BRIDGE MAINTENANCE MANAGEMENT SYSTEM: FEW CONCEPTS

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BRIDGE MAINTENANCE MANAGEMENT SYSTEM

- **Bridge management systems assist bridge owners in selecting and performing work that is the right activity, to the right bridge, at the right time, and at the right cost**

- **Bridge management systems help bridge owners achieve their bridge performance objectives and goals, and maximize returns on investment.**

BRIDGE MAINTENANCE MANAGEMENT SYSTEM

- A **bridge management system** or **BMS** is a means for managing bridges throughout design, construction, operation and maintenance of the bridges.

- As funds available become tighter, road authorities around the world are facing challenges related to bridge management and the escalating maintenance requirements of large infrastructure assets.

- Bridge management systems help agencies to meet their objectives, such as building inventories and inspection databases, planning for maintenance, repair and rehabilitation (MR&R) interventions in a systematic way, optimizing the allocation of financial resources, and increasing the safety of bridge users.

BRIDGE MAINTENANCE MANAGEMENT SYSTEM

- The major tasks in bridge management are: collection of inventory data; inspection; assessment of condition and strength; repair, strengthening or replacement of components; and prioritizing the allocation of funds.

- A BMS is a means of managing bridge information to formulate maintenance programs within cost limitations. A BMS includes four basic components: data storage, cost and deterioration models, optimization and analysis models, and updating functions

Bridge Inventory Component	Contents
Bridge Identification Information	• Bridge location • Bridge spatial location • Identification of routes under and/or above the structure
Bridge Type and Specifications	• Type of the bridge • Deck, deck surface, and other bridge component materials
Operation Conditions	• Construction year, rehabilitation year • Type of services and traffic carried over and/or under the structure • Number of the lanes over and/or under the bridges, average daily traffic, average daily truck traffic and information regarding to bypasses, detours, etc.
Bridge Data	Geometry, inspection data, ratings and appraisal results

Table 2. Data Inventory Components

FEDERAL HIGHWAY ADMINISTRATION Bridges & Structure website

- http://www.fhwa.dot.gov/bridge/nbis.cfm

US Department of Transportation: FHWA Practice

- A bridge management software program named AASHTOWare Bridge Management (formerly known as Pontis) was developed in the early 1990's under an FHWA contract. The software became an AASHTO product in 1994. For more information on AASHTOWare Bridge Management see their website http://www.aashtoware.org/Bridge/Pages/Management.aspx?PID=2.

NCHRP
SYNTHESIS 397

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Bridge Management Systems for Transportation Agency Decision Making

A Synthesis of Highway Practice

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

The AASHTOWare **Bridge Management** analytical software in USA

- http://www.aashtoware.org/Bridge/Pages/Management.aspx?PID=2

National Bridge Inventory Rating by FHWA, USA

- 9 = Excellent
- 8 = Very Good
- 7 = Good
- 6 = Satisfactory
- 5 = Fair
- 4 = Poor
- 3 = Serious
- 2 = Critical
- 1 = “Imminent” Failure
- 0 = Failure
- N = Not Applicable

RATING FOR BRIDGE DECKS,SUPERSTRUCTURE & SUBSTRUCTURE

Rating	General Description of Condition
9	EXCELLENT CONDITION
8	VERY GOOD CONDITION: no problems noted.
7	GOOD CONDITION: some minor problems.
6	SATISFACTORY CONDITION: structural elements show some minor deterioration.
5	FAIR CONDITION: all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
4	POOR CONDITION: advanced section loss, deterioration, spalling, scour.
3	SERIOUS CONDITION: loss of section, deterioration, spalling, or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.

RATING FOR BRIDGE DECK, SUPERSTRUCTURE & SUBSTRUCTURE

2	CRITICAL CONDITION: advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
1	"IMMINENT" FAILURE CONDITION: major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structural stability. Bridge is closed to traffic but corrective action may put back in light service.
0	FAILED CONDITION: out of service—beyond corrective action.
N	Not applicable.

Source: FHWA 1995.

