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Consolidated Asset Management for Minnesota Local Agencies

Prepared by CTC & Associates LLC

Transportation agencies are increasingly turning their attention to transportation asset management (TAM), a systematic process for tracking the conditions of physical infrastructure to make better decisions about its maintenance. TAM is mandated by the Moving Ahead for Progress in the 21st Century Act (MAP-21) and can help justify funding to the public and elected officials. Consequently, the Minnesota Local Road Research Board (LRRB) is interested in increasing the awareness of cities and counties as to the importance of asset management and providing guidance to them about best practices for developing asset management plans, systems and software.

The purpose of this Transportation Research Synthesis was to support this effort by conducting a literature review, consulting with national practitioners and interviewing representatives at local agencies about their practices.

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The purpose of this TRS is to serve as a synthesis of pertinent completed research to be used for further study and evaluation by the Local Road Research Board and Minnesota counties and cities. This TRS does not represent the conclusions of the authors or LRRB.

Consolidated Asset Management for Minnesota Local Agencies

Introduction

The transportation community is increasingly interested in the use of transportation asset management (TAM) for tracking the performance of assets and improving decisions regarding their maintenance. TAM helps agencies define performance measures and goals, and use economics and engineering to optimize investment strategies. The American Association of State Highway and Transportation Officials (AASHTO) defines asset management as the "strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their lifecycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decisionmaking based upon quality information and well-defined objectives" (http://www.fhwa.dot.gov/asset/if08008/amo_02.cfm).

The benefits of TAM for transportation agencies include improving investment decisions; being able to use comprehensive, accurate system condition data to justify funding to the general public and elected officials; establishing greater accountability in the effective use of funds; increasing the relationship between performance and funding; and establishing more sustainable transportation solutions. TAM is also mandated by federal legislation: Moving Ahead for Progress in the 21st Century Act (MAP-21) requires state departments of transportation (DOTs) to use TAM for pavements and bridges, and encourages its use for all assets within the right of way. State DOTs that receive federal funding for roads and bridges are required to establish a transportation asset management plan (TAMP), a document that acts "as a focal point for information about the assets, their management strategies, long-term expenditure forecasts, and business management processes" (http://www.fhwa.dot.gov/asset/plans.cfm). TAMPs allow agencies to more effectively manage their systems and communicate their funding needs to the public. It is increasingly important that city and county transportation agencies in Minnesota become aware of TAM, TAMPs and software systems that support asset management.

Consequently, the Local Road Research Board (LRRB) would like to increase the awareness of Minnesota cities and counties as to the importance of asset management and provide guidance to them about best practices for developing asset management plans and systems. In support of LRRB's future efforts to develop an asset management guide for cities and counties, CTC & Associates:

- Conducted a literature search on TAM, with a focus on information relevant to local agencies.
- Identified city and county transportation agencies as possible candidates for interviews (Task 4).
- Interviewed a national expert from Federal Highway Administration (FHWA) about existing guidance and best practices applicable to local agencies for initiating, developing and improving an effective, consolidated asset management system.

Summary of Findings

Survey of Local Agency Practices

CTC conducted interviews with representatives from eight local transportation agencies. Interviewees were asked about their population and asset classes for which they are responsible, software and systems used for asset management, formal asset management planning, whether software automates asset management decisions, challenges using or implementing software and systems, and the role of political considerations in asset management decisions. Highlights include:

1. **Population and assets:** CTC interviewed local agencies with a wide range of populations, from 25,000 to 4.7 million. These agencies were generally responsible for multiple asset types, including roads, bridges, street signs, signals and culverts.

2. **System/software (including decisions and challenges):**
    a. Most agencies use asset management software for multiple asset types and identify training and data collection as significant challenges to implementation. Systems are typically tied to a GIS, and in some cases to more specific asset management software for each asset type. Cole County (Missouri) Public Works uses only ArcGIS for Desktop for its assets, but is currently looking at vendors for asset management systems.
    b. The Kent County (Michigan) Road Commission and all Michigan local agencies use Roadsoft, which is capable of managing all assets. Roadsoft software and training are free for Michigan local agencies via the Michigan Tech Local Technical Assistance Program. Roadsoft does not automate decisions but has some prediction capability, including modules that address each asset's inventory, condition, location and work done by asset or location, and is linked to work orders and finance. Training and data collection are the most significant challenges.
    c. Tillamook County (Oregon) Public Works uses the Integrated Road Information System (IRIS), which has modules for various asset types. Similarly to Roadsoft in Michigan, this software was developed by the Oregon Association of Counties and is made available to Oregon counties at no cost. The software does not automate decisions but is a repository of data and information on conditions that is used to make risk-based decisions.
    d. Hillsborough County (Florida) Public Works can give a qualified recommendation to its system, MaintStar, but the product has some difficulties. The representative interviewed by CTC highly recommended Cityworks and mentioned Lucity, which the City of Tacoma (Washington) Public Works is currently installing. Lucity seems to be capable of automating asset management decisions.
    e. The City of Calgary, Alberta, Canada, and Seattle (Washington) Department of Transportation (Seattle DOT) use Infor Hansen for multiple asset types. Earlier versions of this software seem not to be capable of automating decisions, but current versions may be able to. Calgary and Seattle also uses multiple systems for more detailed data on various asset types, some of which feeds into Hansen. Previous versions of Hansen seem to have a number of drawbacks, including the difficulty of getting data into it from other systems and general cumbersomeness. Current versions may be better. Hillsborough County previously used Hansen, but was unhappy with its GIS interface.
3. **TAM planning:** Six of the eight agencies conducted formal planning and had a plan of some sort available online. Tillamook County seems to be a national leader in this area. Cole County does not have a plan, and the City of Tacoma is currently developing one. Seattle DOT has a status and condition report as robust as many plans, but is working on a complete asset management plan to be published in two years.
4. **Political considerations:** Most agencies agreed that the data provided by asset management systems was invaluable in persuading the public and elected officials of the need for infrastructure funding.

The following table gives an at-a-glance overview of these results:

Agency	Population	Software	Plan
City of Calgary	1 million	Infor Hansen and others for various asset classes. Currently configuring for risk and level of service analysis.	http://www.calgary.ca/CS/IIS/Pages/About-land-information/About-Infrastructure---Information-Services.aspx#cpam
Cole County Public Works	30,000	ArcGIS for Desktop for all assets. Currently looking at vendors for asset management systems.	No plan or formal asset management planning.
Hillsborough County Public Works	1.3 million	MaintStar and Esri GIS for most assets. The software does not automate decisions. Cityworks is recommended over MaintStar.	http://www.planhillsborough.org/wp-content/uploads/2014/09/2040-LRTP-System-Preservation-Costs-Benefits-Tech-Memo.pdf
Kent County Road Commission	650,000	Roadsoft for all assets. There is some prediction capability.	http://www.kentcountyroads.net/media/files/default/default2015StrategicPlan.pdf
Seattle DOT	700,000	Infor Hansen for all assets at a general level, and multiple systems for these assets at a more detailed level. The software (not the latest version) does not automate decisions.	A plan will be complete in two years. See the DOT's status and condition report: http://www.seattle.gov/transportation/docs/SDOT2015SCReportFinal12-7-2015.pdf.
Southeast Michigan Council of Governments	4.7 million	Roadsoft for all assets. It includes both inventory and forecast modules for road conditions.	http://semcog.org/Plans-for-the-Region/Performance-Measures
City of Tacoma Public Works	210,000	Currently installing Lucity, initially for pavements and signs and eventually for all assets. Lucity will automate asset management decisions.	In development.
Tillamook County Public Works	25,000	Integrated Road Information System (IRIS) for all assets. It does not automate decisions but has modules that address each asset's inventory, condition, location and work done by asset or location, and is linked to work orders and finance.	http://www.co.tillamook.or.us/gov/pw/Documents.htm#Asset Management Plan

Consultation with National Practitioners

CTC interviewed Steve Gaj of FHWA to gather information about existing asset management guidance most applicable to local agencies. Gaj pointed to the FHWA asset management website (see Asset Management in **National Resources**): https://www.fhwa.dot.gov/asset/. He cited the following resources as particularly useful:

- An FHWA video overview of TAM: http://www.youtube.com/watch?v=ep3j7f__LuM&feature=youtu.be.
- A generic work plan for developing an asset management plan, which while designed for state DOTs is also applicable to local agencies: http://www.fhwa.dot.gov/asset/tamp/workplan.pdf.

- New Zealand's International Infrastructure Management Manual: http://www.nams.org.nz/pages/273/international-infrastructure-management-manual-2011-edition.htm.
- For the purposes of communicating the basics of asset management, two PowerPoint presentations (see **Appendix A** and **Appendix B**).

National Resources

Guidance on asset management from FHWA, AASHTO and the National Cooperative Highway Research Program (NCHRP) is plentiful. See the links recommended by Steve Gaj of FHWA in **Consultation with National Practitioners** as well as:

- FHWA's Asset Management website (https://www.fhwa.dot.gov/asset/), which provides a comprehensive set of resources for transportation agency asset management, including an:
  - Overview defining asset management: https://www.fhwa.dot.gov/asset/if08008/amo_02.cfm.
  - Sample TAMPs and templates: https://www.fhwa.dot.gov/asset/plans.cfm.
  - A review of current practices by local agencies: https://www.fhwa.dot.gov/asset/if08008/amo_06.cfm.
- AASHTO Transportation Asset Management Guide: A Focus on Implementation (https://bookstore.transportation.org/item_details.aspx?id=1757), which gives a "'step-by-step' presentation of the tasks to implement asset management in a transportation agency" for agencies "at any level of maturity." The guide walks agencies through eight steps for implementing asset management, including establishing performance measures.
- U.S. Domestic Scan Program: Best Practices in Transportation Asset Management (http://onlinepubs.trb.org/onlinepubs/trbnet/acl/NCRHP2068_Domestic_Scan_TAM_Final_Report.pdf), which includes information on asset management systems used by seven state DOTs and three local agencies.

