



5 Keys to Success

Pavement Management for Local Governments



It's Time for a New Approach to Pavement Management

Local governments face a complex set of challenges in pavement management. The pressure to modernize critical infrastructure, improve safety, and reach sustainability targets is intense, and budgets and resources are limited. Plus, beyond maintaining existing roads, many municipalities need to expand their transportation networks to meet the demands of rapid population growth.

A proactive approach is needed, but many owners lack the resources to pursue a forward-looking strategy. Instead, it's common for cities, counties and metropolitan planning organizations (MPOs) to resort to treating the “worst” pavements first, or to prioritize projects using a simple ranking method based on a basic cost-benefit analysis. These traditional approaches, while sometimes effective at meeting short-term goals, rarely succeed in helping owners achieve the long-term objective of delivering safer, longer-lasting, and more cost-effective infrastructure. As a result, far too many locally owned pavement systems are in need of serious repair.

With traditional management approaches, the pavement network as a whole continues to deteriorate exponentially, despite ongoing maintenance and repairs. According to the American Society of Civil Engineers' [2021 Report Card for America's Infrastructure](#), 43% of U.S. public roadways are in poor or mediocre condition. Of these low-performing roads, the vast majority are rural and urban collectors or roadways that are not part of the interstate highway system.

Bringing these failing roadways to a level of good repair requires more than short-term fixes. The worst-first and simple ranking approaches to pavement management fail to address the long-term challenges of safety, sustainability, and modernization. These traditional approaches also fail to make the best use of available funds. To meet current challenges and future demands, local governments need to take a more modern approach to pavement management.

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Source: American Society of Civil Engineers, 2021 Report Card for America's Infrastructure

Modern pavement management enables owners to be proactive in preserving the entire pavement network in good condition rather than letting the infrastructure degrade to the point of needing costly rehabilitation or reconstruction. The modern approach incorporates data and advanced analysis to support a more holistic infrastructure lifecycle management strategy—a proven method to increase the safety and longevity of assets while reducing maintenance costs.

This guidebook provides five keys to help city, county, and MPO leaders get the most value from infrastructure funds to manage streets, sidewalks and other local pavement assets. Using examples from successful agencies, this guide illustrates strategies to improve the performance and cost-effectiveness of your local pavement network.

The strategies outlined in this guide are designed to help you:

- + Maximize the impact of infrastructure funding to manage and maintain local pavement assets
- + Improve pavement data quality and analysis to make better decisions for capital programming, operating budgets, and staffing
- + Leverage modern pavement management practices to improve the maintenance of your broader infrastructure network





Key #1:

Modernize Your Pavement Management

Pavement assets—which may include highways, streets, sidewalks, curbside ramps, parking lots and more—are often the largest infrastructure investments a local government has to manage. That's why an effective pavement management practice is an essential part of an infrastructure management strategy that relies on proper stewardship of public funds.



Infrastructure Asset Lifecycle Management

Before delving deeper into the essential components of modern pavement management, it's helpful to define what we mean when we talk about infrastructure management in general. Experts generally agree that infrastructure management is the science of using the right data to make the right decisions at the right time to deliver the most value from infrastructure assets across their full lifecycle.

Infrastructure managers, then, may include those groups of professionals involved with managing any portion of the infrastructure asset lifecycle—from planning to design, construction and maintenance operations. For the purposes of this guide, we will focus specifically on the maintenance phase of the asset lifecycle, which includes both strategic planning and day-to-day operations to keep the asset in good repair.

