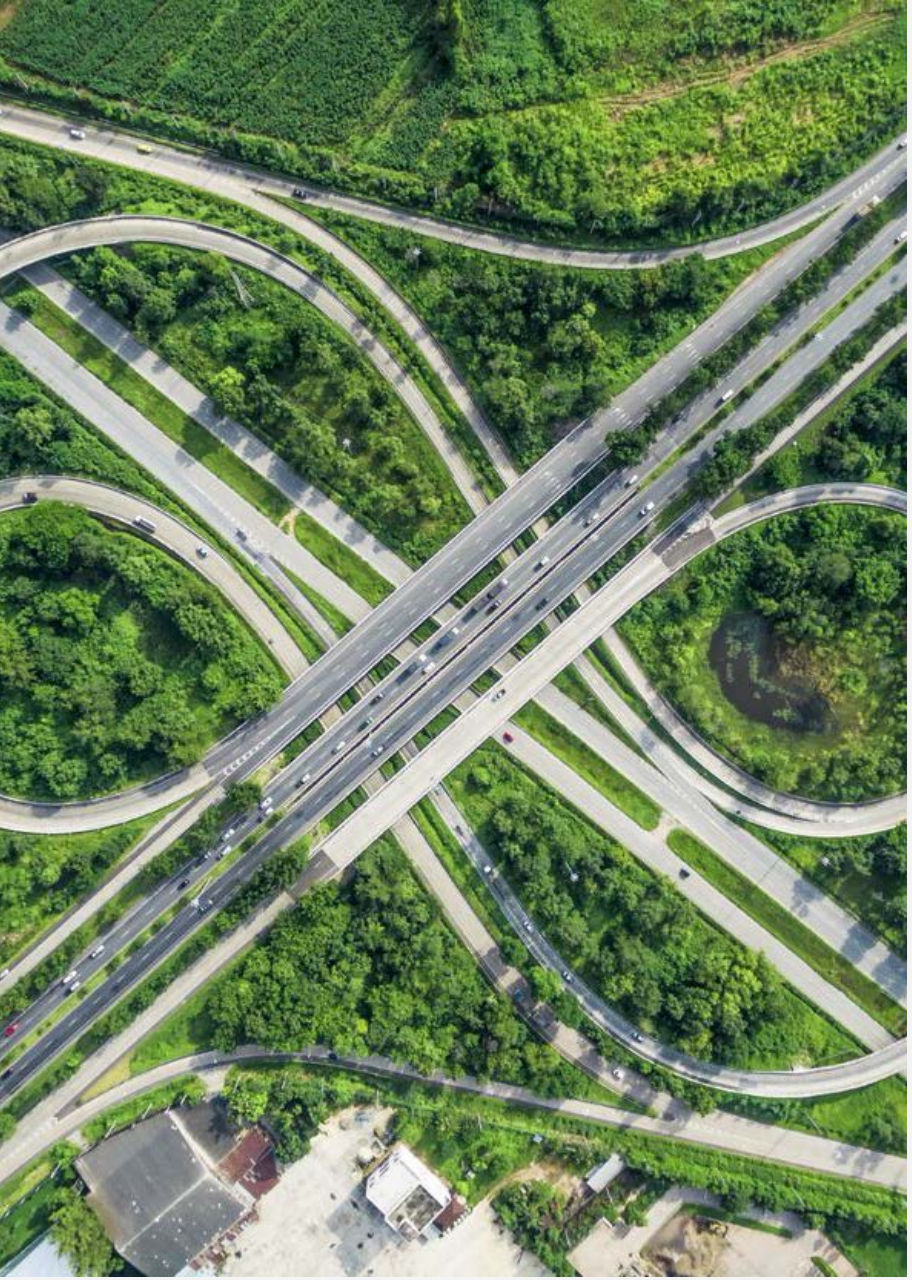
Guidehouse

Arkansas Highway Commission Review and Advisory Subcommittee Meeting

Recommendations Report Presentation: Expenditures

August 19, 2020



Agenda

Guidehouse

| The recommendations and findings included in the presentation are a point in time representation and are subject to change. Also, Anticipated Impacts are estimates, directional in nature. Please see the assumptions slide in the appendix for further details.

