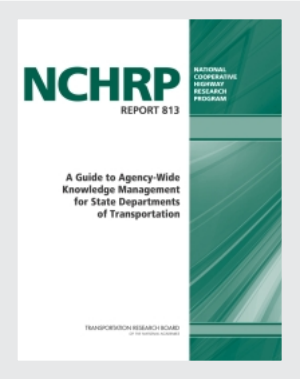

A Guide to Agency-Wide Knowledge Management for State Departments of Transportation

DETAILS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP REPORT 813

A Guide to Agency-Wide Knowledge Management for State Departments of Transportation

Spy Pond Partners, LLC
Arlington, MA

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TRANSPORTATION RESEARCH BOARD

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2015
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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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FOREWORD

By Andrew C. Lemer
Staff Officer
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NCHRP Report 813: A Guide to Agency-Wide Knowledge Management for State Departments of Transportation presents guidance for state transportation agencies on adopting an explicit knowledge management (KM) strategy and the ways that organizations have successfully implemented such strategies. KM is an umbrella term for a variety of techniques for preserving and enhancing the knowledge of an organization's employees and effectively employing that knowledge as a productive asset. The goal of KM is to enhance organizational effectiveness and efficiency by facilitating mobilization and productive employment of this knowledge. This guide is designed to be a starting point for agencies interested in implementing KM, and will be helpful particularly to senior- and mid-level management staff responsible for the agency's strategic direction as well as others seeking to put KM into practice.

The knowledge that any organization possesses is a valuable asset to be applied in pursuit of the organization's mission. That knowledge resides with the organization's staff and in myriad files, manuals, databases, and other forms distributed throughout the organization, which staff members may use. State departments of transportation (DOTs) rely on this knowledge to pursue their missions: the management of the complex systems of facilities and services that support our nation's economy and quality of life.

DOTs face many challenges in effectively maintaining and applying their knowledge assets. For example, employees depart through retirements, downsizing, and reorganization; and physical and electronic information resources become inaccessible or underutilized because of technology change or loss of staff. Failures to take advantage of experience reduce organizational productivity. The changing character of the workforce is requiring changes in techniques for knowledge capture and transfer. In addition, the evolving mission of the DOT raises needs for new knowledge.

KM comprises the set of principles and practices an organization can use to identify, capture, organize, preserve, disseminate, share, and apply critical knowledge in pursuit of the organization's strategic mission. Effective KM helps ensure that people have the knowledge they need to do their work and make good decisions, that they have the knowledge when they need it, and that they understand why and how this knowledge can be useful. KM practices and tools help an organization avoid knowledge loss; promote knowledge capture, preservation, and sharing; and facilitate access to useful knowledge and its application. These practices and tools have been developed and adopted by a range of private- and public-sector organizations, but currently are not widely used by DOTs.

The objective of *NCHRP Project 20-98: A Guide to Agency-Wide Knowledge Management for State Departments of Transportation* was to develop a guide to the fundamentals of agency-wide KM for state DOTs. This guide presents (a) the meaning of agency-wide KM

and motivations for its application within a state DOT context; (b) typical KM strategies and processes for developing an agency-specific strategy; (c) steps in developing an agency-wide KM plan and the roles of state DOT leadership and staff in the plan development and execution; (d) performance measures and procedures for assessing KM effectiveness; and (e) the key factors underlying successful agency-wide KM. The guide is meant to inform state DOT leadership and staff on the benefits of KM and assist them in applying and sustaining KM in their agencies. This guide is intended to be an introduction to the subject; additional NCHRP-sponsored research work will supplement this guide.

This initial research was conducted by a team led by Spy Pond Partners, LLC, of Arlington, MA. The research team conducted a critical review of literature and KM practices in a variety of public- and private-sector organizations. This review was informed by a survey of leading practices conducted under NCHRP Project 20-68A: U.S. Domestic Scan Program. Users of this guide may find the report of that survey to be a useful supplement to this guidance material; the report is available for download from the NCHRP web site at http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_12-04.pdf.

From examples such as those documented in the scan report and described elsewhere, the research team developed a framework for assessing how KM can be useful to an agency and for crafting a strategy for implementing and monitoring KM practices. The step-by-step process for applying the framework is illustrated with examples from agencies that have adopted KM to support such tasks as management succession planning, talent management, building communities of practice, and retaining institutional knowledge. A glossary of terms and references to readily available supplemental materials are included to make the guide immediately useful to agency staff at all levels. The guide is supplemented by a slide presentation that may be useful for introducing KM principles and guide agency staff; the presentation is available online at www.trb.org by searching for "NCHRP Report 813."

Contents

Acronyms

AAR – After Action Review

AIIM – Association for Information and Image Management

Alaska DOT & PF – Alaska Department of Transportation and Public Facilities

Caltrans – California Department of Transportation

CKO – Chief Knowledge Officer

CoP – Community of Practice

DOT – Department of Transportation

FTA – Federal Transit Administration

FTE – Full Time Equivalent

GDOT – Georgia Department of Transportation

HR – Human Resources

IM – Information Management

IRMT – International Records Management Trust

ISO – International Standards Organization

IT – Information Technology

KM – Knowledge Management

KPI – Key Performance Indicator

LL – Lessons Learned

MASK – Method of Analyzing and Structuring Knowledge

NASA – National Aeronautics and Space Administration

OSHA – Occupational Safety and Health Administration

ROI – Return on Investment

SAA – Society of American Archivists

SME – Subject Matter Expert

TRAC – Transportation Center

TRB – Transportation Research Board

TVA – Tennessee Valley Authority

USAID – United States Agency for International Development

USDOT – United States Department of Transportation

VDOT – Virginia Department of Transportation

WisDOT – Wisconsin Department of Transportation

Summary

Why DOTs Need Knowledge Management

What Is Knowledge Management?

"Knowledge Management" (KM) is an umbrella term for a variety of techniques for building, leveraging and sustaining the know-how and experience of an organization's employees. The goal of KM is to make the organization act in an intelligent manner. KM emerged as a recognized discipline in the 1980s, and is now a well-established field with documented successes in both the private and public sectors. Fundamental to KM is the recognition that the intellectual capital (or collective knowledge) of an organization is an essential asset that should be recognized and managed to ensure organizational efficiency and effectiveness.

KM has been embraced by a diverse group of organizations, including the National Aeronautics and Space Administration (NASA), the World Bank, State Farm Insurance and Kraft Foods, to name a few. KM programs or initiatives are also in place at several USDOT administrations (Highways, Transit and Aviation) and state Departments of Transportation (DOTs) including Caltrans, Georgia DOT, Virginia DOT, and Wisconsin DOT. Private companies use KM to build competitive advantage over other companies; public-sector organizations use KM to manage risk, improve operational effectiveness, and make maximum use of employee talents.

Knowledge: A Limiting Factor for DOTs

Knowledge – the ability of staff to take effective action and make good decisions – is becoming a key limiting factor in a DOT's ability to make progress and adapt to changing requirements.

DOT CEO Perspectives on KM

"As the CEO of a DOT you wake up one day and realize that every hand you shake is connected to a head full of knowledge.

Knowledge management collects, shares and puts that knowledge to work over and over again across the entire agency—saving money, saving time, delivering quality projects, and reducing risk."

– former CEO of the Virginia Department of Transportation

"We are not just Departments of Transportation. We are knowledge organizations that specialize in transportation."

–Director, Arizona Department of Transportation

Why Should DOTs Be Interested in KM?

State DOTs rely on the skills and experience of their workforces to plan, fund, design, construct and maintain multi-modal transportation systems. Knowledge about what to do, when and how to do it, AND what not to do is critical to success – and much of this knowledge resides only in the heads of employees, especially the most experienced employees.

Maintaining a strong knowledge base agency-wide is not easy: "baby boomers" are retiring and taking knowledge with them; mid-career employees at the peak of their productivity are looking to leave for higher salaries, and the millennial generation has less interest in learning from and staying with one agency than did their parents' generation. Without a conscious strategy for replacing critical employees, building bench strength (possible successors for a given position), getting new staff up to speed and growing expertise and experience in the right areas, DOTs face a steady decline in their resilience – and an increased risk of poor performance and public criticism.

There is no such thing as a "corporate brain" in a DOT, but there is such a thing as a corporate brain trust. When a DOT faces an emergency situation, it is primarily the agency's people and their ability to act that make the difference between public appreciation for a job well done and an embarrassing disaster. Success depends less on the DOT's physical assets than it does on employees' knowledge and how they are able to apply this knowledge in a given situation.

The DOT landscape is changing – dollars for transportation are declining yet public expectations for service remain very high. Knowledge and performance are inextricably linked. And a strong knowledge base for DOTs is too precious a resource to leave to chance. KM offers an effective set of strategies not only to maintain the knowledge required to meet today's needs, but also to expand agency knowledge resources in order to meet tomorrow's new challenges.

What Is the Payoff from KM?

In the current environment of declining revenues and shrinking workforces, where every agency is challenged to "do more with less," DOTs need new approaches for operating in a more streamlined manner. KM is an important piece of the puzzle for agency executives seeking to shore up their organization's capabilities

to deliver projects and services more effectively and efficiently, on time and within budget. KM practices can:

- Provide opportunities for experienced employees to get newer employees up to speed, increasing productivity and reducing the need to "reinvent the wheel."
- Minimize impacts of workforce transitions - if not carefully managed, these transitions can result in loss of important institutional knowledge, which increases risks of ill-informed decisions and repeated mistakes.
- Ensure that DOTs can retain and build essential expertise "in-house" as they make increased use of outsourcing and public-private partnerships for delivery of projects and services.

Increasingly, DOTs operate in a fishbowl. Inefficiency or poor decisions on the part of inexperienced staff leave the agency open to a loss of public confidence. In this environment, the importance of the knowledge possessed by each and every employee is magnified. Proactive steps to strengthen and leverage available employee expertise are more important than ever.

Using KM to Reduce Risk

As DOTs cut costs and downsize workforces, this often leads to a loss of expertise and experience in key functions. The erosion of staff capabilities can take its toll on organizational effectiveness and the track record of the chief executive.

KM in Practice

What Does It Mean to Implement KM?

KM includes a range of simple and relatively low cost actions that DOT executives can consider to reduce risks, leverage available opportunities for innovation, and ensure that what employees have learned in the course of their careers is shared with newer employees and contemporaries in other organizational units. Techniques include:

- Workforce planning to identify and close gaps between needed skills and existing capabilities;
- Communities of practice that enable less experienced employees to learn from their peers;
- Expertise directories that employees can use to identify who to contact if they have a question;
- Capture of specialized knowledge from employees before they leave the organization;
- Project management methodologies that ensure project teams learn from prior experience and document lessons learned for future efforts; and

- ☐ Use of information management methods to ensure that employees can quickly find the information they need to be effective.

Aren't We Already Doing KM?

It can be argued that many organizations – including DOTs – are already managing knowledge to some extent: through employee training, mentoring, team meetings, business process documentation, updates to manuals, etc. Nevertheless, such activities are often carried out by individual organizational units with a narrowly defined perspective. The effectiveness of these activities can be greatly enhanced through a more strategic, agency-wide and organized approach to KM – drawing upon the rich base of KM experience from both public- and private-sector organizations.

How Do We Get Started?

There are many practical steps that can be taken to ensure that existing employee know-how is well-utilized and to grow the agency's knowledge base to meet anticipated future needs.

Key activities include: (1) Assessing the organization's strengths, weaknesses and vulnerabilities with respect to knowledge for critical business functions; (2) developing a strategy that involves people, process and information management/technology elements for leveraging existing expertise and mitigating anticipated knowledge losses; (3) implementing a set of KM techniques; and (4) tracking results and adjusting techniques as needed, while allowing room for flexibility and experimentation.

Aligning KM activities with the agency's established objectives and strategic initiatives provides DOT leaders with an opportunity to ramp up support for what they are trying to achieve within their limited tenures. KM techniques can be focused in priority areas (e.g. safety, asset management, or innovative finance) to get some easy short term wins, while creating a sustainable longer-term foundation. Agencies can start small with a pilot effort, track costs and results and expand as appropriate based on the payoff they are seeing.

Key KM Activities

Purpose of the Guide

This Guide was developed because KM offers promising solutions to DOT challenges, yet relatively few DOTs have implemented agency-wide approaches to KM.

The Guide is intended to help DOT leaders examine the business case for undertaking or strengthening KM in their agencies. It introduces a variety of KM tools and techniques that a DOT could apply and provides a roadmap for DOTs wishing to experiment or get started with implementing an agency-wide approach to KM. Finally, it provides links to resources that agencies can use to develop and strengthen their KM activities over time.

Throughout the Guide, key points and quick tips are highlighted with this light bulb symbol.

Using this Guide

The Guide can be used to get an overview of:

- The fundamentals of KM,
- How KM can be applied at a DOT, and
- How to track KM results.

Roadmap to the Guide

While this Guide can be read cover to cover, the roadmap shown to the right can be used to navigate directly to sections of particular interest. The Guide is organized into three sections:

- **Understanding KM** provides an overview of KM, its relevance for transportation agencies and its key elements.
- **Implementing KM** describes a four-step process for moving forward with an agency-wide approach to KM.
- **Learning from Experience** provides a set of resources that agencies can use to get ideas and examples for KM implementation.

Understanding KM

"Those who cannot remember the past are condemned to repeat it."

– George Santayana

Talking about KM

What Is Knowledge?

The words "knowledge" and "information" are often used interchangeably, but they are not the same. In this Guide, the term "knowledge" is used to refer to what exists inside the human brain – as opposed to "information," which can be represented on paper, independent of any person. Knowledge is built over time through education, work experience, and interactions. It enables people to make good decisions and act in an effective manner.

In any organization, there are veteran employees that are the source of institutional knowledge – accumulated through years of experience. Sometimes this institutional knowledge is not helpful and inhibits positive change – as in "we've always done it this way." However, much of this knowledge is very valuable. If properly tapped, it can help the organization to avoid repeating past mistakes and improve on past performance. Once employees leave, this knowledge may be lost forever.

How Do You Manage Knowledge?

"Knowledge Management" is an umbrella term for a variety of techniques for building, leveraging and sustaining the know-how and experience of an organization's employees and partners to carry out its mission in an intelligent manner.

Information

Data and documents that have been given value through analysis, interpretation or compilation in a meaningful form.

Example: A map showing high crash locations.

Knowledge

The basis for a person's ability to take effective action or make an effective decision.

Example: A safety professional's understanding of what countermeasures would be appropriate in different situations.

Preserving Knowledge

"Most of the engineers who were part of the design teams planning, designing and building the highways in Maine from the 1950s through the 1970s have retired. Moreover, that was the 'golden years' for highway construction in Maine when most of its limited-access highways were built. The knowledge of how the planning, design and construction of those highways occurred is starting to wane."

"The objective of this project was to have influential engineers from the 'golden years' of road construction give seminars where they presented highlights from their careers and to document how large projects in the state of Maine were done and what can be learned from this for future large projects."

