Improving Knowledge and Information Management for Practical Solutions at WSDOT: Executive Summary

**Washington State
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Improving Knowledge and Information Management for Practical Solutions at WSDOT

Executive Summary

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16. Abstract

This document summarizes a series of reports developed for the Washington State Department of Transportation's (WSDOT) Accelerated Innovation Deployment (AID) project, "Deploying Practical Solutions with Lean Techniques and Knowledge Management" (PS AID Project). This report provides an overview of the importance of reliable information supporting practical solutions, understanding knowledge and information needs for practical solutions, insights about moving forward with practical solutions, and recommended activities.

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Improving Knowledge and Information Management for Practical Solutions at WSDOT

Contents

This document summarizes a series of reports developed for the Washington State Department of Transportation's (WSDOT) Accelerated Innovation Deployment (AID) project, "Deploying Practical Solutions with Lean Techniques and Knowledge Management" (PS AID Project) and is organized into the following sections.

1. Importance of Reliable Information Supporting Practical Solutions

Practical Solutions at the Washington State Department of Transportation (WSDOT) is transforming the agency's approach to operating, maintaining and improving the state's transportation system – leading to performance-driven, context-sensitive and optimized solutions that consider the multimodal transportation system as a whole. Figure 1 illustrates the eight stages of the Practical Solutions life cycle at WSDOT.
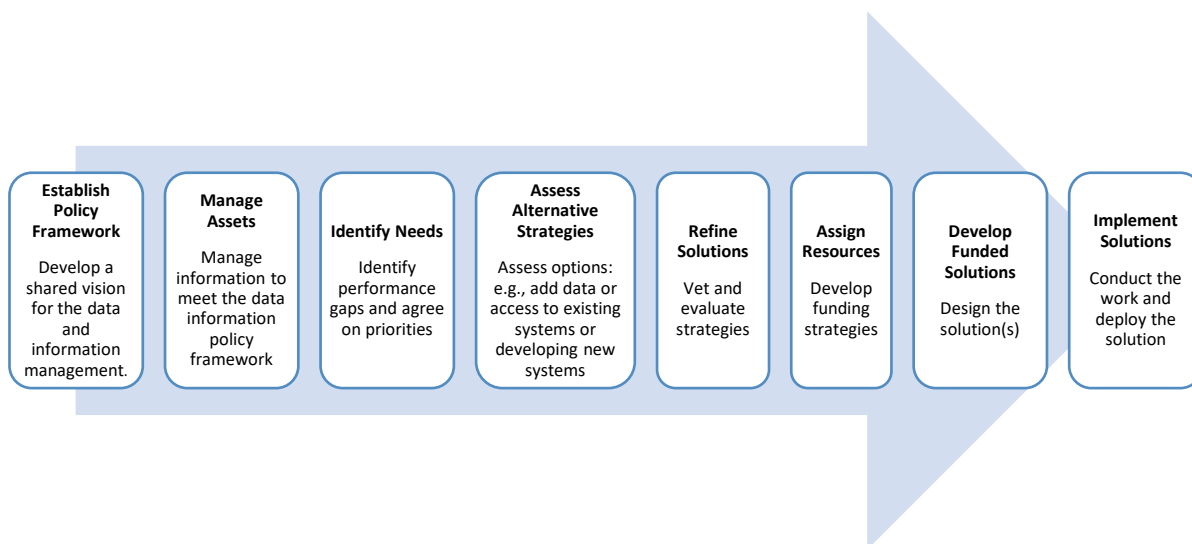

Figure 1. The Practical Solutions Life Cycle at WSDOT

Access to reliable data and information is fundamental to Practical Solutions. It is what allows planners, engineers and analysts to identify performance gaps, analyze alternative strategies, and tailor solutions to the context.

Historically, WSDOT, like many other DOTs, has followed a predominantly decentralized approach to collecting data, transforming this data into information, and creating reports. This approach has allowed each business unit to meet their specific needs, but has resulted in the proliferation of databases, reports, and other information sources that are difficult to link together. A more intentional and coordinated approach to information management would improve efficiency, resulting in improved information at a lower total cost. More importantly, improved information management is essential to WSDOTs continued successful rollout of Practical Solutions. A lack of easily accessible information in the right form introduces delays and costs into each stage of the Practical Solutions life cycle – from identifying needs to monitoring and evaluating the system. Conversely, getting the right information into the right hands at the right time enables the process to work smoothly and effectively and results in well-supported decisions that save the agency money and improve service to customers.