Recommendations

Expenditures

Guidehouse

Expenditures - Current State Findings

	Key Finding(s)	Supporting Evidence
Recommendation 7: Implement project and portfolio planning frameworks	**EX1:** Project development, construction, and maintenance functions present unique resource management challenges **EX4:** The construction project development process may be enhanced through formalized project management tools **EX5.1:** Existing project management tools may have broader applications for construction staff **EX5.2:** Change orders are not formally reviewed **EX 6:** Scheduling and evaluation of maintenance activities may be improved through the use of project management tools	• ***The Department budgets ~$40M*** for Planning, Design, and Construction monitoring Activities, yet, ***Mechanisms*** to ***match STIP projects*** with these ***budgets and resources are "homegrown" or non-existent*** • ***Target costs*** associated with executing pre-construction, construction monitoring or maintenance activities ***do no exist***
Recommendation 8: Implement leading practices in construction project design	**EX2.1:** Formal protocols around the use of practical design are lacking **EX2.2:** ArDOT has not taken advantage of the full benefits of Value Engineering **EX3.1:** Engineer's estimates are not formally evaluated to identify future design cost efficiencies	• ***Absent formal documentation*** around its iteration of practical design, ArDOT is ***unable to implement leading practices***, ***show cost savings***, and sustain critical knowledge management • ArDOT completes ***2.2. VE studies per year and realized a total savings of $377k since FY2015,*** which puts ***ArDOT below the national average*** • The cost of Change Orders directly tied to "Plan Omissions/Errors" has averaged $3.1M from CY2014 to CY2019

| The recommendations and findings included in the presentation are a point in time representation and are subject to change. Also, Anticipated Impacts are estimates, directional in nature. Please see the assumptions slide in the appendix for further details.

GLOSSARY

STIP: Statewide Transportation Improvement Plan *VE: Value Engineering*

7. Implement project and portfolio planning frameworks

ArDOT's pre-construction, construction and maintenance Project Portfolio Management (PPM) systems vary in maturity. Enhancing these systems may allow ArDOT to more effectively budget, plan, execute, and communicate on its construction and maintenance projects.

Anticipated Impact*

- A more ***mature project management framework*** may allow ArDOT to realize ***~$3.82M in annual savings*** related to ***internal pre-construction and construction costs***

**See Appendix for calculation assumptions*

Considerations

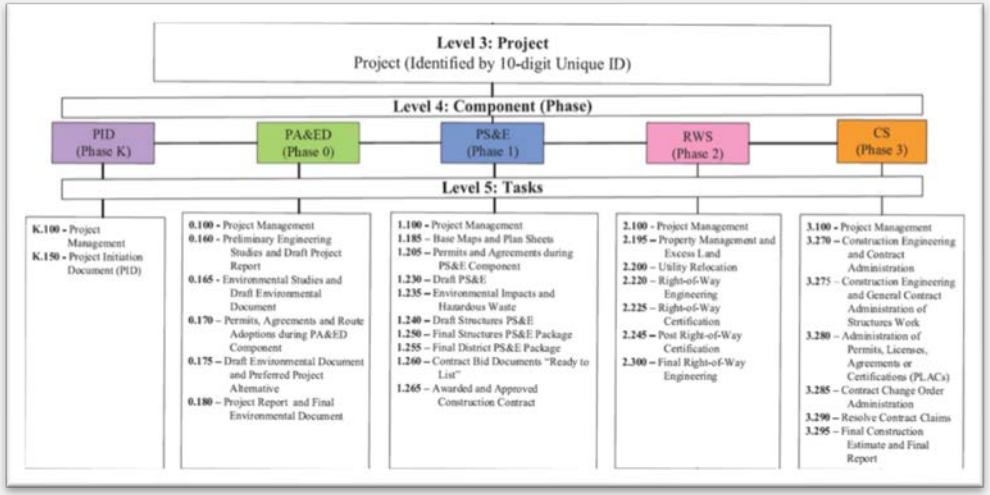
- Will require a ***Department-wide effort to unify disparate initiatives and assets*** and build out PPM framework
- Implementation of PPM/PMO ***will be perceived as overhead, but will yield long-term benefits***
- ***Change management and new IT applications*** may be required

