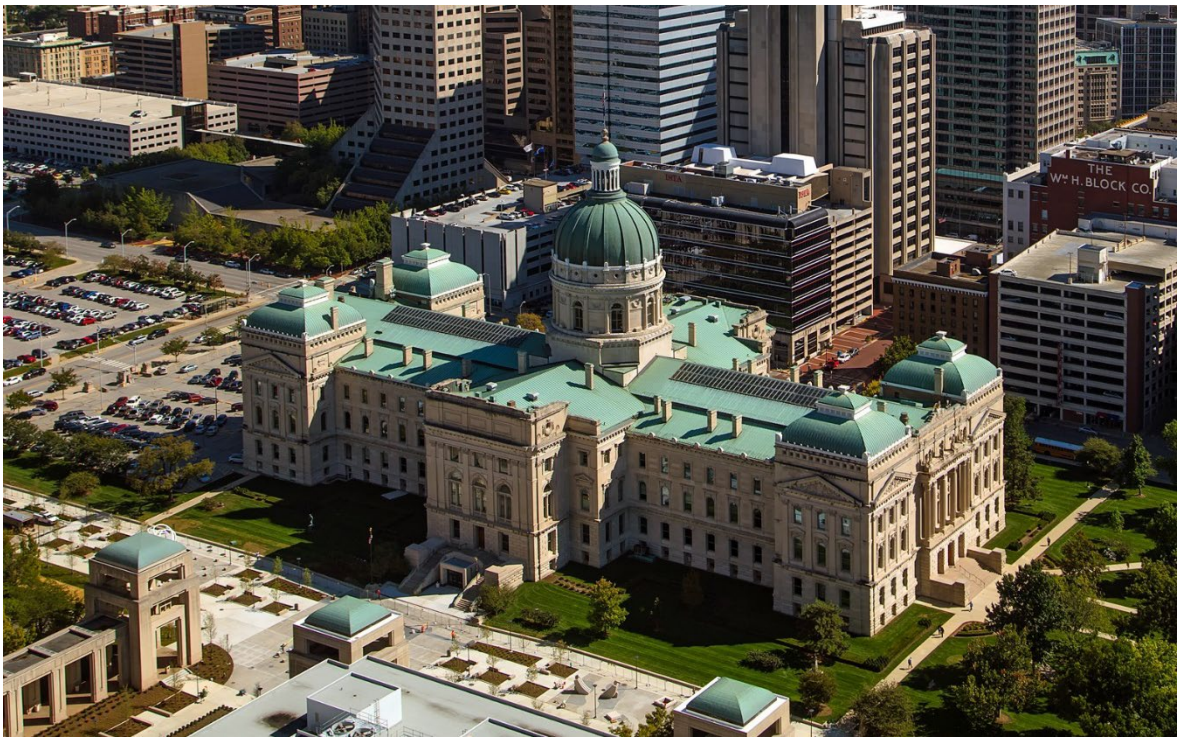
Organizational Approach to Implementing Asset Management and Managing Risk

Indiana Department of Transportation (INDOT) Case Study



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16. Abstract

This case study provides a summary of how INDOT has organized its staff and established processes and tools to implement its TAM practices. It explores how INDOT's reorganization has improved coordination with both internal and external stakeholders. INDOT has reorganized its planning and programming resources, practices, and data around asset management to coordinate performance-based programming. Through this effort, the agency has balanced responsibilities between the Central Office and District offices, recognizing the clarifying responsibilities and authority between different organizational units.

INDOT develops and delivers its capital program in a decentralized manner. This allows the staff in each district to control projects within their respective geographic areas. However, INDOT has determined that the Central Office is responsible for establishing policy that governs the overall program. The Central Office has also dedicated staff to coordinate with and support the districts in development and delivery of the program. This helps to keep the program aligned with statewide objectives. It also supports continual improvement efforts by providing a way to share information with and among different offices.

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LIST OF ABBREVIATIONS

BIAS	Bridge Investment Analysis System
CADD	Computer Aided Drafting and Design
DOT	Department of Transportation
EFT	Executive Funds
INDOT	Indiana Department of Transportation
FHWA	Federal Highway Administration
GIS	Geographic Information System
ITS	Intelligent Transportation System
LCP	Life-cycle Planning
LPA	Local Public Agency
MAP-21	Moving Ahead for Progress in the 21st Century (Act)
NBI	National Bridge Inventory
NHPP	National Highway Performance Program
PMG	Pavement Management Group
PMS	Pavement Management System
ROW	Right of Way
SOGR	State of Good Repair
SPMS	Scheduling and Project Management System
TAM	Transportation Asset Management
TAMP	Transportation Asset Management Plan
USDOT	United States Department of Transportation
WMS	Wall Management System

BACKGROUND

In 2012, Congress passed the Moving Ahead for Progress in the 21st Century Act (MAP-21) (Pub. L. No. 112-141) and established the National Highway Performance Program (NHPP) (23 U.S.C. 119). MAP-21included requirements for each State Department of Transportation (DOT) to develop and implement a risk-based transportation asset management plan (TAMP) (23 USC 119(e)). At the time of MAP-21's enactment, the Indiana Department of Transportation (INDOT) faced several challenges to complying with these requirements. For instance, INDOT lacked a comprehensive system to determine the most cost-effective life-cycle planning (LCP) strategies for its assets. INDOT's capital program focused on system improvements rather than sustaining asset conditions, and the agency struggled to effectively communicate the importance of asset management and system preservation to agency leadership and policymakers (INDOT 2022c).

INDOT's project-focused approach to the capital program worked to optimize individual solutions. Changes to the scopes, costs, and schedules, of projects already in the pipeline, resulted in unintended impacts on the overall program (INDOT 2022c). Under these conditions, the agency was in constant struggle to allocate budgets among preservation, rehabilitation, replacement, and system enhancement projects. As a result, the physical condition of all State-owned transportation infrastructure assets not limited to pavements and bridges were declining.

That began to change around 2015 and 2016 when an opportunity to address these challenges came in the form of *Next Level Indiana*[1] which became State law in 2017. *Next Level Indiana* provided 20 years of funding to develop a strategic, systematic, and coordinated approach for operation, maintenance, and improvement of physical highway and bridge assets. In addition to the funding, this legislation established a performance-based framework to determine goals and monitor progress toward network safety, enhanced mobility, asset sustainability, and stimulated economic growth in Indiana. INDOT established both short and long-term condition targets for bridges and pavement as well as set forth 20-year bridge and pavement plans to achieve the desired states of good repair (SOGR).

As a result of *Next Level Indiana,* INDOT fully embraced transportation asset management (TAM) implementation. The agency's implementation has centered on reorganizing its Central Office Planning staff to focus on the highway and bridge asset preservation. The reorganization provided resources and procedures to improve coordination between centralized planning and district-led project selection and delivery. As the implementation has progressed, INDOT has developed state-of-art information technology tools to further improve coordination, tracking performance, and increasing efficiency.

