN1	14.55	\$5,820.00	1.1	0.0002
0	09 Abutments	02.12 concrete cover defects	2	C	CN3	14.55	\$2,910.00	1.1	0.0003



Create Optimal Work Plan



List of all Projects to be Implemented

- Multi-Year Analysis Based on Objectives & Constraints

Work Plan										Treatments				
Structure Name	Route	Direction	Lane	Offset	Start MP	End MP	Plan Year	MWP	Project Sta	Span	Defects	Severity	Extent	Treatment
I-25-278.84-ALB	ML25	Both	All	0	278.840	278.840	2010	Preliminary		0	02.01 Spalls	2	B	CN1
I-25-247.53-AKB	ML25	Both	All	0	247.530	247.530	2010	Preliminary		0	02.01 Spalls	2	B	CN1
P-20-32.65-FEY	ML20	Both	All	0	32.650	32.650	2010	Preliminary		0	02.01 Spalls	2	B	CN1
I-80-391.39-BAE	ML80	Both	All	0	391.390	391.390	2010	Preliminary		0	02.04 Cracks in Reinforced Concrete	2	B	CN3
S-2101-15.25-CVM	ML2101	Both	All	0	15.250	15.250	2010	Preliminary		0	02.04 Cracks in Reinforced Concrete	3	B	CN2
S-2201-10.37-CXD	ML2201	Both	All	0	10.370	10.370	2010	Preliminary		0	02.05 Cracks at prestressed concrete	1	A	CN3
I-80-30.4-ANJ	ML80	Both	All	0	30.400	30.400	2010	Preliminary		0	02.07 Efflorescence: white deposits	2	B	CN1
S-2103-9.92-JMZ	ML2103	Both	All	0	9.920	9.920	2010	Preliminary		0	02.10 Concrete Forms deficiencies	1	C	CN3
I-90-63.51-BDN	ML90	Both	All	0	63.510	63.510	2010	Preliminary		0	02.10 Concrete Forms deficiencies	1	B	CN3
P-51-5.31-FEM	ML51	Both	All	0	5.310	5.310	2010	Preliminary		0	02.10 Concrete Forms deficiencies	1	B	CN3
I-25-10.59-ABC	ML1118	Both	All	0	10.590	10.590	2010	Preliminary		0	02.10 Concrete Forms deficiencies	1	B	CN3
I-25-46.15-DCV	ML25	Both	All	0	46.150	46.150	2010	Preliminary		0	02.10 Concrete Forms deficiencies	2	B	CN3

Plan Year	Budget Group	Budget Constraint	SUM PROJ COST
2010	General	200000	199946.30250000002
2011	General	200000	199357.19499999998
2012	General	200000	199517.225
2013	General	0	

Plan Year	SSCPI Av.	SSCPI Crit.	Sum Project Benefits
2009	83	67	0
2010	85	71	260.4682
2011	86	72	102.9606
2012	87	74	72.185

- Example
 - Condition Improvement, Benefits – Corresponding to Varied Funding Scenarios

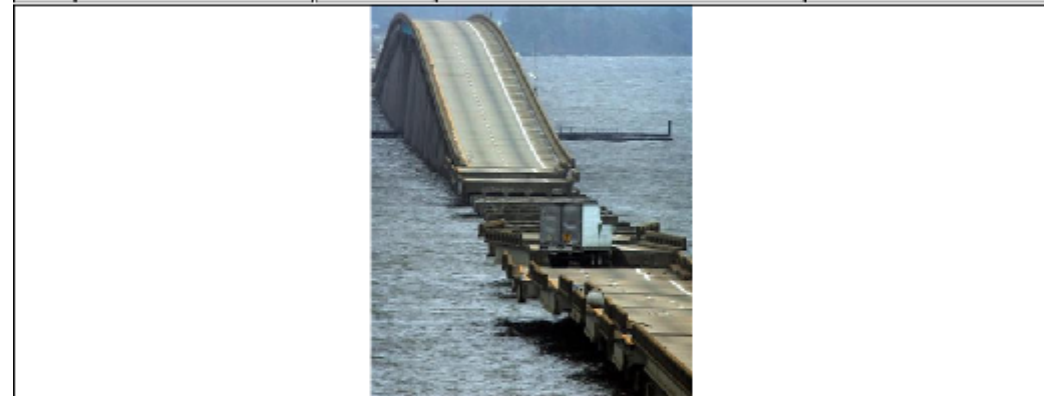
Scenario	Year	Budget	Spent	SSCPI-Avg	SSCPI-Crit	Benefits
111	2009			83	68	0
	2010	\$100,000	\$98,944	85	71	184
	2011	\$100,000	\$99,723	86	72	74
	2012	\$100,000	\$99,714	86	73	50
	FINAL			\$298,381	86	73
112	2009			83	68	0
	2010	\$200,000	\$199,946	86	72	260
	2011	\$200,000	\$199,549	87	73	93
	2012	\$200,000	\$198,295	88	74	69
	FINAL			\$597,790	88	74

- Bridge Information
- Geometric Data
- Service Data
- Element Condition
- Inspector Findings
- Inspection History
- Photos
- Drawings

Bridge & Culvert Identity Card V. 5-2007

Page 1 of 5

No.	Item	Unit	Value	Remarks
1. Identification Data				
1.1	Structure No.	code	Pascal	01.01
1.2	Structure Name	code	ThereIsNoSpacesInThisSentence	01.02
1.3	Structure Identification	code	JustAsItIsAbove	01.03
1.4	General Description	Description	this is a jut a try to see if the text show the right way in the report. It surely doesn't mean anything and should be eventually deleted, like this structure anyway. Please review the report to make sure everything works appropriately.	
1.5	Region	Value	South	01.05
1.6	Road Number	Value	109	01.06
1.7	Kilometer Point	Value	0.99	01.07
1.10	Ordinate - N	Value	999999	01.10
1.11	Ordinate - E	Value	999999	01.11