2. Understanding Knowledge and Information Needs for Practical Solutions: Products

Through the project *Deploying Practical Solutions using Lean Techniques and Knowledge Management* (Practical Solutions Accelerated Innovation Deployment or PS AID Project), WSDOT's Knowledge Services unit worked with a consultant team to conduct a high level evaluation of the knowledge, data and information needed to support the Practical Solutions life cycle and current practices to manage these data and information resources.

The project started with a series of meetings and workshops with approximately 100 WSDOT employees to identify types of information used and produced across different stages of the Practical Solutions life cycle. Then, interviews were conducted with representatives from organizations responsible for managing information functions and large repositories. These interviews sought to understand current information management practices in comparison to industry best practices and to identify opportunities to better support WSDOT's deployment of Practical Solutions. WSDOT's current IT applications were also analyzed. In parallel to the investigation of information needs and management practices, the project team looked at learning needs and strategies to foster an environment that facilitates and enables learning to take place.

This work produced a set of interrelated products that provide WSDOT with a foundation for moving forward with a coordinated set of improvements to how the agency gathers, manages and produces information: *Resource Models for Practical Solutions at WSDOT, Enterprise Architecture: An Overview of Practice, Improving Information Management for Practical Solutions at WSDOT, Words Matter: Vocabulary Resources to Support Productivity*, and *Strengthening WSDOT's Learning Culture for Practical Solutions*. Each of these products is described briefly below.

RESOURCE MODELS FOR PRACTICAL SOLUTIONS AT WSDOT

What is it?

This document analyzes each stage of the Practical Solutions life cycle to identify the activities conducted, the knowledge and information needed, and the information produced. It also identifies key roles played by groups internal to WSDOT as well as external organizations that participate in some way. Knowledge sources and products include documents, data sets, applications, and people.

How can we use it?

The resource models can be used in several ways:

- They provide a high level look at current roles and responsibilities which helps us understand the *multidisciplinary engagement needs* of Practical Solutions and can inform efforts to build a *multimodal decision framework*.
- They provide insight into the common information needs across the different stages of the life cycle, which can inform development of a framework for meeting the information needs of individuals participating in each stage of the process.
- They provide a way to look at *handoffs* across the different stages. They help to answer the question: what information produced in one stage is needed within a downstream stage?

To maximize value of this product, WSDOT should establish a regular process to review and refine the resource models. This will ensure that they are kept current as roles and information resources evolve.