Source: *Institutional Memories of Road Design*

See reference [11]

Building knowledge requires providing opportunities for employees to learn from their peers – both within and outside of the organization.

Leveraging knowledge requires making sure that individuals and project teams are learning from prior experience and are not re-inventing the wheel.

Sustaining knowledge requires retaining critical capabilities and institutional memory as employees retire or transition to other jobs-either within or outside of the organization.

Fundamental activities of KM are knowledge capture and knowledge transfer. Both of these are needed in order to build, leverage and sustain an organization's institutional knowledge.

- **Knowledge Capture.** A technical expert can be interviewed and asked to summarize important lessons and techniques they have learned. These lessons and techniques can be recorded and made available to others. This is called "knowledge capture" – and, in effect, results in transforming human knowledge into codified information.
- **Knowledge Transfer.** A seasoned project manager can be asked to mentor or collaborate with others as they tackle a task or project. This allows for "knowledge transfer" – person-to-person.

Different Types of Knowledge

There are different types of knowledge and each type may require different approaches to capture and transfer:

- **Descriptive knowledge** concerns the "what" – e.g., what projects similar to this have been done over the past five years?
- **Causal knowledge** concerns the "why" – e.g., why was this pavement mix type selected?
- **Procedural knowledge** is concerned with the "how" – e.g., what are the options for procuring services of a particular type?
- **Social knowledge** is concerned with "who" – e.g., who is the best person to talk to about how to handle a particular customer concern?

Knowledge and Information Management

Knowledge management and information management are interrelated and have overlapping activities:

- **Information management** is the means by which an organization collects, stores and provides access to information.

- **KM** can rely on information management practices to ensure access to digital and paper content, but it emphasizes activities related to employee networking, collaboration, learning and knowledge application that fall outside of the realm of information management.

To understand how information and KM are interrelated, it is helpful to look at the information and knowledge life cycle illustrated in Figure 1. This cycle highlights the touch points between knowledge and information management.

Key activities in the information life cycle are:

- Information is created or acquired – for example, a new procedure document is drafted.
- Information is documented and classified – the new procedure is assigned keywords, and a brief description of it is added.
- Information is stored or archived for active use or long-term preservation – the procedure is posted on the agency website.
- Information is periodically culled to identify what should be saved and what is no longer needed, subject to applicable records retention schedules – older versions of procedures are discarded to avoid confusion.
- Information is discovered and accessed through search engines, web pages or library catalogs.

Key activities in the knowledge life cycle are:

- Employees build knowledge through a learning process – informed by content that they discover and access and/or through collaboration or mentoring relationships with their peers.
- Employees use and apply their knowledge in the course of carrying out their jobs.
- Periodically, employee knowledge is captured and codified for use by others. This capture process may yield information in multiple forms – e.g., procedural documents, training materials, lessons learned descriptions, blog posts or taped interviews. This captured knowledge becomes an input to the information cycle.

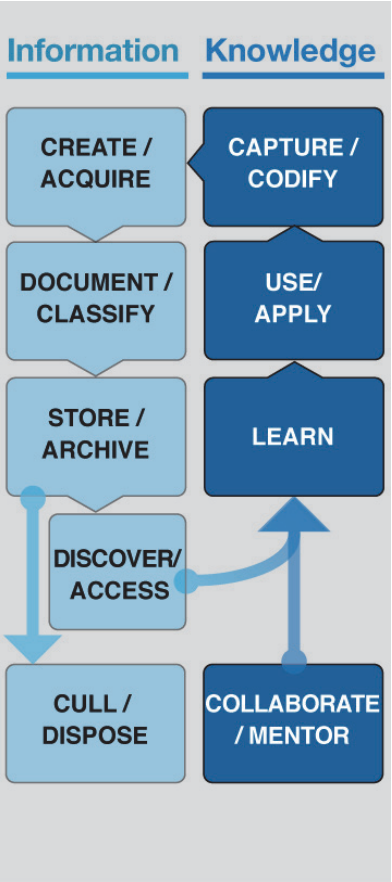


Figure 1. The Information and Knowledge Life Cycle

Information management and KM are synergistic – coordinating activities in these areas is a successful strategy.

KM for Transportation Agencies

The Business Case for KM at a DOT

DOTs are simultaneously facing changes in their missions, project and service delivery methods, customer expectations, revenue streams and workforce demographics. These changes are creating both challenges and opportunities. Effective DOT leaders recognize that "business as usual" is not an option. They understand the need to retool their organizations to be more adaptable and resilient. An agency-wide approach to KM can help DOTs make the necessary changes in workforce capabilities and culture to achieve this resilience. DOTs can use KM to foster innovation, improve delivery of transport-ation projects and leverage increasingly limited resources (Figure 2).

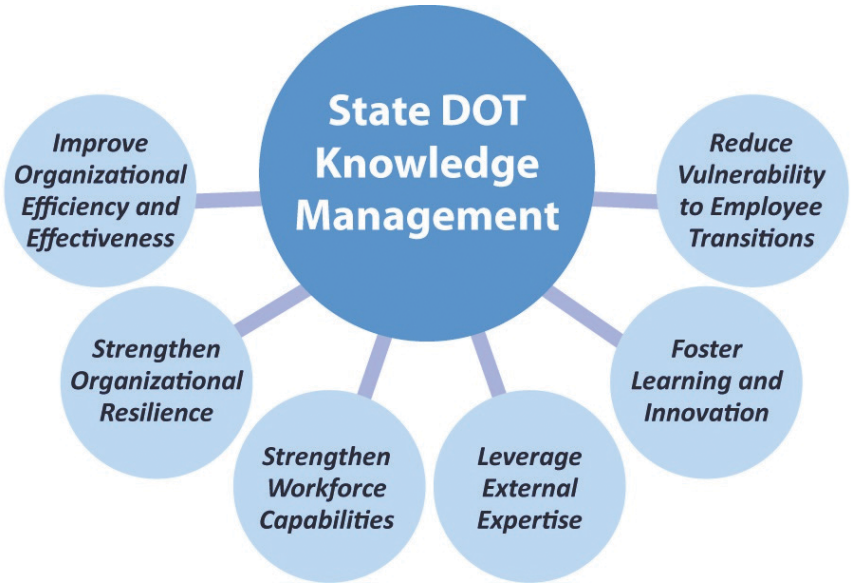


Figure 2. Business Case for KM at a DOT

Improving Organizational Efficiency and Effectiveness. DOTs are facing increased competition for available funding, shrinking revenues and growing public expectations for accountability about what tax dollars are buying. In this context, agencies are under pressure to increase efficiencies and strengthen performance measurement and management capabilities. Agencies have a compelling incentive to identify stronger and weaker performers within the organization and bring all work units up to a higher level of performance.

Workforce Knowledge Loss

"With slightly less than half of the workforce with 10 years or less department experience, the number of employees who possess the seasoned expertise and process 'wisdom' is in short supply."

– Texas DOT Strategic Plan 2013-2016

Strengthening Organizational Resilience. When there is an emergency situation or a critical need to be met with little or no tolerance for error, most DOT managers will put their "A Team" on it. The "A Team" understands what is needed, and has the experience and skills to get to the finish line and handle any curve balls thrown along the way. DOTs, like most organizations, have a limited number of "A Team" members. And many agencies are facing a "brain drain" with the loss of their most experienced staff from the baby boomer generation. Knowledge – the ability of staff to take effective action and make good decisions – is often in short supply. Without a solid strategy for replacing critical employees, building bench strength, getting new staff up to speed and growing expertise and experience in the right areas, DOTs face a steady decline in their resilience – and an increase in their risk exposure.

Strengthening Workforce Capabilities. One important success factor for all DOTs is having a strong and capable workforce that is aligned with the agency's mission and public expectations. As the role of the DOT shifts from construction to more of a focus on operations and maintenance, DOTs need to reassess the types of skills, capabilities and experience that are needed. KM techniques can leverage existing workforce planning capabilities and bring a rich understanding of the organization's strengths and vulnerabilities, considering anticipated retirements and changing demographics. KM strategies are also available to foster culture change – to reduce information hoarding, build more effective teamwork, and reward employees that share their knowledge with others for the benefit of the organization.

Leveraging External Expertise. Constraints on hiring mean that DOTs rely on outside contractors for a wide range of services. With increased use of outsourcing and public-private partnerships, DOTs must consider how best to leverage external capabilities of partners, while providing opportunities for knowledge transfer from contractors back to agency staff.

Fostering Learning and Innovation. Knowledge is becoming a key limiting factor in a DOT's ability to make progress and adapt to changing requirements. As the need for innovation in areas such as performance management, traffic operations and project delivery/finance increases, DOTs need to make sure that they tap into and share the latest available knowledge about requirements, techniques and lessons learned. Rapid advances in technology have created opportunities for DOTs to deliver improved services at a lower cost. There are additional opportunities for gaining efficiencies through creative use of contract resources for project delivery,

Organizational Resilience

"Organizational resilience is anchored in organizational processes aimed at enhancing an organization's overall competence and growth (especially the ability to learn and to learn from mistakes) … quickly process feedback and flexibly rearrange or transfer knowledge and resources to deal with situations as they arise."

– Sutcliffe & Vogus (2003) *Organizing for Resilience*. See reference [26]

maintenance and operations. In order to take advantage of these opportunities, DOTs must have the ability to change established ways of operating. Innovation requires a boost to the level and speed of communication, learning and knowledge transfer within the agency.

Reducing Vulnerability to Employee Transitions. DOTs have been facing workforce challenges over the past decade, related to the large wave of baby boomer generation retirements. Workforce issues are still an important concern today. KM practices can help DOTs to proactively manage workforce transitions as senior employees retire and mid-level employees move on to other opportunities. KM can also be used to minimize the consequences of losing an employee with mission-critical knowledge such as a veteran chief financial officer or chief engineer.

How KM Can Help

DOTs can use KM to strengthen capabilities and reduce risks. Establishing a KM lead in the organization can provide a focal point and ensure a strategic approach to these activities.

Consider Intellectual Capital Within DOT Strategic Planning. An agency KM lead can be charged with identifying the gaps between the agency's current skill and experience profile and the profile that will likely be needed over the next 5-10 years. (See Figure 3.)

Use KM to:	Benefits:
Elevate consideration of intellectual capital within DOT strategic planning.	• Better targeting of human resources investments and practices to support strategic objectives of the DOT.
Transition the DOT to meet emerging needs.	• Strengthen critical skill areas – e.g., contract negotiation, operations, technology integration.
Build bench strength.	• Reduce vulnerability to loss of employees in critical areas. • Better leverage available expertise.
Strengthen employee collaboration and information sharing.	• Build on lessons learned – avoid "reinventing the wheel." • Reduce duplication of effort.
Foster innovation.	• Transition from "we've always done it this way" to a more streamlined approach.

Figure 3. KM Benefits

Transition DOT to Meet Emerging Needs. Armed with an understanding of gaps, the KM lead can work in a proactive fashion to identify how to develop and/or acquire the necessary mix of skills and experiences.

Build Bench Strength. KM techniques can be used to establish and support networks for knowledge sharing and mentoring to build expertise and capabilities in critical areas.

Strengthen Collaboration. An agency KM lead can work to improve collaboration and teamwork across the organization, using Communities of Practice (CoPs) and other techniques. They can ensure that lessons learned through projects and initiatives are documented – and that relevant lessons are identified and applied to future practice.

Foster Innovation. An agency KM lead can support the innovation process by facilitating access to the experience of peer agencies, and supporting internal knowledge transfer through CoPs within target domain areas.

Key Elements of Agency-Wide KM

A Holistic, Agency-Wide Approach

This Guide emphasizes an agency-wide approach to KM that is driven by a strategic view, and draws on a wide variety of available KM techniques. An agency-wide approach to KM makes sure that:

- ☐ KM activities are focused on the organization's greatest risks and opportunities;
- ☐ Expected outcomes are clearly defined and tracked; and
- ☐ The most appropriate and effective KM tools and techniques are applied to achieve the desired outcomes.

Some organizations view KM as primarily a staff development or succession planning activity that is within the purview of the Human Resources (HR) unit. For others, KM is synonymous with content management or business intelligence. They view KM as a function of the Information Technology (IT) unit – or perhaps as a library reference desk responsibility. These more narrow views of KM are not incorrect. However, organizations that pigeonhole KM as a single-

A holistic, agency-wide approach to knowledge management ensures that the right combination of techniques is applied to tackle an agency's most pressing needs.

dimensional function within a training or IT unit make two mistakes:
Mistake #1: not taking a strategic view of KM and
Mistake #2: only having a single tool in the KM toolbox.

What Does an Agency-Wide KM Approach Look Like?

An agency-wide approach to KM ideally includes the following four elements:

1. Leadership & Direction. Agency leadership makes the connection between KM and critical business goals. They show clear support for KM, designate a KM lead, articulate what outcomes they expect, and provide resources needed to accomplish these outcomes. They request regular updates on status and achievements.

2. Collaboration & Communities. The organization fosters a culture of collaboration and provides its employees with both online and face-to-face opportunities for knowledge sharing, mentoring and problem solving. Newer employees are able to quickly identify who to talk to when they have questions, and they are encouraged to learn from colleagues.

3. Knowledge Codification & Dissemination. Mission-critical, unique and at-risk knowledge is proactively identified and either documented and made available online, or transferred from person to person as appropriate. Standard operating procedures are put in place to capture lessons learned from completed activities and fully leverage the organization's base of prior experience as new activities are undertaken.

4. Succession & Talent Management. Human Resources and Training functions work together with the management team to identify emerging workforce knowledge gaps and risks. They pursue a coherent and synergistic approach to addressing these gaps and risks through recruiting, employee onboarding (steps to orient new employees and help them adjust to the organization), training, and succession management activities. In addition, information about the skills and training of individual employees is made available to enable the organization to make best possible use of the available talent.

Where Do We Start?

The next section of this Guide takes you through a four-step process for implementing KM. This section can be used to identify specific areas where KM would benefit your organization, develop an initial implementation strategy, identify which specific techniques are suitable, and set up a process for monitoring results.

KM at Virginia DOT (VDOT)

In 2003, VDOT began using proven KM techniques to maximize effective management and delivery of 15 mega-projects, with a total construction value of approximately $7-$8 billion. VDOT reasoned that even small improvements in these projects could have substantial payoffs.

These early KM efforts were well-received by agency staff and gained senior management support. Over 10 years later, VDOT has expanded use of KM agency-wide and has become a national KM leader in the DOT community.

Implementing KM

"If you don't know where you are going, you will end up somewhere else."

– Yogi Berra

Step 1: Assess Risks and Opportunities

The first step in implementing an agency-wide approach to KM is to identify focus areas based on an assessment of agency risks and opportunities.