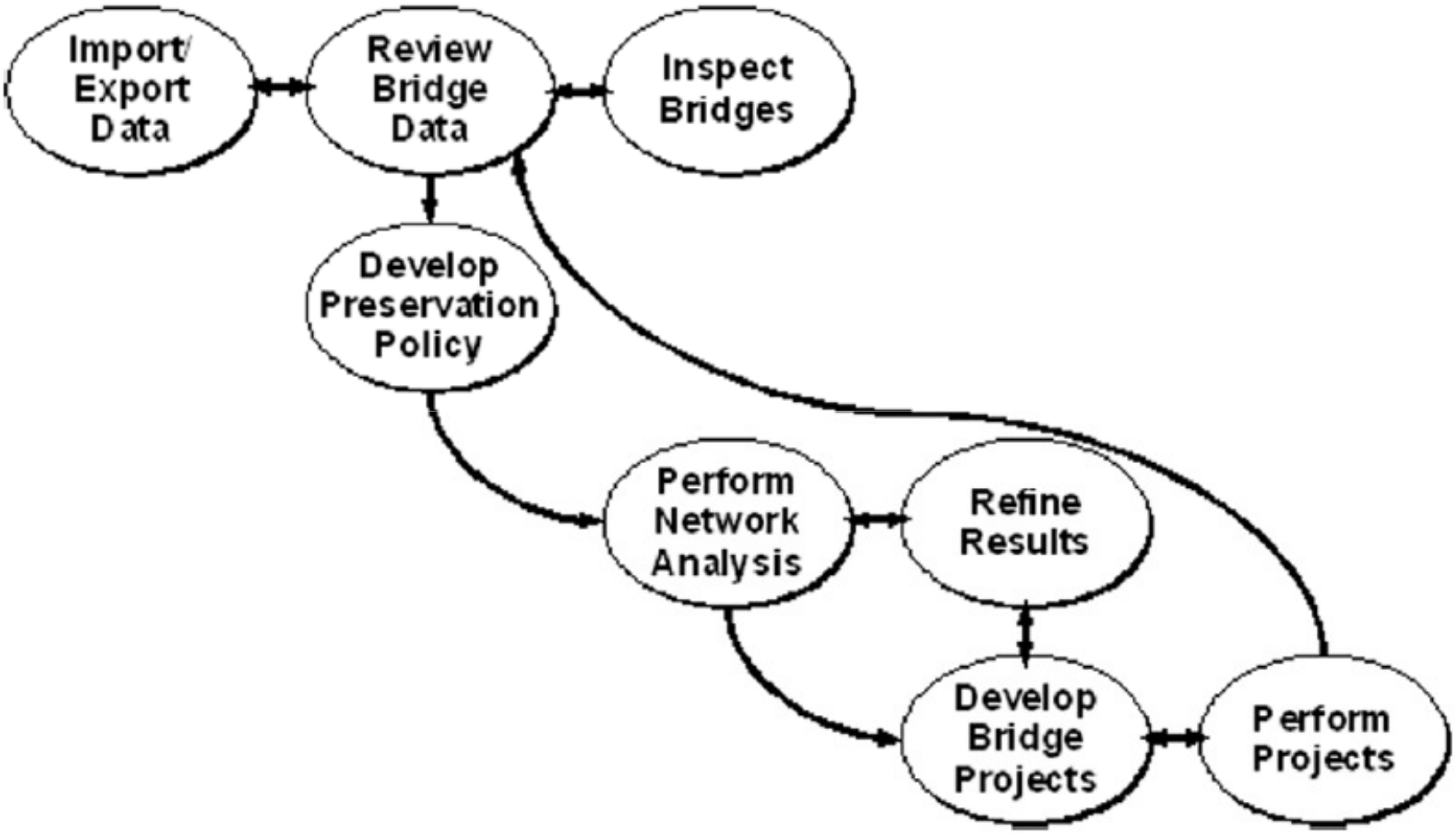


FIGURE 5 Overview of Pontis' analytic processes (*Source:* Cambridge Systematics, Inc. 2004).

Bridge Distress Data Collection Methods

- Effective support of bridge management decision making requires obtaining timely and quality data about bridge conditions, project costs, and effectiveness.

- Because of the expense of data collection, bridge managers must exploit new technologies and process efficiencies to continually improve data quality while simultaneously controlling the costs of data collection.

- Further development and evaluation of improved visual inspection procedures, innovative nondestructive testing methods, and automated methods to gather and manage data should be encouraged.