Implementation Summary

- ***Catalog existing and in-flight PPM capabilities*** and identify baseline and target state (e.g. new MMS)
- ***Identify gaps in PPM*** (e.g. pre-construction resource planning)
- ***Establish PMO and Governance***, and build on existing strengths and capabilities
- ***Phase deployment***, develop tools, and train staff members

Leading Practices

- ***Six of the 10*** comparison DOTs utilize ***project management frameworks*** or offer ***project management training***
- ***Seven DOTs*** implement a ***performance-based maintenance management system***
- ***Caltrans offers a mature project management framework*** that helps constrain project development and administration costs (see right)
- TxDOT's approach to PPM identifies the ***right portfolio of projects at the right time and allocates resources***



Source: CalTrans

| The recommendations and findings included in the presentation are a point in time representation and are subject to change. Also, Anticipated Impacts are estimates, directional in nature. Please see the assumptions slide in the appendix for further details.

GLOSSARY

MMS: Maintenance Management System PPM: Project Portfolio Management PMO: Project Management Office

(Rec Report pg. 39)

Implementation Roadmap

1 CATALOG EXISTING PPM CAPABILITIES AND TARGET STATE

Catalog current portfolio planning and project management protocols, capabilities, software applications, and reporting

Conduct landscape review of industry-approved frameworks and those used by State DOTs to identify baseline and target portfolio planning (e.g. WisDOT Compass) and project management frameworks (e.g. VDOT PM[1])

2 IDENTIFY GAPS IN THE CURRENT SYSTEM

Conduct internal review to identify system gaps in construction and maintenance; focus on:

Pre-construction and construction monitoring
- Resource and budget planning
- Project management

Maintenance
- Portfolio planning
- Resource and budget planning
- Project management

3 ESTABLISH PMO AND BUILD ON EXISTING STRENGTHS

Create PMO with identified governance and resources to oversee design and implementation of Project Portfolio Management across pre-construction, construction and maintenance activities

Leverage existing organization assets (e.g. IT PMO), practices (e.g. STIP process), resources (e.g. Garver PM supports) and software (e.g. new MMS) to kickstart PMO planning

4 PHASE DEPLOYMENT, DEVELOP TOOLS, TRAIN EMPLOYEES

Prioritize deployment based on organizational maturity and need; for example:
- 1a: Project management for pre-construction and construction activities;
- 1b: LOS portfolio planning framework for maintenance activities

Develop standards, toolsets, and formalize reporting, risk/issue management, and change control protocols

Train staff members, deploy resources, operationalize PPM and PMO processes

| The recommendations and findings included in the presentation are a point in time representation and are subject to change. Also, Anticipated Impacts are estimates, directional in nature. Please see the assumptions slide in the appendix for further details.

GLOSSARY

WisDOT: Wisconsin DOT VDOT: Virginia DOT PM: Project Management PMO: Project Management Office

STIP: State Transportation Improvement Plan MMS: Maintenance Management System LOS: Level of Service PPM: Project Portfolio Management

8. Implement leading practices in construction project design

While ArDOT implements these leading project design practices, they lack formal frameworks to ensure their consistent use. By adopting such procedures, ArDOT may strengthen institutional knowledge, reduce project costs, and improve achievement of system targets.

Anticipated Impact*

- ***~$664K*** in cost savings per project by ***adopting formal framework for practical design***
- ***Between ~$1M and ~$15.8M*** in additional cost savings by bringing ***ArDOT up to national averages for Value Engineering (VE)*** studies

**See Appendix for calculation assumptions*

Considerations

- ***Not all projects are well suited to*** or would benefit from ***such approaches***
- This recommendation will not require creation of new technical practices but will require ***formalizing and expanding existing practices***

Implementation Summary

- ***Develop formal framework*** around use of performance-based ***practical design***
- ***Conduct value engineering earlier*** in design (i.e., at 30% complete) ***and more often***
- ***Evaluate gap between original bid and final payment*** amounts to inform ***best practices in design***

Leading Practices

- Nationally State DOTs average ***~3.3 VE studies per year with savings close to $22M***, far exceeding what ArDOT has been able to achieve through its VE program
- ***Several States*** have seen considerable ***cost savings*** through robust ***Practical Design protocols***. For example, WisDOT adopted a flexible design approach including a ***"least cost" methodology,*** creating performance measures, and shifting culture

40%

Average project cost savings from practical design (from a sample of 10 projects)

$21.5M

Average project cost savings from practical design (from a sample of 10 projects)

Source: Washington DOT

| The recommendations and findings included in the presentation are a point in time representation and are subject to change. Also, Anticipated Impacts are estimates, directional in nature. Please see the assumptions slide in the appendix for further details.