2. General Classification Data				
2.1	Primary Classification	Value	CLV	02.01
2.2	Secondary Classification	Value		02.02
2.3	Road Class	Description	Dual carrieway main road	02.03
2.4	Emergency Classification	Description	Yes	02.04
2.5	Built By	Description	Unknown	02.05
2.6	Owner	Description	Ministry of Defense with IDF	02.06
2.7	Maintenance Responsibility	Description	Public Infrastructure Companies	02.07
2.8	Toll	Description	Yes	02.08
2.9	Special Loads Route	Description	Yes	02.09
2.10	Historical Significance	Description	Yes	02.10
2.11	Temporary Structure	Description	Yes	02.11
3. Service Data				
3.1	Year Built	Year	1236	03.01
3.2	Year of Rehabilitation	Year	6524	03.02

Structure No:	0001-S-CLV-0007300	Structure Name:	הגנה מפני תאונות כלי רכב	Page no.:	1	Of:	16
Company:	אגיל אסטים	Inspector Name:	דניאל גרין	Inspection Date:	10/06/2007		
General Data							
Structure Type:	Culvert	General Description:	הגנה מפני תאונות כלי רכב	Inspection Type:	Visual	Inspection Date:	10/06/2007
Company:	אגיל אסטים	Inspector Name:	דניאל גרין	Inspection Type:	Visual	Inspection Date:	10/06/2007
Structure No:	0001-S-CLV-0007300	Structure Name:	הגנה מפני תאונות כלי רכב	Structure Inspection Classification:	Culvert type 2		
Structure Identifying Mark:		Coordinates:		Easting:	647269	Northing:	657269
Project No.:		Project Name:		Project Start:		Project End:	
Structure Material:	Concrete	Structure Condition:		Structure Age:		Structure Status:	
Number of Spans:	1	Number of Spans Formed Separately:	1	Number of Spans Formed Together:	1	Number of Spans Formed Together:	1
Number of Spans Formed Separately:	1	Number of Spans Formed Together:	1	Number of Spans Formed Together:	1	Number of Spans Formed Together:	1
Number of Spans Formed Together:	1	Number of Spans Formed Together:	1	Number of Spans Formed Together:	1	Number of Spans Formed Together:	1
Number of Spans Formed Together:	1	Number of Spans Formed Together:	1	Number of Spans Formed Together:	1	Number of Spans Formed Together:	1



Structure No:	0001-S-CLV-0007300	Structure Name:	הגנה מפני תאונות כלי רכב	Page no.:	5	Of:	16
Company:	אגיל אסטים	Inspector Name:	דניאל גרין	Inspection Date:	10/06/2007		
Element Condition Scores - By Span							
Span	Element No.	North of Sub-Element	Total Quantity	Measurement Unit	CRS		
0	01.14	Culvert/Pipe/Subway - Box sec. top slab	1	SM - Sq Meter	2.70		
0	03.14	Culvert/Pipe/Subway - Floor slab changed to element 8 or 29 see inspection Checklist	1	SM - Sq Meter	2.70		
0	09	Abutments	2	SM - Sq Meter	3.05		
0	1E	Spandrel wall/head wall	2	SM - Sq Meter	2.35		
0	17	Water crossing	1	SM - Sq Meter	1.00		
0	21	Fences, Hand/safety barrier	4	M - Meter	1.00		
0	23	Hand/safety barrier	4	M - Meter	1.00		
0	24	Contemporary walling	1	SM - Sq Meter	1.00		
0	31	Wing walls	2	SM - Sq Meter	3.00		
0	33	Embankments	2	SM - Sq Meter	1.00		
0	41	Cuts	1	M - Meter	1.00		
					Span 6 Indices C55 Average = 1.87 C55 Critical = 2.70		
					Bridge Indices CR Average = 61.63 CR Critical = 65.32		

Structure No:	0001-S-CLV-0007300	Structure Name:	הגנה מפני תאונות כלי רכב	Page no.:	3	Of:	16	
Company:	אגיל אסטים	Inspector Name:	דניאל גרין	Inspection Date:	10/06/2007			
Element Inspection Documentation [3]								
Span	Element No.	Sub-Element No.	Def.	S	Ea	Findings Documentation	Photo Code	
0	01.14	Culvert/Pipe/Subway - Box sec. top slab	1	02.07	2	B	התקנה נמצאת במצב טוב	ipm7094.jpg
0	01.14	Culvert/Pipe/Subway - Box sec. top slab	1	02.10	2	E	התקנה נמצאת במצב טוב	ipm7095.jpg
0	01.14	Culvert/Pipe/Subway - Box sec. top slab	1	02.11	2	B	התקנה נמצאת במצב טוב	ipm7096.jpg
0	01.14	Culvert/Pipe/Subway - Box sec. top slab	1	02.12	2	C	התקנה נמצאת במצב טוב	ipm7097.jpg
0	01.14	Culvert/Pipe/Subway - Box sec. top slab	1	02.13	2	C	התקנה נמצאת במצב טוב	ipm7098.jpg
0	03.14	Culvert/Pipe/Subway - Floor Slab changed to element 8 or 29 see inspection Checklist	1	06.02	2	E	התקנה נמצאת במצב טוב	ipm7099.jpg
0	09	Abutments	A	02.01	2	B	התקנה נמצאת במצב טוב	ipm7100.jpg
0	09	Abutments	A	02.04	2	C	התקנה נמצאת במצב טוב	ipm7101.jpg
0	09	Abutments	A	02.07	1	B	התקנה נמצאת במצב טוב	ipm7102.jpg
0	09	Abutments	A	02.10	2	E	התקנה נמצאת במצב טוב	ipm7103.jpg
0	09	Abutments	A	02.11	2	B	התקנה נמצאת במצב טוב	ipm7104.jpg
0	09	Abutments	A	02.13	2	D	התקנה נמצאת במצב טוב	ipm7105.jpg
0	09	Abutments	B	02.04	3	C	התקנה נמצאת במצב טוב	ipm7106.jpg
0	09	Abutments	B	02.04	2	C	התקנה נמצאת במצב טוב	ipm7107.jpg
0	09	Abutments	B	02.07	1	B	התקנה נמצאת במצב טוב	ipm7108.jpg
0	09	Abutments	B	02.11	2	E	התקנה נמצאת במצב טוב	ipm7109.jpg