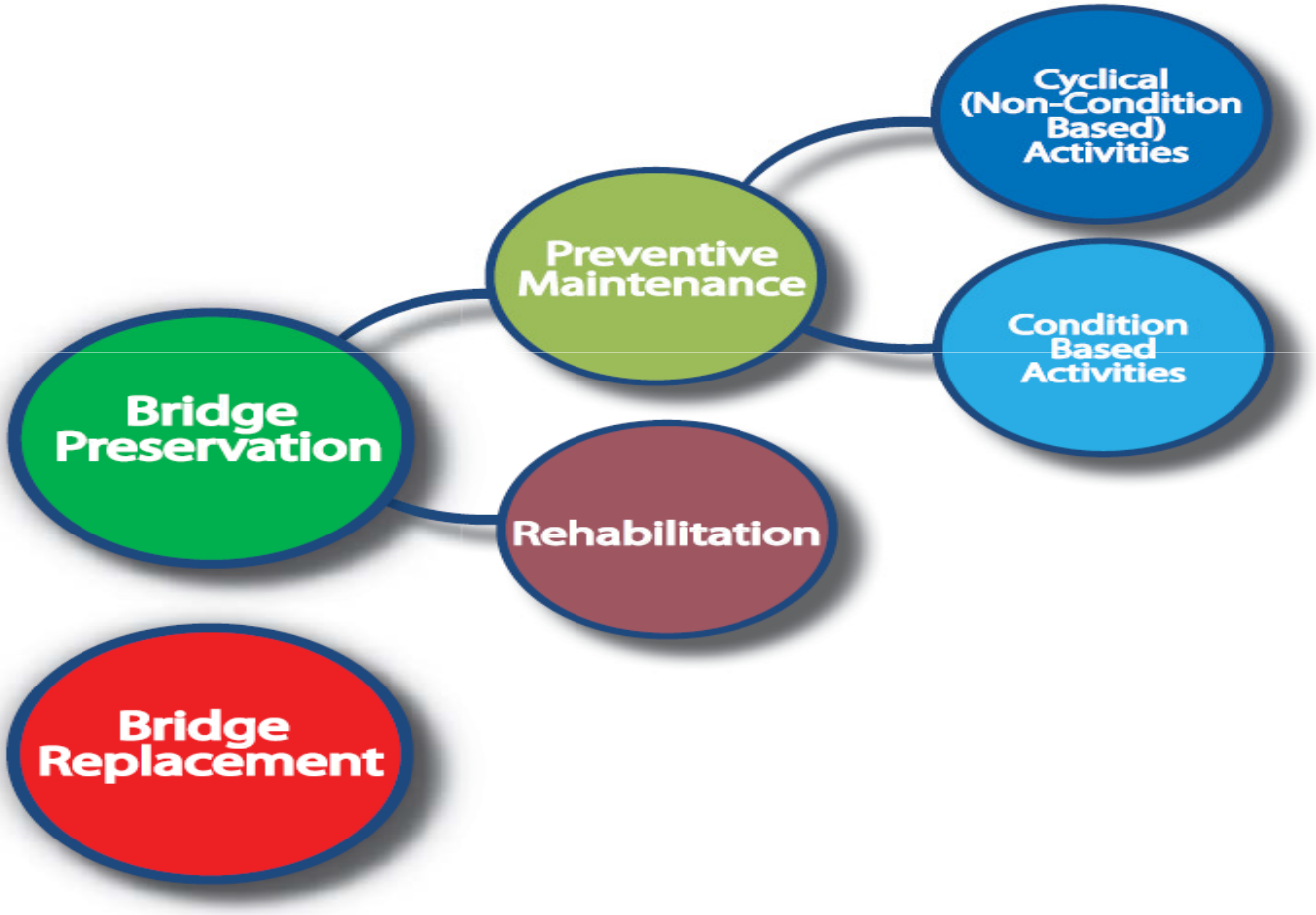
Models of Bridge Deterioration and the Effect of Maintenance Activity

- One way in which BMSs assist decision makers is in forecasting the effect of agency actions on the health and economic performance of the bridge inventory.

- By studying the changes observed in bridge conditions over time, researchers can develop models to distinguish the effects of maintenance activity from the normal processes of bridge deterioration.

- State-of-the-art work in this area includes deepening our understanding of physical deterioration processes, especially the effect of structural damage on the reliability and performance of structural components.