GLOSSARY

VE: Value Engineering *WisDOT: Wisconsin Department of Transportation*

Implementation Roadmap

1 DEVELOP FRAMEWORKS

Determine methodologies, timing, and frequency of analyses for:

- Practical design
- Value engineering
- Engineers estimates compared to final cost

For example, FHWA[1] suggests VE studies for:

- High-cost and/or high-priority projects
- Complex or challenging projects with multiple stages / traffic control
- Projects involving multiple stakeholders

2 TRACK OUTCOMES & REVIEW TRENDS

Conduct analyses and track outcomes in accordance with set policies, for example:

- Benefits, cost savings and ROI from practical design and value engineering

Identify trends and leverage learnings to strengthen design approach:

- Project types most likely to have change orders due to plan error or omission
- Projects that have exceeded timelines
- Project types likely to benefits from certain practice design solution

3 MONITOR & REEVALUATE

Evaluate policies and procedures by continuing to monitor trends in key areas, at predetermined frequencies

Determine if revisions to policies and procedures are necessary to obtain desired outcomes

If so, implement necessary revisions

GLOSSARY

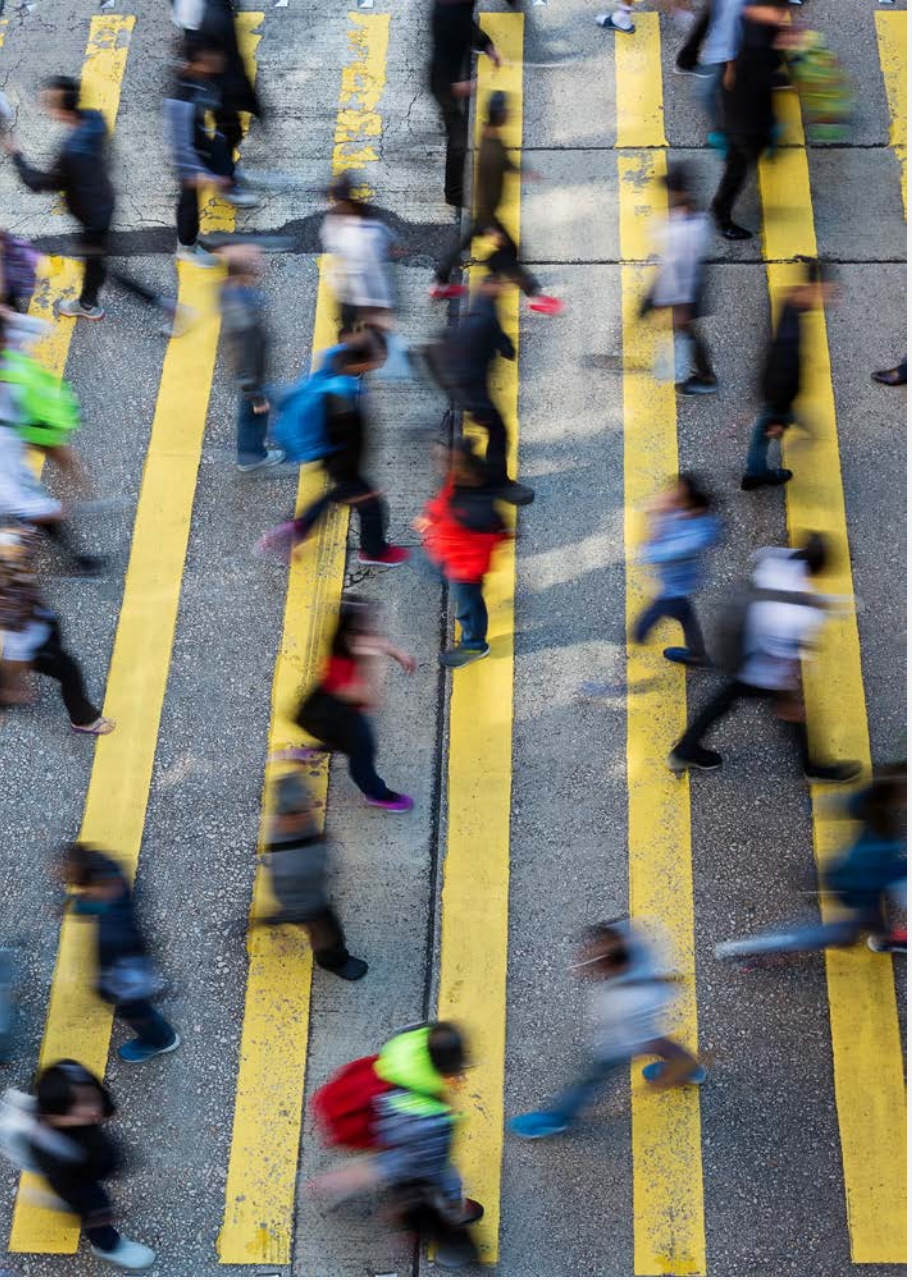
FHWA: Federal Highway Administration *VE: Value Engineering* *ROI: Return on Investment*