Related Research and Other Resources

Asset Management for Local Agencies

CTC found a number of resources focused on asset management by local agencies. See especially:

- Asset Management for Kansas Counties: The State of Practice (http://krex.k-state.edu/dspace/bitstream/handle/2097/480/KevinFriedrichs2007.pdf;jsessionid=583638023F418CFDE1DD23953731F458?sequence=1), which includes a survey of Kansas counties about their asset management systems, their successes and failures, how they prioritize maintenance, what assets they have inventoried and what software they use.
- Transportation Asset Management for Local Government Agencies: Threshold Levels and Best Practice Guide (http://minds.wisconsin.edu/handle/1793/6962), which identifies key practices and thresholds for agencies of different sizes, and gives an extremely detailed review of available software packages, their costs and capabilities, and their relevance to local agencies. Finally, the report provides case studies for nine local agencies.
- Asset Management Guide for Local Agencies in Michigan (http://www.michigan.gov/documents/MDOT_AMC_Revised_TAMC__guide_text_159561_7.pdf), which is meant to help Michigan local agencies "understand and implement the principles of asset management." It includes sections on performance measures, data collection and condition assessment; predicting future condition as a function of investment levels; and various pavement management systems.

Integrated/Consolidated Asset Management

CTC found very limited information on consolidated asset management, whether at local agencies or any other level. Kentucky has implemented an integrated system "for pavement management, bridge management, equipment/fleet management, and maintenance management" (A New Pavement Management System as Part of Integrated Asset Management in Kentucky).

Decision Frameworks and Implementation

CTC found several useful resources related to the implementation of asset management systems, including:

- Development and Implementation of Highway Structures Information System for Wisconsin Department of Transportation, which concerns the development of Wisconsin DOT's asset management system.
- Asset Management Systems Review: A Detailed National Report on Asset Management Systems, To Assist Our Members with Making Informed Decisions, which reviews tools available in Australia.
- Cornell Asset Management Program—Roads & Streets (CAMP-RS), an overview of a pavement management system.

Next Steps

Interviews revealed that most local agencies are in the early stages of development of TAM systems, or tried something in the past and now are reworking their systems because of emerging and improving technology. This validates LRRB's goal to create a guide for local agencies to implement such systems if they so choose. LRRB will examine the possibility of another project to evaluate available asset management systems and software to create a decision tree that local agencies can follow when choosing a system. This project might also develop a template document for asset management planning.

Other possible next steps for LRRB to consider include:

- Contacting the Alcona County (Michigan) Road Commission, Kentucky Transportation Cabinet and Oconomowoc (Wisconsin) Public Works for their experiences with asset management.
- Following up with Seattle DOT for a copy of its full asset management plan (available in about two years).
- In about a year, following up with the City of Tacoma Public Works concerning its experience implementing Lucity.

Detailed Findings

Survey of Local Agency Practices

Based on its literature review and interview with Steve Gaj of FHWA, CTC identified 16 potential state and local agencies to be interviewed about their TAM practices. With the assistance of the Technical Advisory Panel, CTC narrowed this down to the following list of interviewees:

- Alcona County Road Commission, Michigan.
- Cole County Public Works, Missouri.
- Hillsborough County Public Works, Florida.
- Kent County Road Commission, Michigan.
- Kentucky Transportation Cabinet.
- Oconomowoc Public Works, Wisconsin.
- City of Tacoma Public Works, Washington.
- Tillamook County Public Works, Oregon.

Brad Henry of the TAP also provided contacts for the following agencies:

- City of Calgary, Alberta, Canada.
- Seattle DOT, Washington.
- Southeast Michigan Council of Governments (SEMCOG).

CTC was able to reach representatives at eight of these agencies: Cole County, Hillsborough County, Kent County, City of Tacoma, Tillamook County, City of Calgary, Seattle DOT and SEMCOG. Email and phone messages were left with the following contacts at the remaining three agencies:

- Alcona County Road Commission: Jesse Campbell, managing director, 989-736-8168, manager@alconacrc.com. CTC could not find contact information for or referrals to other individuals within this agency.
- Kentucky Transportation Cabinet: Jon Wilcoxin, transportation engineer branch manager, Jon.Wilcoxson@ky.gov, 502-564-4556; Keith Dotson, Keith.Dotson@ky.gov, 502-564-7183. Dotson replied with a promise to provide referrals within the agency.
- Oconomowoc Public Works: Mark Frye, director, 262-569-2184, MFrye@oconomowoc-wi.gov; Kathy Buss (administrator, 262-569-2189, KBuss@oconomowoc-wi.gov) couldn't provide referrals within the agency other than Frye.

Interviews were conducted by phone unless otherwise noted. Interviewees were asked the following questions:

1. What is the population of the area served by your organization? For which infrastructure assets are you responsible?
2. What system/software does your organization use to inventory assets? Which assets are included? Are there separate systems for assets or asset types, or is the system consolidated? If you have used multiple systems/software, which have you found to be best for managing particular assets or asset classes? Can you provide any documentation about this system or systems?

3. Beyond inventory, are you engaged in more formal asset management? Do you have an asset management plan? If so, can you provide a copy of this plan?
4. Is your system/software strictly for inventory or can it assist in making asset management decisions?
5. What challenges have you experienced in implementing and using your inventory or asset management system? How have you benefited? What practices have you found to be most and least useful?
6. What role do political considerations play in your asset management decisions? How do you convince decision-makers (such as county commissioners and mayors) of the importance of asset management? What successful practices have you used to communicate with decision-makers?

Summary of Survey Results

Summaries of interview results are provided below. For reference, an abbreviated version of each question is included before the response. Responses have been edited for clarity.

City of Calgary

Contact: Steve Wyton, Manager, Corporate Project and Asset Management, The City of Calgary, Alberta, Canada, 403-268-5746, Steve.Wyton@calgary.ca.

Steve Wyton provided a response by email.

1. **Population and assets:** Calgary has a population of roughly one million.
2. **System/software:** With over 550 services and over $60 billion in assets, Calgary has multiple asset management tools in place, each typically managing a specific asset portfolio or class. For instance, it uses Fleetfocus M5 for fleet/transit vehicles (http://www.assetworks.com/fleet/fleetfocus/), Infor EAM for buildings (http://www.infor.com/solutions/eam/), Infor Hansen for Roads (http://www.infor.com/product-summary/public-sector/asset-management/), Oracle WAM for water/wastewater assets (http://www.oracle.com/us/products/applications/utilities/business-solutions/work-asset-management/overview/index.html), and Remedy for IT (http://www.bmc.com/it-solutions/remedy-itsm.html). It also has a corporate wide tool called RIVA for long range capital planning (http://www.powerplan.com/product-solutions/riva-modeling.html). It has a very complex architecture for a lot of functionality including CMMS, CWMS, etc.
3. **TAM planning:** Calgary has had a formal asset management plan and framework since 2004, and has very advanced asset management processes in place. This information is found in its Corporate Asset Management Plan (http://www.calgary.ca/CS/IIS/Pages/About-land-information/About-Infrastructure---Information-Services.aspx#cpam). Calgary also has technical asset management plans for every major asset portfolio (water, wastewater, transit, roads, IT, Parks, Rec, etc.). It will have refreshed asset management plans completed for the end of this coming year, and they all justify Calgary's long range investment plans.
4. **TAM decisions:** Calgary's software is currently being configured to do advanced asset management, including risk and level of Service analysis.
5. **System/software challenges:** No response.
6. **Political considerations:** Calgary's elected officials see the merit and understand asset management at a high level – there is no convincing required. Many of Calgary's practices, including our council approved Asset Management Strategy from 2004, are found on its website.

Cole County Public Works
Contact: Eric Landwehr, County Engineer, Cole County Public Works, Missouri, 573-636-3614, ELandwehr@colecounty.org.

Due to time considerations, CTC conducted a very brief phone interview with Eric Landwehr.

1. **Population and assets:** The population of Cole County is 30,000, and the Public Works department manages roads and bridges and anything related to these, including signs and culverts.
2. **System/software:** ArcGIS for Desktop. The department is currently looking at vendors for pavement management systems and other asset management software.
3. **TAM planning:** None.
4. **TAM decisions:** No. Decisions are based on institutional knowledge and historical information. The department is small.
5. **System/software challenges:** Newer, more specialized software will probably be more efficient.
6. **Political considerations:** Political considerations play a minimal role. The department operates under a three-person county commission, which allows the department autonomy and doesn't micromanage.

Hillsborough County Public Works
Contact: Erick Sumner, Manager, Geomatics, Hillsborough County Public Works, Florida, 813-307-4756, SumnerE@hillsboroughcounty.org.