[1] IN Code § 5-10.2-2-3.5 (2018)

CASE STUDY FOCUS

This case study summarizes how INDOT has organized its staff and established processes and tools to implement its TAM practices. It explores how INDOT's reorganization has improved coordination with both internal and external stakeholders. INDOT has reorganized its planning and programming resources, practices, and data around asset management to coordinate performance-based programming. Through this effort, the agency has recognized and clarified responsibilities and authority between different organizational units. As a result, responsibilities have been balanced between the Central Office and the district offices.

INDOT develops and delivers its capital program in a decentralized manner. This allows the staff in each district control over projects within their respective geographic areas. However, INDOT has determined that the Central Office is responsible for establishing policy that governs the overall program. The Central Office has also dedicated staff to coordinate with and support the districts in program development and delivery. This approach helps to keep the program aligned with statewide objectives. It also supports continual improvement efforts by providing a way to share information with and among different offices.

Examples of statewide polices that have been established include life-cycle strategies for pavements and bridges that in turn led to consistent investment priorities among districts. This has been a critical step in integrating asset management into the programming and project scoping process. The Central Office has also developed guidelines for bundling projects to maximize project delivery efficiency.

This case study also highlights the following information technology tools that have been developed to support performance-based planning and programming:

- An inventory of critical ancillary assets was developed. It provides detailed information for culverts, bridge clearance, pedestrian assets, retaining walls, patching activity, signs, intelligent transportation system (ITS) assets, and others.
- INDOT uses a proprietary straight line diagram tool that provides one-click access to information for the roadway network aligned to a common linear referencing system.
- A *20-year Plan Editor* was developed. This tool allows planners to see the 20-year life-cycle strategies for each asset as well as review historical activity.
- The *Project Scoping Application* is a stand-alone communication tool used during project set up to provide stakeholders with the ability to review all relevant background information based on project location.
- The S*cheduling and Project Management System* (SPMS) stores and reports project data. It includes functionality scoring and prioritizing projects based on agency needs, goals, budgets, and targets.

ORGANIZING TO DIRECT AND SUPPORT ASSET MANAGEMENT IMPLEMENTATION AT INDOT

Prior to the passage of *Next Level Indiana*[2] in 2017, INDOT planning functions within the Central Office had responsibility for overseeing the statewide program. However, the Central Office's authority to set expectations for the districts was unclear. While some staff were preparing to comply with new Federal requirements for asset management, there was no overarching connection between TAM and planning or programming. Each performance area (i.e., pavements, bridges, mobility, safety) operated with independent objectives and procedures. Not all staffers were fully aware of the changes to practices required to comply with the requirements to develop and implement a TAMP (23 U.S.C. 119(e); 23 CFR part 515).

At the same time, INDOT was struggling to align project development processes focused on specific locations with broader goals. Each project development team was encouraged to modify and expand the scope of its selected projects as needed to address local needs, without concern for the programmatic implications across the district or State. This led to challenges related to on-time, on-budget delivery of projects as well as a lack of understanding on how to allocate resources to achieve long-term goals. To effectively implement TAM and broader performance-based planning, INDOT needed to reorganize its offices, clarify roles and responsibilities, and dedicate resources to support district and other staff in making and sustaining changes to the way the agency selected and delivered projects.

According to INDOT, *Next Level Indiana* established 20 years of dedicated funding to implement 20-year life-cycle strategies as defined by INDOT. INDOT committed to achieving its desired SOGR for both pavements and bridges through data-driven processes. Leadership at INDOT recognized that delivering on the promises of this new law would need significant changes to the agency's organization and operations.

In response, INDOT established new organizational units to support the implementation, improve coordination, and clarify lines of authority. The Asset Management Office was formed, and asset teams for pavements, bridges, safety, and mobility were established in the Central Office. Each team has clear responsibilities related to statewide policy and support to district staff. The teams are responsible for:

- Developing life-cycle strategies.
- Providing project and treatment recommendations.
- Supporting project scoping.
- Tracking project development to understand the implications of project-level decisions on program level outcomes.

Each asset team includes representatives from each district as well as the Central Office. The asset teams score and rank submitted projects. These prioritized lists are then submitted to INDOT's Program Management Group (PMG) for final approval.

[2] IN Code § 5-10.2-2-3.5 (2018)

Districts are expected to develop programs that will achieve performance goals based on modeling analysis performed by the asset teams.

The Asset Management Office coordinates the process of developing the capital program, ensuring that the statewide goals are accomplished. Policies, goals, and financial data are provided to the districts, along with project recommendations and condition forecasts. District staff uses this data to develop draft programs based on the current field conditions, local issues, and expected resources. During the project selection process, there are no hard budgets or allocations established by the districts. To ensure the program remains balanced, the PMG and asset leads ensure the selected program will meet the budget constraints and meet the asset goals. During project selection, if the asset team cannot agree to the proposed program, the asset management lead has "tie-breaker" authority between districts and statewide priorities.

In addition to having authority to finalize the program, the Asset Management Office supports the districts through program and project development. The asset teams work hand-in-hand with the districts, providing direction and support during project selection, scoping, and development. The asset management teams' project recommendations provide a starting point for districts to develop initial program requests. The recommendations are developed using the asset management systems that are also used to establish life-cycle strategies, as well as short- and long-term performance goals.

Once projects are selected into the program and move into design, it is not uncommon for new engineering information to become available. This information may lead to changes in the scope of work. For example, a project may have been selected to overlay a pavement section based on planning-level distress data, but during the project design, it could be determined that more significant structural issues exist. To adequately address such changes in conditions, the project scope may need to be changed to a more significant treatment, requiring additional funds. To help the districts understand the broader implications of such project-level decisions, the asset teams include area engineers who help district staff develop project scopes and manage the balance of work across work types. This effort helps to ensure network level strategies are prioritized over project-level preferences. The area engineers provide technical assistance for design and construction. They watch for issues in one district that may be a statewide concern and work with other experts to fix those issues.

Figures 1 and 2 show the current make-up of the bridge and pavement asset teams, respectively. Additional area engineers are expected to be added over time.

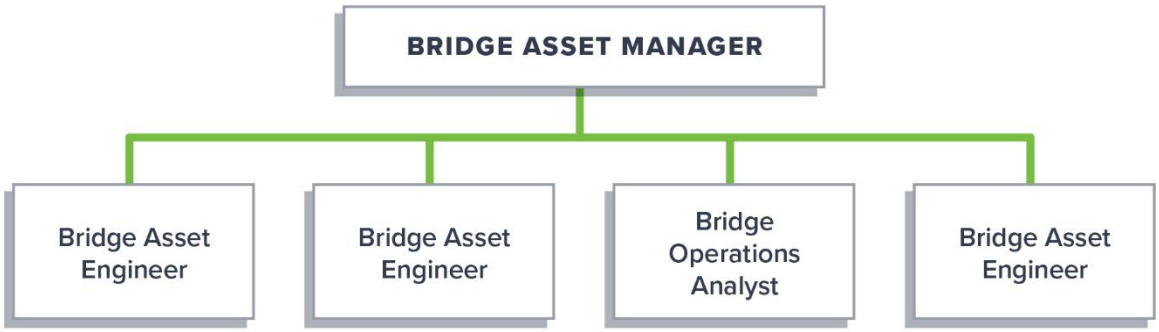


Figure 1. Bridge asset team organization (Data source: INDOT).