Questions?

Guidehouse

Appendix

Guidehouse



Appendix Contents

Assumptions

1. The recommendations included in the presentation and in the corresponding Recommendations Report are based on a point in time Current State Report delivered to the Highway Commission and Advisory Subcommittee on March 13, 2020. This Current State Report was based on interviews conducted with the Arkansas Department of Transportation (ArDOT) staff members and various external stakeholders and a review of documents ArDOT provided to Guidehouse from September 2019 – February 2020. Recommendations and Findings are subject to change based on mitigating documentation and clarifications provided by ArDOT subsequent to the publication of this report.
2. The Anticipated Impacts identified within this presentation and the corresponding Recommendations Report are estimates, directional in nature, and represent the upper end of the savings range

Recommendation 7 - Anticipated Impact Assumptions

1

A more mature project management framework may allow ArDOT to realize ~$3.82M in annual cost savings

PMSolutions', Project Management Maturity & Value Benchmark Report[1] revealed:

- An organization with less mature project management platform realizes cost reductions of 6% per project
- The average cost savings for all organizations is 16% (This represents cost savings from an organization with an average level of project management maturity)

ArDOT's percentage cost savings by implementing a more mature project management platform:

- Assume ArDOT has a less mature project management platform and 6% cost savings are already factored into their internal construction costs.
- Assume implementation of a more mature project management platform ArDOT can yield the average cost savings per PMSolutions (16%). As a result, ArDOT can increase cost savings by 10%.

ArDOT's five year (FY2015 – FY2019) average internal state specific construction project costs based on actual pre-construction, construction engineering right of way, utility engineering, utility audit, misc. engineering, state force, EEO, and surveys expenditures*.

- ArDOT five year average state specific construction costs = $38,168,661[2]

Cost savings by implementing rising to an organizational average project management platform = $38,168,661 * 10% = ~$3.82M

** Costs include 20% of Federal Participating and Billable costs; 100% of Non-Participating costs; 20% IRP Bond Funds to supplement Federal Participating costs; 100% of IRP Bond Funds to supplement Non-Participating costs*

Recommendation 8 - Anticipated Impact Assumptions

1

~$664K in cost savings per project by adopting formal framework for practical design[1]

MoDOT saved 13% on average in its first year of implementing a formalized practical design program. ArDOT's average contract amount 2014-19 is $5.1M.

- 13% * $5,113,314 = $664K

2

Increased total project savings by bringing ArDOT up to national averages[2] of: annual number of VE studies (~$1M), cost savings generated per VE study (~$7.7M), or both (~$15.8M)

ArDOT can increase its cost savings from value engineering by: 1) increasing the % of cost savings yielded per study (i.e., by conducting studies earlier in the design process, generating more recommendations per study); 2) increasing the # of studies, or 3) both. ArDOT currently conducts an average of 1.75 VE studies per year (total project costs $181M), generating 0.7% in project costs saved (~$1.3M). The national average is 3.30 studies per year and 5.0% of savings. Note: applied to ArDOT, 3.30 studies per year would yield a proportional project cost of $343M.