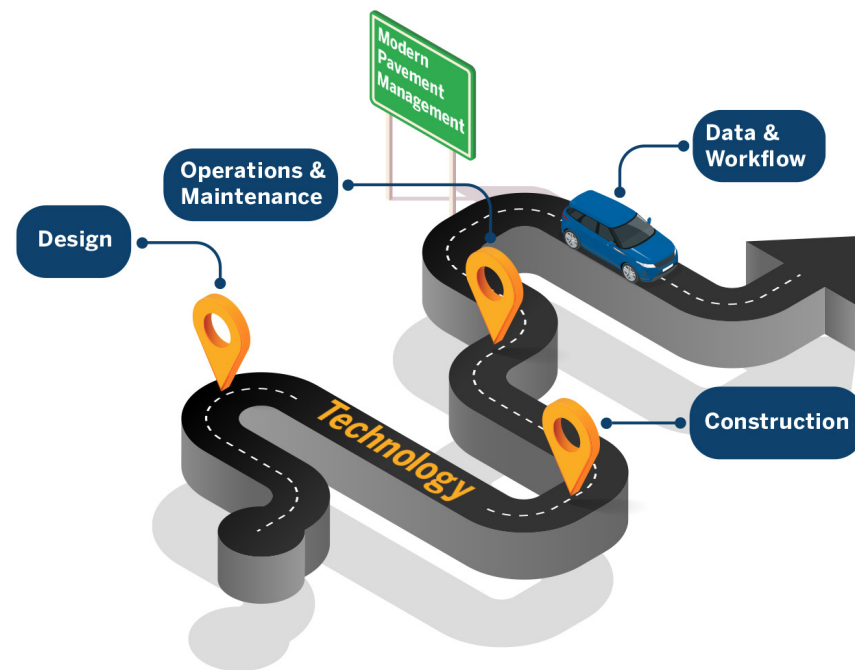
Maintenance activities may include both routine and preventive maintenance work as well as major repairs or rehabilitation. At the end of the asset's service life, the maintenance phase may give way to the beginning of a new lifecycle (through reconstruction) or to the asset's permanent decommissioning.

Applying this same lifecycle concept to pavement assets in particular, we can say that pavement management is using the right treatment at the right time on the right pavement asset to optimize the impact of the available funds and preserve the pavement network as a whole in good condition.

What Makes Pavement Management Modern?

Modern pavement management relies on robust data collection and advanced analytics to facilitate well-informed decisions about how best to plan, design, build, manage and maintain all the pavement assets in the network. In contrast to traditional approaches, a modern approach to pavement management breaks down information silos and leverages new technologies to connect complex datasets and workflows throughout the entire lifecycle of pavement assets.

In addition, a modern approach integrates pavement management into a holistic infrastructure management framework, coordinating the management of pavements, bridges and many other types of assets—from traffic signs and signals to stormwater structures, charging stations and more. This integrated approach helps infrastructure managers improve operational efficiency and save costs. It also increases the long-term performance and sustainability of all the infrastructure assets throughout their lifecycles. The end result is to deliver more value to the public in the form of safer, longer-lasting, and more affordable infrastructure.





Key #2:

Elevate Your Data Quality

Modern pavement management relies on high-quality data. However, many agencies don't have up-to-date information about their assets. The following data challenges are common among local pavement owners:

- + Incomplete asset inventory data
- + Lack of data on pavement distress, surface characteristics, and structural capacity
- + Lack of historical data on previous repairs and maintenance work
- + Lack of usage data, such as average daily traffic (ADT)



How To Improve Data Quality

To improve data quality, owners need to collect comprehensive pavement data and centralize it so it can be properly shared and analyzed. Successful pavement owners generally take one of two approaches to make these improvements.

Collect it yourself

The do-it-yourself solution is better for larger organizations that have the budget to support trained, certified pavement inspection teams. Smaller organizations may find themselves too short-staffed to collect the volume of data needed. Either way, make sure to define your data and asset standards clearly before the data collection begins.

Defining Data and Asset Standards

Before beginning your pavement data collection, you'll need to define your data and asset standards. For example, does your project data-capture standard match your scanning and imaging data-capture standard? Many infrastructure owners are moving toward "universal" data-capture standards so they are able to capture assets in the same way on construction projects as for operations and maintenance. If working with an external data-collection provider, your third-party partner will need to know the details of your data collection standards to accurately scope the required services.

Use a third-party data collection service or consulting firm

Third-party providers offer specialized pavement assessment expertise. When working with a third-party provider, verify that their equipment is calibrated and certified and their operators are well trained and certified. It's also important to have your staff perform random tests to validate the data collected by the third party.

Data Collection Technologies: Smarter and More Affordable

Today's data-capture options span a wide array of technologies—from surveying and mapping to scanning and imaging. Selecting the right option may seem daunting, given the speed of innovation of these emerging tools. The "right" technologies for your projects may vary depending on the assets, accuracy and data outputs needed, as well as on your organization's data standards and goals.

For example, mobile scanning and imaging technologies tend to be more expensive than other options, but are also the most cost effective if you need to collect a large amount of data on a large number of assets within a road corridor or right of way. Bridge assets tend to require a mix of scanning and imaging tools, including mobile, static and drone technologies. Data collection for signage adds complexity to the mix, because asset-specific details such as reflectivity measurements can impact the workflow and required technologies.