S = severity Ea = extent Def = defect type
 [3] to be fixed at initial and routine inspections only
 [4] not to be fixed by inspector



Reports - Inspection Report



- Condition Indices Calculated for Elements in Each Span

Structure No.	0004-S-BRG-00015501	Structure Name	I-25-250.00-ABH	Page no.	9	Of	17
Company	null	Inspector Name	null	Inspection Date	15/12/2008		

Element Condition Scores - By Span

Span	Element No.	Numb of Sub-Elem.	Total Quantity	Measurement Unit	ECS
------	-------------	-------------------	----------------	------------------	-----

Span 2 Indices CSS Average = 2.11 CSS Critical = 4.05

3	01.04 primary beam/girder	6	55.38	M - Meter	4.05
3	02 Transverse beams	4	60.00	M - Meter	3.08
3	03.04 Deck slab	1	180.00	SM - Sq Meter	4.00
3	07 Shear Keys	2	2.00	EA - EACH	1.00
3	08 Foundations	1	50.00	SM - Sq Meter	1.00
3	11 Pier/column	3	31.65	SM - Sq Meter	4.00
3	12 Cross-head/capping beam	1	11.80	M - Meter	3.00
3	13 Bearings	10	10.00	EA - EACH	1.00
3	14 Bearing plinth/shelf	5	0.40	SM - Sq Meter	1.00
3	21 Finishes: Handrail/safety barrier	2	43.40	M - Meter	1.00
3	23 Handrail/safety barrier	2	43.40	M - Meter	1.00
3	24 Carriageway surfacing	1	5200.00	SM - Sq Meter	1.00
3	26 Invert/river bed	1	5200.00	SM - Sq Meter	1.00
3	36 Signs	4	4.00	EA - EACH	
3	37 Lighting	10	10.00	EA - EACH	
3	38 Services	2	18.00	M - Meter	

Span 3 Indices CSS Average = 2.26 CSS Critical = 4.05

4	01.04 primary beam/girder	6	55.38	M - Meter	3.05
4	02 Transverse beams	2	30.00	M - Meter	3.15
4	03.04 Deck slab	1	180.00	SM - Sq Meter	3.10
4	07 Shear Keys	2	2.00	EA - EACH	1.00

- Attached Pictures & Drawings Available in Reports

Structure No.	0004-S-BRG-00015501	Structure Name	I-25-250.00-ABH	Page no. 13	Of	17
Company	null	Inspector Name	null	Inspection Date	15/12/2008	
Photos [8]						

Connecting elements not sufficient to hold hte structure together.



Corroded_Superstructure.jpg

the deck has severe cracks in most of this span



Deck Cracking 1.gif

null



Severe Crack in the Column



Locating Bridge Inventory on Map

Pavement **Bridge** Roadway Facilities Fleet Resources IPS System AgileAssets Management System [Development] Version

Utilities Setup/Inventory General BMS Data Network Analysis NBI Simple Reports

Bridge Inventory

4 pages (55 rows)