- Increasing %: 1.75 studies of projects totaling $181M @ 5.0% cost savings = $9.1M (= $7.7M greater than current savings)
- Increasing #: 3.30 studies of projects totaling $343M @ 0.7% cost savings = $2.4M (= $1.0M greater than current savings)
- Both: 3.30 studies of projects totaling $343M @ 5.0% cost savings = $17.2M (= $15.8M greater than current savings)

| The recommendations and findings included in the presentation are a point in time representation and are subject to change. Also, Anticipated Impacts are estimates, directional in nature. Please see the assumptions slide in the appendix for further details.

GLOSSARY

MoDOT: Missouri DOT *VE: Value Engineering*

Disclaimer: Anticipated Impacts are estimates, directional in nature, and represent the upper end of the savings range

Expenditures Current State Findings

EX1: Project development, construction, and maintenance functions present unique resource management challenges.

Overview
- ArDOT is implementing an enterprise resource planning tool that will integrate existing systems for financials, inventory, and purchasing, among others.
- Yet this is disconnected from project development and management, which require distinct approaches to better manage human capital / resource staffing, consultant, procurement, and IT resources at the project and enterprise levels
- While the Department is consistently able to execute on its project development, construction, and maintenance functions with current practices, improved resource planning may allow them to do so while saving costs.

Project Development
- At the project development phase, ArDOT should correctly identify and plan for staffing needs, particularly as it informs procurement for professional engineering and design-related services contractors.
- Further, effectively projecting the capacity required to execute project development tasks may inform cost-benefit analyses that justify the purchase of tools like software applications that improve efficiency and quality.

Construction
- At the construction phase, ArDOT should correctly identify and plan for staffing, particularly for entry-level positions that require extensive on-the-job training.
- The current system to determine crew complements relies on outdated technology and does not yield outputs that are easily usable by staff for resource planning.

Maintenance
- At the maintenance phase, ArDOT should correctly identify and plan for staffing, equipment, and materials needs.
- Currently, crew complements are based on historical data and not level of service.
- Further, effectively projecting the location, scope, and volume of the maintenance activities required may inform cost-benefit analyses that justify the purchase of equipment or services that improve efficiency and quality.

Expenditures Current State Findings

EX 2.1: Formal protocols around the use of practical design are lacking.

- FHWA requires that state DOTs adhere to certain criteria in their plans and specifications for projects on the National Highway System. The standard for roadways is set by AASHTO's "A Policy on Geometric Design of Highways and Streets," also known as the Green Book.
- Yet DOTs have some flexibility to depart from traditional designs as system performance, fiscal sustainability, and public needs demand.
- Practical Design is a leading example: a context-sensitive approach through which DOTs can optimize roadway and bridge designs to obtain the maximum system benefit while still achieving project objectives.
- Missouri DOT has used practical design since 2005 to generate cost savings and improve safety, implementing lower cost solutions system-wide rather than higher cost solutions in isolated areas, resulting in reduced fatalities (see graph) and $400M in cost savings in Year 1.
- ArDOT applies a context-sensitive approach, but lacks formalized policies and procedures to govern and document its usage and outcomes.
- Absent documentation, the Department is unable to implement best practice, show cost savings, and maintain knowledge management.

PP 2.1: The Annual maintenance budgeting process is based on Historical Precedent.

- Value Engineering (VE) is a tool to analyze projects and identify opportunities to reduce costs, improve quality, and reduce completion time. It typically takes place during the planning phase.
- Federal regulations require states to conduct VE for National Highway System (NHS) projects with $50M+ in project costs. For bridge projects, the threshold is $40M+.
- ArDOT's Value Engineering Guidelines and Procedures dictate project selection, team selection, required training, work plan, and resources.
- ArDOT conducts an average of 2.2 VE studies per year, yielding an average of 5.75 recommendations per study. However, only 2 VE recommendations have been approved since FY15, a total of ~$377K.
- This puts ArDOT below the national average, as seen in the table below.
- Anecdotally, staff shared the limitations of current VE practices, namely that it is conducted too late in the process to provide maximum value.
- ArDOT allows construction contractors to submit VE Change Proposals (VECP) for all projects $2M+ after the contract has been executed. ArDOT approves an average of 1.5 VECPs per year, ~$904K on average.
- This puts ArDOT near the national average for VECP.