ENTERPRISE ARCHITECTURE: AN OVERVIEW OF PRACTICE
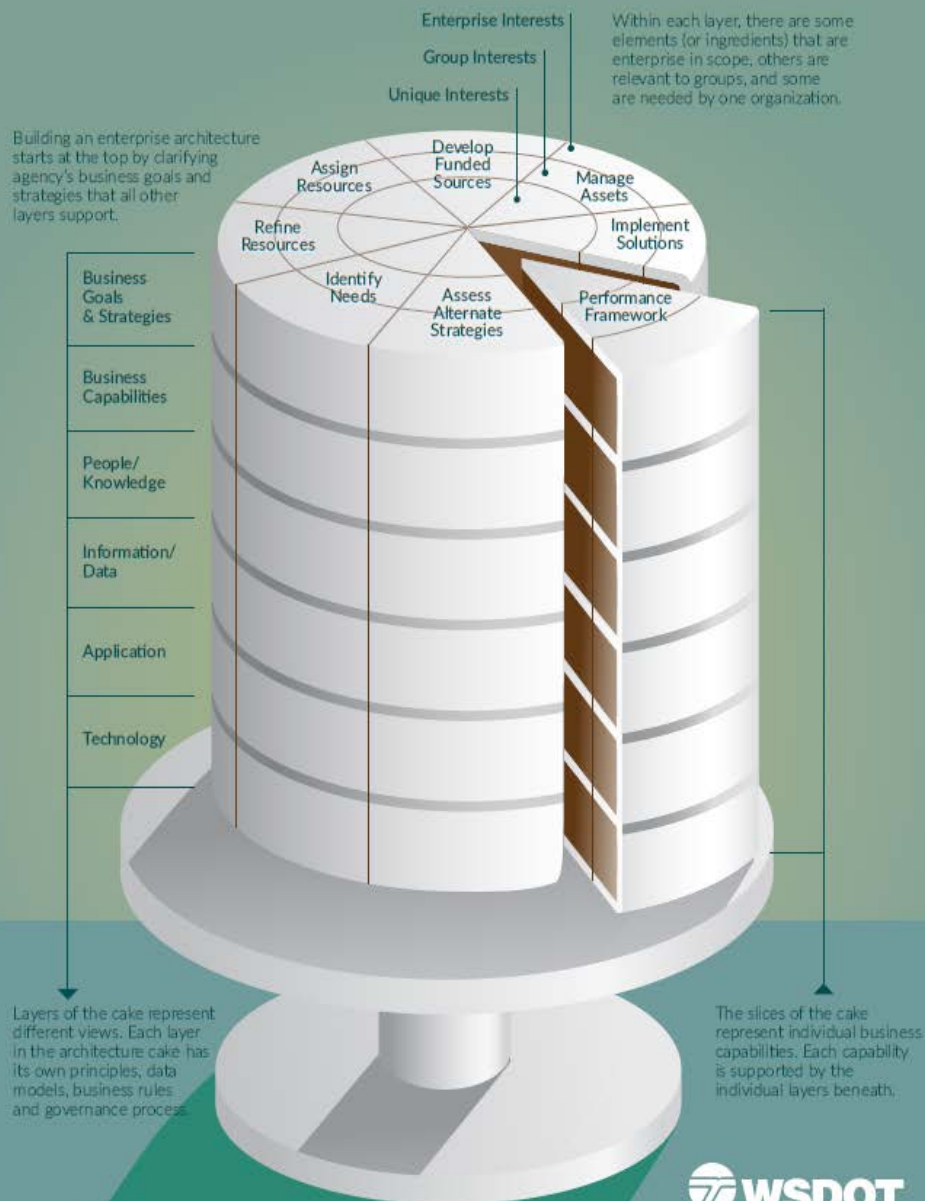
What is it?

This document introduces the practice of enterprise architecture (EA), which has been implemented by many organizations to better align their data, applications, technology and staff with organizational goals and objectives, and improve organizational agility. As illustrated in Figure 2, enterprise architecture is built out in layers that provide different viewpoints (typically including layers for goals and objectives, lines of business, people and knowledge, information and data, applications, and technology). As WSDOT continues to advance the Practical Solutions approach, techniques from enterprise architecture can provide models for defining a desired future state and aligning workforce, data and information, and technology management in support of that future state. Resource Models provide the connective tissue across the different layers of an EA, defining resource needs (e.g. data, information, applications and people/skills) associated with different business capabilities. The top two tiers of a business function classification scheme were drafted based on the information commonly needed to deploy Practical Solutions. A business function classification scheme helps organize essential work of the department to align enterprise resources with business objectives and promotes cross-organizational connections.

How can we use it?

This overview document can be used to explain the concepts underlying EA and support future efforts to adopt EA practices at WSDOT.

ENTERPRISE ARCHITECTURE

There are several authoritative enterprise architecture reference models. A common business-friendly, non-technical perspective of enterprise architecture is the architecture layer cake.

Enterprise Interests

Group Interests

Unique Interests

Within each layer, there are some elements (or ingredients) that are enterprise in scope, others are relevant to groups, and some are needed by one organization.

Building an enterprise architecture starts at the top by clarifying agency's business goals and strategies that all other layers support.

Assign Resources

Develop Funded Sources

Manage Assets

Refine Resources

Implement Solutions

Identify Needs

Assess Alternate Strategies

Performance Framework

Business Goals & Strategies

Business Capabilities

People/ Knowledge

Information/ Data

Application

Technology

Layers of the cake represent different views. Each layer in the architecture cake has its own principles, data models, business rules and governance process.

The slices of the cake represent individual business capabilities. Each capability is supported by the individual layers beneath.

WSDOT

Final 1/22/19

Figure 2. Enterprise Architecture View for WSDOT: The Layer Cake

IMPROVING INFORMATION MANAGEMENT FOR PRACTICAL SOLUTIONS AT WSDOT

What is it?

This document presents objectives and recommendations for improvements to information and data management at WSDOT. Common information needs were identified based on the resource models. The current state of information management was assessed based on structured interviews with WSDOT information managers. These interviews were used to identify gaps in current practice and formulate recommendations for improvement.

How can we use it?