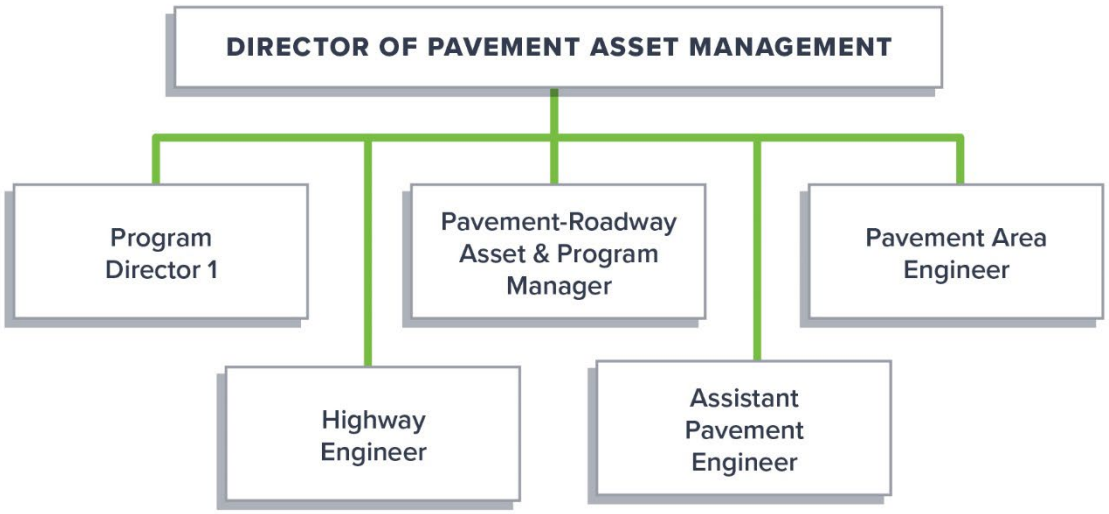


Figure 2. Pavement asset team organization (Data source: INDOT).

ALIGNING PROGRAMMING WITH TAM STRATEGY

With its reorganization under way and clarified roles for Central Office and district staff, INDOT's asset managers were able to focus on connecting long-term asset management analysis results with shorter-term program development and performance monitoring. This effort focused on the two foundational efforts of developing 20-year investment strategies for pavements, bridges, and other assets and establishing a data governance structure. Those two efforts were soon followed by attempts to improve the management of scopes throughout the project development process and establish project bundling criteria.

20-year Life-cycle Strategies

INDOT has established 20-year bridge and pavement plans to achieve the desired SOGR for each asset class. INDOT has documented these asset life-cycle strategies to support consistent decision making for treatments on pavement and bridge assets. The strategies provide 20-years of treatment recommendations for each pavement section and bridge, representing a cost-effective approach to achieving asset condition targets, while balancing risks. The asset life-cycle strategies are published internally and available to support staff in project identification, selection, and scoping efforts.

The asset life-cycle strategies are intended to:

- Provide an overview of INDOT's life-cycle planning and investment decision-making processes for its assets.
- Document the business rules and considerations used to determine treatment strategies.
- Identify the various treatment types for consideration when preparing life-cycle strategies.
- Consider both capital and operating expenditures.
- Evaluate the costs associated with INDOT's investment options.
- Demonstrate that INDOT has a strategy in place to help achieve its established condition targets for the transportation network at the lowest life-cycle cost (INDOT 2022a, INDOT 2022b).

Currently, INDOT's life-cycle strategies are based on three approaches, each of which focuses on a major asset class or subgroup: flexible pavements, rigid pavements, and bridges. The approach for each asset subgroup is detailed below. Additional approaches will be developed for other asset classes and subgroups over time:

- Flexible pavements: INDOT's asset life-cycle strategy for asphalt pavement includes a combination of preservation treatments, preventative maintenance, minor structural, and major structural treatments. The sequencing of these treatments and frequency of occurrences varies based on the roadway category. This approach accounts for differences in the levels of service and risk factor associated with the roadway category.

The approach also considers the impact the treatment has on the pavement's functional life and condition (INDOT 2022a).

- Rigid pavements: Asset life-cycle strategies for rigid pavement consists of a series of patching treatments, patching and profiling treatments, major structural treatments, and/or concrete pavement replacement. The sequencing and frequency of the treatment types are tailored based on the roadway category type. The approach also considers the impact of the treatments on the pavement's condition (INDOT 2022a).
- Bridges: INDOT's overall asset strategy for bridges is generally comprised of a combination of thin deck overlays, deck overlays, deck replacements, superstructure replacements, and bridge replacements. INDOT tailors this strategy to specific assets based on the site-specific factors (INDOT 2022b).

Data Governance Structure

The objective of INDOT's data governance structure, illustrated in figure 3, is to implement a standardized method of structuring and enhancing data across the asset classes and across INDOT's various groups. This creates a network of INDOT staff focused on data quality and access. In addition, the data governance model defines the roles and responsibilities for entering, processing, and managing data. The *Data Governance Council* sets strategy and policy. *Data Trustees* oversee data domains and define function specific policies, processes, and tool decisions. *Data Stewards* monitor data quality, enforce policies, and manage inquiries. *System Custodians* implement system policies within systems, control access, and manage data flows. *Data Producers and Data Consumers* follow policies and procedures, report integrity issues, and attend trainings.

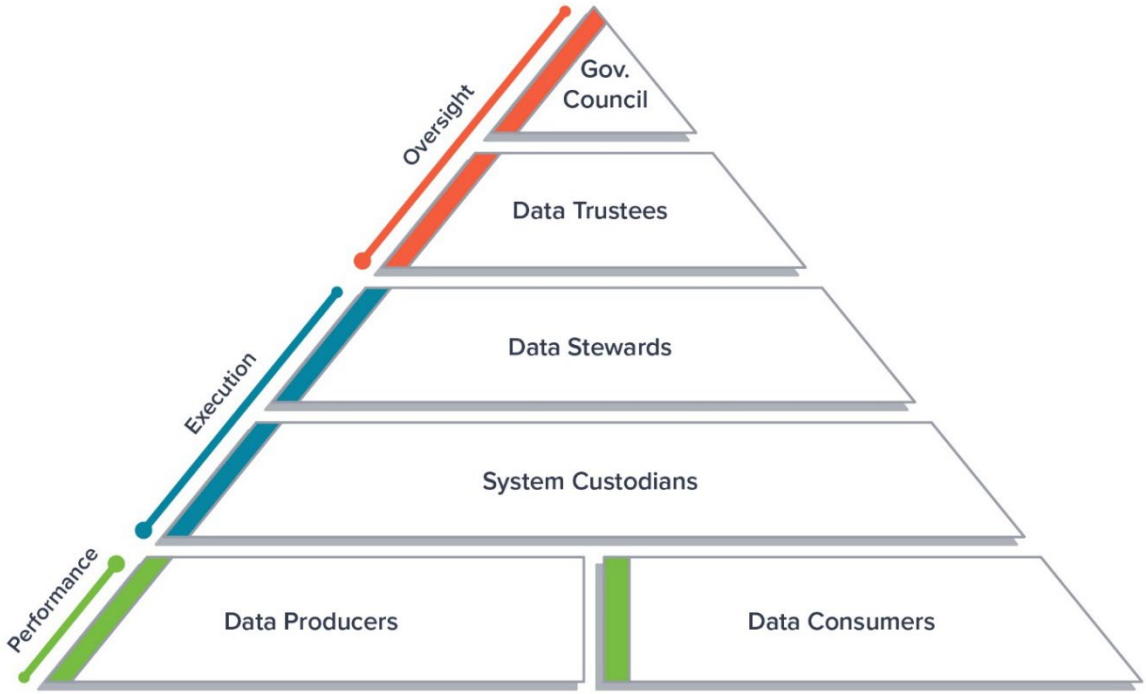


Figure 3. Data governance model (Data source: INDOT).