Purpose of a Knowledge Assessment

- ☐ Identify current areas of vulnerability – e.g., employees of retirement age with valuable and difficult to replace knowledge.
- ☐ Assess your organization's current level of capability and bench strength in key skill areas that will be needed for future achievement of strategic goals – e.g., active traffic management or contract negotiation.
- ☐ Identify opportunities for expanding use of existing techniques for knowledge transfer that are working well in the organization.

Options for Conducting a Knowledge Assessment

A knowledge assessment can be approached with different levels of detail. Some agencies may want to use a thorough approach involving surveys and focus groups to understand how knowledge is currently

Knowledge Assessment Options

- ☐ Quick Litmus Test
- ☐ Senior Leadership Workshop
- ☐ In-depth Knowledge Survey
- ☐ Knowledge Risk Assessment

being captured and shared – and where the specific gaps are. Other agencies may want to begin with a more "lightweight" assessment approach. Guidance for different assessment methods is provided below.

KM Litmus Test. The following "KM Litmus Test" can be taken by senior managers to provide a quick indication of the need for (and likely payoff from) implementing an agency-wide approach to KM in the organization. This won't yield the types of insights that are really needed to identify specific focus areas, but it can provide an initial indication of key risk areas and some motivation for moving forward.

A knowledge assessment provides an opportunity to understand current strengths, risks and weaknesses. The results should be used to shape the KM strategy and set priorities for what to do first.

The KM Litmus Test for DOTs

Please check which of the following apply:

- ☐ More than 20 percent of our most senior managers will be eligible to retire in the next 5 years.
- ☐ Many knowledgeable mid-career employees are likely to leave the organization over the next few years to pursue other opportunities.
- ☐ We haven't identified specific skill or knowledge areas important to our organization.
- ☐ We don't track how many employees we have with critical skills or experience levels.
- ☐ We don't generally maintain up to date documentation of our core business processes and procedures.
- ☐ We don't have standard ways of debriefing employees, contractors and consultants before they leave in order to capture lessons learned and other valuable knowledge.
- ☐ There are no mentoring programs or organized forums for sharing knowledge between experts and novices (newcomers).
- ☐ Employee training and development budgets are limited and shrinking.
- ☐ One part of our organization may not know what the other part is doing—even if working on a similar task or problem.
- ☐ It is difficult or time consuming to find current information that would help us to improve efficiency – templates, lessons-learned, checklists, etc.
- ☐ Employees don't feel they have the time to chat with colleagues in the organization in an informal way.
- ☐ Our peer agencies are ahead of us in implementing knowledge management and retention strategies.

Scoring: If you marked 7-12 items, then your organization would likely reap substantial benefits from an agency-wide approach to KM. If you checked 4-6 items, then your organization could be enhanced through additional knowledge management practices. If you checked 1-3 items, you can focus on fine-tuning and sustaining what you are already doing.

Senior Leadership Workshop. This knowledge assessment approach involves convening the senior management team for a half-day workshop to identify and agree on the critical "at risk" knowledge areas that are important to the strategic mission of the organization. Key questions for each workshop participant are:

- What are the key challenges and opportunities facing your specific area in the next 2-3 years?
- What Key Performance Indicators (KPIs) do you use to measure success? How do you see these changing over the next 2-3 years?
- What are the critical types and areas of skill or know-how that will be needed for success in the next 2-3 years?
- Which of these areas are currently weak or at risk given existing bench strength and likely retirements or employee departures?
- What are you currently doing to address weaknesses and risks – e.g., succession planning, updating position descriptions, improving documentation, cross training, mentoring, communities of practice, etc.?
- What more should we be doing as an organization?

After the workshop, the Human Resources department can be requested to develop a knowledge attrition profile that (1) identifies key employees in each business area – i.e., those with specialized or unique expertise and (2) estimates the likelihood of these individuals retiring within the next 2, 5 and 10 years. This profile is helpful for understanding potential future knowledge gaps in the organization.

In-Depth Knowledge Survey. A more formal, in-depth knowledge assessment method is to circulate a Knowledge Assessment Survey to the employees in the agency. A sample survey is included as resource 1-1 in the "Additional Resources" section of this Guide. The survey is comprehensive, and identifies:

- How and where employees currently seek information and knowledge – from both people and codified sources;
- Current knowledge sharing behaviors; and
- Perceived gaps in available information or knowledge that impact job performance.

Compiled survey results can help agencies to identify:

- The extent and nature of knowledge gaps that may be impacting organizational effectiveness;
- Key employees who are serving as the "go to" sources of information and knowledge;
- Isolated employees or workgroups that aren't accessing available sources of information and knowledge; and

Georgia DOT Loss of Institutional Knowledge

The Georgia DOT (GDOT) conducted a workforce assessment that found that critical agency knowledge was at risk of being lost due to pending staff retirements:

- Forty-five percent of the senior leadership (Division Director and above) was within five years of retirement.
- Thirty-seven percent of the GDOT office heads was within five years of retirement.
- Forty-three senior staff positions were expected to retire within 15 months.

To mitigate these risks, succession planning, mentoring, and KM education was introduced throughout the GDOT community.

- ☐ Strengths and weaknesses in both formal and informal methods for knowledge sharing.

Knowledge Risk Assessment. A quantitative assessment of the level of knowledge risk for each position in the agency (or within selected departments) can be performed to guide both workgroup-level and agency-wide KM activities.

The Tennessee Valley Authority (TVA) developed a simple approach to calculating a knowledge risk score. This approach has been adapted by Constellation Energy/Exelon to examine knowledge risk for 160 program areas and allocate resources effectively to ensure future success.

The knowledge risk score for a position can be calculated as the product of two factors: attrition risk and position risk. Based on the total risk score, positions can be prioritized and options can be identified to retain or mitigate knowledge loss.

Knowledge Risk Assessment

Attrition Risk is a number from 1-5 where:

5 Projected retirement or departure within current or next fiscal year
4 Projected retirement or departure in 3rd fiscal year
3 Projected retirement or departure in 4th fiscal year
2 Projected retirement or departure in 5th fiscal year
1 Projected retirement or departure in or after the 6th fiscal year

Position Risk is a number from 1-5 where:

5 Mission critical knowledge (knowledge undocumented, unique, no duplication)
4 Critical knowledge and skills (limited duplication exists at other sites)
3 Important systematized knowledge and skills (documentation exists)
2 Proceduralized or non-mission critical knowledge and skills (training programs are current)
1 Common knowledge and skills

Total Risk Score = Attrition Risk * Position Risk

20-25 High priority (immediate action needed)
16-19 Priority
10-15 High importance
Under 10 Moderate to low importance

There is no single "one-size-fits-all" KM strategy—use the knowledge risk assessment to target areas for improvement.

Agencies can tailor the level of detail and limit the knowledge risk assessment to particular focus areas in order to keep the effort to a manageable size.

Using the Assessment Results

Regardless of which assessment methods are used, it is important that the assessment findings be summarized in a manner that helps the agency determine priorities and strategies. Developing an agency-wide KM strategy is covered in Step 2.

Step 2: Develop a KM Strategy

What Is a KM Strategy?

A KM Strategy is a written document that defines what the agency hopes to accomplish through KM techniques and how. The strategy should support the agency's overall strategic plan and reflect what is learned in the assessment of risks and opportunities. The strategy need not be lengthy or elaborate – it can fit on a single page.

Why Develop a KM Strategy?

The process of developing the KM strategy allows key players in the organization to get engaged and aligned. It provides an opportunity for the agency leadership to set a clear direction and commit to holding staff accountable for moving forward.

How to Develop an Agency KM Strategy

A KM Strategy can be developed either as a follow-on activity from the agency's broader strategic planning process, or through a stand-alone effort. A small working group of 3-5 individuals can be designated to develop the strategy. These individuals can be drawn from the following functions: central office business units (e.g., planning, maintenance, design, construction), field offices (e.g., district or regional maintenance, traffic operations, project delivery) and relevant support functions (e.g., human resources or organizational development, information technology, research/library, public affairs/ communications). Each working group member can be responsible for seeking input from a broader group as part of the process. A single individual should be designated to lead the effort and serve as the liaison to the executive team.

The charge of the working group is to (1) establish KM goals based on the agency's strategic plan and the priority focus areas identified in the assessment step; (2) identify appropriate KM strategies to pursue; (3) identify resources required for the first 6-12 months; and (4) seek executive team endorsement of the strategy – and commitment of resources.

KM at NASA

NASA's KM strategy was shaped, in part, as a result of the Space Shuttle Columbia disaster. The agency recognized that while it had many written procedures and "knowledge databases," improvements were needed in NASA's culture of knowledge sharing.

A Chief Knowledge Officer (CKO) position was established to address these concerns and develop a KM strategy. This strategy focused on creating stronger collaboration networks and online communities of practice, building a culture of openness and sharing, infusing lessons learned into the project development life cycle, and holding project teams accountable for capturing and leveraging lessons learned.

NASA's recognition and reward structure was revised to encourage learning and knowledge sharing proficiencies.

A KM Strategy must align with the mission of the organization. Establishing a clear linkage between the KM strategy and existing organizational goals puts the KM strategy on a solid foundation.

Linking to Agency Strategic Plans

Many transportation agencies have developed strategic plans and/or business plans that include organizational values or goals related to KM. Here are some examples from current state DOT strategic plans:

- ☐ Innovation
- ☐ Excellence
- ☐ Organizational Strength
- ☐ Learning and Growth
- ☐ Collaboration
- ☐ Partnerships
- ☐ Customer Service

The KM strategy can "hook into" these values or goals that have already been articulated. KM strategies can also consider more externally focused agency goals related to safety, mobility, infrastructure preservation, economic development and environmental stewardship. For example, pending loss of key individuals in the agency's safety function may impact the agency's ability to select and deliver the most effective set of safety improvements for the available dollars. Lead managers from key functional areas of the department can help to identify situations where KM strategies are needed to mitigate risks of employee departures or to build capabilities in emerging skill areas.

KM Goals

A KM strategy document should begin with a statement of goals for KM, which may include one or more of the following:

- ☐ Addressing priority risks of knowledge loss associated with pending retirements of experienced employees;
- ☐ Building the institutional memory of the agency before people leave or retire;
- ☐ Building bridges across "islands of knowledge" that may exist within functional silos or individual field offices;
- ☐ Stimulating innovation through the sharing of ideas and knowledge across disciplines;
- ☐ Strengthening the agency's adaptability and agility;
- ☐ Increasing employee efficiency and effectiveness in specific functional areas; and
- ☐ Strengthening customer service.

KM at Caltrans

Caltrans developed an enterprise risk profile, following Risk Management Standards from the International Standards Organization (ISO 31000). Through this process, workforce development was identified as one of the top agency risks. The Chief Risk and Ethics Officer led the development of Knowledge Transfer initiatives as a key risk management strategy – including development of a Knowledge Transfer Guidebook.

See reference [6].

These examples are fairly general, but can be tailored as needed to the agency's specific areas of concern. For example, one agency may choose to emphasize strengthening knowledge sharing across staff serving in similar roles in different field offices. A second agency may want to focus on fostering innovation in areas such as context-sensitive design, public-private partnerships or traffic management.

KM Strategies

The next step is to identify a set of strategies that will achieve the goals that have been established. For example, if the goal is to address priority risks associated with pending retirements, strategies might include a mix of analyses (to identify unique expertise), training and job shadowing (to bring other employees up to speed), documentation and targeted recruiting.

KM strategies can be considered from each of the categories outlined above in the section on Key Elements of KM:

- **KM Leadership & Direction** strategies involve strengthening the agency's understanding of KM, defining roles and responsibilities for KM, collecting information to help identify and diagnose gaps in skills, and tracking results of KM activities.
- **Social Learning & Communities** strategies involve facilitating person-to-person knowledge sharing and collaboration. Communities of practice are perhaps the most well-known KM technique in this category.
- **Knowledge Codification & Dissemination** strategies involve documentation of business processes and procedures, and capture of information (e.g., lessons learned) from project teams, individual employees and contractors through structured interviews. Results of these interviews may be produced in various forms – documents, slide presentations, videos, charts, etc., stored in various repositories for convenient retrieval.
- **Succession & Talent Management** strategies related to KM involve proactive steps to identify and manage risks associated with knowledge loss resulting from employee transitions. These include tracking and sharing information about the available skills within the organization, and activities to address current or emerging skill or experience deficits.

As illustrated in Figure 4, a balanced set of KM strategies will target People, Process, and Information Management/Technology:

- *Information Management/Technology* elements include provision of electronic platforms for knowledge sharing as well as

KM Is Not a Content Repository

"Although IT is a wonderful facilitator of data and information transmission and distribution, it can never substitute for the rich interactivity, communication, and learning that is inherent in dialogue. Knowledge is primarily a function and consequence of the meeting and interaction of minds."

– Fahey & Prusak (1998)
See reference [29]

practices to ensure that relevant data and content are captured, stored and documented for easy retrieval.

- *People* elements seek to foster knowledge sharing behaviors and build individual employee skills.
- *Process* elements seek to ensure that work processes are improved based on prior experience, and that lessons learned are distilled to inform future processes.

These three elements combine to provide the motivation, the means, and the opportunity for knowledge sharing in an organization.

One common pitfall is to have Technology be the centerpiece of the KM strategy. It should not be. Look first at People and Process elements, and then identify a limited number of technology strategies needed to support these other elements. Technology should not be the driver of KM.

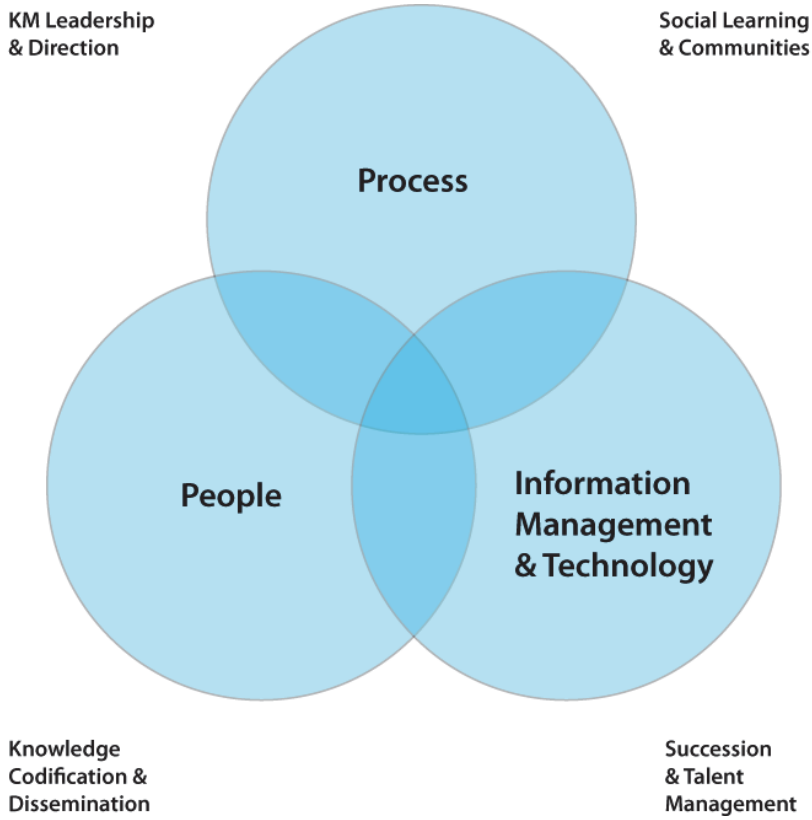


Figure 4. KM Strategies

Table 1 below displays elements of agency-wide KM, classified by People, Process and Information Management & Technology. Descriptions of each of these elements are provided in the next section. Note that many elements fall into more than one of the three categories – for example, Communities of Practice fit into all three: they reinforce knowledge sharing behaviors, provide opportunities for problem solving related to ongoing work processes, and may be supported by online collaboration tools.