1. **Population and assets:** The county population is about 1.3 million. Assets include anything in the right of way: roads, bridges, culverts, signs, etc.
2. **System/software:** The department uses MaintStar (http://www.maintstar.com/) for asset management and uses Esri GIS to collect field data and digitize as-built data. Another system, CAMS (http://www.nexcortech.com/cams.htm) is used for potable water and wastewater utilities.
3. **TAM planning:** The department's asset inventory team collects all assets via as-built records or via physical collection in field. Asset management plan: http://www.planhillsborough.org/wp-content/uploads/2014/09/2040-LRTP-System-Preservation-Costs-Benefits-Tech-Memo.pdf.
4. **TAM decisions:** The software does not help make decisions. Users must conduct queries and analyze data.
5. **System/software challenges:** MaintStar is a decent system and Sumner can give it a qualified recommendation. It is difficult to implement and has documentation that is not always clear. The company seems to be a small Russian company with 8 to 10 people. Customer support involves a time zone factor. MaintStar is also limited in its ability to work in concert with GIS. Because it is difficult to get this data into the system, the department hasn't updated data since 2014. The department previously used Infor Hansen (http://www.infor.com/product-summary/public-sector/asset-management/). While newer versions of Hansen look good, the department was not satisfied with the version it was using (it had a poorer GIS interface than MaintStar). A panel selected MaintStar as a replacement, and has been using it for four years. Sumner's first choice would not have been MaintStar but Cityworks (http://www.cityworks.com/), which didn't respond to the department's RFP. Sumner sees Cityworks as a comprehensive, highly advanced solution and believes that every asset managed by local government should be in GIS. The panel also considered Lucity (http://www.lucity.com/), which is used in Portland and Seattle. Sumner notes that many agencies use software to automate bad practices and recommends they build the system they want and then modify processes to conform with that system.
6. **Political considerations:** Everyone understands the need for infrastructure maintenance, and some of the county's bond ratings are tied to pavement condition index ratings. As the rating goes down over the entire network over time, more money is devoted to maintenance.

Kent County Road Commission

Contact: Steve Warren, Managing Director, Kent County Road Commission, Michigan, 616-242-6962, SWarren@kentcountyroads.net.

1. **Population and assets:** Kent County has a population of 650,000. In Michigan road commissions are organized along county boundaries. There are 83 counties and road commissions, most of which are independent bodies in the sense that they're not actually part of county government but a separate board of directors. They are appointed by a county board of commissioners, but they basically operate independently. Assets include 1,956 centerline miles of roadway, 172 bridges, and anything road-related, including signs and signals.
2. **System/software:** The Kent County Road Commission and all other road commissions in Michigan use a program called Roadsoft (http://www.roadsoft.org/), which was developed by the University of Wisconsin and adapted by the local technical assistance program [LTAP] at Michigan Tech (http://michiganltap.org/). The LTAP provides software and training for free. It has a condition tracking system for roads, and has sign, culvert and other modules. Bridges are tracked at the state level in the national bridge inventory system. Before Roadsoft, which Kent County started using in 2004, it used MicroPaver, originally developed by the University of Illinois for tracking conditions on airport runways. Kent County found this system to be too complicated, with a 100-point pavement condition scale that required intense in-the-field, out-of-the-vehicle measurements of cracks and determinations of cracking patterns and wheel rutting. Kent County used to use PASER as a pavement surface rating system. It has a 1 to 10 rating scale and allows surveying from within vehicles rather than exact measurements. All types of roadways are evaluated with the same methodology. The Council has found it to be efficient to evaluate surface deterioration and help determine timing for pavement preservation treatments. The Council rates all federal aid roads annually. It took a number of years for the use of Roadsoft to become reliable and consistent, because those rating in the field must be trained. Individuals go into the field to do ratings and enter information into Roadsoft via a mobile data collector. The Council worked with the LTAP to develop training programs so that ratings would be consistent and accurate. For the sake of simplicity, ratings are divided into three groups: good, fair and poor. This allows them to be placed on a color-coded map (green, yellow and red) and helps analyze data from an investment perspective. For more information on Roadsoft, contact Tim Colling at the LTAP (http://www.mtti.mtu.edu/faculty-and-staff/tim-colling).
3. **TAM planning:** Kent County is updating its plan right now—it is not yet available but will be online soon. For its current plan, see http://www.kentcountyroads.net/media/files/default/default2015StrategicPlan.pdf.
4. **TAM decisions:** With Roadsoft program agencies are able to track the rate of deterioration with some prediction capability. It can help evaluate different improvement programs by forecasting future conditions based on these improvements. It has a bias toward preservation treatments as the least costly and most efficient way to bring the system condition up. But this isn't something agencies can do forever.
5. **System/software challenges:** Training for data collection is the biggest challenge. There is always a tradeoff between being able to collect data quickly and efficiently and how much time is spent on it. The more quickly the data is collected, the more subjective and prone to error it is. Those doing the rating are moving down the road fairly quickly and must be able to quickly distinguish different kinds of cracking patterns.
6. **Political considerations:** Data from Roadsoft has been very useful in making presentations to state legislatures. The commission puts the condition data graphically into maps and charts, giving it instant credibility. Once people understood that this wasn't just opinion but based on science, people never really challenged the validity of data. Politicians trust what the commission is saying, and are confident in the data. Statewide Roadsoft data has been used to write a report whose findings as to needs and

recommendations for a major investment program were adopted and endorsed by the governor. Roadsoft also provides a lot of valuable information when putting together a road improvement budget at the county level. It's a powerful tool for determining which lane miles to target for improvements and convincing others of this need. The commission can take its maps to townships and show them what their road conditions are and where it is they need to make investments, and what the cost will be and what the impact will be. All of this is done graphically.

Seattle DOT

Contact: Terry Martin, Asset Management Program Director, Seattle Department of Transportation, 206-615-1744, Terry.Martin@seattle.gov.

1. **Population and assets:** Seattle has a population of 700,000 in the city itself and then 3.5 to 4 million in the metropolitan area. Seattle DOT manages 47 different asset classes, including pavement, sidewalks, retaining walls, bridges and signals. See Seattle DOT's Asset Management Status and Condition Report for more information: http://www.seattle.gov/transportation/docs/SDOT2015SCReportFinal12-7-2015.pdf.
2. **System/software:** The city has used Infor Hansen (http://www.infor.com/solutions/ps/) since 2006 and synchronizes data with Esri GIS. Hansen is used for all assets but there are also different, more detailed systems for each asset class. The DOT uses modules in Esri called Treeworks and Treecollector for its forestry assets. For bridges, it uses BridgeWorks (http://www.wsdot.wa.gov/LocalPrograms/Bridge/BridgeWorks.htm), where bridge staff can track very detailed data. Part of that data feeds into Hansen, which is much more generic and doesn't cover as much detail. Similarly, pavement data is tracked in StreetSaver and some of this data reaches Hansen. The data does not feed in automatically, but involves a labor-intensive and awkward process. The DOT is trying to solve this problem by establishing a central group to sync GIS with Hansen rather than using a decentralized group of onboarders for whom adding data to Hansen is 5 percent of their job. Most other assets are tracked with spreadsheets (before data is pulled into Hansen). Hansen is awkward to deal with in the sense that locating assets involves not a spatial x-y coordinate but distance from the end of a block. It is cumbersome, fraught with mistakes, and requires training the DOT doesn't have time for. If configured properly and with the right training, Hansen might be a good solution. Most agencies are not fond of their database, whatever it happens to be.
3. **TAM planning:** See the status and condition report: http://www.seattle.gov/transportation/docs/SDOT2015SCReportFinal12-7-2015.pdf. See also: http://www.seattle.gov/transportation/assetmanagement.htm. Seattle DOT is currently transitioning to a full asset management plan (available in two years). The current status and condition report is more comprehensive than many full asset management plans and includes condition assessments, performance metrics and long-term operational costs by asset classes. The DOT had an asset management group until the late 2000s, after which it went away because of the recession. It has been back in operation for the last two and a half years.
4. **TAM decisions:** The DOT doesn't have the latest version of Hansen. The software cannot automate decisions. It's a data repository against which one can run reports or queries.
5. **System/software challenges:** Training and getting data into the system are the biggest challenges. Hansen is not the most intuitive software to use. Ultimately the goal is to bring in assets spatially through GIS rather than through Hansen. The benefits of using Hansen have been showing accountability to the public and decision-makers.
6. **Political considerations:** Generally not a huge interest in asset management from executives. They're more interested in higher profile, more political things, like transit. MAP-21 requires TAM, and it is required in order to sustain the DOT's funding. Asset management also helps show due diligence for creating curb ramps under the Americans with Disabilities Act. Unless the city shows that it's building enough curb ramps, it could be sued for a lot of money.

SEMCOG

Contact: Tom Bruff, Manager, Plan and Policy Development, Southeast Michigan Council of Governments, 313-324-3340, Bruff@semcog.org.

Tom Bruff responded in writing.

1. **Population and assets:** SEMCOG encompasses the seven counties that surround the Detroit metropolitan area. There are 4.7 million people in the region. As the MPO [metropolitan planning organization] for the region, SEMCOG does not have jurisdiction over any infrastructure assets. However, the agency does help collect road condition data. The agency also develops and serves as a repository of several different data sets, including bridge conditions, traffic counts, ITS architecture, traffic signals, crash, and other data sets that support the planning activities for the region. See SEMCOG's Data and Maps (http://www.semcog.org/Data-and-Maps) and Open Data Portal (http://maps.semcog.opendata.arcgis.com/).
2. **System/software:** SEMCOG uses Roadsoft (http://www.roadsoft.org/) to collect and store road condition data. The software is the standard software for collecting road condition data in Michigan. The main module is the road condition/asset management module. The software also has other modules including bridges, culverts, guardrail, pavement markings, sidewalks, signs, and traffic signals. Other data is stored on SEMCOG's GIS system. The information is stored in several different systems. Some communicate, most do not communicate directly, instead rely on the GIS system to integrate the systems.
3. **TAM planning:** SEMCOG maintains dashboards for inventory conditions, provides targets and performance measures (http://semcog.org/Plans-for-the-Region/Performance-Measures) for several asset types. It also forecasts road conditions for the long range transportation plan. SEMCOG also initiated an effort to coordinate transportation and utility (underground) assets (http://semcog.org/Plans-for-the-Region/Infrastructure). The Council started with a simple spreadsheet but [is] considering placing the information in a relational database, ProjTracker. ProjTracker is our database management system used to maintain our long- (RTP) and short-range (TIP) transportation projects.
4. **TAM decisions:** Roadsoft includes both inventory and forecast modules for road conditions. SEMCOG also uses other forecast tools (e.g., Pavement Condition Forecasting System, developed [b]y Michigan Department of Transportation) to supplement the forecast module in Roadsoft.
5. **System/software challenges:** SEMCOG is required to participate in the inventorying of federal aid roads in the region. There are 8,300 miles of federal aid road[s] in the region. All of the paved, federal aid roads in the region are collected on a two-year cycle. It works with the Michigan Department of Transportation and the county road commissions to collect the data. The data collection is a large undertaking with a lot of commitment of staff time. However, the data and forecasting is invaluable for making decisions for using scarce tax dollars. SEMCOG also provides direct assistance to local communities to help them start collecting data on their own local roads. And it offers assistance to communities to help them develop asset management plans. SEMCOG would like to provide more assistance to communities in the future, including helping a community develop a full-featured asset management system. For challenges, it is more difficult to make asset management-based decisions on all road and bridge projects. Not all funding sources allow capital improvement projects to be used. Some communities still employ worst-first strategies for road improvements. They don't feel they have the capacity or political clout to employ a mix of fixes that look at the road network holistically. There is also a challenge of using an asset management approach to maintaining underground utilities such as water and sewer. Some agencies are reluctant to provide us with long-term plans for maintaining/expanding their system. Most useful—there has been buy-in to using the road condition data for project selection. The PASER data is considered to be impartial and uniform, so it is a useful selection criteri[on].

