OM-8

Bridge Management System[i]

Goal

Leverage a Bridge Management System (BMS) to balance activities that extend the life and function of bridges with impacts to the human and natural environment.

Sustainability Linkage

Maintaining and using a BMS supports the environmental and economic principles by optimizing the management of bridge structures, including preservation, restoration, and replacement, to maximize their lifetimes. This reduces costs, the environmental impacts of construction, and raw material usage.

Potential Triple Bottom Line (TBL) Cost Savings*

$$ - DOTs can save by extending the useful service-life of bridges through more efficient maintenance.

$$ - System users benefit from reduced traffic congestion and reliability costs due to bridge postings and closures.

$ - Less frequent and shorter construction reduces emissions released from congestion/ detours associated with bridge closures.

$$$ - Safety/access costs avoided due to bridge closures.

*Order of magnitude dollar equivalent potential savings: $~1M, $$~10M, $$$~100M

Figure 1: AASHTOWare Bridge Management Software Logo

[i] Strictly speaking, a bridge management system is a planning and analysis tool that helps inform the larger process of bridge management which includes all the managerial functions of an agency necessary for policy analysis, planning, programming, budgeting, and project decisions for bridges. As used here the terms bridge management and bridge management system are basically synonymous.

Basis for Savings

Bridge management helps agencies identify bridge preservation and improvement activities that provide the maximum cost benefit for minimum given level of investment.[1] Improvements in preservation, restoration, and replacement of bridge structures through bridge management can:

Reduce life cycle costs by enabling agencies to spend their money where it is most effective on projects regarding preventative maintenance repair, rehabilitation, or replacement by utilizing a life cycle approach.[2]

Generate road-user benefits in terms of reduced travel time, vehicle operation, and accident-related costs as the result of bridge reconstruction.[3] With billions worth of travel benefits that could be affected, user costs due to traffic delays and lost productivity are often more than 10 times the direct cost of maintenance, repair, and rehabilitation.[4]

Reduce environmental impacts caused by fuel consumption and CO_2 emissions by decreasing traffic congestion and detour vehicle miles traveled through avoidance of long-term bridge closures.

Improve safety and access by at least a few percent of the tens of millions of dollars associated with the avoidable cost of crashes by avoiding the traffic impacts associated with major reconstruction projects, thus providing safer travel conditions on a more reliable system for personal vehicles, buses, and commercial and emergency users.

Agency Experience

BMS information can help agencies make balanced, rational, defensible, and cost-effective decisions[5] that together with prudent bridge management investments can increase the fraction of bridges within a network that are in fair or good condition and significantly reduce life cycle costs, while conferring other benefits across the triple bottom line.

Idaho, Michigan, and Virginia were successful in using bridge management to improve the structural health of their bridges. Idaho has increased the percentage of bridges in good condition from 67 percent in 2006 to 73 percent in 2010. Michigan increased its percentage of good and fair bridges from 79 percent in 1998 to 92 percent in 2011, and Virginia increased its percentage of fair and good bridges from 90 percent in 2000 to 92 percent in that same year.[6]

North Carolina Department of Transportation

In the 1980s North Carolina State University (NCSU) developed OPBRIDGE, a BMS program.[7] In 1988, OPBRIDGE calculated an annual user cost of $566 million due to detours and accidents on NCDOT bridges. In 1993 the NCDOT bridge management budget was increased from $100 million to $150 million, resulting in user costs savings of approximately $245 million and a total cost savings over $300 million.[8]

Agency	Initial Investment	Additional Investment	Annual Cost Savings
NCDOT	$40-60 million	$100 million	> $300 million

More recently, NCDOT has been able to use their BMS to help implement cost-efficient low-impact bridge replacement designs that have decreased replacement time by as much as four years and typically shrink project costs by 25 percent, while supporting water quality goals.[9]

Oregon Department of Transportation

Financial projections from a statewide bridge improvement study in Oregon indicated that substandard bridges would cause a potential loss to Oregon's economy of some $123 billion in lost production and 88,000 lost jobs in the next 25 years unless steps were taken to improve the state's bridges.[10] Subsequent investments informed by ODOT's BMS reduced bridge deficiency percentage from 33 to 23 percent since 2004 according to a 2012 report. These results indicated a continuing upward trend in fair and good bridges that began in 2007.[11]

Florida Department of Transportation

FDOT has implemented and customized the bridge management software Pontis (which is now known as AASHTOWare BrM). FDOT's BMS identified improvement projects that had the most benefit for FDOT:[12]