Table 1. Elements of Agency-Wide Knowledge Management

AGENCY-WIDE KM ELEMENTS	PEOPLE	PROCESS	INFO MGT & TECHNOLOGY
KM LEADERSHIP & DIRECTION			
Strategic Planning & Policy Development	•	•	•
KM Education/Training	•		
Knowledge Assessment	•	•	•
Knowledge Mapping/Social Network Analysis	•		•
KM Metrics	•	•	•
SOCIAL LEARNING & COMMUNITIES			
Communities of Practice	•	•	•
Peer Reviews	•	•	
After Action Reviews		•	
Social Networking and Collaboration Platforms	•		•
Expertise Locator/Smart Org Charts	•	•	•
Recognition & Rewards for Collaboration	•		
KNOWLEDGE CODIFICATION & DISSEMINATION			
Lessons Learned Repository		•	•
Organizational Narratives/Storytelling		•	
Knowledge Books/Continuity Books	•	•	
Business Process Documentation/Automation		•	
Contractor Knowledge Transfer		•	
Content Management/Portals/Wikis			•
Common Vocabulary/Content Classification			•
Personalization/Role-Based Subscriptions			•
SUCCESSION & TALENT MANAGEMENT			
Talent Tracking	•		•
Desk-Side Reviews	•	•	
Mentoring, Shadowing and Job Rotation	•		
Phased Retirements	•	•	
Leadership Training	•		

Remember to consider a holistic approach to KM—this is more sustainable and more effective than a set of disconnected initiatives.

Designating a single KM lead with the right set of capabilities is a critical element of an agency-wide KM strategy.

Use Technology as an enabler rather than as the centerpiece of the KM strategy.

Moving the Strategy Forward

Once strategies are identified, the working group needs to consider who will be responsible for KM implementation, and which resources will be required. A detailed implementation plan isn't required at this stage – just enough information to enable the senior leadership of the agency to decide to endorse the strategy and approve moving it forward.

Keep in mind that an agency-wide approach to KM may not require significant new investments, since most organizations are already doing elements of KM. Agencies can start with a modest effort and expand as appropriate once benefits are clearly demonstrated.

Importance of a KM Lead

In addition to strong top management support, an essential element of any agency-wide KM strategy is identifying a single KM lead person. While different elements of KM can be carried out by staff in multiple divisions, the KM lead is responsible and accountable for making sure the entire collection of activities is meeting the established goals. They are in a position to best understand what combination of strategies would work best to address identified gaps – and to adjust priorities as new needs arise or as availability of resources changes. In order to ensure that KM is sustainable in the organization, the KM lead should work closely with 1-2 others who would be in a position to take over KM lead responsibilities in their absence.

It is important to recognize that the success of KM initiatives will depend on the capabilities of the designated KM lead, and the level of upper management support they are given. Ideally, the KM lead will have the necessary knowledge and personality to serve as a champion for KM techniques across the organization. Because KM involves working across organizational silos, the lead should be perceived as neutral and have good communication and negotiation skills.

There is no single best organizational location for a KM lead. Possibilities include: Research, Training, Human Resources, Risk Management, Performance Management or Business Support. Because KM should not be a technology-centric initiative, the Information Technology (IT) unit is not generally the best choice for locating the KM lead. However, the KM lead will need to develop a close working relationship with IT.

Example KM Strategies

An example outline of a "modest KM strategy" for a fictitious DOT is shown below. This strategy allocates 50% of a full-time equivalent (FTE) employee to serve as the KM lead and orchestrate implementation. Figure 5 shows a second example from a real organization. This example illustrates a useful format linking agency strategic goals, KM goals, KM strategies, and implementation steps.

A Modest DOT KM Strategy

1. Business Case for KM

a. Within the next 2 years, four of the six district administrators are likely to retire. The next level of management in the districts has less than 5 years of experience.
b. There is a need to strengthen the support system for newer staff – encourage them to learn from the existing core of senior, experienced staff in other districts.
c. There is a need for consistency in core work processes across districts.

2. Goals

a. Increase opportunities for collaboration across districts.
b. Capture critical institutional knowledge from senior district staff before they leave the agency.

3. Strategies

a. Establish and support communities of practice for district construction engineers and district maintenance engineers.
b. Map standard business processes and use as part of the orientation process for new employees.
c. Conduct knowledge interviews with senior district administrators and document key lessons for their successors.

4. Implementation and Resource Needs

a. Designate a KM lead – allocate 50% of an FTE for overseeing all KM activities.
b. Train two individuals in business process mapping.
c. Brief managers on KM strategy and gain buy-in for staff participation in Communities of Practice.
d. Establish quarterly reporting on progress to executive team.

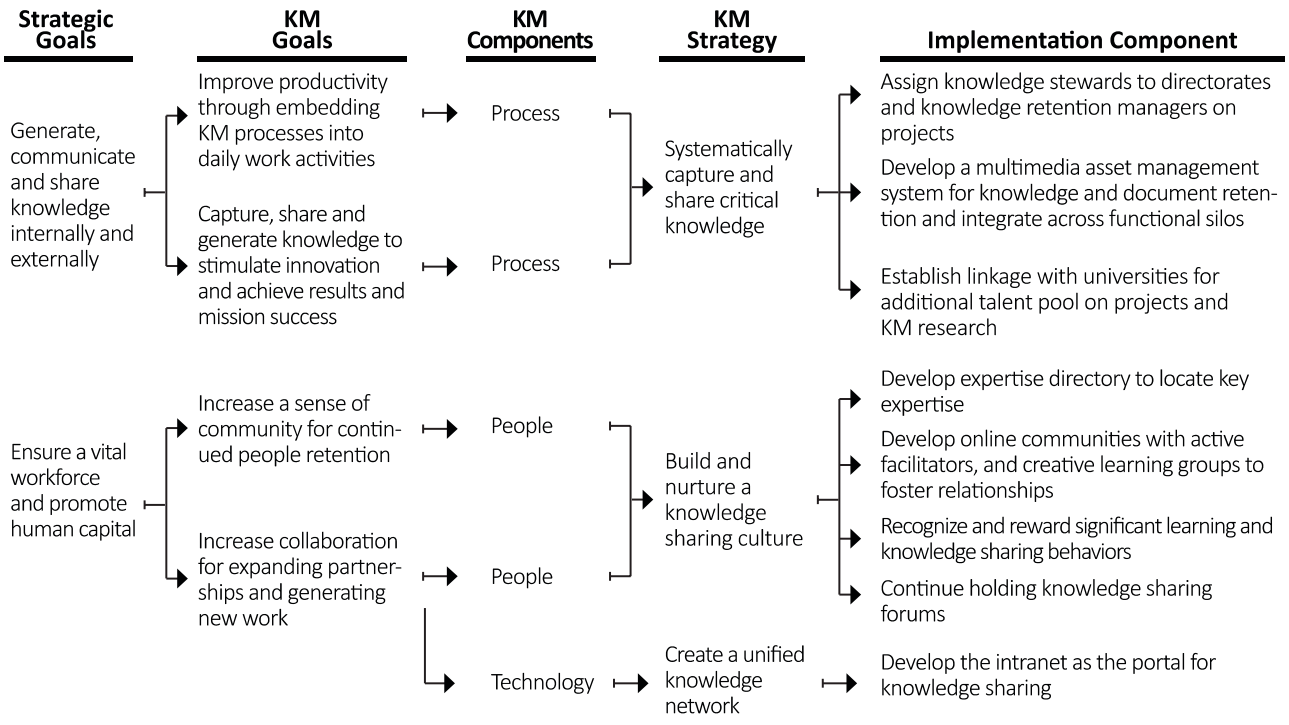


Figure 5. An Example KM Strategy Source: Adapted from Reference [25]

Building a Sustainable KM Program

One DOT tried to develop a KM strategy in conjunction with a quality initiative. KM pilots were launched with promising results. Unfortunately, even though there were good intentions, it was difficult to get traction because staff and management felt that they were already overburdened and couldn't take on any new activities. Then, the executive champion for KM left the agency, and KM activities were discontinued. This program suffered from having a single point of failure.

Building more broad-based buy-in at the start could have enabled the initiative to persist through a change in leadership. One strategy is to have "Knowledge Stewards" in each of the main business units who have the recognition of their peers so that they can then spearhead and infuse KM efforts in their respective units.

Step 3: Create a KM Implementation Plan

Why Develop a KM Implementation Plan?

The KM Strategy defines the goals for KM, outlines the types of initiatives that the agency wants to pursue, and designates a lead person to move it forward. A KM Implementation Plan provides more detail on how the strategy will be carried out. It provides an opportunity to identify specific activities, make sure that the right people are involved, and ensure that the necessary resources are made available to maximize their effectiveness.

How to Develop a KM Implementation Plan

The following steps can be followed to develop a KM implementation plan:

1. Identify KM activities to carry out the strategy.
2. Identify metrics and evaluation methods.
3. Develop a detailed plan for first set of initiatives.
4. Develop a communication plan to build and sustain awareness and engagement.
5. Identify resource needs: personnel, IT infrastructure, consultant support, etc.
6. Develop a budget.
7. Establish a schedule of milestones.
8. Set up periodic review and reporting cycles to track milestone completion and metrics.

Additional guidance for identifying and planning appropriate KM techniques is provided below. See the next section (Step 4) for guidance on defining metrics for KM.

KM Techniques

Capsule summaries of KM techniques that can be considered for implementation are provided below, organized by strategy type.

KM Leadership & Direction

Applicability: Agencies wanting to pursue a holistic KM approach.

Expected Results: Identify and address the agency's priority risks and needs; target KM activities where they will have the greatest payoff.

Implementation Tip: Designating a KM lead is essential for making progress, but educating and involving a larger set of individuals in planning and implementation will ensure that KM takes root in the organization and has sustained impact.

Techniques:

- ☐ **Strategic Planning and Policy Development.** Periodic review and revision to the KM strategy and supporting agency policies.
- ☐ **KM Education/Training.** Education and training to build understanding of KM strategies and techniques.
- ☐ **Knowledge Assessment.** Information gathering to understand where critical knowledge resides, what gaps there are (areas where additional knowledge is needed), as well as how knowledge is currently shared within the organization. It may also include assessment of key risk areas associated with potential loss of critical expertise or institutional knowledge. The results of this assessment can be used to target and plan appropriate KM techniques.
- ☐ **Knowledge Mapping/Social Network Analysis.** Formal mapping and analysis of knowledge sources and flows; this may be part of a knowledge assessment or a separate effort. Knowledge maps may also be produced to facilitate access to knowledge resources – see, for example, NASA's Knowledge Map at: http://km.nasa.gov/knowledge-map/ .
- ☐ **KM Metrics.** Developing metrics to measure results of KM initiatives and tracking and reporting these metrics.

KM at Wisconsin DOT

Wisconsin DOT developed a useful matrix that provides additional guidance on when to consider various KM techniques, and the approximate level of effort required. This matrix is included as Table 2 on the next page.

WisDOT also produced a KM Guide emphasizing simple, low-cost techniques.

See reference [10].

Table 2. Wisconsin DOT KM Tools Matrix

TOPIC AND TASKS	BRIEF DESCRIPTION	MIGHT BE GOOD FOR…	RESOURCES
Documenting processes			
Writing down processes	Incumbent writes down steps in key tasks.	Stable, routine tasks; quick reference	Low
Videotaping processes	Incumbent is videotaped performing key tasks.	Quick capture; including context	Low
Formalizing process			
Formalizing process	Manually require steps be completed in certain way.	More complex tasks	Low
Automating process	Automation requires steps be completed in certain way.	Highly complex tasks with many players	Med
Expert decision system	Incorporates expert judgment. Provides decision.	Complex decisions that can be modeled	High
Experiencing together			
Double filling key positions	New employee and retiring employee work together.	Critical positions with sole complex knowledge	Low
Cross training	Train employees to do a range of overlapping work.	Positions with sole knowledge	Med
Communities of practice	Employees with similar work regularly communicate.	Positions scattered throughout agency	Med
Sharing experience			
Exit interviews	HR or supervisor asks questions of departing employee.	All departing employees	Med
Expert interviews	Interviewer asks questions of knowledgeable employee.	Employees with extensive specific knowledge.	Med
Last lectures	Departing employee gives open-ended talk.	Departing employees with extensive tacit knowledge.	Med
Storytelling	Current employees share stories of challenges faced.	Current employees with extensive tacit knowledge.	High
Developing leaders			
Rotation program	Selected employees work in one or more new areas.	Employees showing leadership promise.	High
Leadership program	Selected employees receive agency exposure.	Employees showing leadership promise.	High

Source: Wisconsin DOT

Social Learning & Communities

Applicability: Agencies wanting to shift the culture of their organizations to foster innovation, collaboration and group problem solving.

Expected Results: Increased innovation, faster ramp-up time for new employees, less chance of "rookie mistakes," improved organizational resilience, improved employee retention, less dependence on any single individual.

Implementation Tip: Collaboration and social networking tools have value, but face-to-face interaction is also essential for building the kinds of trust relationships required for productive collaboration.

Techniques:

- ☐ **Communities of Practice.** Communities of individuals with similar roles in the organization that meet periodically to brainstorm, problem-solve and share their experiences.
- ☐ **Peer Reviews.** A peer review process prior to initiation of a major project phase or initiative to ensure that lessons from prior efforts are considered.
- ☐ **After Action Reviews.** Holding a team meeting following completion of an initiative or major project phase to identify and document what went well, what could have been improved, and how to fix things to be sure that they don't go wrong again. Some organizations also use Before- and During-Action Reviews to document lessons learned as they go and make corrective actions as needed.
- ☐ **Expertise Locator System/Smart Org Charts.** Tracking specialized expertise or skills and providing an online "yellow pages" of expertise in order to locate appropriate individuals in the organization.
- ☐ **Social Networking and Collaboration Platforms.** Platforms for social networking and forums that allow people to share views on related topics of interest - either in-house or external. These may include specific areas for onboarding of new employees to allow them to connect to peers and "learn the ropes" together.
- ☐ **Recognition and Rewards for Collaboration.** Recognition of collaboration and knowledge sharing behaviors in employee performance reviews, providing opportunities to showcase and reward collaborative efforts.