6. **Political considerations:** For the last two long-range transportation cycles, SEMCOG ha[s] presented its policy boards and the public with scenarios for future road improvements. The region adopted a funding scenario where one third of funding would be spen[t] to capital preventive maintenance, one third on rehabilitation, and one third on reconstruction. Based on the forecast, the funding would result in the best network health over the course of the plan. However, there are no built-in mechanisms to make sure funding is spent in that ratio. Flexing of funding may get us close, but there is more money spent on rehabilitation and reconstruction than the adopted ratios. The road condition data was also used to make the case for increased funding through higher gas and diesel taxes, higher vehicle registration fees, and pledges for monies from the State's general fund to be used for road improvements. This legislation was passed in 2015. The total funding will increase over several years. Asset management practices have to have buy-in from local elected officials. With robust data, it is easier to make the case that increased funding can determine the most appropriate strategies for maintaining our assets. SEMCOG makes the asset management dashboards available on the web site. In addition, the data is available on the agency's open data portal so anyone can see the data. The State also has a dashboard (http://tamc.mcgi.state.mi.us/MITRP/Data/PaserDashboard.aspx).

City of Tacoma Public Works

Contact: Rae Bailey, Street Operations Division Manager, City of Tacoma Public Works, Washington, 253-591-5488, RBailey@cityoftacoma.org.

1. **Population and assets:** There are about 210,000 people in the City of Tacoma. Assets include 48 bridges; 757 lane miles of arterial streets; 8,600 blocks of residential streets; 38,000 street name signs and stop signs; 21,000 street lights; and 364 traffic signals.
2. **System/software:** In the late 1990s the city elected not to do asset management for roads and got rid of its pavement management software. It is now at the beginning stages of returning to asset management: It has just purchased Lucity (http://www.lucity.com/), and a consultant does a condition index. It will use this system for pavement, traffic signs and eventually all other assets. The department currently uses Esri GIS as well as SAP financial software, which has a lot of asset management capabilities. The department also looked at StreetSaver (https://www.streetsaveronline.com/), which didn't seem to be powerful enough.
3. **TAM planning:** The city has no asset management plan but is currently developing one (and hired a pavement manager for this purpose).
4. **TAM decisions:** Lucity will automate asset management decisions in line with a budget and asset management plan.
5. **System/software challenges:** The software has been challenging to install, but primarily because of the department's information technology security restrictions.
6. **Political considerations:** The department gives a presentation to policymakers every budget cycle to update them on goals and the type of maintenance and reconstruction activities needed. The public works director is currently trying to convince its city manager to provide more funding. This is harder to do without data; an asset management system will help.

Tillamook County Public Works

Contacts:

- Liane Welch, Director, Tillamook County Public Works, Oregon, 503-842-3419, LWelch@co.tillamook.or.us. (Welch was interviewed by phone.)
- Patricia Bugas-Schramm, PBS Consulting, Inc., 503-320-3421 (cell), 503-288-8912, Patricia@pbsconsultinginc.com. (Bugas-Schramm consults to Tillamook County Public Works for the purposes of asset management and provided answers in writing.)

1. **Population and assets:** Tillamook County's population is 25,000 people and is largely rural. The Public Works department is responsible for transportation assets, including 3,000 culverts, 268 miles of paved road, 64 miles of gravel roads, 103 bridges, signs, levees, striping, and related vehicles, equipment and buildings required to provide transportation services. In 2015, the replacement value for this system was $845 million.
2. **System/software:** A custom-designed software system, IRIS, was developed by the Oregon Association of Counties and is made available to Oregon counties at no cost. All assets listed above are included in this system. There are modules within IRIS that address each asset's inventory, condition, location and work done by asset or location, and are linked to work orders and finance. Culverts are within the system by location but condition is only known for about 20 percent of the system. The pavement management system is StreetSaver, developed by San Francisco region of governments. This is linked to IRIS. A private contractor visually assesses road segment conditions every other year and these are tracked with a pavement condition index. PONTIS is used for bridges and information input into IRIS. The county contracts for bridge condition assessment; it is done every other year. Tillamook has been using IRIS for more than 20 years, and Welch could not speak to comparisons with other systems. For information about IRIS, contact the Association of Oregon Counties (http://oregoncounties.org/). For more information about StreetSaver, contact the Metropolitan Transportation Commission (http://mtc.ca.gov/). Buildings are not managed within either of these systems; this is an identified need.
3. **TAM planning:** Tillamook County has been using an asset management plan since 2008, available at http://www.co.tillamook.or.us/gov/pw/Documents.htm#Asset Management Plan. Inventory and condition, replacement value and risk are updated each year since 2008. Strategies to manage assets and risk-management priorities are identified in the plans.
4. **TAM decisions:** The software does not make asset management decisions but is a repository of data and information on conditions that are used to make risk-based decisions. The knowledge needed to make asset management decisions is the product of some performance forecasting (e.g., PMS five-year performance projections), but the integration of strategy for which asset and location is highest priority in order to achieve the longest life cycle for the lowest life-cycle cost is not produced from software. This is done by the department in risk-based community workshops and ongoing consultation with the Road Advisory Committee. See Tillamook's cost accounting system: http://oregoncounties.org/roads/county-road-program/integrated-road-information-system/cost-accounting-reports/.
5. **System/software challenges:** According to Bugas-Schramm, challenges include the fact that within a small department at the local level, inadequate staffing levels and turnover result in expertise leaving. Cross-training occurs, and each asset plan documents the frequency of asset condition assessments, standards, data maintenance roles and accountability for decisions for each asset class. This helps the department to keep information current, accountability transparent and information useful for department and community decision-making.
6. **Political considerations:** According to Welch, IRIS helps the department tell their story to voters via public meetings (for infrastructure, voters tax themselves via bonds). She uses a PowerPoint presentation at annual community briefings to remind the public of challenges and priorities, and talk about the condition of the system and where money needs to be spent. Asset management data is

instrumental in getting public support. The information is also provided twice a year to the County Road Advisory Committee, which meets monthly. The County Commission adopted an asset management policy in 2009 that places emphasis on its role in strategically managing transportation assets. According to Bugas-Schramm, this ongoing commitment to communicate and involve the commissioners and community is a hallmark of Tillamook County Public Works and its director, who is recognized as a national and state leader in asset management and county engineering.

Consultation with National Practitioners

CTC interviewed Steve Gaj of FHWA and requested interviews with Matt Hardy of AASHTO and Bryan Cawley of FHWA. CTC will continue to attempt to contact national practitioners as part of Task 4 of this project.

FHWA

Contact: Steve Gaj, Office of Asset Management, Pavements, and Construction, Federal Highway Administration, 202-366-1336, stephen.gaj@dot.gov.

Gaj recommended the following video as particularly applicable to local agencies:

- **Transportation Asset Management**, FHWA, February 2014.

  http://www.youtube.com/watch?v=ep3j7f__LuM&feature=youtu.be

  This video gives an overview of TAM:

  - TAM is a two-step approach:
    - Maintain assets.
    - Manage assets for the future so they meet needs of future generations.
  - TAM is a strategic and systematic approach to managing assets that considers risk and investment over the life of a project and helps ensure funding available for highest priorities. It balances desirability with affordability and considers long-term costs when making purchases (the total cost of maintaining a road or bridge can be three times construction costs).
  - To help estimate future costs, asset management plans create an inventory of assets and the level of service they provide; predict future demands to help set up life-cycle and risk management plans; and provide insight into developing financial plans and investment strategies.
  - The process of developing plan helps agencies understand what it costs to take care of what they already own so they can better manage long-term needs and commitments. Future generations depend on this foresight to ensure long-term financial sustainability of the services provided.
  - MAP-21 requires all state transportation departments to develop risk-based asset management plans.

Gaj also said that the following TAMP resources are appropriate for local agencies, despite being geared toward state DOTs:

- Transportation Asset Management Plans (see Asset Management in **National Resources**) https://www.fhwa.dot.gov/asset/plans.cfm
- Pilot Project—Development of Transportation Asset Management Plans (TAMP) https://www.fhwa.dot.gov/asset/tamp/

This page includes a link to a generic work plan for developing a TAMP, which is a good place to start for local agencies:

> http://www.fhwa.dot.gov/asset/tamp/workplan.pdf (see Asset Management in **National Resources**) as well as links to sample work plans for DOTs.