A current trend is that data-capture technologies are improving while also becoming more affordable. Automated scanning of data into 3D models is advancing rapidly, while artificial intelligence (AI) and machine learning are already being used on certain assets, such as pipes, to convert scanned data into model data. Infrastructure owners will increasingly have access to a growing number of lower-cost options to accurately capture and model assets in the future.

Trimble's global network of data-collection technology providers and engineering consultant partners can provide guidance on today's most advanced technologies—including **laser scanning** and **mobile mapping**—based on your organization's data standards and needs. Our teams also provide training and support.

Case Study: Better Budgeting Starts with Better Data Collection

Local governments face different challenges than state departments of transportation when it comes to collecting pavement data. In contrast to state or interstate highways, the slower traffic speeds and more irregular blueprint of urban streets and county roadways can make consistent data collection difficult.

The City of Austin provides an excellent example of innovative practices in both data collection and pavement management. The city was able to justify and achieve a 37% increase in pavement maintenance funding over a three-year period by improving their data quality and implementing advanced analysis capabilities to be able to predict the future performance of the pavement network.

Based on research and practice, the City of Austin's pavement engineer recommends the following actions that local governments can take to improve data quality:

- + Adjust International Roughness Index (IRI) data based on the speed of the collection vehicle to improve accuracy
- + Collect twice as much data as needed so that profiles for pavement sections may be matched or averaged
- + Collect data each year in the exact same location to improve reliability
- + Use law enforcement for continuous data collection to improve process efficiency
- + Collect data at night to reduce traffic disruptions

Beyond data-quality improvements, the City of Austin was able to use predictive analytics to provide legislators with visibility into reliable, compelling future scenarios that helped illustrate funding gaps in the city's pavement maintenance budget. As a result, the city was able to make a data-driven business case for the 37% maintenance funding increase.

The availability of robust data also made it possible for the city to justify an additional 25% increase in funding per year for pavement rehabilitation and reconstruction projects—above and beyond the increased preventive maintenance budget.

Watch the on-demand webinar, [Improve Urban Pavement Roughness Measures to Meet Customer Expectations](#).

Key #3:

Use Advanced Analytics to Make Better Decisions

Having a large, accurate data set is only useful if your organization has the advanced analytical capabilities to gain actionable insights from it. Many agencies still rely on spreadsheets as their primary analytical tools; however, spreadsheets provide limited analysis capabilities and are cumbersome to share and update efficiently. In addition, the manual processes associated with using spreadsheets increase the likelihood of data inaccuracies and inconsistencies.

To select the best mix of projects that will help preserve and improve the condition of your local pavement network, you need to use advanced analytics that include true optimization analysis. True optimization analysis goes beyond simple ranking methods by taking multiple factors into account—such as pavement condition, budget, performance targets, time horizon and more—to identify the best mix of projects to meet your objectives with the available funds.



Evaluate pavement network trends

Before you can set goals for improvement, you'll need to know the baseline condition and trends of your pavement network. This means monitoring whether overall conditions are improving or deteriorating with time. It's also important to monitor conditions by roadway classification (e.g. major vs. minor arterials). If your roadways have different pavement types, you'll want to monitor trends by that distinction as well.

Define your objectives

Since modern pavement management requires a proactive approach to preserving the entire pavement network, it's important to establish goals that go beyond simply repairing the roads that are in the worst condition. Instead, you'll need to set network-level performance targets. For example, set a target average Pavement Condition Index (PCI) of 85 or 90, or plan to reduce the percentage of surface cracking by 5%.

Know your constraints

Budget limitations, time constraints, and the target condition of your pavements—along with other environmental constraints—will all impact your capacity to achieve your objectives. Identify which constraints are non-negotiable, and which can be defined to “flex” according to your organization's needs. Optimization analysis enables you to determine the best mix of projects to meet your objectives, given all these strict and variable limitations.

Predict future performance

Advanced analytics enable you to forecast future performance based on available funds, different budget categories, and the various constraints that you've identified and defined. By comparing various what-if scenarios, forecasting allows you to respond to questions from council members, boards, and judges about how increasing or decreasing funding levels will impact the condition of your pavement assets.

Better Staffing Through Analytics

An added benefit of using advanced analysis to understand your infrastructure network is that the information you gain will also help you determine your staffing needs and personnel budget requirements. If your available funds do not allow for sufficient staffing, your organization may use analytical insights to guide the development of a scope of work for a consulting firm that can fill staffing gaps.



Key #4:

Engage Leadership Support

Pavement management requires collaboration from disparate internal groups that may also be widely distributed throughout a geographic area. Many agencies also work with partners in neighboring jurisdictions. Implementing modern pavement management practices requires these groups to change how they work together.