Recognize that interpersonal trust and respect are prerequisites for knowledge sharing. Allow time for face-to-face communication and relationship building.

Encourage learning and knowledge sharing behaviors through the agency's recognition and reward system. Consider including learning and knowledge sharing proficiencies as part of the employee's annual performance review.

Knowledge Codification & Dissemination

Applicability: Agencies wanting to ensure that all employees have ready access to documentation about the "who, what, how, when and

Knowledge Books at Kraft Foods

Kraft Foods has developed a series of "Knowledge Books" to capture and retain specialized knowledge held by individuals with unique expertise – such as formulation of concentrated dairy products. These knowledge books are created through application of a standard methodology called MASK (Method for Analyzing and Structuring Knowledge). They focus on explaining *why* things are done a certain way and are rich with commentary and examples.

See reference [1]

Captured knowledge has no value if it is not used. Any knowledge capture activities should be accompanied by specific strategies for ensuring that the organization benefits.

why" of key business processes. Codification and dissemination activities focus on the kind of knowledge that lends itself to capture and documentation – such as procedural knowledge, key lessons and past events.

Expected Results: Improved consistency of practice across the agency, lower chance of employees "reinventing the wheel," greater awareness across the agency of effective techniques (or costly mistakes).

Implementation Tips: It is best to be selective about what is captured, and make sure that the effort required will have sufficient payoff in the future. Information products should be designed to facilitate future use (e.g., checklists, presentation slides) and opportunities for using them should be actively pursued.

Techniques:

- ☐ **Lessons Learned Capture.** Collecting, reviewing and publishing lessons that can be easily accessed and applied. These lessons can document both reasons for success as well as reasons for outcomes that varied from original expectations.
- ☐ **Organizational Narratives/Storytelling.** Capturing nuggets of wisdom through interviewing individuals before they retire and making them accessible/searchable via agency intranet sites or other information repositories.
- ☐ **Continuity Books.** Writing the "how to do my job manual," or the do's and don'ts of various organizational processes and making them available through a content management system.
- ☐ **Knowledge Books.** Conducting in-depth interviews with experts to distill and document unique knowledge that can't be found in other available sources.
- ☐ **Business Process Documentation/Automation.** Systematically mapping current business processes to provide a common understanding of steps, inputs, outputs and roles. This can be helpful for complex processes, and those where multiple business units are involved. In some cases, it may be possible to take this a step further and automate processes via workflow management tools.
- ☐ **Contractor Knowledge Transfer**. Building in standard contract requirements for documentation of information sources, assumptions, products, lessons and other resources discovered as part of consultant or contractor projects.
- ☐ **Content Management Systems And Knowledge Repositories.** Providing electronic platforms for storing and retrieving content including procedure manuals, business process maps, training

videos, presentations, photographs, and lessons learned documents. Ensuring that new (and existing) employees are made aware of these resources and encouraged to use them.

- ☐ **Common Vocabulary/Content Classification.** Developing standard key words and content classification methods to facilitate discovery of available content.
- ☐ **Personalization/Role-Based Subscriptions.** Enabling employees to subscribe to newly added content based on their roles or specific areas of interest.

Succession & Talent Management

Applicability: Agencies looking to lessen the impacts of employee departures – targeting certain critical positions (e.g., a senior engineer within one year of retirement); or addressing more general needs (e.g., growing the next generation of leaders).

Expected Results: Smoother transitions as employees retire or transition to new jobs; improved availability of employees with skills to take on challenging technical or leadership positions.

Implementation Tip: It is best to be proactive about succession and talent management – don't wait until key employees announce their retirement to take action.

Techniques:

- ☐ **Talent Tracking.** Defining knowledge, skills, and abilities for each position and tracking employee skill sets over time as they complete training and gain experience.
- ☐ **Desk-Side Reviews.** A successor sits down with the upcoming retiree at the retiree's desk and listens as he/she shows notes, templates, shortcuts, or memory aids for performing his/her job.
- ☐ **Job Shadowing.** A less experienced employee follows a more experienced employee in the organization throughout the day, learning through observation.
- ☐ **Job Rotation.** An individual is moved to different parts of the organization in order to learn the "system" perspective.
- ☐ **Mentoring.** A formal program is set up that links mentees (less experienced employees) with mentors (more experienced employees) in the organization. The program may include guidelines and coaching for mentors in order to maximize effectiveness. Reverse mentoring can also be done for certain technology-related skills to allow a more experienced employee to learn from a newer employee.

Don't wait until employees are close to retirement to begin succession management and knowledge capture activities. Knowledge retention should start from day 1 of the employee's tenure.

- **Succession Management.** Targeting positions for succession management strategies including training, shadowing, double-filling positions, etc.
- **Formal Phased Retirement Programs.** As individuals are nearing retirement in the organization, have them reduce their time by partially retiring and spending time in training/educating their successors. (Note: double-filling positions may be prohibited in some states by law.)
- **Retirees and Alumni Callbacks.** Bringing back an organization's retirees in various roles to bridge certain knowledge and skill gaps.
- **Leadership Training.** Offering training and apprenticeship experiences to further development of future leaders of the organization.

Lessons Learned: Mentoring

One DOT established a mentorship program. The goal was to capture the expertise and field knowledge of long-time employees, and to pass this knowledge on to the next generation. This initiative enjoyed strong top management support. However, the program had mixed success, and the agency learned some valuable lessons about what it takes to make a mentoring program work. More careful implementation planning and oversight would have ensured a greater level of success and sustainability.

Defining Roles and Responsibilities for KM Implementation

Roles and responsibilities for implementation will depend on the scope of planned KM activities. Some agencies may choose to focus their KM efforts on succession management, and have the HR department take the lead. Others may focus on capturing lessons learned as part of major projects, and have the Project Management Office lead. Agencies interested in potentially pursuing the full range of KM strategies will want to appoint a single individual (or small team) to handle the KM leadership and strategy activities. This individual or team can then initiate some KM techniques and play a support role on others. Table 3 illustrates what a logical mix of responsibilities might be, indicating lead or support involvement for the KM lead, HR, IT, Research/Library and managers of major divisions and their constituent business units.

Additional Implementation Advice

Some additional tips to ensure successful KM implementation are:

- Start small – use pilots to test different methods and expand using the benefit of your experience.
- For each initiative, recognize that there will be a life cycle: startup planning, pilot, evaluation, and evolution.
- Think about how you will evaluate and report on each activity *before* you begin.
- When estimating time requirements for the KM lead, anticipate a mix of planned activities and responsive services based on requests and opportunities for value-added interventions.

Table 3. Responsibility Chart for KM Elements

AGENCY-WIDE KM ELEMENTS	KM LEAD	HUMAN RESOURCES	IT	RESEARCH/ LIBRARY	DIVISION/ OFFICE MANAGER
KM LEADERSHIP & DIRECTION					
Strategic Planning and Policy Development	●	○	○	○	○
KM Education/Training	●	○			
Knowledge Assessment	●				○
Knowledge Mapping/ Social Network Analysis	●		○	○	
KM Metrics	●			○	
SOCIAL LEARNING & COMMUNITIES					
Communities of Practice	○		○		●
Peer Reviews	○				●
After Action Reviews	○				●
Social Networking and Collaboration Platforms	○		●		
Expertise Locator/ Smart Org Charts	○	●	○		
Recognition & Rewards for Collaboration	○	○			●
KNOWLEDGE CODIFICATION & DISSEMINATION					
Lessons Learned Repository	●			○	○
Organizational Narratives/ Storytelling	●				○
Knowledge Books/ Continuity Books	○				●
Business Process Documentation/Automation	○		○		●
Contractor Knowledge Transfer	○				●
Content Management/ Portals/Wikis	○		●		○
Common Vocabulary/ Content Classification	○			●	○
Personalization/ Role-Based Subscriptions	○		●		
SUCCESSION & TALENT MANAGEMENT					
Talent Tracking	○	●			
Desk-Side Reviews	○				●
Mentoring, Shadowing and Job Rotation	○	●			○
Phased Retirements	○	●			○
Leadership Training	○	●			○

Key: ● Lead Role ○ Support Role

Step 4: Monitor Results

A balanced approach to monitoring KM value and effectiveness should include tracking of costs, outputs, exposure or use, and outcomes.

Documenting return on investment is important, but it is also valuable to capture success stories and qualitative descriptions of outcomes.

Purpose of Measurement

Without a good understanding of return on investment or value being added, KM initiatives will be difficult to sustain. Beyond ensuring accountability for KM activities, measurement also provides important information to the KM lead about what is working well, what isn't, and what adjustments need to be made.

Measurement for an agency-wide KM effort seeks to answer four questions:

- **Costs:** What are we spending on KM support activities? How much time is it consuming?
- **Outputs:** What are we delivering or producing?
- **Exposure/Use:** What is the "market penetration" of the KM support activities? Who are we reaching?
- **Outcomes:** Is the effort having its intended impact? Are we accomplishing our goals?

Approaches to Measurement

Agencies can approach measurement at different levels of detail. Since measurement can be a time-consuming activity, it is best to begin by identifying a few key measures and then add new ones as needed as the KM effort evolves. It is important to strike a balance between the level of effort needed to track KM results and the value of information being produced.

Costs: Costs of KM implementation can be estimated based on the time spent by the KM lead (and others) to plan, facilitate and support KM activities. IT development and content management cost elements may be included as well.

Outputs: The KM lead can maintain a simple activities log to track products and services provided to support KM implementation. Products may include guidance documents or model policies; services may include briefings, trainings, or meeting facilitation.

Exposure/Use: Employee participation in KM activities, and use of knowledge resources can be tracked via manual methods such as meeting sign-in sheets, or automated methods built into systems (e.g., tracking of web page hits or document downloads).

Outcomes: Tracking outcomes is challenging because of the intangible nature of the results being sought – e.g., employee knowledge, organizational effectiveness, and consistency in application of policies and procedures, and resilience. Typical approaches to measuring outcomes involve either surveys or interviews with employees, or studies of specific business process efficiency changes. While time or cost savings should be quantified wherever possible, it is helpful to supplement this with qualitative information that helps people to understand why and how a KM technique was beneficial.

In some cases, employee stories about how they benefited from a KM activity can be translated into estimates of cost savings for the agency. For example, the VDOT KM office facilitated a business process streamlining effort that resulted in an estimated savings of $300,000 annually. Table 4 provides examples of output, exposure/use and outcome metrics for the four categories of KM techniques discussed above.

In order to mitigate risks, the KM outcome metrics should map back to the agency's strategy, goals and objectives.

How to Measure KM Results

The US Navy has developed an excellent *Metrics Guide to Knowledge Management Initiatives* - see reference [27]. This guide defines the following steps for measuring and monitoring KM results:

1. Identify key stakeholders and what they want to know about KM results (e.g., agency leadership, project managers, KM lead).
2. Select a measurement framework (e.g., balanced scorecard, cause-and-effect diagram, matrix showing expected versus actual results).
3. Define how the monitoring results will be used by each stakeholder.
4. Identify measures – tailored to KM initiatives and their implementation phase, including both quantitative and qualitative measures.
5. Develop data gathering approach (surveys, interviews, automated usage logs, etc.).
6. Collect and analyze information.
7. Identify changes to be made based on the results.

The Navy Guide is a useful reference for design of an approach to KM measurement, and includes an appendix with sample metrics.

Table 4. Sample KM Metrics

AGENCY-WIDE KM ELEMENTS	KM OUTPUTS	EXPOSURE/USE	IMPACTS/OUTCOMES
KM LEADERSHIP & DIRECTION			
Strategic Planning and Policy Development KM Education/Training Knowledge Assessment Knowledge Mapping/Social Network Analysis KM Metrics	• Completion of KM strategy • Completion of KM implementation milestones	• Number and percent of individuals participating in KM planning & implementation	• Awareness of KM strategies and resources
SOCIAL LEARNING & COMMUNITIES			
Communities of Practice (CoPs) Peer Reviews After Action Reviews (AARs) Social Networking and Collaboration Platforms Expertise Locator/Smart Org Charts Recognition & Rewards for Collaboration	• Number of CoPs coordinated • Number of briefings conducted on AARs • Modifications to recognition programs	• Number of posts on collaboration site • Number of participants in CoPs • Number of AARs completed	• Employee satisfaction • Employee retention • Reported benefits from collaboration (stories)
KNOWLEDGE CODIFICATION & DISSEMINATION			
Lessons Learned Repository Organizational Narratives/Storytelling Knowledge Books/Continuity Books Business Process Documentation/Automation Contractor Knowledge Transfer Content Management/Portals/Wikis Common Vocabulary/Content Classification Personalization/Role-Based Subscriptions	• Number of processes documented • Number of lessons learned added to repository • Number of videos produced • Policy in place for contractor knowledge transfer	• Number of lessons downloaded • Number of videos watched • Average number of monthly updates to Wiki page • Number of active subscriptions	• Employee awareness and evaluation of available resources • Savings from process streamlining and automation (study) • Reported benefits from use of available resources (stories) • Process consistency (study)
SUCCESSION & TALENT MANAGEMENT			
Talent Tracking Desk-Side Reviews Mentoring, Shadowing and Job Rotation Phased Retirements Leadership Training	• Number and percent of position descriptions updated with knowledge, skills & abilities requirements • Number of training sessions for mentors	• Number and percent of employees completing leadership training • Number and percent of employees participating in job rotation or mentoring	• Bench strength (number of possible successors for given position) • Reported benefits from job rotation and mentoring (stories)

KM Outcomes

Before outcome measures can be defined, it is helpful to define expectations for each KM activity or initiative. Key types of outcomes for KM implementation include: adaptability/agility, creativity, institutional memory building, organizational internal effectiveness, and organizational external effectiveness. Once expectations are set, then specific surveys, interviews, or studies can be designed to assess results. The following examples provide a starting point for thinking about expected results from selected KM activities.

Expertise Locator System:

- ☐ Reduced training time or learning curve.
- ☐ Improved decision making due to knowing the right person to address the questions from the expertise locator system.
- ☐ Reduction of re-work.
- ☐ Improved service to external partners or stakeholders.

After-Action Reviews (AARs):

- ☐ Application of existing know-how in future similar activities.
- ☐ Reduced training time or learning curve.
- ☐ Improve organizational decision making or quality of products resulting from application of best practices/lessons learned.
- ☐ Time reduction for document preparation process due to learning from others via the AAR.
- ☐ Improved agency image (as measured by customer satisfaction surveys) due to learning from previous successes and failures and reacting expeditiously.

Lessons Learned (LL) Repository:

- ☐ Improved performance and decision making through use of the LL resources.
- ☐ Reduction in cycle time through use of the LL resources.
- ☐ Decreased learning curve for new employees.
- ☐ Increased consistency in performing job duties across similar roles in the agency.