INDOT's data governance model institutes a shift away from a systems-centric focus on data to a focus on data domains such as asset management, maintenance operations, construction, capital programs, etc.

The TAM data, or domain, is divided into the following sub-domains:

- Bridges, large culverts, and structures.
- Pavement.
- Road inventory.
- Roadway features including small culverts, signs, guardrail, and others.
- Engineering.

Each domain is managed by a *Sub-domain Steward*, responsible for ensuring data standards are followed, policies are enforced, and data quality is monitored and controlled within the respective area. Throughout the life cycle of the asset, the *Sub-domain Stewards* validate the integrity of the data within their respective sub-domains. In turn, the system custodians are responsible for managing and executing the data policies and standards for the data systems and applications that house the data throughout the asset's life cycle.

Figure 4 illustrates the flow of the data governance model using the bridges, large culverts, and structures as a sub-domain example. The *Domain Trustee* oversees data domains; defines function specific policy, process, and tool decisions; and manages oversights of data inquiries. The *Sub-Domain Steward* ensures standards are followed, enforces policies, monitors data quality, handles data inquiries, and identifies data issues. *Dataset Sub-Stewards* validate data integrity, such as standards, inquiries, and quality assurance/quality control for specific asset attributes. The *System Custodian* develops, maintains, and modifies systems and applications in support of data domains and functions. *System Custodians* are established for the SPMS, Wall Management System (WMS), computer aided drafting and design (CADD), bridge investment analysis system (BIAS), Construction Data, and the Pavement Management System (PMS).

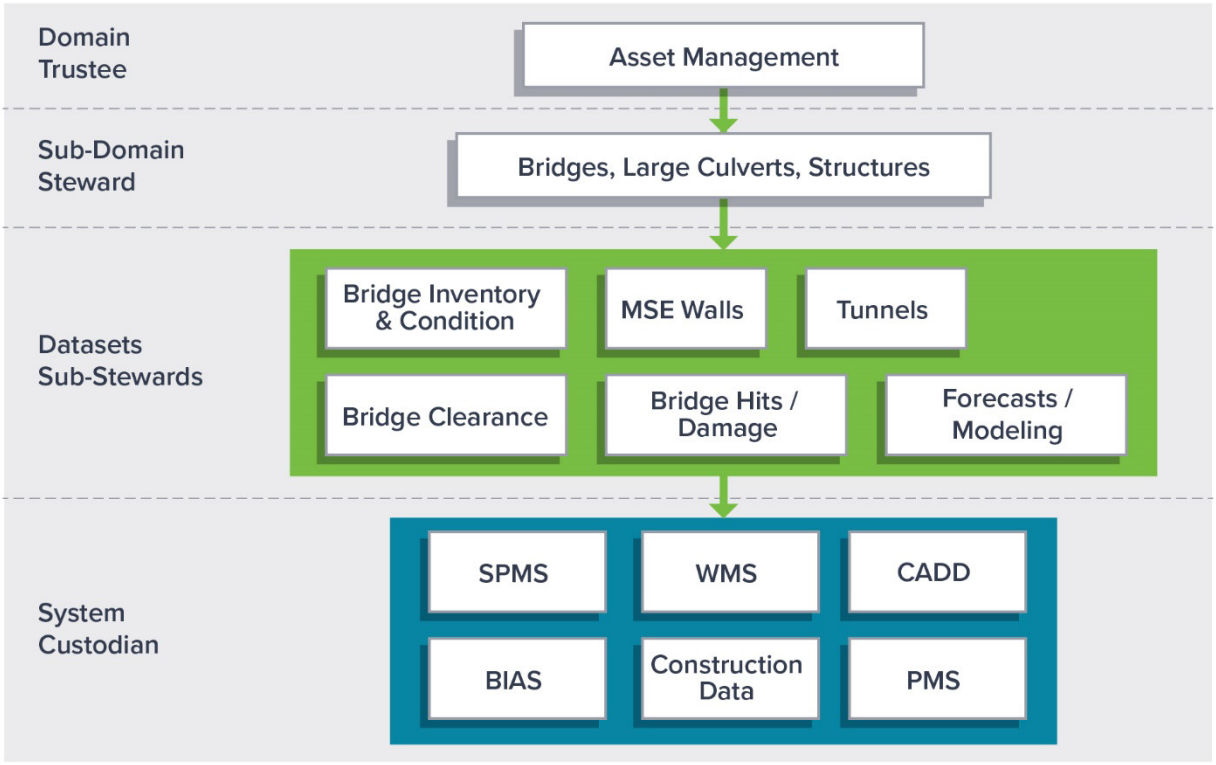


Figure 4. Flow of data governance model (bridges, large culverts, and structures) (Data source: INDOT).

Managing Project Scopes Throughout the Development Process

One of the first objectives INDOT's Asset Management Office established was to improve the accuracy of project scopes. Inaccurate scopes can cause longer project development times and project costs to exceed their budgets. There was no process for determining or considering the impact of schedule and cost changes made during project design on the rest of the program. To address this situation, INDOT sought to improve the accuracy of initial project scopes and establish clear processes and criteria for managing scope changes (INDOT 2022c).

Initial Project Scopes

Initial project scopes start from project recommendations from the pavement and bridge management systems. The recommendations are based on the published 20-year strategies described above. District staff review the recommendations and incorporate additional planning and engineering data to develop initial scopes. While the scopes are developed by the districts, the central office area engineers are involved throughout the initial scoping process. To facilitate this process, INDOT developed a project scoping application to develop scopes for bridge and pavement projects. It reduces data entry time, improves the accuracy of data going into the SPMS, features a mobile application to collect field notes and pictures on site, and provides desktop interface to fully develop abbreviated engineering reports. Additional information on the SPMS is provided later in this case study.

INDOT's Program Management Group (PMG) establishes the overall program budget. The four asset teams, in coordination with district technical services staff, score and rank proposed projects. During project scoping staff identify the necessity and appropriateness of treatments and evaluate whether there is an immediate safety concern that needs to be addressed. INDOT asset teams work together to make sure each scope meets the needs of its location and fits the system wide strategy. If a scope changes from the recommendation(s) of the 20-year strategies to meet local needs, the forecast is rerun to understand the impact on system-wide performance and budgets.