GLOSSARY

AASHTO: American Association of Highway Transportation Officials *VE: Value Engineering* *VECP: VE Change Approvals*

NHS: National Highway System

Expenditures Current State Findings

EX 3.1: Engineer's estimates are not formally evaluated to identify future design cost efficiencies.

- The engineer's estimate is developed based on the quantities of labor and materials required for each design. ArDOT uses an estimating software tool to complete this.
- Accurate cost estimates are essential to the Department's financial accountability, constraints, project budgeting, resource planning, and contractor management.
- However, the Department does not engage in any formal evaluation of estimates against final project cost to integrate learnings that improve future cost estimates.
- In contrast, other DOTs may compare the engineer's estimate to the low bid, award amount, and final contract amount to assess the accuracy of their estimates.
- The volume of change orders related to plan omission suggests some issues with the Department's current estimate approach: ~$3.1M in change orders were approved on average per year due to this reason, between 2014 and 2019.
- As demonstrated in the graph (right), this trend is declining, indicating that ArDOT has taken positive steps to mitigating this issue. Yet there is still room for improvement.

PP 3.2: Right of Way (ROW) faces external obstacles to reducing costs.

- ROW takes the longest of any critical path steps and can be expensive. This process is hampered by external factors: negotiation delays and increasing acquisition costs.
- ArDOT has ~34 ROW projects per year; each is, on average, 15 months and $834K.
- State regulation allows property owners to challenge ArDOT's "just compensation" in condemnation. If the court awards an amount >20% of ArDOT's offer, they must cover the property owner's legal fees and expenses in addition to the acquisition cost.
- This provision extends to other entities, including public utilities, which will increase ArDOT's costs if they are responsible for utility right of way reimbursement.
- ArDOT acquisitions costs increased as a result. Before the legislation took effect in 2016, the Department paid, on average, 9% above appraisal value in condemnations; afterwards, ArDOT paid, on average, 26% above appraisal value.
- ArDOT is limited in disposing surplus land due to state law requiring 3 appraisals for purchase. The total appraisal cost of ~$4,500 exceeds the value of some land. The Department has $7.2M in surplus land, of which 11% ($764K; 912 tracts) is below $4,500 and 89% ($6.4M; 223 tracts) is above.

GLOSSARY

ROW: Right of Way

Expenditures Current State Findings

EX 4: The construction project development process may be enhanced through formalized project management tools that increase accountability, identify process efficiencies, and facilitate collaboration across teams.

- ArDOT uses a critical path approach for pre-construction: after projects are adopted in the State Transportation Improvement Program, the path follows through the Survey, Roadway Design, Environmental, and Right of Way Divisions at determined intervals before Program Management lets it to contract.
- This process is monitored via the Staff Minutes, which provides project information and tracks progress against interim milestones for each division.
- Staff Minutes are maintained by Program Management and reviewed biweekly to highlight upcoming projects and troubleshoot projects behind schedule.
- Yet there is no tool that offers robust project management for this process, which could increase accountability and identify process efficiencies earlier.
- Further, design, reviews, and handoffs are not necessarily conducted within the same software platform.
- Some DOTs seeking to reduce project development time, increase accuracy of estimates, and reduce likelihood of future change orders utilize tools that allow different divisions to dynamically design within an open access model.
- One example of this approach is WisDOT's use of 3D Modeling and BIM, which would also facilitate coordination with construction staff (graphic below).
- Anecdotally, district staff want more time for feedback on plan designs at 90% complete to potentially reduce the number of change orders down the line.

PP 5.1: Existing project management tools may have broader applications for construction staff.

- Construction schedules are set by contractors, but Resident Engineers must efficiently coordinate construction monitoring tasks.
- ArDOT lacks a project management system to fill this gap, by, for example, interfacing with the contractor's project plan to trigger construction monitoring tasks and check-ins at key milestones.
- Though ArDOT uses Primavera P6, it is primarily for contractors. For ArDOT, it facilitates time impact analysis and change order analysis.
- The use of this tool is limited to projects with A+C bidding.
- Districts use SiteManager for contract administration, daily work reports, current and final estimates, materials management, and other functions. SiteManager is a leading information management tool, but does not provide project management support.
- In the absence of a project management tool, Resident Engineers rely on daily meetings and weekly and monthly reports to plan, manage, and troubleshoot. They review major overruns, projects behind schedule, missing documentation, change orders, and more.