Route
ML25
ML90
ML80
ML25

Google Map

Map Satellite Hybrid

Map data ©2009 Tele Atlas

GIS Analysis

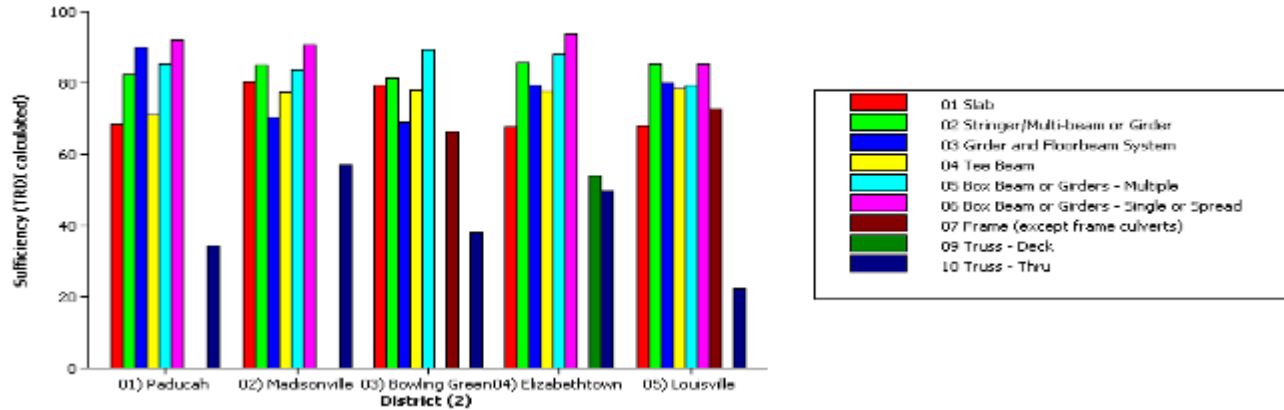
Creating GIS Reports

Selection | **Setup** | Report

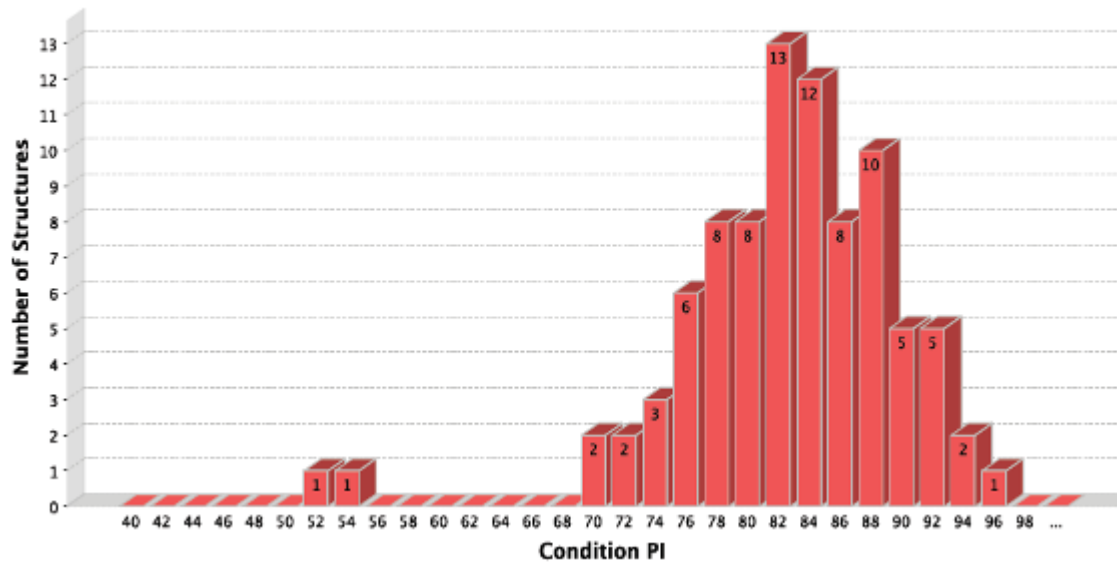
Filter

Existing GIS Themes					Report Columns	
<< < 1 Go > >> 2 pages (25 rows)					<< < 1 Go > >> 2 pages (30 rows)	
THEME NAME	Show Theme	Show Labels	Active Theme	Color	Column Label	Show
Routes	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Attach.	<input type="checkbox"/>
Districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Direction	<input type="checkbox"/>
States	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		End MP	<input type="checkbox"/>
Water Resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		GRADE	<input type="checkbox"/>
Gardens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		IRI for analysis	<input type="checkbox"/>
Municipalities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		IRI100 AVG	<input type="checkbox"/>
Palestinian Territ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		IRI100 STD	<input type="checkbox"/>
Cemeteries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		LANE #	<input type="checkbox"/>
Cities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Lane	<input type="checkbox"/>
Walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		North/South	<input checked="" type="checkbox"/>
Rivers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		OFFSET M	<input type="checkbox"/>
Slopes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		PCI	<input type="checkbox"/>
Streets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		RADIUS H	<input type="checkbox"/>
Gates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		RADIUS V	<input type="checkbox"/>
Railroads/Landi...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		RUT 0 10	<input type="checkbox"/>
Paths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		RUT 10 20	<input type="checkbox"/>
Borders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		RUT 20 OVE	<input type="checkbox"/>