Local agencies will have asset management systems of varying sophistication depending on their size. It may be as simple as an Excel worksheet or a database. A good place to start is a draft work plan (https://www.fhwa.dot.gov/asset/tamp/, which tells local agencies what they need to do. Gaj also recommended the International Infrastructure Management Manual: http://www.nams.org.nz/pages/273/international-infrastructure-management-manual-2011-edition.htm.

Gay provided two brief PowerPoint presentations useful for local agencies:

- **Asset Management including Requirements in MAP-21**(**Appendix A**).
  Asset management comes down to five core questions:
  - What is the state of my assets?
  - What is my required level of service/performance?
  - What assets are critical to sustained performance?
  - What are my best "Operations and Maintenance" and "Capital Improvement" investment strategies?
  - What is my best long-term funding strategy?
- **Asset Management**, four slides defining asset management (**Appendix B**).

Gaj also recommended that AASHTO's bimonthly asset management webinars be promoted to local agencies (https://www.fhwa.dot.gov/infrastructure/asstmgmt/events.cfm) as well as National Highway Institute training courses (https://www.fhwa.dot.gov/asset/training.cfm).

For software, Gaj suggested AgileAssets, Dynatest and AASHTO Bridge. But small localities would probably start with an Excel spreadsheet.

For local agency interviews, Gaj recommended Dallas–Fort Worth, San Francisco, Cleveland, Vancouver and especially localities in Washington state (including Seattle and Tacoma).

National Resources

Asset Management, FHWA, January 2016 (last updated).
https://www.fhwa.dot.gov/asset/
FHWA provides a comprehensive set of resources for transportation agency asset management:

> **Asset Management Overview**
> https://www.fhwa.dot.gov/asset/if08008/amo_02.cfm
> This page defines asset management: "Transportation Asset Management is a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their lifecycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well defined objectives." It also describes its core principles (as in *NCHRP Report 551*):
>
> - **Policy-driven**—Resource allocation decisions are based on a well-defined set of policy goals and objectives.

- **Performance-based**—Policy objectives are translated into system performance measures that are used for both day-to-day and strategic management.
- **Analysis of Options and Tradeoffs**—Decisions on how to allocate funds within and across different types of investments (e.g., preventive maintenance versus rehabilitation, pavements versus bridges) are based on an analysis of how different allocations will impact achievement of relevant policy objectives.
- **Decisions Based on Quality Information**—The merits of different options with respect to an agency's policy goals are evaluated using credible and current data.
- **Monitoring Provides Clear Accountability and Feedback**—Performance results are monitored and reported for both impacts and effectiveness.

Finally, it describes the goals of asset management for a public agency:

1. Keeping the infrastructure in as good or better condition than it is now.
2. Developing and implementing a logical capital improvement plan.
3. Containing the costs of planning, building, operating and maintaining the facilities.

Transportation Asset Management Plans, FHWA, February 2016 (last updated).
https://www.fhwa.dot.gov/asset/plans.cfm
This page includes links to:

- Pilot projects for the development of asset management plans, including a generic work plan (details below) for developing a plan and work plans for Louisiana, Minnesota and New York state: https://www.fhwa.dot.gov/asset/tamp/.
- Sample TAMP templates (e.g., https://www.fhwa.dot.gov/asset/templates/example01.cfm).
- TAMPs from Minnesota (details below), New York and Wyoming.
- New Zealand's State Highway Asset Management Plan (2012-2015): http://www.nzta.govt.nz/assets/resources/state-highway-asset-management-plan/docs/state-highway-asset-mgmt-plan-2012-2015.pdf.

Generic Workplan for Developing a TAMP, FHWA, January 2016 (last updated).
http://www.fhwa.dot.gov/asset/tamp/workplan.pdf
This generic work plan, which Gaj recommended as applicable to local agencies, includes an introduction to TAM and guidance on what needs to be included in a plan. See also: A Strategic Framework to Support the Implementation of Transportation Asset Management in State Transportation Agencies: https://www.fhwa.dot.gov/asset/pubs/framework.pdf.

MnDOT Transportation Asset Management Plan, MnDOT, July 2014.
http://www.dot.state.mn.us/assetmanagement/index.html
MnDOT worked closely with FHWA to develop a TAMP that serves as an example and guide for other states as they develop TAMPs of their own. It includes chapters on:

- Asset management planning and programming framework.
- Asset management performance measures and targets.
- Asset inventory and condition.
- Risk management analysis.
- Life-cycle cost considerations.

- Performance gaps.
- Financial plan and investment strategies.
- Implementation and future developments.

The software that MnDOT uses for asset management is AgileAssets (https://www.agileassets.com/), which is used by several state DOTs and local agencies.

Current Practices in Transportation Asset Management, FHWA, July 2015 (last updated).
https://www.fhwa.dot.gov/asset/if08008/amo_06.cfm
This section includes an account of local government experience with TAM:

- **Cole County, Jefferson County, Missouri:** The Cole County Public Works Department decided to develop its own asset management software after canned packages turned out to be costly and complicated. From the Web page: "The new software, designed to be simple to use and maintain, was based on a spreadsheet model, with inventory data collected using inexpensive global positioning system (GPS) devices purchased at a local electronics store."
- **City of Redmond, Washington:** Redmond has an asset management system that includes not only pavements, but signs, curbs and gutters, and right of way. These are tracked by GIS. The system is not fully integrated. From the Web page: "Streetlights and traffic signals are reported in a separate asset listing. Hiking and biking trails are also included among the transportation assets the Public Works Department manages, but they are managed in a separate module."
- **Common Issues Raise by Local Governments** include getting management and staff commitment, building and maintaining an asset inventory, finding software that matches the needs of the agency, and maintaining asset inventories and monitoring their conditions.

"Resources," Asset Management, FHWA, November 2015 (last updated).
https://www.fhwa.dot.gov/asset/resources.cfm
This page includes links to guidance, webinars, videos, an FAQ and a literature review: Risk-Based Transportation Asset Management Literature Review (details below).

"Guidance," Asset Management, FHWA, February 2016 (last updated).
This page includes links to legislation, policy and other information, including:

- **Moving Ahead for Progress in the 21st Century Act (MAP-21)**
  http://www.fhwa.dot.gov/map21/legislation.cfm
- **Transportation Asset Management Guide—A Focus on Implementation** (details below)
  https://www.fhwa.dot.gov/asset/hif10023.cfm

"Videos," Asset Management, FHWA, October 2015 (last updated).
https://www.fhwa.dot.gov/asset/video/index.cfm
See especially:

- AASHTO—Transportation Asset Management
  https://www.youtube.com/watch?v=ep3j7f__LuM&feature=youtu.be

  Gaj recommended this AASHTO overview. See **Consultation with National Practitioners** for details.
- City of Ryde—Sustainable Asset Management Video
  http://www.lgam.info/forum/t-564419

  This video gives an overview of a locality managing a wide range of assets.

- MDOT—Asset Management at Work
  https://www.youtube.com/watch?v=2k2jYoOxPdY&list=UU23tfYjZxEq5GeHGCtV6iJA

ARNOLD Reference Manual, FHWA, September 2014.
http://www.fhwa.dot.gov/policyinformation/hpms/documents/arnold_reference_manual_2014.pdf
ARNOLD, or All Road Network of Linear Referenced Data, refers to an FHWA requirement, announced in 2012, for state DOTs to submit linear reference data that includes all roads. This manual is intended to help states implement this requirement. This data is intended to be part of a national Highway Performance Monitoring System (HPMS), but will also be valuable in its application to asset management.

2014 Transportation Asset Management Peer Exchange—Preparing for MAP-21, FHWA, 2014.
http://www.fhwa.dot.gov/asset/pubs/hif14013.pdf
See Section 3 (pages 15-24) for development of asset management plans by various DOTs, and Section 4 (pages 30-36) for a discussion of performance measures. From the overview:

> This report summarizes the proceedings of the 2014 Transportation Asset Management Peer Exchange hosted by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO). The peer exchange was held in Miami, Florida on May 1st, 2014. The purpose of this peer exchange was to provide participants from State Departments of Transportation (DOTs) an opportunity to share information on the best and current practices in transportation asset management (TAM) and the preparation for implementing the TAM-related requirements in the transportation reauthorization legislation Moving Ahead for Progress in the 21st Century Act (MAP-21). The peer exchange was organized around three primary themes: developing a MAP-21-compliant Transportation Asset Management Plan (TAMP); making TAM performance measures work; and TAMP development and risk – climate change and extreme weather events.

AASHTO Transportation Asset Management Guide: A Focus on Implementation, AASHTO, January 2011.
https://bookstore.transportation.org/item_details.aspx?id=1757
Executive summary (AASHTO, June 2013): https://www.fhwa.dot.gov/asset/pubs/hif13047.pdf
This guide gives a "'step-by-step' presentation of the tasks to implement asset management in a transportation agency" (page 2 of executive summary) and is meant to be broadly applicable to agencies "at any level of maturity":

> Chapters 1 through 4 provide the context and preparatory steps that any agency will need to undertake as it prepares for asset management implementation. The material in these chapters is broadly applicable to agencies at any level of maturity. In Chapter 4, differences emerge among agencies at varying levels of maturity, as the more advanced agencies will typically have more formalized and extensive TAMPs in place. Chapters 5 to 8 are designed to be used selectively, depending on the priority areas of improvement identified by the gap analysis in Chapter 2.

The guide walks agencies through the following steps:

- Step 1 (pages 4-5): Set Agency Goals and Objectives for TAM.
- Step 2 (pages 5-7): Perform an Agency Self-Assessment and TAM Gap Analysis. This guide includes a self-assessment tool with structured questions.
- Step 3 (page 7): Define the Scope of TAM in the Agency.
- Step 4 (page 8): Develop the Change Strategy.
- Step 5 (pages 8-9): Integrate TAM into the Organizational Culture.
- Step 6 (page 9): Integrate TAM into Business Processes.