Change Management Policy

A formalized change management process is essential to balance project needs with program fiscal constraints and overall system performance. This process is comprised of three tiers:

- Placeholder Tier: A Placeholder is generated when each district reviews its estimates for the fiscal year program and is determined to have a remaining balance. The placeholder tier commits the funding to the district and the district may direct the use of that funding at a later date.
- Tier 1 – Contingency Fund: Tier 1 is when each district receives a change management contingency fund for $5 million each fiscal year to use at its discretion, with agreement amongst the district deputy commissioner, technical services director, and the capital program management director.
- Tier 2 – Exhausted Contingency Fund: Tier 2 is initiated when the contingency fund has been exhausted for a FY, there has been a change in fiscal year, or if the change to the project is a change in purpose and needs greater than $5 million in the construction estimate. If one of these criteria are met, the change management process within the SPMS will be initiated.

The change management requests for the projects being delivered by the major projects team would immediately go to tier 2 of the process to the change control board. With many of these project decisions being made at the executive level, this is most appropriate. All changes, whether placeholder, tier 1, or tier 2, are documented in the SPMS project log.

The change management module in the SPMS is the agency's documented change control process and is focused on approving or rejecting changes to the project scope, schedule, or budget. If funds do not become available, then the lower scoring projects will move out to the first year that funds are available. All projects submitted in the change management application would receive a new score, and the bridge management director and/or the pavement director would need to agree with the program changes. The goal is to complete the cycle of change management, from the point it reaches Central Office, within two to four weeks.

Project Prioritization and Programming

The scope and change management processes are parts of the broader project prioritization and programming processes. INDOT has developed data driven processes for identifying and selecting pavement and bridge projects.

Pavement Programming

The roadway asset team uses a commercial pavement management system to develop an initial list of candidate projects. The team then reviews the list of recommended projects and evaluates them based on purpose, need, and field knowledge. Project proposals are then submitted for review and statewide deliberation to the other asset management teams. The teams then review the projects and submit a list of recommended statewide projects to the PMG and Executive Funds Team (EFT) for review. The PMG creates a prioritized list of statewide projects based on need, project categories, priorities, funding limitations, and corridor planning. As part of this, the EFT divides available revenue among the asset management teams based on estimated revenue for the 5-year program. The PMG provides final project recommendations for the capital program, and following approval of the capital program, districts are notified to input approved and funded projects into the SPMS.

Bridge Programming

INDOT begins its investment decision-making process based on known budgetary constraints. INDOT then develops an initial list of its bridge treatment priorities based on the 20-year plan, using the commercial bridge management system (BMS) to develop and validate the plan. INDOT then uses a project scoring methodology to prioritize the suggested projects. Bridge asset engineers evaluate recommended projects, and based on their recommendations, projects are then submitted for final deliberation and inclusion in the program.

Project Bundling

In 2017, INDOT developed a machine learning algorithm to improve the existing bundling process, identify erroneous assumptions, include multi-disciplinary factors, and change organizational perception on bundling by grouping and clustering. The algorithm considers a variety of factors to calculate a district rating sheet (scorecard). These factors include homogeneity of different work types, bundle size, geographic concentration, flexibility of contracting in scheduling/sequencing, similarity of site conditions, cost effectiveness of maintenance of traffic, and user impacts

Benefits

NDOT practices bundling to reduce customer impact, construction costs, and internal manpower limitations. The ultimate goal is to assemble smarter project packages, creating less inconvenience for the traveling public. Efficiencies of project bundling can exceed efficiencies of treatment timing. Bundling minimizes impacts to system users and can save money and time. Project bundling improves public perception of the agency. According to an analysis performed by INDOT in 2017, after breaking a project into 3 projects let separately, the project cost was 8.5 to 9 percent higher than if it had been bundled (INDOT 2022c).

Approaches

In reviewing bundle packages over the past 2 years, INDOT found optimum bundling opportunities in three areas:

- Geographic location.

- Corridor.
- Work type.

The construction staff, most notably engineers, are key to providing feedback and project-specific knowledge when considering future bundles. The determination of contract bundles is most successful when there is a team effort at the district level (INDOT 2022c).

Geographic

When looking at a geographic bundle, INDOT found a 15- to 20-mile radius of geographic bundles are the most efficient. At this radius, INDOT typically does not see an increase in construction costs. A larger radius requires the contractors to have additional supervisory staff onsite. This distance is also on par with INDOT construction teams' staffing concerns and reduces time spent driving between job sites. The agency considers proximity to quarry, asphalt, concrete plant, and regular bidders in the region to decide on bundling size. INDOT found it beneficial to consider work types as well (i.e., concurrent and consecutive) since that can impact contractors' capacity per season. The agency practices caution when bundling local and State projects because complicacies can arise from differences in specifications and agreements between INDOT and local public agencies (LPA). Looking beyond district boundaries is often beneficial to find ideal bundles (INDOT 2022c).

Corridor

INDOT found that bundling mixed and multiple work types on a corridor is key to successful bundling. The agency bundles multiple work types with similar attributes such as interstate or high-volume multi-lane routes, city or single highway, maintenance and operation of traffic, and construction time. INDOT did not experience much success in mixing interstate and non-interstate projects.

Work Type

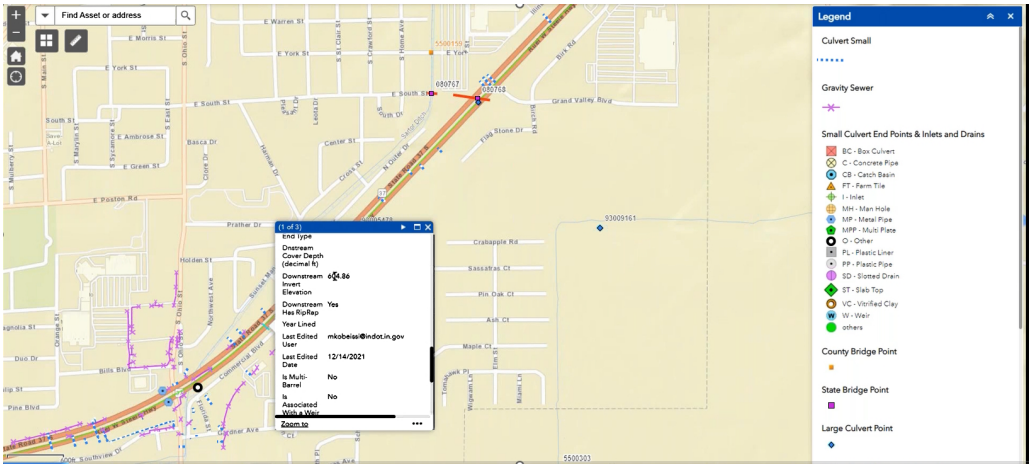
As a practice, INDOT determined that unless the project is along a corridor, mixed work types are not beneficial or more cost effective, with the exception of bridges, traffic signals, landslides, and other specialty work types. As a practice, the agency does not find road bundles ideal.

ASSET MANAGEMENT TOOLS

INDOT has implemented a number of information technology tools to support its TAM implementation.