The current state assessment can be used to build awareness of strengths and opportunities for improvement. The recommendations can guide development of specific improvement actions that will provide a stronger foundation for Practical Solutions.

WORDS MATTER: MANAGING VOCABULARY RESOURCES TO SUPPORT PRODUCTIVITY

What is it?

This document examines WSDOT practices for developing, applying, and maintaining metadata, taxonomies, glossaries, and thesauri. These are collectively called vocabulary management for the purposes of this report. These vocabulary resources support search, navigation, and filtering of data and information. Current practices for managing these resources were analyzed for their ability to support multidisciplinary engagement throughout the Practical Solutions life cycle. This information was used to identify strengths and weaknesses and develop recommendations.

How can we use it?

The descriptions of metadata, taxonomies, glossaries and thesauri can help to establish a common understanding of these resources and their value. The recommendations provide a direction for continued work on enhancing vocabulary resources in support of Practical Solutions.

STRENGTHENING WSDOT'S LEARNING CULTURE FOR PRACTICAL SOLUTIONS

What is it?

This document explores the current state of WSDOT's learning culture and identified opportunities to strengthen learning in order to support the continued integration and evolution of practices.

How can we use it?

The recommendations can guide future efforts to build a learning culture at WSDOT that will help the agency adapt to the Practical Solutions approach.

3. Moving Forward with Practical Solutions: Insights

EVOLVING PROCESSES AND ROLES

The Practical Solutions approach increases the expectation for multidisciplinary and multi-organizational engagement and integrated decision-making. The resource models help to articulate the activities required to deploy Practical Solutions and set a baseline for organizational development.

Further work is needed to: update the decision framework and roles and responsibilities as the integrated practices emerge; review and strengthen the products handed off between functional stages; and improve the management of information to increase efficiency, clarify authoritative sources, and facilitate information sharing and collaboration.

COMMON INFORMATION NEEDS

The Practical Solutions approach requires a greater level of collaboration and information sharing across functional areas of the Department than the previous project development approach.

Figure 3 provides a high level summary of the type of data and information needed to support different stages of the Practical Solutions life cycle. Columns of the matrix represent the eight stages of the life cycle. Rows of the matrix represent high level categories of data, information and knowledge that are inputs to these life cycle stages.

Practical Solutions Lifecycle

Knowledge & Information Needs	Establish Policy Framework	Manage Assets	Identify Needs	Assess Alternative Strategies	Refine Solutions	Assign Resources	Develop Funded Solutions	Implement Solutions
System/Service/Asset Inventory	✓	✓	✓		✓		✓	✓
System Condition & Performance	✓	✓	✓	✓	✓	✓	✓	✓
Demand/Utilization/Travel	✓	✓	✓	✓	✓	✓	✓	✓
Stakeholder Concerns & Priorities	✓	✓	✓	✓	✓	✓	✓	✓
Fed & State Laws, Regulations & Policies	✓	✓	✓	✓	✓	✓	✓	✓
Agency Standard Operating Procedures & Standards	✓	✓	✓	✓	✓	✓	✓	✓
Local Policies & Plans	✓		✓		✓			
State & Regional Transportation Plans	✓	✓	✓	✓	✓	✓		
Strategy Costs & Effectiveness		✓	✓	✓			✓	✓
Revenues, Budges & Expenditures	✓	✓			✓	✓	✓	✓
Resource Availability		✓				✓	✓	✓
Solution Development History		✓		✓	✓	✓	✓	✓
Commitments & Agreements		✓		✓	✓	✓	✓	✓
Projects, Programs, Grants			✓	✓	✓	✓	✓	✓

Figure 3. Common Knowledge and Information Needs across Process Steps

Figure 3 illustrates several areas of commonality and overlap in the information needs across the eight Practical Solutions life cycle stages. For example, all the eight stages make use of information on System Condition and Performance; Demand/Utilization/Travel; Stakeholder Concerns and Priorities; and, Laws, Regulations and Policies. Understanding the shared information needs of the business process can be used to guide strategies supporting the objectives and recommendations for improving information management.

Despite the shared interests, WSDOT does not yet have a holistic strategy in place for providing a common pool of information that can meet these common needs in an efficient and effective manner. While several components are in place or under development, more can be done to make sure that data and information development activities are better coordinated and focused – and to reduce the complexity of WSDOT's technology environment.