- Step 7 (pages 9-10): Establish Asset Management Roles.
- Step 8 (page 10): Establish Performance Management Standards.

Pages 11-14 discuss TAMP development (see Table 2 for a recommended TAMP outline). Pages 15-36 cover processes and tools. Recommended performance measures include (pages 16-18):

- Condition.
- Life-cycle cost.
- Safety.
- Mobility.
- Reliability.
- Customer measures.
- Externalities.
- Risk.

Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities, FHWA, June 2012.
http://www.fhwa.dot.gov/asset/pubs/hif12036.pdf
From the abstract:

> This literature review summarizes existing research, publications and proceedings relating to risk management and how it can be applied to transportation asset management (TAM.) The review examines domestic sources from the public and private sectors, as well as reports from international public sector agencies. This report provides background for a series of five reports on how risk management can be incorporated into TAM.

NCHRP Synthesis 439: Use of Transportation Asset Management Principles in State Highway Agencies, Neal Hawkins, Omar Smadi, 2013.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_439.pdf
This report explores the state of practice for TAM among state DOTs. It synthesizes the results of two surveys (pages 13-23). For a discussion of state DOT asset management plans, see pages 27-31.

NCHRP Synthesis 371: Managing Selected Transportation Assets: Signals, Lighting, Signs, Pavement Markings, Culverts, and Sidewalks, Michael Markow, 2007.
http://www.ogra.org/files/Roadside/Managing%20Selected%20Transportation%20Assets.pdf
From the executive summary:

> The objectives of this synthesis were to gain a better understanding of the state of practice for managing transportation infrastructure assets other than pavements and bridges, to identify best practices, and to document gaps in existing knowledge and needs for further research.

For each of the following assets, the report addresses agency management approaches, methods to determine and forecast their conditions, service life models for rehabilitation and maintenance, and technologies for collecting and analyzing information:

- Traffic signals, including structural components.
- Lighting, including structural components.

- Signs, both ground-mounted (or roadside) and overhead, including structural components.
- Pavement lane striping and other markings.
- Drainage culverts and pipes (but not bridges).
- Sidewalks, including the walkway itself, curbs, and corners on urban roads and streets (corner curbs, and curb cuts and ramps, if present).

U.S. Domestic Scan Program: Best Practices in Transportation Asset Management, AASHTO, 2007.
http://onlinepubs.trb.org/onlinepubs/trbnet/acl/NCRHP2068_Domestic_Scan_TAM_Final_Report.pdf
This scan includes information from seven state DOTs and the following local agencies:

- Hillsborough County, Florida (Section 3.1).
- Kent County Road Commission, Michigan (Section 3.2).
- City of Portland (Oregon) Office of Transportation (Section 3.3).

These sections include an account of the asset management systems used, their investment decision-making process and lessons learned.

NCHRP Report 551: Performance Measures and Targets for Transportation Asset Management, NCHRP, 2006.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_551.pdf
From the executive summary:

> The objectives of this project were to develop an understanding of what set of performance measures can best serve the principles of good asset management and to recommend procedures that help an agency apply this understanding.

It includes a literature review and the results of interviews with 15 transportation agencies.

NCHRP Report 545: Analytical Tools for Asset Management, NCHRP, 2005.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_545.pdf
From the abstract:

> This report presents two tools developed to support tradeoff analysis for transportation asset management. These software tools and the accompanying documentation are intended for state departments of transportation (DOTs) and other transportation agencies to help them improve their ability to identify, evaluate, and recommend investment decisions for managing the agency's infrastructure assets.

See Table 3 (pages 15-19) for a list of tools used by different DOTs for different kinds of analysis. See Section 3 (pages 23-29) for a review of existing tools.

Research in Progress

Development of an Implementation Manual for Geotechnical Asset Management for Transportation Agencies, NCHRP 24-46, pending.
http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4065
An upcoming NCHRP project will "produce a manual for developing and implementing a geotechnical asset management [GAM] program. The manual will provide plans and tools for a consistent management program that is flexible enough to allow varying adaptations by different agencies as they integrate the geotechnical

assets into their overall asset management program." The manual is intended to meet a need for (from the research project page):

- Guidelines for managing geotechnical assets consistent with and to supplement the AASHTO Transportation Asset Management Guide – A Focus on Implementation (2011). The contents would describe procedures, forms, and electronic data collection and management tools for inventory and condition assessment of assets and elements at all plan levels to provide agencies with a baseline risk-based asset management approach, considering MAP-21, FAST [Fixing America's Surface Transportation] Act, and AASHTO-supported performance measures.
- Examples of successful and unsuccessful GAM strategies for incorporating GAM into TAM, performance management, or risk management programs; concepts for the measurement and tracking of economic, safety, mobility, and condition consequences from geotechnical asset performance; and life-cycle analysis tools.
- Definition and taxonomy of geotechnical assets to support communication and comparability among state DOTs.
- Performance-based goals, targets, and means of measurement for geotechnical assets. Measurements can be technical (such as specified movement) or they can be non-technical, for example, a user perspective or a maintenance cost.
- Ways to incorporate risk analysis principles and processes into asset management for geotechnical assets. Define risk and identify risk elements related to specific geotechnical assets. These should include typically understood consequences such as personal injury or loss of life and property damage, but also including such elements as economic consequences and impacts to environment, mobility and performance, and maintenance costs.

Related Research and Other Resources

Common Commercial Off-the-Shelf Asset Management Applications

- Cityworks (http://www.cityworks.com/).
- Oracle (https://www.oracle.com/applications/supply-chain-management/solutions/maintenance-management/asset-maintenance.html).
- Maximo (http://www-03.ibm.com/software/products/en/maximoassetmanagement).
- Accela (https://www.accela.com/solutions/asset).
- Infor Hansen (http://www.infor.com/product-summary/public-sector/asset-management/).
- EnerGov (http://www.tylertech.com/solutions-products/energov-product-suite).
- Cartegraph (http://www.cartegraph.com/).
- Lucity (http://www.lucity.com/).
- PubWorks (http://www.pubworks.com/).
- Maintenance (http://www.managerplus.com/).
- VUEWorks (http://www.vueworks.com/).
- AgileAssets (https://www.agileassets.com/).
- Elements (http://3.elementsxs.com/).
- CityView (http://msgovern.com/software/detail/cityview_gis/).

Asset Management for Local Agencies

International Infrastructure Management Manual, NAMS, 2015.
http://www.nams.org.nz/pages/273/international-infrastructure-management-manual-2011-edition.htm
Gaj recommended this manual as a resource that could be helpful to local agencies in implementing asset management.

MN2050 State of the Infrastructure 2015 Survey, MnDOT, October 2015.
http://mn2050.org/
The goals of this survey were to:

- Learn to what degree city, county and state agencies are using asset management practices in Minnesota.
- Share collective knowledge regarding the wide range of infrastructure types and condition of infrastructure assets in Minnesota.

From the summary of key findings:

> Agencies use standard tools, including MS Excel, Esri GIS, and pencil and paper to manage their infrastructure. However, respondents have not standardized their use of more specialized asset management systems; over 40 systems are being used across jurisdictions that participated in this survey, with Cartegraph, Icon, SIMS, and Simple Signs most commonly used.

The report recommends making resources available to Minnesota cities and counties for the implementation of asset management systems, including training and the recommendation of select systems. To further explain why asset management and TAMPs should be encouraged at the local level, preliminary data from the 2015 MN2050 survey show that (by value) cities manage about 47 percent of Minnesota's infrastructure, counties about 25 percent, and MnDOT and the Metropolitan Council about 28 percent.

The full results of the survey will be available online in July 2016.

Transportation Asset Management for Local Agencies, Rutgers Center for Advanced Infrastructure and Transportation, November 2011.
http://cait.rutgers.edu/cait/transportation-asset-management
This training might serve as a model for training aimed at Minnesota local agencies.

"Making Asset Management Work: Innovative Components for Successful Implementation by Local Agencies in Michigan," *Transportation Research Record 2121*, pages 22-29, 2009.
Citation at http://trid.trb.org/view/881800
From the abstract:

> Michigan is using an innovative approach to help local agencies incorporate the principles of asset management in their transportation management process—focusing first on pavements and later moving on to other assets. … This paper details the components that have led to making local agency asset management work in Michigan and provides agency case examples.

Asset Management for Wyoming Counties, Vol. I, II, III, University of Wyoming, Laramie, 2011.
http://www.mountain-plains.org/pubs/pdf/MPC11-238.pdf
This report document's the development and implementation of asset management programs for counties in Wyoming by Wyoming DOT. Assets include roads, bridges, culverts, signs, cattle guards and approaches. Wyoming LTAP developed the software for this in-house using Esri ArcGIS (page 3). See pages 9-11 for rating systems for various assets.

"Asset Management for a Durable Infrastructure: Practical Perspectives," *TR News*, Issue 270, September-October 2010.
http://onlinepubs.trb.org/onlinepubs/trnews/trnews270.pdf
This issue of *TR News* contains two articles on local agencies:

- "Local Communities Adopting Asset Management: Initiatives, Models, and Results in Michigan and Wisconsin" (pages 22- 27), which documents initiatives in Michigan and Wisconsin to encourage local agencies to adopt an asset management approach to paved road conditions. This includes trainings, workshops, conferences and MDOT's Asset Management Guide for Local Agencies in Michigan.
- "Asset Management to Improve Highway Performance: Lessons from North Carolina and Tillamook County, Oregon" (pages 6-15), which discusses a TAMP developed by Tillamook County, Oregon.