Collaboration Platforms:

- ☐ Decreased average problem-solving time.
- ☐ Reduced rework through learning from others.
- ☐ Improved employee retention due to higher satisfaction associated with collaborative environment.

Organizational Narratives/Continuity Books/Knowledge Books:

- ☐ Reduced tendency for employees to "reinvent the wheel" or repeat past mistakes due to improved institutional memory.

KM at Chevron

"Of the initiatives we've undertaken at Chevron during the 1990s, few have been as important or as rewarding as our efforts to build a learning organization by sharing knowledge. In fact, I believe this priority was one of the keys to reducing our operating costs by more than $2 billion per year—from about $9.4 billion to $7.4 billion—over the last seven years."

– Derr, T.K. (1999)
See reference [28]

- ☐ Accelerated transfer and use of existing know-how for increased learning.
- ☐ Decreased learning curve for new employees.

Communities of Practice:

- ☐ Increased collaboration due to stronger sense of belonging and trust.
- ☐ Innovations and creativity increased through knowledge sharing.
- ☐ Improved decision making and work quality resulting from collaborative efforts.
- ☐ Increased organizational resilience due to improved collaboration and networks.

Development of an evaluation approach should be an integral part of the planning for each new initiative.

Table 5 and Figure 6 illustrate how the Virginia DOT has characterized outcomes from their KM initiatives.

Table 5. Sample Outcomes from the Virginia DOT KM Initiatives

Initiative	Outcome
Lessons Learned Database	Increased knowledge base on successful construction practices, strong level of support and utilization from construction managers and inspectors, national recognition for agency.
After Action Review: Winter Maintenance	Led to statewide implementation of anti-icing program based on techniques developed by frontline managers; findings will be incorporated into staff training programs.
Standard Operating Procedure Development: Emergency Response Task Force	Definition and common understanding of VDOT's response to different incident types: crashes, terrorist attacks, HAZMAT spills, and weather-related events.
Facilitation: Interagency Coordination on Incident Management	Improved working relationships, leading to shortened incidence clearance times.
Organizational Network Analysis: for Successful Construction Project	Evaluation of how team member communication network contributed to project delivery efficiency and effectiveness – lessons can be applied to future construction projects.
Process Mapping: Environmental Review Process	Annual cost savings of $300,000 from process streamlining, improved understanding of process and its intersection with other processes, model for other groups.
CoP Support: Construction	Statewide vertical and horizontal integration of construction expertise used to inform the state strategic plan.

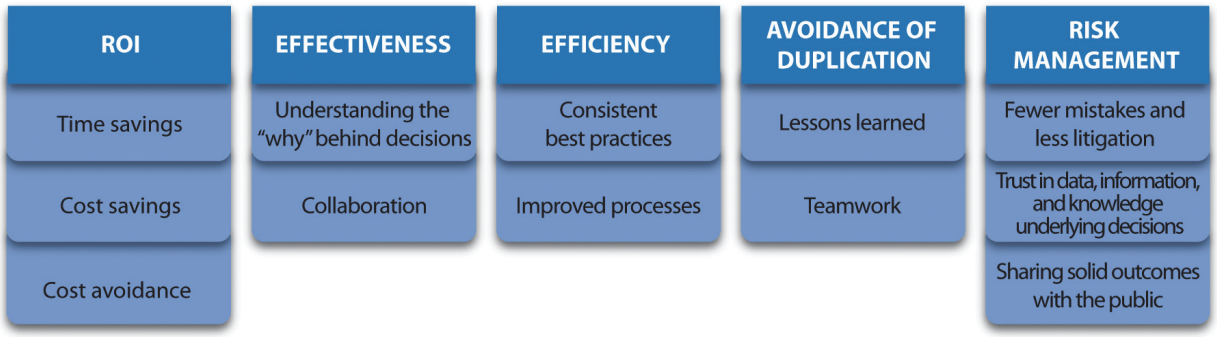


Figure 6. Virginia DOT Measurement Framework for KM Outcomes (ROI = return of investment)

Learning from Experience

"There is only one thing more painful than learning from experience, and that is not learning from experience."

– Laurence J. Peter

Transportation Agencies with KM Initiatives

Table 6 provides brief descriptions of KM initiatives at federal and state transportation agencies. References and contacts (where available) are included for agencies wishing to find out further information about implementation approaches and results.

Table 6. KM Initiatives at Transportation Agencies

Organization	Description	Contact/Reference
Alaska DOT & Public Facilities	Strategic workforce planning Information management in support of KM	Amanda Holland, Division Operations Manager, Administrative Services - amanda.holland@alaska.gov
Alberta Transportation	Provincial KM framework and Leadership Development Program; "Business Knowledge and Coordination Unit" within Traffic and Safety Services Division	Colleen Delany, Policy and Information Analyst - colleen.delany@gov.ab.ca http://www.pao.gov.ab.ca/learning/knowledge/framework.pdf
Caltrans	Knowledge transfer activities under the agency's risk management function, in support of workforce and succession planning	Michelle Tucker, Chief Risk and Ethics Officer – michelle.tucker@dot.ca.gov

Organization	Description	Contact/Reference
Georgia DOT	Communities of Practice; Succession Management	Jeff Conrad, HR Program Manager - jconrad@dot.ga.gov
Kansas DOT	Field Inspector Mentor Program	Susan Barker, PE, Technology Transfer Engineer - SusanB@ksdot.org
Missouri DOT	Practical Design, Innovations Challenge, consolidated wiki-based policy and procedures manual, accelerated Leadership Development Program	Kathy Harvey, Assistant Chief Engineer - Kathy.Harvey@modot.mo.gov
Virginia DOT	KM Office, Communities of Practice, Lessons Learned, Business Process Analysis	Maureen Hammer, Knowledge Management Director - Maureen.Hammer@vdot.virginia.gov
Washington State DOT	Knowledge mapping, knowledge interviews, knowledge capture guidance, information management	Leni Oman, Knowledge Strategist – loman@wsdot.wa.gov http://www.wsdot.wa.gov/NR/rdonlyres/77C67CCC-05B7-471D-B254-26AA362295CF/0/KMFolio.pdf
Wisconsin DOT	Guidance on low-cost KM techniques, AARs, process documentation	Randy Sarver, Human Resources Director - randy.sarver@dot.wi.gov
U.S.DOT Federal Aviation Admin.	Communities of Practice, Learning Throughout the Project Life Cycle (FAA calls their activities "organizational learning" rather than "KM")	Rick Wallace, Organizational Effectiveness Group Manager - rick.wallace@faa.dot.gov
U.S.DOT Federal Highway Admin.	Discipline Support System – focal point for workforce planning, collaboration, and learning & development	Anne Audet, Director, Office of Human Resources - Anne.Audet@dot.gov
U.S.DOT Federal Transit Admin.	Chief Knowledge Officer, Communities of Practice, After-Action Reviews, Knowledge Capture, Business Process Review/ Improvement, Knowledge Portal	Susan Camarena, Chief Knowledge and Learning Officer – Susan.Camarena@dot.gov Arthur Dexter, Knowledge Resources Manager - Arthur.Dexter@dot.gov

Selected References

Table 7 includes a selection of references on KM that are either related to specific transportation agency implementations, or that provide useful syntheses of practices likely to be of interest to transportation agencies.

Table 7. Knowledge Management References

ID	Resource	Type	Year	Link
1	NCHRP 20-68A – US Domestic Scan Program – Scan 12-04, "Advances in Transportation Agency Knowledge Management" – Final Report	Report	2014	http://www.domesticscan.org/wp-content/uploads/NCHRP20-68A_12-04.pdf
2	Dexter, Arthur, "Knowledge Management and its Practice at the FTA"	Presentation	2014	http://www.nccaiim.org/Downloads/AIIM_dexter_20140109.pptx
3	FTA, "KM Strategy Overview "	1-pager	2013	http://1105govinfoevents.com/KM/Conference/Camarena_FTA_KM_Strategy_One_Sheet.pdf
4	Grant, Robert M., "The Development of Knowledge Management in the Oil and Gas Industry," Universia Business Review, 2013 (useful synthesis of KM strategies, metrics and lessons learned)	Article	2013	http://ubr.universia.net/article/download/895/1021
5	Alaska University Transportation Center research report: "Knowledge Transfer Needs and Methods"	Report	2012	http://ine.uaf.edu/autc/files/2013/07/510009.Perkins.-FINAL.pdf
6	Caltrans Knowledge Transfer Guidebook	Guide	2012	http://www.dot.ca.gov/docs/ct_knowledge_transfer_guidebook.pdf
7	Cronin, Brian, et al., "Knowledge Management as Part of Strategic Workforce Development in Transportation Agencies"	Research Paper	2012	http://docs.trb.org/prp/13-2705.pdf
8	Gibson, J. W., and C. Wallace, "Outsourcing and Its Impact on Knowledge Management: A Case Study of the Kentucky Transportation Cabinet"	Research Paper	2012	http://docs.trb.org/prp/13-1376.pdf
9	Wheeler, Anthony, "Succession Planning in State Departments of Transportation"	Research Paper	2012	http://131.128.106.203/uritc-org/media/finalreportspdf/0003082.pdf
10	Adams, Teresa, and E. Wittwer, "Best Practices in Guidance for Workforce Transition and Succession Planning," WisDOT 0092-10-15, CFIRE 04-03 – includes WisDOT Guide to Knowledge Management	Guide	2011	http://wisdotresearch.wi.gov/wp-content/uploads/WisDOT-Policy-Research-0092-10-15-final-report.pdf

ID	Resource	Type	Year	Link
11	Garder, Peter, and T. Sandford, "Institutional Memories of Road Design," New England University Transportation Center	Report	2011	http://utc.mit.edu/uploads/UMEE21-15%20FP.pdf
12	ICF International, "NCHRP Report 685: Strategies to Attract and Retain a Capable Transportation Workforce," TRB	Report	2011	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_685.pdf
13	Kingsley, Gordon, J. Knox-Hayes, and J. Rogers, "Developing Strategic Systems Supporting Communities of Practice in the Georgia Department of Transportation," Georgia Institute of Technology, prepared for Office of Materials and Research, Georgia DOT	Report	2011	https://www.dot.ga.gov/doingbusiness/research/Documents/1005.pdf
14	Perkins, R. A., "Serving Future Transportation Needs: Succession Planning for a State Department of Transportation Organization, Its People & Mission," University of Alaska	Report	2011	http://ine.uaf.edu/autc/files/2012/05/309038.Perkins.-Final-Report.pdf
15	Wittwer, Ernie, and T. Adams, "Low-Cost Knowledge Management Techniques for Use in a Changing Workforce," TRB 90th Annual Meeting Compendium of Papers DVD	Research Paper	2011	http://trid.trb.org/view/2011/C/1092338
16	Brown, Shane, "Organizational Network Analysis for Two Networks in the Washington State Department of Transportation," Report No. WA-RD 754.1, Washington State Transportation Center (TRAC)	Report	2010	http://www.wsdot.wa.gov/research/reports/fullreports/754.1.pdf
17	CTC & Associates, LLC, "Knowledge Management in the Transportation," prepared for the WisDOT Research and Library Unit	Literature Review	2010	http://wisdotresearch.wi.gov/wp-content/uploads/tsrknowledgemanagement1.pdf
18	Camarena, Susan, "Knowledge Management in FTA," presentation at 2009 Ohio Transportation Engineering Conference	Presentation	2009	http://www.dot.state.oh.us/engineering/OTEC/2008%20Presentations/35B.pdf
19	Novack, Michael J., and Maureen Hammer, "Tacit Knowledge Transfer in a State Transportation Agency, Ohio Transportation Engineering Conference	Research Paper	2009	https://www.dot.state.oh.us/engineering/OTEC/2008%20Presentations/35A.pdf
20	Oman, Leni, "Transportation Knowledge Networks," presentation at 2009 AASHTO Information Systems Conference	Presentation	2009	http://www.wsdot.wa.gov/partners/aashtois2009/images/Presentations/TransportationKnowledgeNetworks.pdf

ID	Resource	Type	Year	Link
21	Spy Pond Partners, LLC, "NCHRP Report 636: Tools to Aid State DOTs in Responding to Workforce Challenges," TRB	Report	2009	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_636.pdf
22	Ward, Maryanne, "NCHRP Synthesis 365: Preserving and Using Institutional Memory Through Knowledge Management Practices," TRB	Report	2007	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_365.pdf
23	Lamont, Judith, "Transportation: Communities of Practice Leverage Knowledge," KM World, July 7, 2006	Article	2006	http://www.kmworld.com/Articles/Editorial/Features/Transportation-Communities-of-practice-leverage-knowledge-16905.aspx
24	Chang-Albitres, Carlos and Paul E. Krugler, "A Summary of Knowledge Management Information Gathered from Literature, Web Sites and State Departments of Transportation," Project 0-4505, Texas Transportation Institute	Literature Review	2005	http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-4505-P1.pdf
25	Liebowitz, Jay. "A knowledge management implementation plan at a leading US technical government organization: a case study." Knowledge and Process Management 10.4, John Wiley & Sons (2003): 254-259	Article	2003	http://onlinelibrary.wiley.com/doi/10.1002/kpm.184/abstract
26	Sutcliffe, K.M. & Vogus, T.J., (2003). Organizing for Resilience. In Cameron, K., Dutton, J.E., & Quinn, R.E. (Eds.), Positive Organizational Scholarship. San Francisco: Berrett-Koehler. Chapter 7 pp: 94-110	Article	2003	http://cpor.org/ro/sutcliffe-vogus%282003%29.pdf
27	Department of the Navy Chief Information Officer, "Metrics Guide for Knowledge Management Initiatives"	Guide	2001	http://cloud.snappages.com/b8898dc2c08e137d03449de65b9e82e108c15658/metricsguide.pdf
28	Derr, K.T., "Managing Knowledge the Chevron Way." Speech given at Knowledge Management World Summit. San Francisco, California.	Article	1999	http://www.chevron.com/chevron/speeches/article/01111999_managingknowledgethechevronway.news
29	Fahey, L. & Prusak, L. (1998). The Eleven Deadliest Sins of Knowledge Management. California Management Review, 40(3), 265-276	Article	1998	http://www.comp.dit.ie/dgordon/courses/researchmethods/Countdown/11DeadliestSi ns.pdf
30	Federal KM Working Group	Web Site	NA	https://sites.google.com/site/fmwgroupnasa/home

ID	Resource	Type	Year	Link
31	Knowledge Sharing Toolkit (ICT-KM Program, World Bank/CGIAR)	Web Site	NA	http://www.kstoolkit.org/
32	"Knowledge Management in Government Organizations" online course via the United Nations Pan American Network Online Training Center (Introduction to KM)	Web Site	NA	http://www.unpan.org/DPADM/ELearning/OnlineTrainingCentre/tabid/1458/language/en-US/Default.aspx
33	KMWorld monthly newsletter/magazine	Newsletter	NA	http://www.kmworld.com

Glossary

This glossary includes terms related to KM. Where possible, definitions from existing sources were utilized. In some instances, minor wording changes have been made to enhance clarity and precision. The following sources are cited as appropriate:

- AIIM - Association for Information and Image Management Glossary: http://www.aiim.org/community/wiki/view/glossary
- IRMT - International Records Management Trust (IRMT) Glossary of Terms: http://www.irmt.org/documents/educ_training/term%20modules/IRMT%20TERM%20Glossary%20of%20Terms.pdf
- ANSI/NISO Z39.19 - Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies (2005) ISBN: 1-880124-65-3 is p. 157-167: http://www.niso.org/apps/group_public/download.php/12591/z39-19-2005r2010.pdf
- SAA - Society of American Archivists Glossary: http://www2.archivists.org/glossary
- OMB Circular A-130: http://www.whitehouse.gov/omb/circulars_a130_a130trans4/
- W3C – W3C Data Catalog Vocabulary - http://www.w3.org/TR/vocab-dcat/#class--dataset

Where no reference is noted, definitions were developed by the authors, based on review of multiple existing sources. A number of other professionals have been invited to suggest terms that should be included and to review the definitions, including members of the NCHRP project panels and standing committees of the Transportation Research Board. However, responsibility for these definitions and any errors they may contain remains with the authors. We invite your comments.