Inventory Viewers for Ancillary Assets

INDOT developed a geographical information system (GIS)-based web map along interstate and state routes in 2019. This web map is used for its drainage asset inventory, containing information such as location, elevation, size, inspection report results, and environmental features (as shown in figure 5). The agency is making better budget estimates for maintenance and rehabilitation work due to the availability of an accurate inventory. Currently, INDOT is developing a system to import construction data on drainage assets directly to its GIS database instead of manually importing the data. In addition to drainage assets, INDOT developed viewers and inventory tools for multiple ancillary assets, such as bridge clearance, pedestrian assets, retaining wall, patching activity, speed limit signs, and ITS assets.



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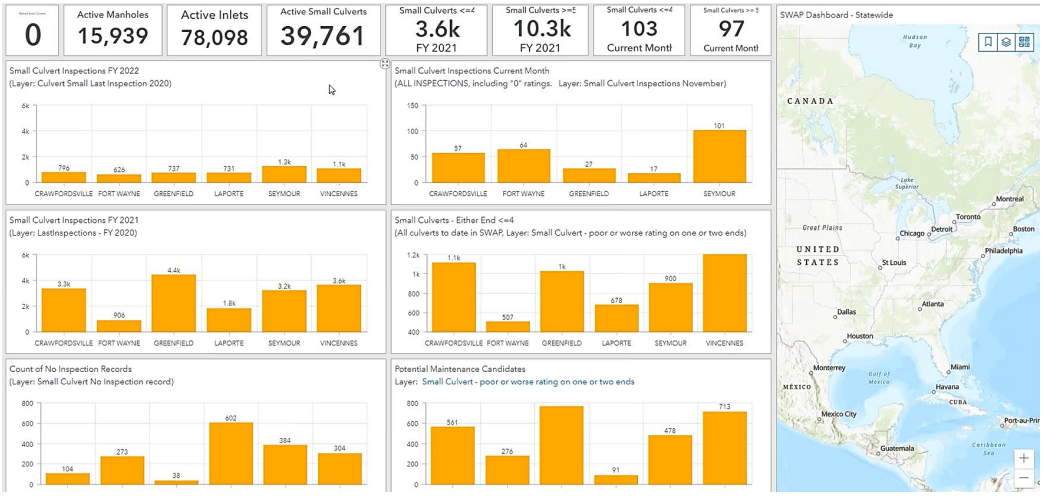

(b)

Figure 5. Drainage asset viewer (a) map view and (b) summary (Source: INDOT).

Straight Line Diagram Analysis Tool

INDOT designed a communication tool using proprietary straight line diagram software for executive offices and districts to better coordinate with county representatives and the general assembly. It offers one-click information for roadway networks, such as pavement history, condition, classification, and location (as shown in figure 6). Historical contractor information, project scope, activity, location, and maintenance history are also available. The tool brings all data streams together and aligns them in a linear referencing system with color codes so that users can pick and choose data attributes of interest. It enables the users to turn on future maintenance activities and visualize the impact of roadway treatments. State-of-the-art technological features, such as street view, can provide the latest pavement condition. A smartphone and tablet app are available to pinpoint geolocation in real time.

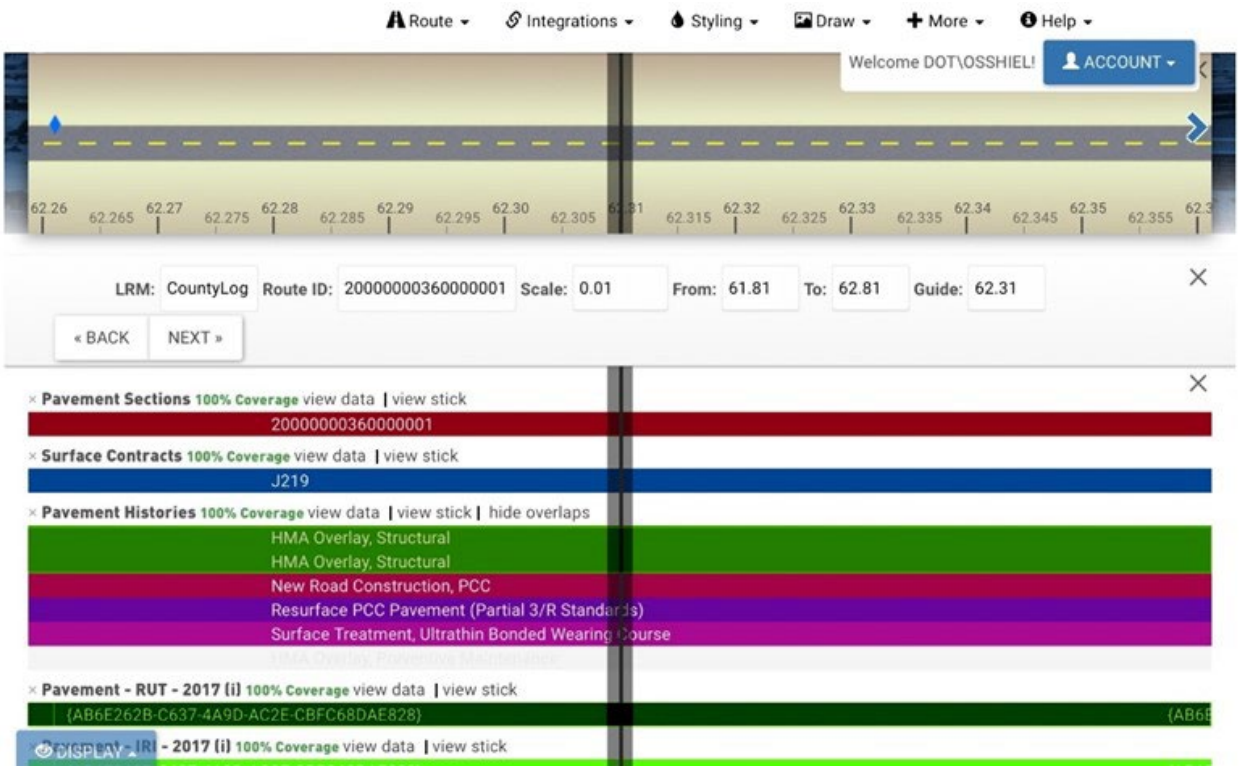

Figure 6. Example straight line diagram screen view (Source: INDOT).

20-Year Plan Editor

INDOT developed a 20-year plan editor using dashboard, as shown in figure 7. It enables viewers to visualize every bridge and roadway section, annual maintenance history, and proposed activity on a GIS map. This map can be filtered by district, national bridge inventory (NBI) number, route, bundle view, and can also be integrated with the straight-line diagram tool. Districts provide feedback on future plans via this tool, and INDOT updates the plan and model as needed. Users can walk through the map for 1- or 2-year windows and assess the overall planning activity in the region.