Related Resources:

Road Asset Management Plan, Tillamook County Public Works, 2009.
http://www.co.tillamook.or.us/gov/pw/Documents/AssetManagement/Final%20TCPWD%20AMP-20090127-v.1.4.pdf

2008 Road Performance Report, Tillamook County Public Works, revised 2009.
http://www.co.tillamook.or.us/gov/pw/Documents/AssetManagement/TCPW_SCPerformance2008-FINAL.pdf

Asset Management for Kansas Counties: The State of Practice, Kansas State University, 2007.
http://krex.k-state.edu/dspace/bitstream/handle/2097/480/KevinFriedrichs2007.pdf;jsessionid=583638023F418CFDE1DD23953731F458?sequence=1
This report includes a survey of Kansas counties about their asset management systems, their successes and failures, how their prioritize maintenance, what assets they have inventoried and what software they use. The report suggests that counties create an inventory of assets using a cost accounting system like Star, NexTech or Baker.

Transportation Asset Management for Local Government Agencies: Threshold Levels and Best Practice Guide, Midwest Regional University Transportation Center, May 2006.
http://minds.wisconsin.edu/handle/1793/6962
This report synthesizes the literature on asset management as it is relevant to local agencies. The report:

- Identifies five key practices: budget and support, coordinated maintenance, interagency cooperation, data collection and technology.
- Establishes standards of practice for agencies depending on whether their population served was small (less than 10,000 persons), medium (10,000 to 100,000 persons), or large (over 100,000 persons).
- Concludes that most asset management strategies and tools can be fruitfully applied by local agencies almost regardless of size.

Chapter 6 (pages 40-62) contains a review of software tools for a range of assets (pavements, bridges, signs and signals). Tables 5-14 (pages 52-61) provide details on market information, data collection and organization, types of assets managed, resource allocation, and maintenance and financial management.

Chapter 8 (pages 67-86) provides case studies on the following localities:

- Kent County, Michigan.
- Ionia, Michigan.

- Hillsborough County, Florida.
- Cole County, Missouri.
- Redmond, Washington.
- Alcona County, Michigan.
- Columbia, Missouri.
- Edmond, Oklahoma.
- Fayetteville, Arkansas.

Asset Management Guide for Local Agencies in Michigan, Michigan Transportation Asset Management Council, March 2006.
http://www.michigan.gov/documents/MDOT_AMC_Revised_TAMC__guide_text_159561_7.pdf
This guide is designed to help Michigan local agencies "understand and implement the principles of asset management" (page 1.1). Section 3 includes information on selecting performance measures, data collection and condition assessment. Section 4 provides information on predicting future condition as a function of investment levels and performing trade-off analyses. Table 4.4 (page 4-8) recommends various pavement management systems, including:

- MicroPaver.
- AgileAssets.
- PAVEMENTview.
- dTIMS.
- Street Master.
- Roadsoft-GIS.

Transportation Asset Management Case Studies—Economics in Asset Management: The Hillsborough County, Florida, Experience, FHWA, 2005.
http://www.fhwa.dot.gov/infrastructure/asstmgmt/difl.pdf
This report documents the development of a comprehensive asset management system for road and stormwater infrastructure by Hillsborough County, Florida: "The new system includes all the forecasting elements necessary to do multiyear budgeting of maintenance, operations, and eventual capital replacement of these assets" (page 3). The project included collecting asset location and condition data and entering them into a custom built system, the Hillsborough County Asset Management System (HAMS). From the executive summary:

> HAMS allows the ready retrieval of the condition and maintenance data, location of assets on the department's geographical information system (GIS) base map, analysis of the data, and the development of efficient strategies to preserve and improve the infrastructure. … A critical component of Hillsborough County's Asset Management strategy is the use of economic analysis tools to aid in the evaluation of asset maintenance, replacement, and improvement strategies.

"Building Blocks for Local Agency Asset Management," *Proceedings of the Fifth International Conference on Managing Pavements*, University of Washington, Seattle, 2001.
Citation at http://trid.trb.org/view/794329
From the abstract:

> Unlike many state departments of transportations (DOTs), local government public works agencies are often responsible for managing a diverse array of physical infrastructure assets. However, the size and scope of these asset networks at the local level tends to be much smaller than at the state level. … This paper discusses asset management issues particular to local governments, the roles of pavement management and APWA [American Public Works Association] accreditation in this process, and the experiences of the City of Columbia, Missouri in asset management development.

Integrated/Consolidated Asset Management

"Integrated Roadway Asset Management," *Transportation 2014: Past, Present, Future—2014 Conference and Exhibition of the Transportation Association of Canada*, 2014.
http://conf.tac-atc.ca/english/annualconference/tac2014/s-10/posavljak.pdf
From the abstract:

> This paper examines an Integrated Roadway Asset Management (iRam) approach to long term investment planning. Trade-off analysis between the bridge and pavement sub-assets is inherit as the bridge network is integrated into the pavement network. Development of the Structural Integration Factor (SIF) is instrumental in converting structures to equivalent pavement sections, such that a homogenous pavement network represents both sub-assets. iRam is subsequently a mutually inclusive (MI) approach of investment planning, compared to current industry practice where pavement and bridge needs are planned through mutually exclusive (ME) organizational processes. Two 10-year investment plans for a model network were developed and compared. iRam outperformed the ME approach in maximizing roadway network performance, optimization of funds, and organizational effectiveness. A theoretical organizational implementation plan for iRam is developed. Further development of iRam is suggested through incorporation of safety and operational performance indicators.

Best Practices in Geographic Information Systems-Based Transportation Asset Management, FHWA, Volpe National Transportation Systems Center, 2012.
https://www.gis.fhwa.dot.gov/documents/GIS_AssetMgmt.pdf
From the abstract:

> This report provides background on geographic information systems (GIS) and transportation asset management (TAM), describes how public agencies have been integrating the two, and identifies benefits and challenges to doing so. The information presented is gleaned from a literature review and interviews with several state departments of transportation (DOTs) and one county agency. The report also identifies some leading industry trends and new, innovative approaches to using GIS for TAM.

"Using an Integrated Asset Management System in North Carolina for Performance Management, Planning, and Decision Making," *Transportation Research Board 91st Annual Meeting*, 2012.
Citation at http://trid.trb.org/view/1130870
From the abstract:

> North Carolina Department of Transportation (NCDOT) has implemented an integrated system comprising of PMS, MMS, BMS and Asset Trade-Off Analyst (ATOA). This paper presents the framework and applications of a sub-set of this integration focusing on NCDOT's Integrated Bridge and Maintenance Management Systems. The paper demonstrates, using examples and case studies, how similar integrated systems can be developed and used by any state agency to manage and share bridge

inventory, condition, maintenance history; track performance of bridge maintenance and preservation work to ensure sustainability of the overall bridge network; prepare and share bridge work plan between BMS & MMS; and, better plan future bridge maintenance and preservation work by reliably determining the resources needed (man-hours and dollars) thereby facilitating planning and decision making. The case studies presented reveal the positive and stabilizing impact that maintenance has on network condition, and highlight the need for more comprehensive review and validation of unit costs used for planning future maintenance work.

"Road Asset Management Systems," *Eighth International Conference on Managing Pavement Assets*, Pontificia Universidad Catolica de Chile, 2011.
Citation at http://trid.trb.org/view/1136939
From the abstract:

> The road asset (excluding structures) includes more than just the pavement; it also includes earthworks, drainage, safety barriers, lighting, signs, lines and the soft estate (grassland, trees and shrubs). This valuable asset, ideally needs to be monitored and managed, and therefore requires asset management systems which are geographic information system (GIS) based, to properly manage the asset information. When these are integrated to a common base, we have an integrated asset management system (IAMS). The value of a good IAMS is that it must be really useful and virtually intuitive to be used, for occasional use by all levels of people from senior managers down. It can be used for considering and comparing reliable data and information they hold, across all assets, from the inventory, network and detailed surveys. The HA (Highways Agency) is responsible for the motorways and trunk roads in England, and already uses individual and shared asset management systems (AMS). They are used in the HA's bidding and prioritisation process for maintenance of all road assets. Proposed maintenance schemes are assessed through the HA's Integrated Value Management process, before approving budget allocations. The HA will be introducing an IAMS nationally next year. This paper covers some of the existing HA's AMS together with the development and implementation of an easy to use GAIMS, an "intelligent" Geographical Asset Integrated Management System, used at the local (MA) level. GAIMS-P (GAIMS for pavements) has been successfully used with the other AMS to optimise maintenance interventions and justify bids for funding for pavement schemes based on projected condition.

"A New Pavement Management System as Part of Integrated Asset Management in Kentucky," *6th International Conference on Managing Pavements: The Lessons, The Challenges, The Way Ahead*, Queensland Department of Main Roads, 2004.
Citation at http://trid.trb.org/view/771257
From the abstract:

> The Kentucky Transportation Cabinet (KYTC) has implemented an integrated highway asset management system on a statewide basis. The TRDI software suite used in the implementation has primary systems for pavement management, bridge management, equipment/fleet management, and maintenance management. During the software configuration, TRDI worked with KYTC staff to enter Kentucky-specific data types, setup parameters, decision trees, treatment types, and cost levels. These activities also included performance modelling from historic data and defining detailed reporting requirements for standard and special reports. These reports can be made in table or graphical format, covering virtually all data available in the Pavement Management Database. This paper describes the KYPMS subsystem in terms of an overview of its implementation within the asset management framework. It then describes its functionality which takes the practice of pavement management to a new plateau in technology.