Catalog. An organized, searchable, annotated list of content objects in a collection. *Example*: the National Transportation Library Catalog.

Content. Information that has been packaged in a format suitable for retrieval, re-use and publication. Content includes documents, data sets, web pages, image files, email, social media posts, video files, audio files and other rich media assets. (Source: adapted from AIIM)

Content Management. The process of establishing policies, systems and procedures in an organization in order to oversee the systematic

creation, organization, access and use of content. Content Management is a subset of Information Management. (Source: adapted from IRMT)

Content Object. An individual unit of content that may be described for inclusion in an information retrieval system, website, or other information source. A content object can itself be made up of content objects. *Examples:* Both a website and an individual web page; a journal and an article in the journal. A content object may also include metadata. (Source: adapted from ANSI/NISO Z39.19)

Data. Representation of observations, concepts or instructions in a formalized manner suitable for communication, interpretation or processing by humans or computers. *Examples*: a crash record, pavement roughness measurements. (Source: adapted from AIIM)

Data Set. A collection of data made available for access or download in one or more formats. *Examples*: a state's crash records for a single year, a database with roughness measures for pavement segments on the state highway system. (Source: adapted from W3C)

Document. Recorded data or information fixed in any media, which can be treated as a self-contained unit. May consist of one or more content objects. *Examples*: A strategic highway safety plan; a DOT transportation asset management plan. (Source: adapted from AIIM and SAA)

Explicit Knowledge. In contrast with Tacit Knowledge, this is Knowledge that has been codified and represented in a usable form. Examples: manuals, checklists, training videos.

Index. List of the contents of a file, document or collection of content objects together with keys or references for locating the contents. (Source: adapted from AIIM)

Information. Presentation of data to facilitate interpretation or understanding; may include textual, numerical, graphic, cartographic, narrative, or audiovisual forms. *Examples:* Map of high crash locations, trend line showing changes in pavement roughness over time, (Source: adapted from AIIM and OMB Circular A-130) Note: the term "information" is frequently used to refer generally to both raw data and processed or packaged data.

Information Life Cycle. The stages through which information passes, typically characterized as creation or collection, processing, dissemination, use, storage, and disposition. (Source: OMB Circular A-130)

Information Management. The means by which an organization (e.g., a department of transportation) efficiently plans, collects, creates, organizes, uses, controls, stores, disseminates, disposes of information and ensures that the value of that information is understood and fully exploited.

Keyword. One of a small set of words used to characterize the contents of a document for use in retrieval systems. May also be referred to as a "Tag." (Source: adapted from SAA)

Knowledge. The basis for a person's ability to take effective action or make an effective decision, built over time through education, work experience and interactions. *Examples*: a safety professional's understanding of what countermeasures would be appropriate in different situations, a pavement engineer's understanding of the underlying causes for pavement deterioration in a given location.

Knowledge Attrition Profile. A workforce analysis output used to understand potential future knowledge gaps in an organization. The profile (1) identifies key employees in each business area – i.e., those with specialized or unique expertise, and (2) estimates the likelihood of these individuals retiring within the next 2, 5 and 10 years.

Knowledge Capture. The process of converting tacit knowledge from individuals into an explicit form that is available to others. *Examples:* documents or videos.

Knowledge Management. An umbrella term for a variety of techniques for building, leveraging and sustaining the know-how and experience of an organization's employees.

Knowledge Transfer. Techniques for disseminating tacit knowledge and explicit knowledge across individuals and/or work units.

Metadata. Data describing context, content and structure of documents and records and the management of such documents and records through time. Literally, data about data. (Source: adapted from AIIM/ISO 15489)

Portal. An entry point, especially a web page, that provides access to information from a variety of sources and that offers a variety of services. (Source: SAA)

Search Engine. A coordinated set of programs for "spidering," indexing and querying content available on the World Wide Web. The spidering program "crawls" the web and creates a list of available pages, using the hypertext links available on each page. The indexing program creates indices based on the words and phrases included in

each content object. The query program accepts a search request and returns a set of matching results from an index, sorted using an algorithm that seeks to present the results that will be most relevant to the user based on factors including match with search term, currency, geographic location, source authority, etc.

Tacit Knowledge. Know-how, insight, judgment and intuition that an individual has gained through education and experience and brings to bear in problem solving and decision making; tacit knowledge has not been captured and represented in explicit form.

Additional Resources

This final section of the guide includes a set of templates, examples, and additional references for KM implementation. It is organized according to the four major categories of KM Elements presented in Table 1.

1. KM Leadership & Direction

- ☐ Resource 1-1: Sample KM Assessment Tool
- ☐ Resource 1-2: Virginia DOT KM Strategy Document
- ☐ Links

2. Social Learning & Communities

- ☐ Resource 2-1: Sample Communities of Practice Charter Template
- ☐ Resource 2-2: Life Cycle Model for Communities of Practice
- ☐ Resource 2-3: Community of Practice Roles and Responsibilities
- ☐ Links

3. Knowledge Codification & Dissemination

- ☐ Resource 3-1: Sample After-Action Review Template
- ☐ Resource 3-2: Creating Lessons Learned—Guidance from VDOT
- ☐ Resource 3-3: Sample Lesson Learned from the Virginia DOT
- ☐ Links

4. Succession & Talent Management

- ☐ Resource 4-1: Guidance for Cross-Generational Mentoring Programs
- ☐ Resource 4-2: Sample Desk-Side Review Interview Questions
- ☐ Links

1. KM Leadership & Direction

Resource 1-1.
Sample KM Assessment Tool

Introduction

A key part of developing a KM strategy is to find out how people gain access to and share knowledge throughout the organization. This survey seeks to gather fairly detailed information about the ways in which you access, share and use knowledge resources in your work. In answering the questions below, please keep in mind the following: answer for yourself, not how you think someone else in your job might answer; answer for how you actually work now, not how you wish you worked or think you should work.

We expect that some questions will require you to think carefully about the nature of the tasks you perform and how you interact with people both inside and outside the organization day-to-day. Carefully completing this survey will probably take about 20 minutes. We appreciate your effort in helping us meet a strategic goal designed to make the organization more effective and to make it easier for all of us to do our jobs on a daily basis.

Please forward your completed survey to _____ via email _____ by _____. Thank you!

Please provide the following information:

Name:

_____

Which division are you a part of: _____

How long have you been a full-time employee in the organization?

- ☐ Less than 6 months
- ☐ 6 months – less than 1 year
- ☐ 1 year – less than 3 years
- ☐ 3 years – less than 5 years
- ☐ More than 5 years

In the course of doing your job, which resource do you most often turn to first when looking for information? (please check only one)

- ☐ Email or talk to a colleague in the organization
- ☐ Email or talk to a colleague who works outside the organization
- ☐ Do a global web search (for example, Google, Yahoo)
- ☐ Go to a known web site
- ☐ Search on-line organization resources (for example, Intranet)
- ☐ Search through documents/publications in your office
- ☐ Post a message on a listserv/on-line community to which you belong
- ☐ Ask your manager for guidance based on his/her experience
- ☐ Other (please specify) _____

What would be your second course of action from the above list?

_____

Think about the times when you've been really frustrated by not having a critical piece of knowledge or information you needed to get something done at the organization. Give an example, including the nature of the challenge and how the need eventually was met.

_____

_____

_____

_____

_____

Knowledge Resources

How often on average do you use each of the following in your job?

	Daily	Weekly	Monthly	Quarterly	Never
Organization-wide database	❑	❑	❑	❑	❑
Organization-operated web site (e.g., intranet)	❑	❑	❑	❑	❑
Department- or division-operated database (e.g., shared calendar)	❑	❑	❑	❑	❑
My own database or contact list file	❑	❑	❑	❑	❑
Organization policy/ procedures manual or guidelines	❑	❑	❑	❑	❑
Department- or division-specific procedures manual or guidelines	❑	❑	❑	❑	❑
Vendor-provided procedures manual or guidelines	❑	❑	❑	❑	❑
My own notes or procedures	❑	❑	❑	❑	❑

List up to 5 resources (hard copy or web-based) that you use to perform your job and indicate how often you use them. These resources can be journals, magazines, newsletters, books, web sites, and so forth.

	Daily	Weekly	Monthly	Quarterly
1.	❑	❑	❑	❑
2.	❑	❑	❑	❑
3.	❑	❑	❑	❑
4.	❑	❑	❑	❑
5.	❑	❑	❑	❑

How often on average do you ask each of the following staff for help with understanding or clarifying how you are to perform your job, solving a problem, getting an answer to a question from a customer or learning how to accomplish a new task?

	Daily	Weekly	Monthly	Quarterly	Never
Your immediate supervisor	❑	❑	❑	❑	❑
Your department head	❑	❑	❑	❑	❑
Your division head	❑	❑	❑	❑	❑
Subject matter expert (in an area of policy, practice or research)	❑	❑	❑	❑	❑
Technical or functional expert (e.g., accounting, legal, contracts administration, technology)	❑	❑	❑	❑	❑
A peer or colleague in your department or division (informal)	❑	❑	❑	❑	❑
A peer or colleague outside your department or division (informal)	❑	❑	❑	❑	❑

Name the top three people, in order, to whom you go when you have questions or seek advice in the following areas:

	One	Two	Three
General advice			
Management and leadership knowledge/advice			
Subject matter expertise/content knowledge			
Institutional/historical knowledge about the foundation			
Technical/procedural knowledge			

List up to five experts outside the organization whom you access to do your job. For each one, please indicate how often on average you contact them.

		Daily	Weekly	Monthly	Quarterly
1		❑	❑	❑	❑
2		❑	❑	❑	❑
3		❑	❑	❑	❑
4		❑	❑	❑	❑
5		❑	❑	❑	❑

Knowledge Use

Which of the following do you usually use and/or perform (that is, on a daily or weekly basis) in doing your job? (check all that apply)

- ☐ Data or information from a known source (e.g., database, files) you have to retrieve to answer a specific question
- ☐ Data or information you have to gather yourself from multiple sources and analyze and/or synthesize to answer a specific question
- ☐ Instruction (step-by-step) you provide (that is, not a document) to a customer, vendor, or staff person
- ☐ Direction you provide to a customer, vendor, or staff person (such as advice, counsel or guidance, not step-by-step)
- ☐ Judgments or recommendations you are asked to make based on data or information that is given to you
- ☐ Judgments or recommendations you are asked to make based on data or information that you must find yourself
- ☐ Routine procedure or process for handling information, paperwork, requests, payments, invoices, and so forth (always done the same way)
- ☐ Variable procedure or process for handling information, paperwork, requests, payments, invoices, and so forth (requires some analysis and judgment to select the proper procedure or process to follow)
- ☐ Reports, memoranda, letters, or informational materials for customers, vendors, or staff that you must compile and/or write.
- ☐ Educational or promotional materials that you must compile and/or write
- ☐ Proposals you develop to recommend new programs, projects, procedures, or processes

After you have received, gathered, or produced information, instructions, documents, proposals, etc., and completed the task, what do you do with them? (check all that apply)

- ☐ Save them in an electronic file in my personal directory
- ☐ Save them in an electronic file in a shared directory (e.g., intranet)
- ☐ Save them in a personal paper file
- ☐ Save them in a secure departmental paper file
- ☐ Save them in an open departmental paper file
- ☐ Share them or distribute them to others
- ☐ Delete or toss them
- ☐ Other *(please specify)*

_____

Knowledge Sharing

When you come across a news item, article, magazine, book, Web site, announcement for a meeting or course, or some other information that may be useful to other organization staff, what are you most likely to do? (check only one)

- ☐ Tell them about it or distribute a copy to them personally
- ☐ Post an announcement on the intranet
- ☐ Send a broadcast email
- ☐ Send a memo or a copy through the interoffice mail
- ☐ Intend to share it but usually too busy to follow through
- ☐ Include it in the weekly update
- ☐ Ignore it
- ☐ Other (please specify)

_____

What are the constraints you face in being able to access or share knowledge?

_____

_____

_____

What critical knowledge is at risk of being lost in your department or division because of turnover and lack of back-up expertise?

_____

_____

_____

Training/Tools

When you want to learn or improve a skill or task, what do you prefer to do? (check all that apply)

- ☐ Get formal face-to-face training or course work outside the work place
- ☐ Get formal self-directed training (e.g., workbook, CD-ROM, online course)
- ☐ Have a specialist train me on-site
- ☐ Train myself (informally, using a manual or tutorial program)
- ☐ Have my supervisor show me how to do it
- ☐ Have a friend or colleague show me how to do it
- ☐ Other (please specify)

_____

What kind of tools or resources do you prefer to help you do your job? (check all that apply)

- ☐ Person I can talk to in real time
- ☐ Help line or help desk via phone, fax, or email
- ☐ Advice via online communities of practice (on the intranet, list serves, or other sources)
- ☐ Printed documents (for example, resource books, manuals)
- ☐ Electronic documents
- ☐ Audiovisual/multimedia material
- ☐ Special software
- ☐ Web-based utility, directory, or service
- ☐ Other (please specify)

_____

Knowledge Needs

What information or knowledge that you don't currently have would you like to have to do your job better? Consider all aspects of your job, including administrative tasks, policies and procedures, interpersonal relationships, and so forth.

_____

_____

_____

What information or knowledge that the organization currently does not have do you think it should or will need to have to execute its mission, improve organizational effectiveness, and serve its customers with excellence? (You may answer for specific departments as well as for the organization as a whole.)