A COMPLEX INFORMATION ENVIRONMENT

WSDOT maintains over 370 IT applications including those providing information access and analysis capabilities to end users.[1] Roughly 60% (231) support one or more stages of the Practical Solutions life cycle; 40% provide administrative functions that are cross-cutting in nature (e.g. financial, human resources, and information management). Figure 4 shows how the 231 applications supporting the Practical Solutions life cycle are distributed across each of the stages.   Note that many applications support more than one stage and may be counted several times in this distribution.
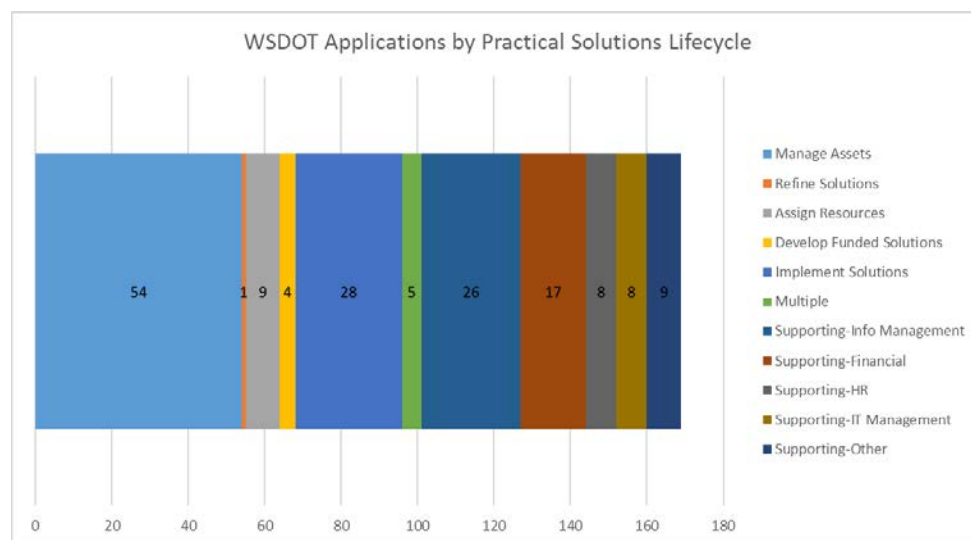

Figure 4. WSDOT Applications by Practical Solutions Life Cycle Stage

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[1] This figure is an estimate based on WSDOT's 2016 application inventory. It excludes internal system utilities and applications slated for retirement.

While the IT applications are highly diversified, much of the content in those systems has value across the life cycle. WSDOT uses a Business Intelligence (BI) environment to facilitate connections between information systems in support of repetitive business needs. The diversified nature of WSDOT's IT applications makes data integration labor intensive. The demand for BI solutions has increased approximately 10% each year for the last seven years and every solution created must be maintained for the life of the business need. The diversified environment also increases the risk of duplicate data collection, questions about authoritative sources, and the potential for decisions to be based on different but related sources.

MATURING INFORMATION MANAGEMENT PRACTICES

WSDOT's data and information resources are typically developed and managed by business units and stored in repositories that generally meet the needs of these individual business units. Some enterprise-wide tools and services are available to meet common needs across business units, such as the Data Warehouse, the GIS Workbench, and the Highway Activity Tracking System (HATS) maintenance management system. However, the following types of challenges persist:

- The lack of common standards and formats across repositories prevents an integrated view of information across the Department.
- Inconsistent use of terminology complicates communication and collaboration.
- Lack of proactive coordination on information needs across different stages of the Practical Solutions life cycle means that available data is not suitable to meet the analysis requirements of downstream users.
- Documentation of decisions made at one stage of the Practical Solutions life cycle are not accessible for downstream processes.
- Feedback loops haven't been established to support continual improvement of processes and decision frameworks.
- Dispersed responsibilities for information collection results in duplication when similar information is collected for different functions.
- Dispersed responsibilities for information management creates a lack of general awareness of what information exists within the Department. In addition, it means that some employees have trouble finding and accessing data and information they need when managed by another office.
- It can be difficult to determine authoritative sources when similar information exists in multiple files or locations.
- Tools for collaboration (such as file sharing and interactive sites), internally and with external partners, are inconsistent with the need for work with both internal and external partners.

VOCABULARY MANAGEMENT

WSDOT currently manages vocabulary resources to support individual business needs. Some resources are applied more broadly, and in general, the standards of practice are applied inconsistently. This adds complexity to search and navigation of information resources across lines of business at WSDOT. Managing vocabulary resources more holistically would improve the findability and interconnectivity of data and information resources.