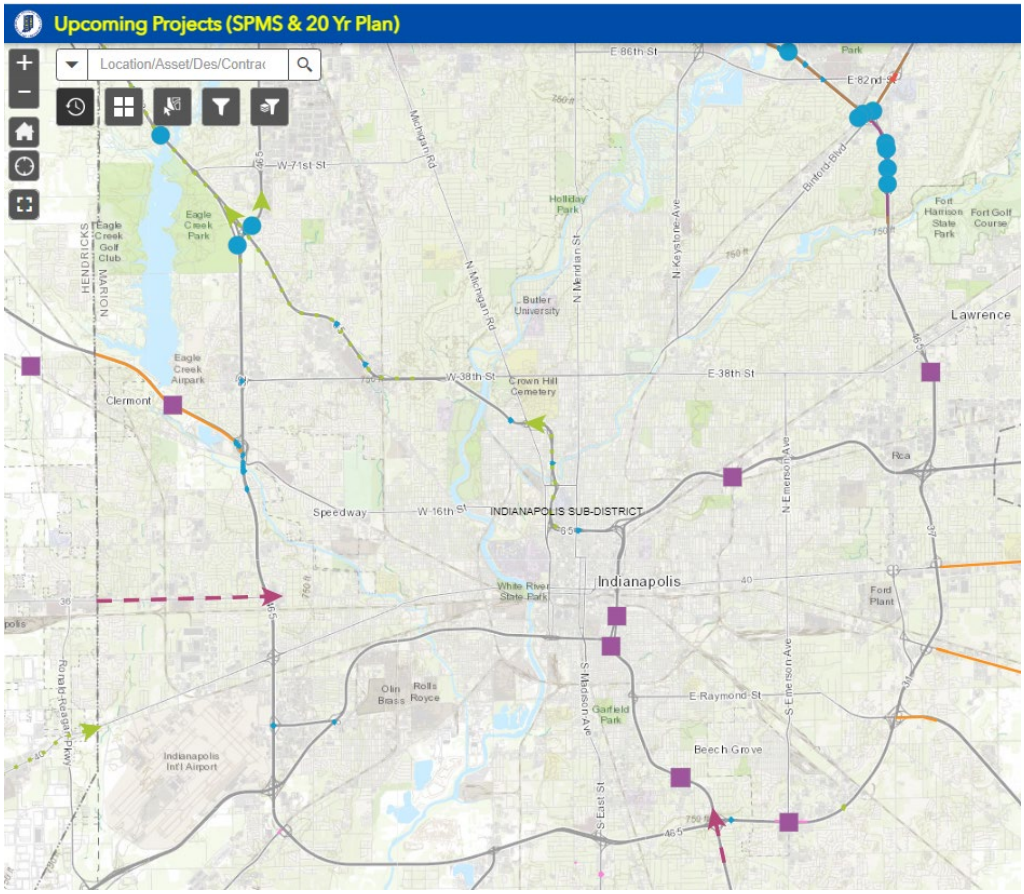

Figure 7. 20-year plan editor (Source: INDOT).

Project Scoping Application

The project scoping application is similar to the straight-line diagram tool since its interface also takes information from the field and from existing databases. The user can filter pavement and bridge projects by attributes, such as district, route, project type, and NBI (as shown in figure 8). INDOT is developing a safety and mobility projects tab in this application. The system is accessible in the field, so users can establish expected project limits while on-site and then review needs based on their selected location. The system can automatically remove duplicated locations and identify overlapping projects. Once a site is identified, the tool allows for the development of a detailed scope for inclusion in the capital program, typically 6 years into the future.

The project scoping application brings all relevant information into a user-friendly format. This includes traffic, roadway information (i.e., length, area, curbs, underdrains), location, surface type, project and maintenance history, condition, the actual work performed, costs, and photos. All information is scanned and documented, thus saving time during project set up and background review. The project scoping application can act as a standalone communication tool since it can be coupled with other apps, such as the straight-line diagram tool and the SPMS. All stakeholders, including members of Congress and district representatives, can collaborate effectively since approved and selected projects automatically slide over to the program management system.

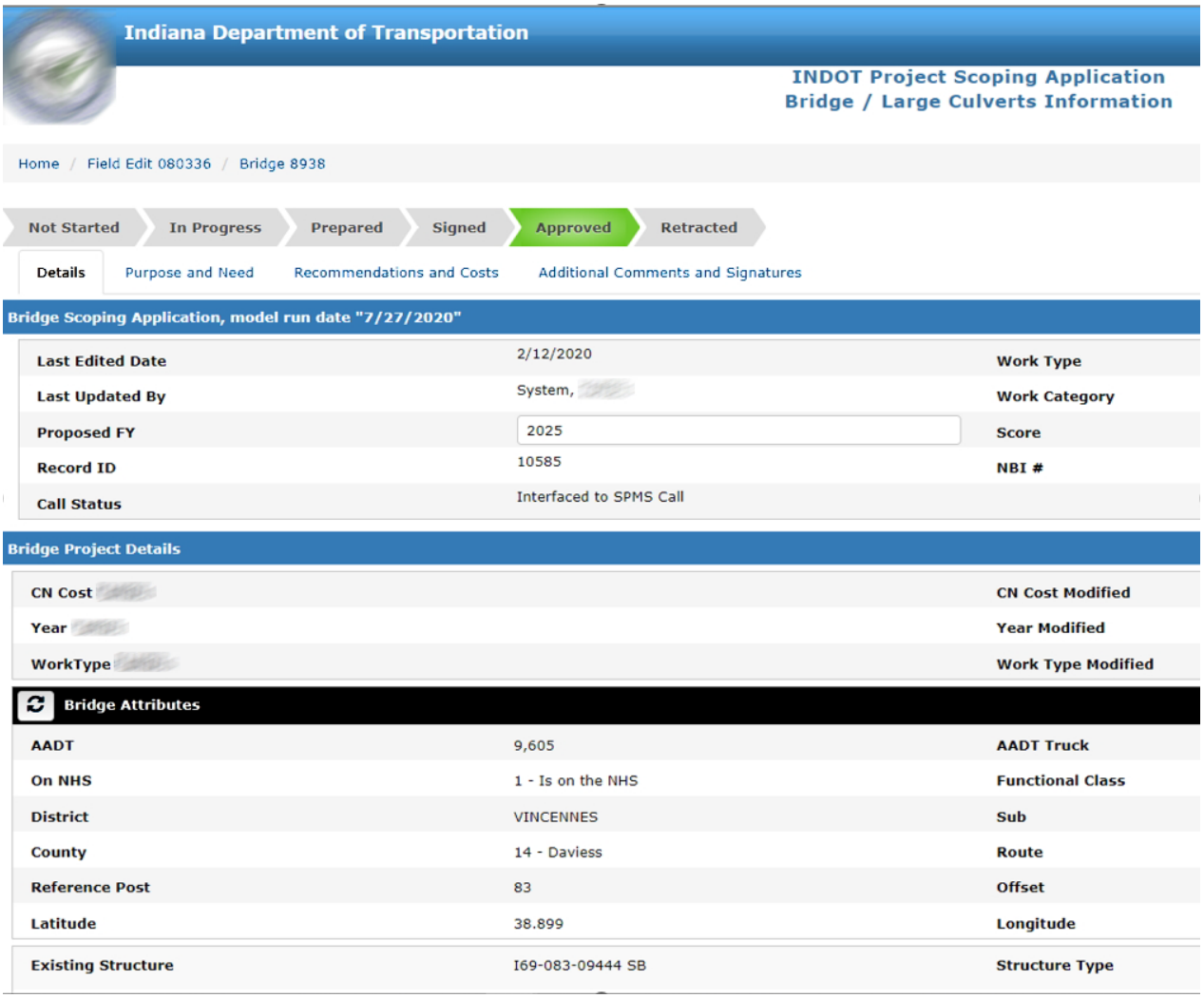

Figure 8. Project scoping application (Source: INDOT).