Average of Sufficiency for 5 Districts and 10 Bridge Types

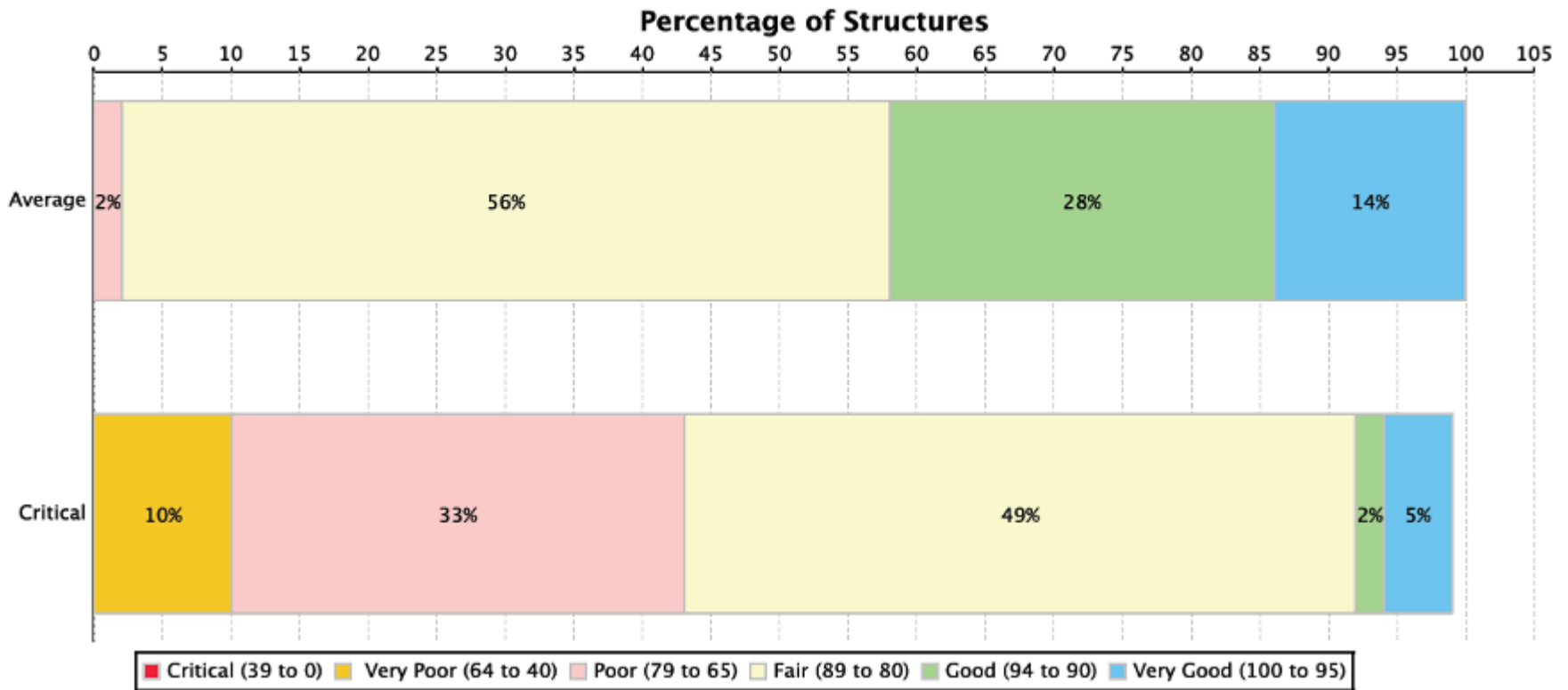


Histogram of Structures Conditions



Overall Network Condition

Structural Stock Conditions (Stack Bar Plot)



New Bridge Management System

IMPACT ANALYSIS

- Address the probabilistic nature of bridge **deterioration** and the differences in the deterioration **patterns of different components**
- **Project the future condition of** structural and other **key elements** and the overall condition of each type of bridge, both **with and without intervening actions**
- **Future Condition** Prediction → **Future Performance** Prediction (e.g. impact of future traffic and load carrying capacity on maintenance, disruption and failure costs)
- Vulnerability to natural and man-made hazards

ECONOMETRIC ANALYSIS

- Analyzing **Life Cycle MR&R Costs**, to determine effectiveness of expenditures
- Life Cycle MR&R Costs Discounted to Present Year (**Net Present Value**)
- The **effect of project timing** on conditions, needs, and **cost effectiveness**, The effect of scoping decisions (action type and quantity) at the element level, and the effect of preserving, rather than replacing, a structure.

MR&R RECOMMENDATIONS - WORK PROGRAMS

- **Decision Support System for MR&R** must include models for consideration of user costs in present and future year bridge analysis
- Incorporate **User Costs** in assessing bridge improvement needs and budget requirements
- To **Prioritize** bridge **MR&R work** programs based on condition, service level, urgency and traffic network importance
- Optimization through Life Cycle Costing Prioritization based on **Multiple Criteria** of safety, functionality, durability and sustainability

Asset Trade-off Analysis

Goals:

- Combine Work Plans from Various Disciplines
- Evaluate Effects of various policies
- Group Projects
- Schedule Projects
- Produce an Integrated Work Plan