Decision Frameworks and Implementation

Iowa Pavement Asset Management Decision Framework, Iowa DOT, 2015.
http://publications.iowa.gov/20731/
From the citation:

> This project has five objectives to accomplish the final goal of developing a pavement asset management framework for selecting a pavement treatment through evaluating benefits of various treatment options from "do nothing" to full replacement. (1) Develop a framework for selecting feasible treatment options when the conditions of a pavement section are given. (2) Develop a methodology for assessing return on investment values of various treatment options available for Iowa pavements. (3) Develop a spreadsheet-based decision aid tool for selecting the most appropriate treatment option that can be used by the Iowa Department of Transportation (DOT) as an input to its current system and used as a stand-alone model for local transportation agencies. (4) Conduct case studies using the tool developed in this project and validate the tool. (5) Train the Iowa DOT and local agency engineers for rapid dissemination of the tool.

Asset Management Systems Review: A Detailed National Report on Asset Management Systems, to Assist Our Members with Making Informed Decisions, ARRB Group Ltd, 2015.
https://www.arrb.com.au/admin/file/content2/c7/ARRB_Group_AMS_Review_Final_Brochure_2015_04_17.pdf
This document reviews several asset management software tools for use in Australia.

Cornell Asset Management Program—Roads & Streets (CAMP-RS), Cornell Local Roads Program, 2014.
Citation at http://trid.trb.org/view/1372961
From the abstract:

> For most municipalities throughout the United States, road and street surfaces represent the largest single cost for local government. Developing a maintenance budget based on cost-effective decisions requires a rational, systematic process of evaluating the condition of the road network and allocating limited funds where they can do the most good. Municipalities need a system that can assess the condition of the network, weigh alternatives, and establish long-term programs and budgets. Although informal approaches to maintaining roads may have worked in the past, it is time to take a much more effective approach. This can be accomplished by the use of an effective pavement management system (PMS). This user manual explains how to set-up and successfully implement a PMS using the Cornell Asset Management—Roads & Streets (CAMP-RS) software tool.

A Framework for Statewide Roadway Asset Management, Michigan DOT, 2012.
http://www.michigan.gov/documents/mdot/MDOT_Research_Report_RC1576_386741_7.pdf
From the abstract:

> Dye Management Group, Inc. (DMG) collected and analyzed local agency inventory, cost, and condition assessment information in order to provide the Michigan Transportation Asset Management Council (TAMC) with (a) the costs expended to maintain its roadway system on a per mile basis and (b) the projected dollars per lane mile that need to be spent in order to bring 100 percent of its system into fair to good condition and to maintain it at that level over the next twenty years. Based on inventory, condition, and expenditure data provided, the analysis showed that Michigan would need to spend approximately $14,123 per lane mile (in 2011 dollars) on an annual basis to bring all of its local agency pavement, bridge, and roadside assets to a fair to good condition level, and to maintain them at this level over a twenty-year period. During the course of this analysis, DMG produced two distinct outputs. First, DMG captured the costs per mile of maintaining pavements, bridges, and roadside assets, and of conducting winter maintenance activities. Second, DMG prepared an updatable workbook tool

that the TAMC and local agencies can use to track local agency expenditures and conditions against the projections developed.

"Asset Management Assessment Model for State Departments of Transportation," *Journal of Management in Engineering*, Vol. 27, Issue 3, pages 159-169, 2011.
Citation at http://trid.trb.org/view/1112619
From the abstract:

> Transportation asset management (AM) research has yielded a well-accepted AM framework for state departments of transportation (DOTs) to model. However, no studies have developed a model to measure the level of AM implementation for a benchmarking purpose. This is accomplished through the deliverable of this study: the AM Assessment Model [(AM)2]. The model was developed through the identification of the most critical indicators that point to successful practices for an ideal AM system. These indicators are weighted according to their level of importance using the analytic hierarchy process (AHP). While identifying the indicators, a new indicator, AM Culture, was identified and recognized as significant by some of the leading AM experts in the United States. The (AM)2 can be used as a quick diagnostic tool for agencies to determine where they stand in regard to AM practice, and it can assist them in determining how to focus their resources to improve AM within their agencies.

Assessing and Interpreting the Benefits Derived from Implementing and Using Asset Management Systems, Wisconsin DOT, 2011.
http://www.wistrans.org/mrutc/files/Training_110222.pdf
This resource documents the benefits of using HERS-ST, a policy analysis tool with several asset management functions.

Implementation of Pavement Management in Minnesota, MnDOT, 2009.
http://www.lrrb.org/media/reports/2009RIC11.pdf
From the abstract:

> Pavement Management Systems (PMSs) are cost effective tools for helping local agency engineers manage the significant investment that has been made in their pavements. PMSs can also estimate future pavement conditions. This capability supports local engineers in making critical funding decisions about valuable pavement assets. Like any computerized system, PMSs are only as good as the data that is put into them and the analysis algorithms that drive them. Data collection, validation, and updating can be expensive. Accurate life cycle analysis is critical for making a PMS effective. However, automation and other new tools offer opportunities for reducing costs and improving the results coming out of PMSs. This report was developed as a resource for Minnesota local agencies, focusing on the capabilities, applications, and benefits of current pavement management systems used on local road systems in Minnesota. This resource will provide information to help local agencies without a PMS to evaluate, select, and justify the purchase and operational costs of a PMS; additionally, it will help local agencies who have a PMS to better use and enhance their capabilities. This report has a related PowerPoint and Brochure.

"Development and Implementation of an Asset Management System for Pavements and Bridges," *Proceedings of the Sixth International Conference on Maintenance and Rehabilitation of Pavements and Technological Control (MAIREPAV6)*, Politecnico di Torino, 2009.
Citation at http://trid.trb.org/view/899709
From the abstract:

> This paper presents a common framework for the optimization of maintenance strategies for existing pavements and bridges. For both infrastructure assets, performance is defined in terms of a condition index that is associated with visual inspections. A set of maintenance actions is defined for each infrastructure, considering common practice in Europe. Optimization using Genetic Algorithms is

carried out to find the best possible balance between cost and performance. This framework will allow more consistent and economically sound decisions at both a national and a local level. The framework, in the pavement's component, uses the deterministic pavement performance model of the AASHTO flexible pavement design method. The quality of road pavements is evaluated by the PSI, which is computed by using a modified version of the PSI AASHTO equation. The framework, in the bridge's component, considers a probabilistic condition index defined by the cracked area of deck, based on experimental data gathered in the Netherlands. The framework, applied to a road network considered as a case study, presented good results. The final part of the paper contains a reflection on the main difficulties encountered so far and presents the developments planned for the near future.

"Development and Implementation of Highway Structures Information System for Wisconsin Department of Transportation," *Transportation Research Record* 1958, pages 3-12, 2006.
Citation at http://trid.trb.org/view/776711
From the abstract:

The philosophy on highway structure asset management has evolved over the past two decades at the Wisconsin Department of Transportation (DOT) and required a new system approach to data management and modeling. The Highway Structures Information (HSI) system was developed to meet such needs. HSI is a systematic approach to effectively managing all state and locally maintained structures through a responsive, efficient online system. When state and local program managers are equipped with real-time performance data, they can make better-informed decisions on resource allocation. In addition, HSI is a valuable resource to contractors, consultants, and DOT management teams as well as a response system for inquiries from legislators, public citizens, and the media. An extensive menu system provides an easy method for users to inquire about specific data and create their own customized reports. This provides instantaneous responses to requestors and eliminates their waiting in line for bridge personnel to generate answers to queries. HSI also incorporates the concept of the structural data life cycle; this allows management of the structure from the planning phase through design, construction, maintenance, and eventual replacement of the structure. This paper presents Wisconsin DOT's development of this system. It explores what work is needed to develop a more complete asset management system and some benefits encountered during the process.

Appendix A

Asset Management including Requirements in MAP-21

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Asset Management -
This is how we do business

Asset Management Basics: Five Core Questions

1. What is the current state of my assets?
2. What is my required level of service/ performance?
3. Which assets are critical to sustained performance?
4. What are my best "Operations and Maintenance" and "Capital Improvement" investment strategies?
5. What is my best long-term funding strategy?

Asset Management Basics: Five Core Questions

- **1. What is the current state of my assets?**
  - What do I own?
  - Where is it?
  - What condition is it in?
  - What is its remaining useful life?
  - What is its remaining economic value?

Asset Management Basics: Five Core Questions

2. What is my required level of service/ performance level?

- What is the demand for services by stakeholders?
- Are there regulatory requirements?
- What is my actual performance?

Asset Management Basics: Five Core Questions

3. Which assets are critical to sustained performance?

- How does it fail? How can it fail?
- What is the likelihood of failure?
- What does it cost to repair?
- What are the consequences of failure?

Asset Management Basics: Five Core Questions

4. **What are my best "Operations and Maintenance" and "Capital Improvement" investment strategies?**
   - What alternative management options exist?
   - Which are the most feasible for my organization?

5. **What is my best long-term funding strategy?**

What is asset management?

- Asset management is a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the lifecycle of the assets at minimum practicable cost. (23 U.S.C. 101(a)(2), MAP-21 § 1103)

What requirements does MAP-21 have pertaining to asset management?

- Each State is required to develop a risk-based asset management plan for the National Highway System (NHS) to improve or preserve the condition of the assets and the performance of the system. (23 U.S.C. 119(e)(1), MAP-21 § 1106)
- States must address pavements and bridges but are encouraged to include all infrastructure assets within the highway right-of-way in their risk-based asset management plan. (Also can include roads other than on the NHS.)

Highway Asset Management Plan

- Plan Contents
  - Pavement and bridge inventory and conditions on the NHS,
  - Objectives and measures,
  - Performance gap identification,
  - Lifecycle cost and risk management analysis,
  - A financial plan, and
  - Investment strategies

Asset Management -

This is how we do business –

For Long-Term Sustainability, Accountability and Performance