To get all key stakeholders on the same page, it's helpful to identify an executive leadership champion who can communicate a unified vision and clarify the roles of the contributing teams. Successful agencies have leadership champions who drive engagement across the organization and among partners to ensure stakeholder buy-in and commitment.



Setting goals and performance targets

The participation of executive leadership is especially important when defining strategic goals. Including senior leaders in the goal-setting process helps to ensure that your targets are realistic, align with agency objectives, and receive support from staff throughout the organization.

Identifying constraints

Senior leaders have a bird's-eye view of many of the regulatory, budgetary, environmental and other constraints impacting your local community. Their input on the strategic impact of current and future constraints will help inform the goal-setting process.

Allocating budget

While technology makes it possible to efficiently collect and analyze pavement condition data, modern pavement management requires adequately staffed teams to validate the strategic and operational plans based on the data. Leadership champions are essential to ensuring sufficient staffing levels in the budget for planning and operational support.

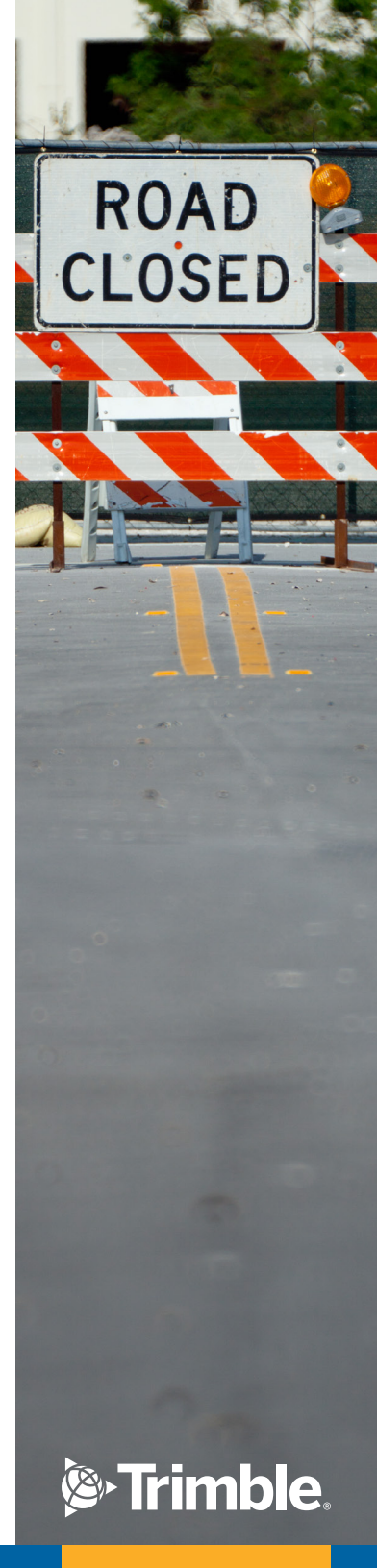
Making the business case for advanced pavement management software

Communicating a clear picture of the current and future state of your pavement network is necessary to justify the agency's investment in pavement management software to meet long-term goals. Leadership champions can work with pavement managers to predict future network performance and identify the right software solution to meet the agency's needs.

5 Things to Look for in a Pavement Management Solution

To identify the right pavement management software for your agency, look for the following features:

- + **Ease of Use:** Choose a web-based solution that's user friendly and straightforward to deploy.
- + **Interactive Reporting:** Select a system that makes it easy for engineers, planners, and senior leaders to access the reports they need to view the current network condition and key performance metrics.
- + **Advanced Analysis and Optimization Capabilities:** Choose a solution that enables you to select the best mix of projects based on available funding and multiple other constraints. The system should also be able to provide data-driven guidance on how best to achieve performance goals.
- + **GIS Functionality:** Make sure the solution allows relevant users to view the condition of all the roads in your network on an interactive map to plan and coordinate projects more effectively.
- + **Application Programming Interfaces (APIs):** To be able to make the best use of shared data across multiple functional areas of your organization, select a solution that uses APIs to integrate with other systems such as finance and work management. APIs enable you to streamline workflows and use a single source of data to improve cross-team collaboration and track metrics such as labor, equipment, and materials costs.