Bottom Line: *“Better Assets Managed Globally and Efficiently”*



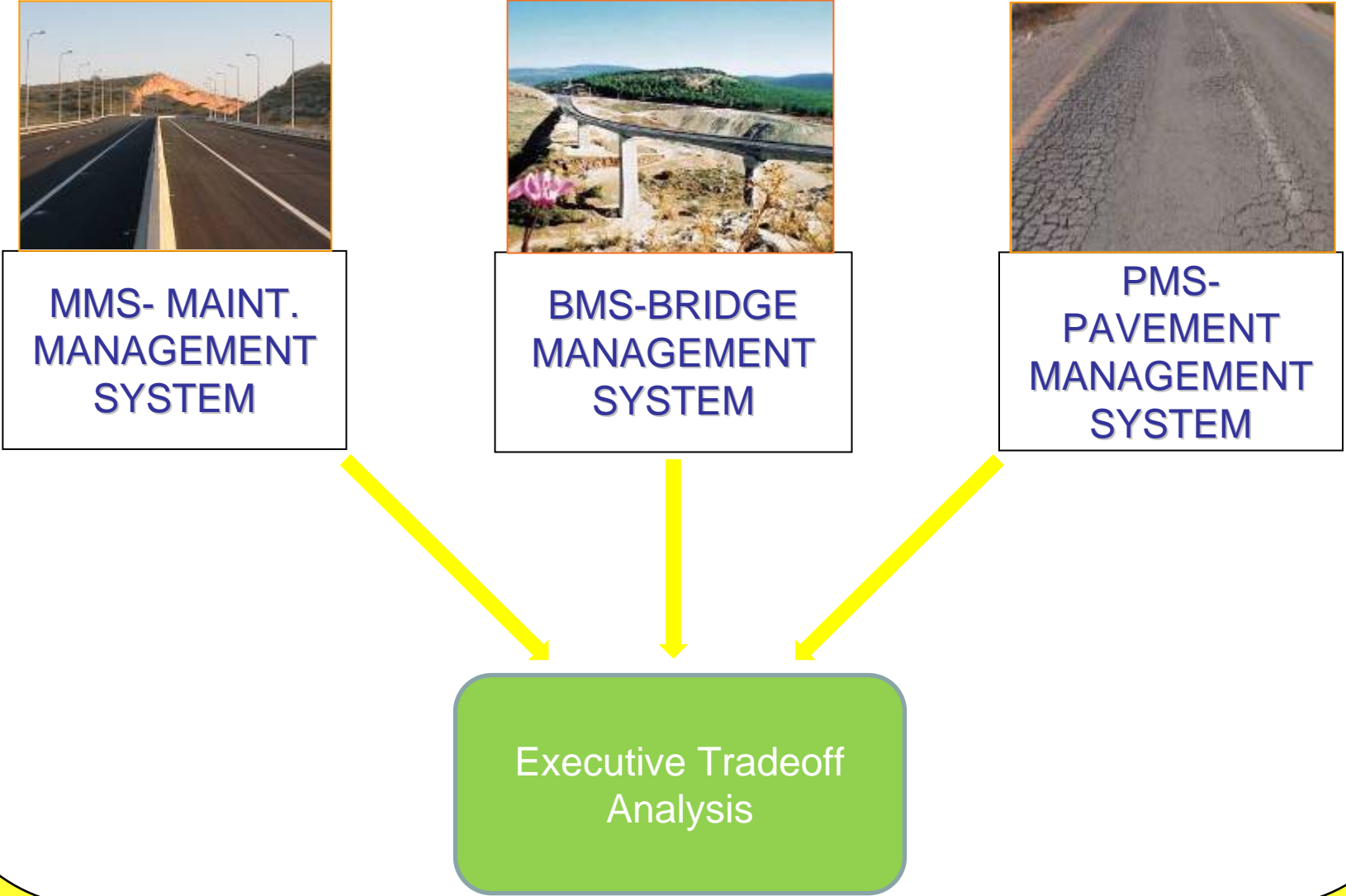
MMS- MAINT.
MANAGEMENT
SYSTEM



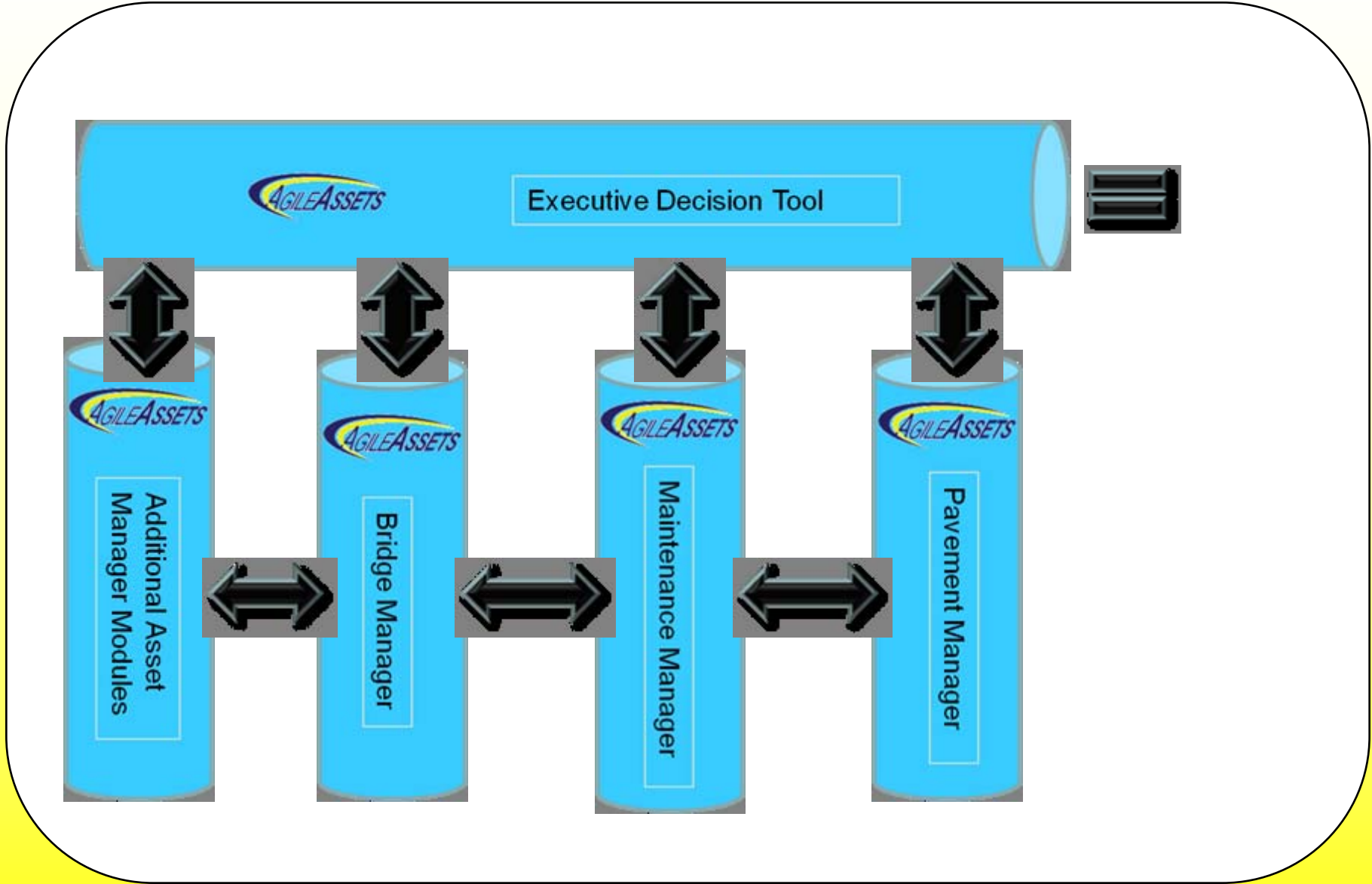
BMS-BRIDGE
MANAGEMENT
SYSTEM



PMS-
PAVEMENT
MANAGEMENT
SYSTEM



Executive Tradeoff
Analysis



Integrated Properties:

- Ability to review globally the discipline's Indicators for the combined work plans
- Ability to search the "closest" scenario
- Ability to apply budget cuts (common benefits)

Generate Window

Search

PMS Budget: 0 | BMS Budget: 0 | SMS Budget: 0
 Year: All Years | Year: All Years | Year: All Years
 Find Closest Scenarios

Scenarios	Details	Projects
PMS Scenarios		
Scenario Name PMS Budget (All ... 1878238		
Scenario for IPS WP - do not delete		
BMS Scenarios		
Scenario Name BMS Budget (All... Year of condition d		
Scenario for IPS WP - do not delete		
SMS Scenarios		
Scenario Name SMS Budget (All... Y		
Scenario for IPS WP - do not delete		

Mainte...	Plan ...	Mainte...	LOS
Painting	2009	100,000.	4
Painting	2010	110,000.	4.4
Cleaning	2009	100,000.	5
Cleaning	2010	110,000.	5.5
Weeding	2009	110,000.	9.9
Weeding	2010	110,000.	9.9
Improving	2010	0	0
Improving	2010	0	0

Maintenance Budgets

Summary Results														
Year	PMS Budget	BMS Budget	SMS B...	Maint...	Total Budget	PMS Benefit	BMS Benefit	SMS Benefit	PCI	IRI	CPI Average	CPI Critical	Accidents	LOS
2009	997,441.00		0.00	310.00...	1,307,441.00	43005816.78			0	80.0851	2.1174			4.725
2010	880,797.00		0.00	330.00...	1,210,797.00	17394987.45			0	76.7537	2.2014			4.95
All Years	1,878,238.00		0.00	640.00...	2,518,238.00	60400804.23			0	76.7537	2.2014			4.95

Combined Indicators

Individual Projects are the basis :

- Ability to group by Proximity Constraint (user input)
- System will set the Group's year by a rule (user defined)

Group Window

Roadway Bridge Safety IPS System

Setup Planning Reports

Plans 1 pages (15 rows)

Plan	PMS Bu...	BMS Bu...	SMS Bu...	Mainten...	Total Budget	PMS Benefit	Year	PMS B...	BMS ...	SMS ...	Mainte...	Total Budget
Babak's Test	189,950.6...	1,328,71...	89,705.7...	0.00	180,985.10...	152477.9...	2008	36,409...	1,328...	50,774...	0.00	88,512,664...
Demo-Plan-Syst	299,968...	531,411.00	913,307...	0.00	1,213,807.5...	3805012428...	2009	25,078...	0.00	25,630...	0.00	50,709,269...
IPS WP docum	1,878.23...	195,509.00	1,784.02...	640,000.00	4,497,768.00	60400804.23	2010	28,461...	0.00	13,301...	0.00	41,763,169...

Plan Details 1 pages (3 rows)

Proximity Constraint (KM): 1

Year Selection Rule: Highest Common B/C

Group

Treatments 240 pages (2160 rows)

ID	IPS Project Name	Discipline	Group ID	Project Year	District	Route (ID)	Direction	Lane	Offset	Start KM	End KM	Inventory Element Name	Treatment	Treatment Cost	Treatment Benefit	Commo
220369-1	M1-O1 Milling 1 + ...	PMS	1	2010	Central	1	Decreasing	All	0	2.008	2.664		M1-O1 Milling 1 + Ovrly 1 layer	1454,638.70	820.1653	
220335-1	M1-O1 - CF-G	PMS	1	2009	Central	1	Decreasing	All	0	2.664	3.664		M1-O1 - CF-G	1,224,704.00	877.4953	
220346-1	M1-O1 Milling 1 + ...	PMS	1	2010	Central	1	Increasing	All	0	3.464	4.664		M1-O1 Milling 1 + Ovrly 1 layer	855,360.00	794.5377	
220396-1	Project #160361	BMS	2	2008	Central	1	Both (All)	All	0	6.39	6.39			1,343.00	0.9401	
220396-2	Project #160361	BMS	2	2008	Central	1	Both (All)	All	0	6.39	6.39			10,072.50	1.0072	
220396-3	Project #160361	BMS	2	2008	Central	1	Both (All)	All	0	6.39	6.39			671.50	1.0072	
220396-4	Project #160361	BMS	2	2008	Central	1	Both (All)	All	0	6.39	6.39			4,029.00	0.8058	
220396-5	Project #160361	BMS	2	2008	Central	1	Both (All)	All	0	6.39	6.39			17,626.88	1.7627	
220396-6	Project #160361	BMS	2	2008	Central	1	Both (All)	All	0	6.39	6.39			174.00	0.9918	

Groups 67 pages (603 rows)