Improvement Project[13]	Average Annual User Benefit	Type of Saving
Bridge Widening	$1.2 million	Estimated as savings in accident costs
Bridge Raising	$14,000	Estimated as savings in truck detour costs
Bridge Strengthening	$93,000	Estimated as savings in truck detour costs

Notes on Valuation

The range in the benefit-cost ratios and agency cost savings potential can be expected to vary across states due to:

- Climate variation and de-icing needs
- Highway congestion
- Labor and material costs
- Degree of management system maturity
- Type and condition of bridges
- Level of investments, strategies, and policies

Individual Assessments

States are encouraged to access the following references and to consult the FHWA Invest BMS Subject Matter Expert, Derek.Constable@dot.gov, for additional working materials in assessing their own unique situations and/or if they have information that could assist others on this topic.

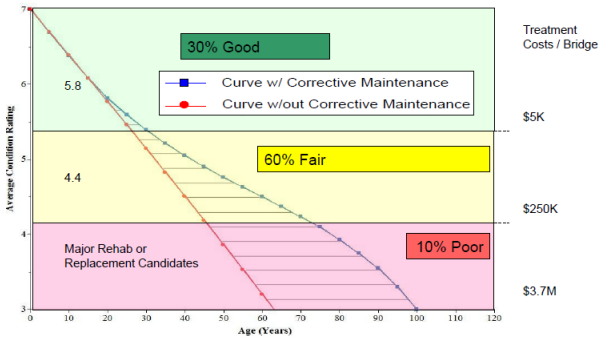

Figure 2: Bridge Service Life Extension Through Effective Maintenance[14]

References

[1] City of Hamilton. "Asset Management – Bridge Management". (n.d.). Accessed May 28, 2014, https://www.hamilton.ca/CityDepartments/PublicWorks/Environment_Sustainable_Infrastructure/Asset+Management/Asset+Management.htm#bm.

[2] Michigan Department of Transportation. "TMS ToolBox – Vol. 2 Issue 6". (n.d.). Accessed June 14, 2014, http://mdotcf.state.mi.us/public/tms/pdfs/TMS_Toolbox_2_6.pdf.

[3] Transportation Research Board (TRB). *NCHRP Synthesis 397: Bridge Management Systems for Transportation Agency Decision Making*. By Markow, Michael J., and William A. Hyman. 2009. Accessed May 28, 2014, http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_397.pdf.

[4] Federal Highway Administration (FHWA). *Corrosion Cost and Preventive Strategies in the United States CC Technologies Laboratories , Dublin, OH, USA — Report R315-01*. By Kock, H. K., Brongers, M.P.H., Thompson, N.G., Virmani, Y.P., and Payer, J.H. 2001. Accessed June 9, 2014, http://www.nace.org/uploadedFiles/Publications/ccsupp.pdf.

5 NCHRP. 2014.

[6] FHWA. *Bridge Management: Practices in Idaho, Michigan, and Virginia*. (n.d.). Accessed May 28, 2014, http://www.fhwa.dot.gov/asset/hif12029/hif12029.pdf.

7 NCDOT. *Bridge Management System Update*. http://www.ncdot.gov/doh/preconstruct/tpb/research/download/2001-18FinalReport.pdf. Accessed July 16, 2014.

[8] North Carolina State University. "Dr. David Johnston – Crossing Bridges Before You Come to Them". *Engineering News*, 1996. Accessed June 11, 2014, http://www.engr.ncsu.edu/news/innerviews/iv.arc.1996.winter.html.

[9] American Association of State Highway and Transportation Officials (AASHTP), FHWA, and FTA. *Leaner and Greener: Sustainability at Work in Transportation*. 2012. Accessed June 9, 2014, http://environment.transportation.org/pdf/LeanerGreener.pdf.

[10] Giroux, Raymond P. "Supplement to Perspective: Sustainable Bridges". *ASPIRE*, 2010. Accessed June 9, 2014, http://aspirebridge.com/resources/Perspective_Giroux_Supplement_spr10_WEB.pdf.

[11] Oregon Department of Transportation. 2012 Bridge Condition Report. 2012. Accessed June 9, 2014, ftp://ftp.odot.state.or.us/Bridge/bridge_website_chittirat/2012_Br_Condition_Report_web_080612.pdf.

[12] Thompson, Paul D., Fazil T. Najafi, Roberto Soares, and Hong J. Choung. *Development of User Cost Data for Florida's Bridge Management System*. (University of Florida, 1999). Accessed May 28, 2014, http://ntl.bts.gov/lib/22000/22300/22306/PB99176877.pdf.

[13] Ibid.

[14] McVoy, Gary R. *New York State Transportation Summit*. 2010. New York City.