Encouraging Leadership Buy-In

To get buy-in from local leaders, demonstrate the value of modernizing your pavement management program:



**Highlight the benefits for the public
(safety, cost savings, sustainability, etc.)**



**Show how business-as-usual practices cost more
in the long term**



Share success stories from similar agencies



Key #5:

Adopt the Connected Construction Approach

One of the most innovative approaches to asset management involves “connected construction” — the seamless integration of workflows across the design, construction, and maintenance phases of the infrastructure lifecycle. The connected construction approach unifies data across these key phases and eliminates the inefficiencies and information gaps that result from siloed processes.



Digital Twins: The Core of Connected Construction

A key element of connected construction is the use of “digital twins” to represent real infrastructure assets as they evolve throughout their lifecycle. A digital twin is a 3D model of the asset that serves as a central source of reliable information about its design, construction history, and changing condition. Changes in the asset’s condition may occur as a result of its operation, related work activities, and environmental impacts over time.

The digital twin makes it possible to view and analyze various aspects of the infrastructure asset without being at the asset’s physical location. When used in conjunction with data sensors and robotic data-collection devices such as drones, the digital twin can help reduce or eliminate the human effort required for activities such as performing asset inspections or ordering replacement parts.

Adopting the connected construction approach allows infrastructure owners to get more value from the asset across its full lifecycle by reducing the effort to collect and use asset-related data, and by increasing the transparency of information shared across relevant teams. This unified approach helps agencies save money by streamlining workflows and improving operational efficiency.

Ultimately, by improving access to reliable data required for effective decision-making, the connected construction approach helps agencies deliver higher-performing, more sustainable infrastructure while reducing safety hazards and other risk factors.

Know the Total Cost of Ownership

An added bonus of the “connected construction” approach—which integrates data across the design, construction, and maintenance phases of the asset lifecycle—is that infrastructure owners are able to know the total cost of ownership (TCO) of each asset in the network.

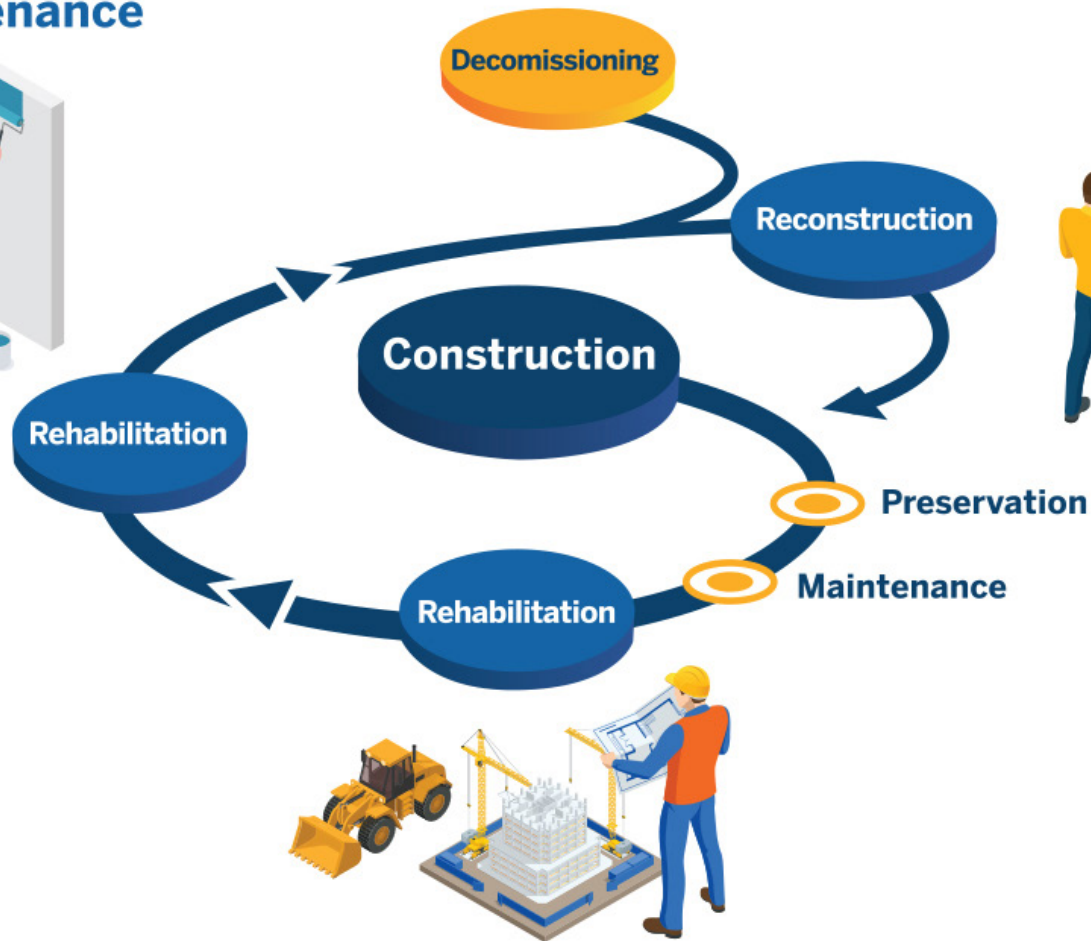
TCO is not equivalent to the replacement cost of the asset. Instead, TCO is the combined cost of designing, building, operating, and maintaining the asset over its full lifecycle. When infrastructure owners have access to all the relevant cost data on a single platform through this integrated approach, they have a clear line of sight into the TCO of each asset.