LEARNING CULTURE

The Practical Solutions approach will continue to evolve, and employee and stakeholder input is essential to identify needs for improvement and feasible solutions. WSDOT has a rich history of innovation but there is considerable opportunity for improvement. Key findings from the review identified four elements to strengthen a learning culture:

- Development of a shared vision and strategy for learning to clearly articulate the future direction and guide learning priorities.

- Strengthening the leadership commitment to learning and change management from espoused values to lived values.

- Providing opportunities for learning through activities such as scheduling time to reflect and capture lessons learned.

- Adoption of methods and tools supporting learning such as building skills and experience for facilitation and coaching to help people learn how to talk about failed activities in a productive way.

4. Recommendations

The results of the PS AID Project suggest a path forward for aligning WSDOT's data and information resources with the Practical Solutions approach. The following recommendations came out of the work products discussed above.

RESOURCE MODEL RECOMMENDATIONS

The resource model provided a high level look at the organizational structure to support deployment of Practical Solutions. The emphasis on collaboration and integrated decision-making has disrupted established patterns. Recommended actions are to:

- Update the decision framework for multimodal, multi-organizational decisions and the roles and responsibilities to support that framework;
- Take steps to strengthen the handoffs between functional stages; and
- Consider conducting a capability assessment within functional areas to help identify and prioritize organizational development needs.

INFORMATION MANAGEMENT RECOMMENDATIONS

There is room for improvement in WSDOT's approach to enterprise data and information management. Improvements to efficiencies in information collection, access, and compilation – and building confidence in existing information resources – will help WSDOT to maximize use of its limited budget and staff capacity. Given continued evolution of the Practical Solutions approach (and continued developments in technology), more agility on the part of WSDOTs information management functions will be required.

Four objectives were identified to guide future improvements:

1. Build and Maintain a Common Pool of Information

WSDOT employees need access to a common pool of authoritative information resources from a variety of internal and external sources supporting:

- Understanding of agency policy and guidance;
- Understanding of transportation system context, performance and needs;
- Understanding of available solutions and their likely costs and effectiveness; and
- Engagement and collaboration.

Recommendations to achieve this objective include clearly articulating information needs, documenting existing shared information assets and identifying gaps, and enhancing enterprise information access tools.

2. Maximize Use of Available Information Resources

WSDOT needs to stretch its available budget and staff resources by maximizing use of available information. Each data set that is collected; each report that is compiled; each map that is created represents an investment in staff time. This investment should be maximized by making sure that information created can be found and re-used.

Achieving this objective requires three strategies: (1) leveraging information produced by one business function for use in other business functions, (2) ensuring confidence and trust in available information resources, and (3) improving discovery of and access to relevant information.

Specific recommendations include strengthening version management and records management, continuing to implement processes for documenting and passing along information across the transportation development life cycle, establishing an enterprise architecture lead at WSDOT, and establishing a common business glossary of terms.

3. Provide the Agility Needed to Respond to a Changing Environment

Information needs, sources and solutions are continually changing. It is more important than ever to shift away from addressing information management needs through separate, single purpose systems that are not easy to adapt to new needs and require specialized IT staff resources to maintain. WSDOT currently has over 370 distinct applications (excluding those that are not managed by IT) and over 60 engineering publications that support the Practical Solutions life cycle.

Recommendations to achieve this objective include identifying opportunities to consolidate content and applications, creating self-service information and analysis solutions, pursuing hosted and other software-as-a-service solutions as appropriate, and addressing training needs. These activities will require an enterprise perspective and an organizational commitment to working across divisions.

4. Facilitate Collaboration and Learning

The Practical Solutions approach has been defined at a high level, and business processes are evolving. Fully realizing the vision for Practical Solutions will necessarily involve considerable collaboration and learning as people continue translating principles and concepts into practice. It will be important for successful practices and lessons learned to be disseminated to ensure a process of continual improvement. Learning Culture recommendations address this point (see below).