Group ID	Group Name	Group Year	Route	From	To	Zone	District	PMS Budget	BMS Budget	SMS Budget	Total Budget	# of Projects	# of Treatments	Comments	Attachment	User Update	Date Update
1	0000001/ 002.0-004.7/P	2010	1	2.008	4.664	2	Central	2,534,702.00	0.00	0.00	2,534,702.00	3	3			BABAK	25/9/2008
2	0000001/ 006.4-006.4/B	2008	1	6.39	6.42	3	Central	0.00	110,647.00	0.00	110,647.00	2	34			BABAK	25/9/2008
3	0000001/ 022.9-024.9/S	2008	1	22.916	24.916	3	Central	0.00	0.00	2,491,400.00	2,491,400.00	2	17			BABAK	25/9/2008
4	0000001/ 024.9-026.9/S	2008	1	24.916	26.916	3	Central	0.00	0.00	2,074,400.00	2,074,400.00	2	14			BABAK	25/9/2008
5	0000001/ 027.9-029.9/S	2009	1	27.916	29.916	3	Central	0.00	0.00	2,176,200.00	2,176,200.00	2	12			BABAK	25/9/2008
6	0000001/ 029.9-031.9/S	2008	1	29.916	31.916	3	Central	0.00	0.00	2,352,160.00	2,352,160.00	2	15			BABAK	25/9/2008
7	0000001/ 031.9-034.6/S	2008	1	31.916	34.636	3	Central	0.00	0.00	2,327,660.00	2,327,660.00	3	18			BABAK	25/9/2008
8	0000001/ 034.6-036.6/S	2008	1	34.636	36.636	3	Central	0.00	481,600.00	0.00	481,600.00	2	6			BABAK	25/9/2008
9	0000001/ 037.4-041.9/P/S	2008	1	37.416	41.916	3	Central	0.00	0.00	1,570,200.00	5,360,529.00	6	13			BABAK	25/9/2008

Grouping Rules

Generated Groups

Groups can be scheduled:

- A group has a year defined – Quarter can be defined
- A ranking rule is used to defined the quarter
 - Treatment Length / Route Length
 - Treatment Length
 - Sum of Treatment Costs
- Scheduling can also be made through the Gantt Chart Tool

Group Window

Plans														Plan Details					Ranking Expression:		
Plan	Ap...	PMS Bu...	BMS B...	SMS B...	Maintenance Budget	Total Budget	Year	PMS Budget	BMS Budget	SMS Budget	Maintenance...	Total Budget	1) Treatment Lengths / Route Lengths								
Babak's Test		89,950.6...	1,328.7...	89,705...	0.00	180,985.1	2008	36,409,698...	1,328,716.00	50,774,250...	0.00	88,512,664...	Schedule								
Demo-Plan-System		299,968...	531,411...	913,307...	0.00	1,213,807	2009	25,078,999...	0.00	25,630,270...	0.00	50,709,269...									
IPS WP document		1,878.23...	195,509...	1,784.0...	640,000.00	4,497.76	2010	28,461,919...	0.00	13,301,250...	0.00	41,763,169...									

Group ID	Group Name	Group Ye...	Group Qua...	Route	From	To	Zone	District	1) Trea...	PMS B...	BMS ...	SMS B...	Total Budget	# of Proj...	# of Tr...	Transfer to ERP?	Comments	Attachment	User Upda	
567	0003500/ 000.0- 000.3/S	2008	4	3500		0	0.309	14	South	1	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
569	0003544/ 000.0- 000.9/S	2008	4	3544		0	0.874	14	South	1	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
573	0003712/ 000.0- 000.5/S	2009	3	3712		0	0.544	14	South	1	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
589	0007579/ 000.0- 000.6/S	2008	4	7579		0	0.595	12	North	1	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
593	0007707/ 000.0- 000.9/S	2008	4	7707		0	0.898	12	North	1	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
595	0007811/ 000.0- 000.8/P	2010	4	7811		0	0.807	9	North	1	273.33	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
596	0007811/ 000.0- 000.8/S	2008	4	7811		0	0.807	9	North	1	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
603	000NT04/ 000.0- 000.2/P	2010	2	NT04		0	0.212	4	Central	1	59,964...	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
581	0006531/ 000.0- 001.0/S	2008	4	6531		0	1	8	North	0.8403	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
565	0003413/ 000.0- 001.0/S	2008	4	3413		0	1	14	South	0.7764	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
575	0005611/ 000.4- 001.2/S	2008	4	5611		0.4	1.208	4	Central	0.6689	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
556	0002414/ 000.5- 001.3/S	2008	4	2414		0.505	1.303	15	South	0.6124	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
570	0003553/ 000.0- 001.0/S	2008	4	3553		0	1	14	South	0.6124	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
580	0006522/ 000.0- 000.5/S	2008	4	6522		0	0.5	8	North	0.5774	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
560	0003403/ 000.4- 001.4/S	2008	4	3403		0.382	1.382	14	South	0.5003	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
222	0000109/ 000.0- 001.1/S	2008	4	109		0	1.138	18	South	0.5	0.00	0.00	4,000.00	2	2	<input checked="" type="checkbox"/>			BABAK	
558	0002544/ 001.0- 001.9/S	2008	4	2544		1	1.931	15	South	0.4821	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
527	0000654/ 001.0- 001.9/S	2008	4	654		1	1.903	8	North	0.4745	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
574	0005233/ 001.0- 001.6/S	2008	4	5233		0.952	1.584	8	North	0.399	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
342	0002444/ 000.4- 002.4/S	2008	4	2444		0.4	2.4	15	South	0.3814	0.00	0.00	4,000.00	2	2	<input checked="" type="checkbox"/>			BABAK	
341	0002422/ 000.7- 002.7/S	2008	4	2422		0.666	2.651	14	South	0.3745	0.00	0.00	4,000.00	2	2	<input checked="" type="checkbox"/>			BABAK	
518	0000531/ 001.1- 002.1/S	2008	4	531		1.1	2.1	4	Central	0.3644	0.00	0.00	2,000.00	1	1	<input checked="" type="checkbox"/>			BABAK	
578	0006502/ 000.0- 000.9/P	2009	3	6502		0	0.934	8	North	0.3444	350,36...	0.00	0.00	350,362.00	1	1	<input checked="" type="checkbox"/>			BABAK





Contact Information

Jim Edgerton

jedgerton@agileassets.com

919.573.5219