Scheduling and Project Management System

INDOT uses the SPMS for managing the connection between costs and accomplishing various objectives. The SPMS scores and prioritizes all projects based on agency needs, goals, budgets, and targets, as shown in figure 9. The tool connects multiple data sets to allow planners to see all

needs identified based on a selected location. This includes pavements, bridges, safety, and mobility needs.

Project prioritization and development using the SPMS was explained earlier in the *Project Prioritization and Programming* section. The project development process typically takes 5 years once a project is selected. For some highly complex locations, such as urban areas, the process can take an additional year. Establishing high-quality scopes has reduced the need for changes during the project development process and helped stabilize INDOT's program.

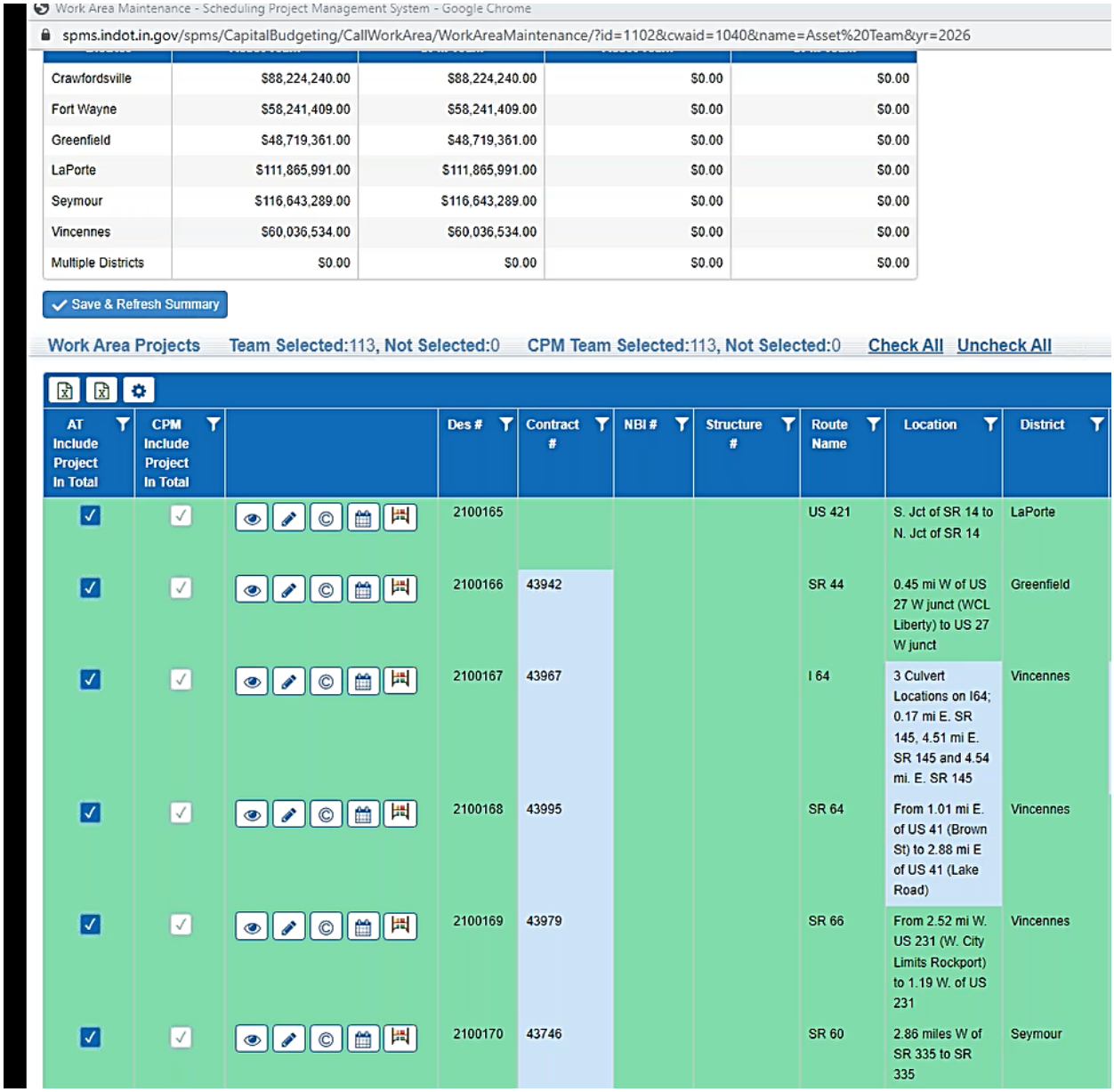

Figure 9. Scheduling and project management system (SPMS) (Source: INDOT).

HOW THE EFFORT HAS REDUCED RISKS AT INDOT

Risks are defined as "the positive or negative effects of uncertainty or variability upon agency objectives" (23 CFR 515.5). Prior to implementation of its asset management program, INDOT faced significant uncertainty and variability related to project scopes, schedules, and costs. There was considerable uncertainty about how individual projects supported achievement of broader network goals. There was even uncertainty regarding the roles different organizational units played in addressing these issues.

Reorganizing Planning staff clarified roles and responsibilities and dedicated needed resources to support decision makers at all levels. INDOT's new procedures rely on data and processes documented in 20-year life-cycle strategies. This documentation provides transparency and accountability for staff and external stakeholders.

The development and use of standardized information technology tools provide consistency in decision making and full access to needed data. Tools such as the SPMS support consistent decision-making processes across the agency, thus reducing variability and stabilizing the program. INDOT's processes recognize that even the best made plans can be derailed by information that comes to light later in the process. The area engineers work hand-in-hand with district staff to address these changes as they are identified to ensure they are addressed at the project level with minimal impact to the broader program.

INDOT will continue to identify, track, and mitigate risks to its assets and asset management program through the risk management process documented in its TAMP. The process will continue to address organization, financial, and natural risks that can be addressed through continued improvements to INDOT's asset management organization, practices, tools, and data.

NEXT STEPS

In the coming years, INDOT plans to move beyond pavements and bridges and include other assets in performance-based management (INDOT 2022c). This effort will start with large culverts in 2022. The agency has a comprehensive inventory of these assets, including condition and performance modeling. The agency is also actively managing several minor assets but does not plan to include them in the TAMP. These are assets that can be effectively managed without one or more of the key data sets for asset management, e.g., full inventory, complete condition assessment, or performance models.

INDOT is working to address uncertainty and variability related to funding, particularly how funding can best be allocated across multiple asset and system performance needs. Using the asset management systems and historic expenditures, INDOT is working to establish forward-looking needs-based budgets that can be used to balance expenditures across multiple programs. This is expected to be a first step toward a multi-objective decision analysis process. The results of this analysis would be one more input into the programming process, providing district and central office planners with an understanding of the mix of projects and work types needed to achieve network wide objectives. The Central Office will continue to support this effort with dedicated staff, quality data, and specialized tools.

REFERENCES

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