BRIDGE ACTION STRATEGIES



Appendix A – National Bridge Inventory General Condition Rating Guidance

Code	Description	Commonly Employed Feasible Actions
9	EXCELLENT CONDITION	Preventive Maintenance
8	VERY GOOD CONDITION No problems noted.	
7	GOOD CONDITION Some minor problems.	
6	SATISFACTORY CONDITION Structural elements show some minor deterioration.	Preventive Maintenance; and/or Repairs
5	FAIR CONDITION All primary structural elements are sound but may have some minor section loss, cracking, spalling or scour.	
4	POOR CONDITION Advanced section loss, deterioration, spalling or scour.	Rehabilitation or Replacement
3	SERIOUS CONDITION Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.	
2	CRITICAL CONDITION Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored the bridge may have to be closed until corrective action is taken.	
1	IMMINENT FAILURE CONDITION Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put back in light service.	
0	FAILED CONDITION Out of service - beyond corrective action.	

Appendix B- Bridge Element Condition State Guidance[10]

Condition State	Description	Commonly Employed Feasible Actions
1	Varies depending on element – Good	Preventive Maintenance
2	Varies depending on element – Fair	Preventive Maintenance or Repairs
3	Varies depending on element – Poor	Rehabilitation
4	Varies depending on element - Severe	Rehabilitation or Replacement

Structurally Deficient (SD)

Bridges are considered SD if significant load carrying elements are found to be in poor condition due to deterioration and/or damage, or the adequacy of the waterway opening provided by the bridge is determined to be extremely insufficient to the point of causing overtopping with intolerable traffic interruptions.

SD is numerically defined as follows:

- A bridge component (deck, superstructure, substructure or culvert) having an NBI general condition rating of a 4 or less (poor condition)

or

- Structural Evaluation or Waterway Adequacy rated a 2 or less (a bridge with a very low load rating capacity, or a bridge that is sub ject to overtopping with significant or severe traffic delays).

	NBI GENERAL CONDITION RATINGS				APPRAISAL RATINGS	
NBI Item#	58	59	60	62	67	71
	Deck	Superstructure	Substructure	Culvert	Structural Evaluation	Waterway Adequacy
Code	<= 4	<= 4	<= 4	<= 4	<= 2	<= 2

Functionally Obsolete (FO)

Bridges are considered FO when the deck geometry, load carrying capacity (comparison of the original design load to the current State legal load), clearance, or approach roadway alignment no longer meet the usual criteria for the system of which it is an integral part. In general, FO means that the bridge was built to standards that are not used today. Examples of characteristics leading to an FO classification:

- Low load carrying capacity
- Low waterway adequacy
- Deck geometry (insufficient deck roadway width)
- Insufficient horizontal and vertical clearances
- Poor approach roadway alignment.

Functionally Obsolete (FO)

	APPRAISAL RATINGS				
NBI Item #	67	71	68	69	72
	Structural Evaluation	Waterway Adequacy	Deck Geometry	Underclearances	Approach Roadway Alignment
Code	= 3	= 3	<= 3	<= 3	<= 3

Table 1. Number of Structurally Deficient and Functionally Obsolete Bridges by State (Source: www.fhwa.dot.gov)

	NHS bridges				All bridges			
State	Number of bridges	Structurally deficient	Functional obsolete	Total deficient	Number of bridges	Structurally deficient	Functionally obsolete	Total deficient
Alabama	2,672	95	577	672	15,648	2,393	2,286	4,679
Alaska	350	42	46	88	1,187	151	202	353
Arizona	2,525	16	160	176	7,119	163	554	717
Arkansas	1,943	55	283	338	12,456	1,238	1,894	3,132
California	7,422	966	993	1,959	23,823	2,894	3,774	6,668
Colorado	2,005	119	282	401	8,182	604	783	1,387
Connecticut	1,585	59	324	383	4,167	345	1,018	1,363
Delaware	236	4	24	28	850	42	80	122
District of Columbia	118	6	61	67	251	23	134	157
Florida	3,983	28	478	506	11,469	317	1,801	2,118
Georgia	2,464	40	258	298	14,461	1,187	1,761	2,948
Hawaii	403	29	148	177	1,099	156	357	513
Idaho	731	34	138	172	4,047	316	414	730
Illinois	3,601	260	395	655	25,727	2,436	1,925	4,361

IMMEDIATE NEED OF IMPROVEMENTS IN PRESENT PWD SYSTEM

- Need of Trained Bridge Inspectors
- Periodic bridge distress data collection
- Updating of bridge Inspection format for different types of bridges
- Need of specialist who will diagnosis the collected bridge distress data
- Ranking of bridges depending upon distress condition
- Doing appropriate maintenance depending upon the bridge distress condition
- Dedicated funding for Bridge maintenance

Thanks