Learn more about how connected construction reduces information loss at every stage of the asset lifecycle to improve outcomes. Read the article, [Asset Owners Have Digitized Their Workflows. What’s the Next Frontier?](#)

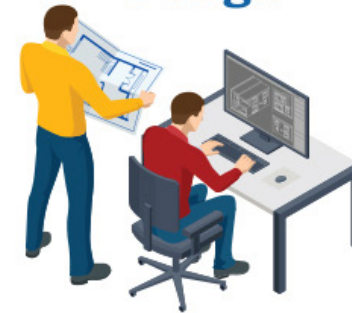


Asset Lifecycle

Maintenance



Design



Construction

Applying Connected Construction to Pavement Management (and More)

For most infrastructure owners, the connected construction approach may seem like a distant vision. For many organizations, disjointed workflows and processes are the norm. According to a recent SmartMarket Brief from Dodge Construction Network, *Connected Construction: The Owners' Perspective*, 59% of owners report frequent breakdowns in communication between themselves and other project team members.

To overcome these communication hurdles, agencies looking to modernize their pavement management practices should look for technologies that are able to integrate the workflows necessary to manage the full pavement infrastructure lifecycle. The optimal pavement management software should be part of a broader ecosystem of technologies, including hardware, that connect the people, processes, and data involved in pavement management. The result is improved collaboration and operational efficiency.

This integrated approach may also be applied to other transportation assets. You can coordinate the management of pavements, bridges, tunnels, traffic signals, signs, charging stations, and virtually all other assets using a holistic framework. You can also manage specific components of an asset, such as ADA ramps on a sidewalk, or striping on a road.

With integrated asset management, you can coordinate related projects to improve processes and outcomes. For example, widening a road may also require that you widen a bridge and culvert, in addition to updating the signage. The connected construction approach is scalable, so you can create a comprehensive asset management plan that allows you to coordinate the operations of multiple asset types, combine maintenance projects, and minimize disruptions to the traveling public.

The Path to Modernization Can Be Accessible and Affordable

Modern pavement management is within reach for cities and counties of all sizes, even with limited budgets. The key is to “start somewhere” by taking the first step in a proven, straightforward process. By following the recommendations below, you can start to improve the efficiency of your practices and the effectiveness of your decision-making.

1. Set clear goals and communicate them to all relevant stakeholders throughout the organization. Use data, including success stories from similar agencies, to make your business case for modern practices and technologies.
2. Get commitment from a leadership champion who can drive stakeholder engagement throughout the process.
3. Partner with the right teams within your organization that can help (engineering, IT specialists, trainers)—or even with third-party firms, if you need extra support.
4. Select and deploy a pavement management system capable of the advanced analysis that will enable you to optimize your pavement management plans and outcomes.
5. Continually communicate the impact and results of your pavement management activities so staff members understand their role in the success—and so stakeholders see the benefits of the public's investment.
6. Continually improve the process—it's not a “one and done,” but a way of operating in alignment with strategic goals.

A Modern Pavement Management Success Story

The City of Raleigh has implemented a proactive, preservation-based approach to pavement management, saving the city millions of dollars a year on maintenance costs while increasing the lifespan of its assets. To learn how the city is using modern pavement management to unlock benefits for the public, watch this [Ask the Expert](#) video.



From Insight To Action

As stewards of public funds, local agencies bear a responsibility to make the best use of their budgets to deliver safe, sustainable, and cost-effective infrastructure for the communities they serve. Traditional asset management approaches do not empower local governments to get the most value from their largest infrastructure investments: pavements. Using the five keys outlined in this guide, you can start to modernize your pavement management practices and proactively preserve your pavement network, maximizing the impact of taxpayer funds to deliver long-lasting infrastructure value.