VOCABULARY MANAGEMENT RECOMMENDATIONS

WSDOT has made significant progress in clarifying vocabulary management needs and strategies for improving search and navigation of information and data resources. The report provides recommendations to strengthen practices in support of Practical Solutions and employee productivity. Recommendations for implementation include:

- Endorsing the role of the Vocabulary Team to support and manage term governance;
- Publishing the metadata framework;
- Developing strategies to integrate metadata management;
- Developing and implementing strategies for taxonomy development and integration;
- Publishing the WSDOT glossary; and
- Managing improvements, and development and management of a WSDOT Thesaurus.

Implementing these strategies will improve the ability to search and navigate information resources and therefore optimize the use of the agency's information and data investments.

Several of the recommendations are being applied in a pilot project to modernize engineering manual management. The project will test the ability to search across the content of several manuals.

ENTERPRISE ARCHITECTURE RECOMMENDATIONS

Establishing an enterprise architecture and enterprise information architecture would help align workforce and knowledge needs, information and data, applications and technology with organizational objectives and business practices.

Recommendations are to:

- Establish an Enterprise Architecture lead at WSDOT (also included under the Information Management recommendations);
- Vet and finalize the top tiers of the draft business function classification for Practical Solutions, and
- Develop an implementation strategy to build out additional tiers.

LEARNING CULTURE RECOMMENDATIONS

Based on the identified learning needs associated with WSDOT's implementation of Practical Solutions and the issues and suggestions raised through this review, five strategies and actions are recommended to strengthen WSDOT's learning culture.

Strategy 1: Develop and disseminate a clear message about the agency's vision and expectations – "how exactly do we expect people to act?"

Recommendations to implement this strategy include producing easily digestible message about expectations for managers and employees, identifying and addressing areas where the vision and expectations may be threatening or difficult for some employees to embrace, and developing a dissemination plan to ensure broad understanding of the messages.

Strategy 2: Align the management team – "demonstrate that we mean it"

Recommendations to implement this strategy include establishing a single point of accountability to help agency managers "walk the walk" of expected behaviors, devoting time at meetings to identify issues

and specific improvement actions, facilitating honest feedback on challenges and barriers to change, providing leadership coaching services to teach and reinforce desired ways of working.

Strategy 3: Establish ongoing monitoring and communication – "make sure we are making progress"

Recommendations to implement this strategy include identifying and gaining agreement on tangible measures of progress, integrating measurement of progress into periodic employee surveys and proactively address areas of concern, reviewing the current employee performance review processes to determine how to strengthen management and leadership competency development and evaluation/follow-up on progress, and establishing regular updates for employees about activities being pursued to address identified issues and suggestions.

Strategy 4: Establish a clear learning cycle for practical solutions – "provide opportunities for learning"

Recommendations to implement this strategy include designating a Practical Solutions Community of Practice (CoP), charged with identifying, disseminating and applying lessons learned; developing a charter for the CoP that includes support for a cycle involving identification of lessons and successful practices, vetting and validation, dissemination and feedback; establishing a set of focus areas representing high leverage points for progress – for example, interactive scoping, community engagement, and identification of alternative strategies; designating a coordinator for the CoP (from the Practical Solutions Core Team) to set up meetings and manage agendas; and identifying an initial project for the CoP and designate a CoP member as the business lead.

Strategy 5: Create and maintain practical solutions learning resources – "provide resources for learning"

Recommendations to implement this strategy include developing a single "home base" for Practical Solutions learning resources, with links to resources; piloting a moderated online discussion forum for Practical Solutions; and piloting an online Expertise Directory supporting Practical Solutions.

5. Conclusion

The Practical Solutions approach is increasing the need for engagement across business areas and with external communities. While WSDOT has developed robust information resources to meet the needs of specific business areas, the current structure of independent business data and information resources was not developed to support the data integration and collaboration needed today. In addition, there is a need for further work to enhance our capacity for learning and innovation through supporting a learning culture.

Activities underway to strengthen multidisciplinary, multimodal, multi-organizational, and inclusive outreach practices are highlighting the need for better findability and management of shared information resources. The information gathered from participants in the Practical Solutions AID Project sends a clear message that data and information resources are out of alignment with today's business needs. This executive summary provides a high level review of the needs and recommendations to address them.

Like Washington's multimodal transportation system, data and information management is multifaceted and requires multidisciplinary, multi-organizational (internal and external), and inclusive outreach to develop useful, affordable, and sustainable resources. Fundamentally, the recommendations provided in this report support use of industry practices for information management and a life cycle approach

for the management and improvement of agency information resources. Working together, we can address data and information management requirements and more rapidly address priority performance gaps in our data and information resources.