GLOSSARY

WisDOT: Wisconsin Department of Transportation

Expenditures Current State Findings

EX 5.2: Change orders are not formally reviewed to identify potential efficiencies or problematic contractors.

- Change orders are used to approve and document changes in how contractors execute work, prompted by plan error, unexpected site conditions, and a range of other reasons.
- Approval of change orders varies by type and amount. In general, Resident Engineers approve change orders <$20K, District Engineers <$75K, and Assistant Chief Engineer above that. Special considerations are made for changes to contract items, contract time, and VE.
- FHWA approves change orders of $20K+ on federal oversight projects.
- Change orders are documented in SiteManager, but not formally reviewed by the Department to identify trends in contractor performance, item costs (particularly those items not included in bid), or to analyze consistency of approvals and amounts across districts.
- Since 2014, the total number of change orders that ArDOT has experienced has declined, however during the same time frame, the dollar value per change order has increased significantly.

GLOSSARY

VE: Value Engineering *FHWA: Federal Highway Administration*

Expenditures Current State Findings

EX 6: Scheduling and evaluation of maintenance activities may be improved through the use of project management tools.

- Maintenance activities are broadly identified as part of the Annual Work Program, which includes a list of activities to be completed and the estimated materials, crew size, and time required.
- The Annual Schedule of maintenance functions outlines during which months each activity is expected to be completed, possible, or in case of emergency.
- District- and area-level maintenance staff use the annual work plans to develop bi-weekly schedules with functions, locations, materials, and crews to be used in two weeks.
- Seasonality facilitates some level of project prioritization. However, of the 50+ activities listed in the Annual Schedule, nearly all are expected or possible each month, offering little guidance to staff on how to prioritize activities throughout the year.
- Schedule management is conducted through comparison of actual progress against the annual work plan, reviewed once per month by district and annual staff.
- Productivity is assessed through a comparison of actual productivity against historical rates (i.e., output per hour), reviewed once per month by the District Maintenance Engineer (DME) and District Maintenance Superintendent (DMS).
- This review may yield a change in the maintenance crew size or other adjustment, but may be too late to make a productive change to the project in question.
- The new Maintenance Management System (MMS) should begin to address many of these issues by optimizing work plans based on system condition within financial and staff constraints.
- Initial implementation of the MMS will emphasize performance-based planning and budgeting, and later phases will add in optimization capabilities.

GLOSSARY

DME: District Maintenance Engineer *DMS: District Maintenance Superintendent* *MMS: Maintenance Management System*

Expenditures Current State Findings

EX 7.1: ArDOT is taking steps to strengthen its internal audit practices.

- Internal Audit (IA) largely conducts Administrative Compliance Audits of divisions, districts, Resident Engineer Offices, and sections, including internal controls, regulatory compliance, and safeguarding of assets.
- "Management findings" are communicated directly to the audited group, and "reportable findings" are included in the audit report; Audit activities are reported to the Highway Commission bi-monthly.
- IA completes a risk assessment every 2 years, per Arkansas Dept. of Finance & Administration (DFA), to identify risks for fraud, waste, abuse, and controls.
- IA is developing audit policies and procedures for each division and district based on their assessed risk, as part of its risk-based approach.

PP 7.2: External audits are primarily conducted by Legislative Audit and FHWA.

- Legislative Audit evaluates ArDOT's financial statements annually in compliance with generally accepted government auditing standards. In addition, every 3 years, Legislative Audit conducts the State of Arkansas Single Audit: ArDOT is one of many entities included.
- FHWA uses a risk-based approach to its stewardship and oversight of federal aid projects, which includes approvals and reviews at the project and program level on a quarterly, annual, and as needed basis.
- FHWA has historically conducted more project-level reviews, but this has declined due to changes at the federal level.

GLOSSARY

IA: Internal Audit DFA: Department of Finance and Administration FHWA: Federal Highway Administration