_____

_____

_____

To what extent do you agree with the following statements:

	Strongly disagree	Disagree	No opinion	Agree	Strongly agree
I would benefit from having access to documents that contain introductory knowledge that I currently have to acquire from experts directly.	❑	❑	❑	❑	❑
I would benefit from templates to help me more easily capture knowledge (e.g., standard format for documenting what I learned at a conference or meeting).	❑	❑	❑	❑	❑
I would benefit from processes to help me contribute knowledge that I don't currently document or share.	❑	❑	❑	❑	❑

	Strongly disagree	Disagree	No opinion	Agree	Strongly agree
I would benefit from support to determine the most relevant knowledge to share for various audiences and how best to share it.	❑	❑	❑	❑	❑
I have knowledge in areas that I know the organization could benefit from but no way to make it available.	❑	❑	❑	❑	❑

Knowledge Flow

Imagine that you've just won the first organization Knowledge Sharing Award. This award is given to a person who shares his or her mission- or operation-critical knowledge so that the organization can be more effective. List the top five categories of knowledge that earned you this award and the category of staff with whom you shared it.

	Knowledge Category	Staff Category
1.		
2.		
3.		
4.		
5.		

How can the knowledge flow in your area of responsibility be improved?

Additional Comments

Thank you for taking the time to complete this survey!

Source: Liebowitz, J. (2008), *Making Cents Out of Knowledge Management*, Scarecrow Press/Rowman & Littlefield, Lanham, MD.

Resource 1-2. Virginia DOT KM Strategy Document

KM, Defined

KM provides applied Business Research and Analysis for VDOT.

An institution is a formal organization of people who know how to provide a specific service or function. For example, VDOT's primary functions are to build, maintain, and operate the roadway system, and it has a rich tradition where people develop deep expertise to do so over decades. To support this primary mission, VDOT has also developed ways to

- Train people both formally and informally,
- Provide logistical support,
- Manage finances,
- Negotiate with the public,
- Work with outside contractors,
- Partner with other agencies,
- Comply with local, state, and federal regulations,
- Conduct research, and more.

Each of these activities also requires a specialized knowledge discipline, and, in an organization that is divided into both divisions and regional areas of responsibility, the manner in which those diverse knowledge disciplines interact grows exceedingly complex, even conflicted.

Handling this complexity and minimizing conflict requires the institution to manage two things simultaneously, information and knowledge. These are often treated as the same thing because of the way they interact, but it is important to understand that they are different things, with specific properties, and therefore present different challenges and require different support structures and management strategies.

Information is captured in documentation and stored in all manner of media, from sticky notes to libraries and databases. Information Management (IM) emphasizes findability, accessibility and accuracy.

Knowing resides only within the person. KM is supported by technology, but focuses on people and emphasizes understanding, collaboration, and choice.

If we only needed information to get things done, then institutions would just need manuals and procedures, but it takes more than information to perform a function, particularly one as complex as

VDOT's; it takes people who not only know what to do and how to do it, but why to do it a particular way. Understanding, negotiating, and fostering these ways of knowing to improve institutional effectiveness and efficiency may be described as KM.

Ultimately, KM may be defined as an effort to develop self-awareness in a corporate context, and on an institutional scale. The benefit of developing a KM program along these lines is that once self-awareness is institutionalized it becomes part of the way people know their work. Together, IM and KM may be seen as an interactive spectrum of activities. IM deals primarily with questions like who, what, when, where, and how? KM deals primarily with why?

Information Management		Knowledge Management
Staff	Project / Program Manager	Director
Who? What? When? Where? How?		Why?

Knowledge Management products and services may be displayed across a similar spectrum:

• Inside VDOT • Lessons learned • Process documentation • Oral histories • Business continuity documents • Best practices • Document repositories and governance • Library collection • Literature searches • Research synthesis bibliographies • VDOT Wikipedia • Knowledge portal	• Business Process Analysis • Communities of Practice • Conflict negotiation • Critical knowledge identification • Facilitation • Interviews • Knowledge Mapping • Organizational Network Analysis • Process management	• Competitive Intelligence Research • Business Research • Operations Research • Problem analysis • Issue identification • Conceptual analysis, design, and development • Wicked Problem Solving • Professional, Leadership, and Management Coaching

KM Outcomes include:

- Improved business practices, relationships, and management
- Collaboration within and between functions

Of course, we need all the informational details to do our jobs, but people work best when they know that what they are doing and how they are doing it matters, and that means they need to know *why*. Why are we doing this? Why are we doing it this way?

VDOT KM Techniques

Communities of Practice (CoPs)

CoPs support the transfer of tacit knowledge from one employee to another through project teams for increased efficiency and effectiveness. They work to create intra-agency networks and share best practices that have resulted in new tools and changes in processes – for engineers, they can create an atmosphere that fosters the solving of similar problems.

VDOT has been employing the use of CoPs since December of 2003. Since that time there have been approximately 70, with some having a finite beginning and end and some extending over a long amount of time. There are CoPs managed directly by the KM while others can self-manage, keeping KM informed. CoPs span geographic regions, use dialogue and learning to ensure agency consistency, and foster innovation through the discovery of new ways to perform functions and obtain results. The intention of an exercise such as a CoP is to better the agency as a whole through employee communication.

Knowledge Mapping

Knowledge mapping is used to help identify areas of need for succession planning and to build networks. This tool is used on a case-by-case basis and can take different forms, such as a network analysis map or a matrix. KM employs this method at the request of executives and it is used in reference to specific knowledge areas

Lessons Learned Initiatives

The Lessons Learned Initiative was formalized with VDOT's Construction Quality Managers in 2007. A CoP was established specifically to encourage a culture of sharing knowledge by construction field staff. Its purpose was to capture lessons from previous experiences that are shared across VDOT; moving tacit knowledge to documented explicit knowledge for future use. The CoP reviewed the lessons for best practices that resulted in changes in processes, procedures, and contract language. At this time, 176 physical Lessons Learned documents have been produced from these learning sessions, spanning a wide array of topics. Of these documents, 100 were written and distributed by a single unit of engineers. These are now archived and were created prior to the formalization of the Lessons Learned Initiative and therefore were not

peer reviewed. The remaining 76 documents were peer-reviewed by multiple functions throughout the agency to ensure accuracy prior to publishing. Fifty-eight are current and 18 archived.

Process Mapping

KM uses a standard process that brings together experts to help map out processes and provides supporting documentation for the map that clearly outlines steps and accountability. The maps attach processes across separate functions, providing a clearer picture of how VDOT operates and documents methods for sharing knowledge.

Electronic Access

The VDOT Research Library provides access to resources with a focus on electronic access. VDOT has a state-of-the-art library catalog and access to several transportation- and business-related databases (such as the National Technical Reports Library with more than 500,000 articles and Books24x7 with more than 18,000 books).

Related links

KM Strategy (full version):

http://polaris.umuc.edu/de/csi/2010_JayLiebowitz/ppt_syn/KMStrategy/KMStrategy_full_version.html

2. Social Learning & Communities

Resource 2-1. Sample Community of Practice Charter Template

Community Name:

(Identify the name of the community, e.g., Logistics CoP)

Community Membership/Audience:

(Identify the functional types that the community is targeting or is trying to attract)

Community Purpose/Intent:

(Identify the purpose/intent of the community)

Community Scope:

(Identify the specific areas/issues that the community is interested in addressing)

Community Roles:

(Identify by name the individuals who are filling roles)

Sponsor:_____

Leader/Facilitator: _____

Content Editor: _____

Critical Business Issues:

(Identify the critical business issues faced by the community)

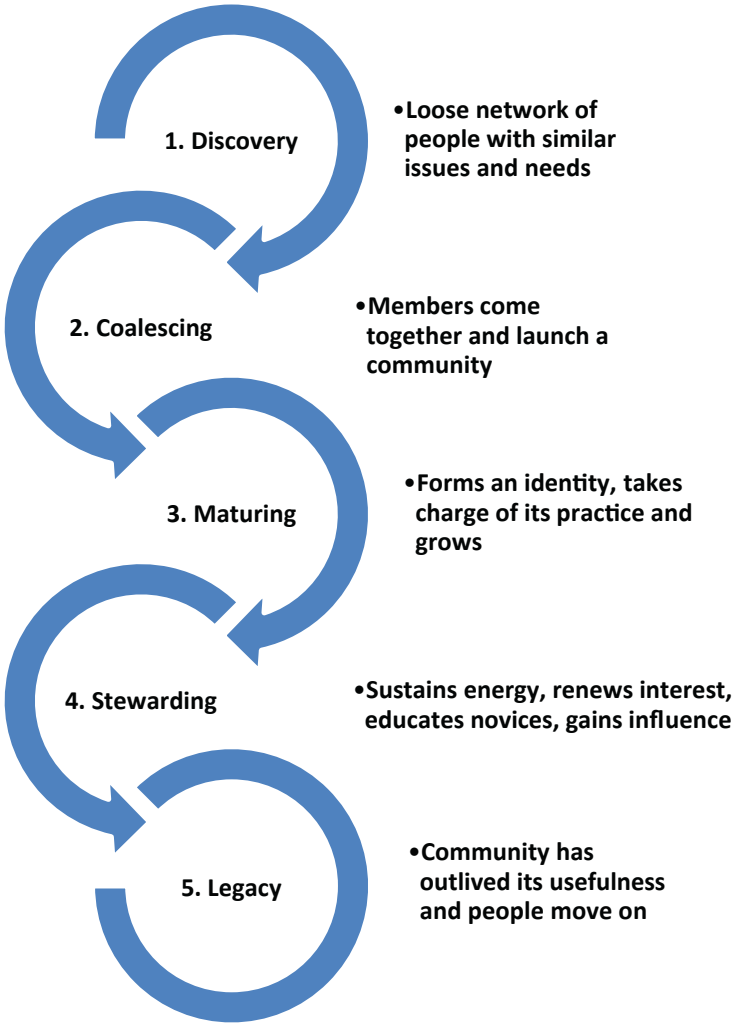
Resources:

(Identify the resources required to support the community – e.g., meeting space, videoconferencing, facilitation services, online portal or wiki, etc.)

Measures of Success:

(Identify how the community defines success and how this will be evaluated and reported)

Resource 2-2. Life Cycle Model for Communities of Practice



Source: Adapted from E. Wenger, R. McDermott, and W. Snyder, *A Guide to Managing Knowledge: Cultivating Communities of Practice*, Harvard Business School Press, Boston, 2002.

Resource 2-3. Community of Practice Roles and Responsibilities

Community Sponsor or Champion

- ☐ Bolsters community membership by spreading the word
- ☐ Provides resources for expansion and usually "sponsors" the community leader and facilitator roles in the community

Community Leader

- ☐ Organizes and coordinates start-up activities
- ☐ Assists community development by establishing and articulating community purpose and strategic intent
- ☐ Provides continuous nourishment for the community
- ☐ Acts as a sounding board for ideas

Subject Matter Expert (SME)

- ☐ Enriches information by summarizing, combining, contrasting, and integrating it into the existing knowledge base

Content Editor

- ☐ Responsible for content within his or her respective area(s)
- ☐ Works with SMEs to identify and map critical knowledge objects and to develop logical organization of content, making it readily available and easily accessible to members

Facilitator

- ☐ Fosters and facilitates member interactions
- ☐ Ensures that community forums are productive for all members by acting as an independent community process expert
- ☐ Seeks out potential content contributions
- ☐ Serves as a knowledge broker

Community Member

- ☐ Members participate because they get value from their participation
- ☐ Shares knowledge, experiences, and lessons learned
- ☐ Suggests contributions
- ☐ Participates in discussions, answers questions

Source: Based on: Defense Acquisition University, Community of Practice Implementation Guide: https://acc.dau.mil/adl/en-US/170879/file/31851/CoP_Guide_v4_May2012.pdf

Related links:

- FHWA Discipline Support System – presentation: http://ashr.transportation.org/Documents/FHWA%20Knowledge%20Management%20Discipline%20Support%20System.pptx
- Defense Acquisition University, Community of Practice Implementation Guide: https://acc.dau.mil/adl/en-US/170879/file/31851/CoP_Guide_v4_May2012.pdf
- Educause Community of Practice Design Guide: http://net.educause.edu/ir/library/pdf/nli0531.pdf
- Wenger, Etienne, B. Trayner, M. de Laat, "Promoting and Assessing Value Creation in Communities and Networks": http://wenger-trayner.com/wp-content/uploads/2011/12/11-04-Wenger_Trayner_DeLaat_Value_creation.pdf
- Centers for Disease Control Community of Practice Resources: http://www.cdc.gov/phcommunities/resourcekit/resources.html
- Video: Social Network Analysis: http://polaris.umuc.edu/de/csi/2010_JayLiebowitz/ppt_syn/KMSocialNetwork/KMSOcialNetwork_full_version.html

3. Knowledge Codification & Dissemination

Resource 3-1. Sample After-Action Review Template

Project/Milestone:

_____

Date of Review:

_____

Recorded By:

_____

What went right?

_____
_____
_____
_____

What went wrong?

_____
_____
_____
_____

How do we fix things to be sure that they don't go wrong again?

_____
_____
_____
_____

Resource 3-2. Creating Lessons Learned – Guidance from VDOT

How to Produce a Lesson Learned: Pointers and Tips to Make the Process Work

Creating a Lesson

- ☐ First of all remember, you are the expert! You do the work. Your knowledge and experience are valuable assets to VDOT, particularly if you are good at your job and can share ways to do what you do better.
- ☐ In choosing a lesson, pick a topic that is worthwhile to be shared with people who work in your area of expertise. The lesson can be a description of a more efficient way to accomplish a job, can be shared information about a new process, standard, or specification that is required, or even can be in the form of a warning of how best to avoid a common mistake.
- ☐ Whatever the topic, stay focused on the lesson and how it can benefit those to whom it is directed. You want to convey the information in the quickest, simplest, and most direct manner.

Using the Process

- ☐ Form a peer group to discuss lessons. Get feedback from the people with whom you work to bring forth and validate lesson ideas. Get their input. Your peers can help you keep focus and can and will contribute ideas and resources to improve your lesson, but only if you ask for their assistance. Include colleagues from other divisions or work units with whom you interact in the work on the lesson topic.
- ☐ A big part of the lesson is the process used to create it. By involving others with whom you work to get their input and feedback and have them validate that the lesson is accurate and worthwhile, the lesson is reinforced within that peer group of experts and vetted for sharing with others. If you are not sure about something, ask the colleague(s) whom you recognize as the expert(s) on the topic of your question.
- ☐ Avoid policy, human resources, or legal issues unless you set policy, work in HR, or provide legal advice to VDOT. Lessons are not forums for discussion of issues beyond your control. Stick with what you know in the field in which you work.

The Lesson Document

- ☐ Write clearly and get to the point quickly. Explain as best you can as if you were telling someone the lesson. Have others read and review it to make sure what you write is accurate and understandable. Limit how much you write. More than two pages may be too many.
- ☐ If a diagram or photo can improve the lesson, use it. Use of photos or illustrations as examples can save a lot of writing.
- ☐ Use hyperlinks in the lesson so readers can go to sources that are cited and get more information from the source material immediately with a click.
- ☐ Create a template. If developing a group of lessons, create a template similar to the one used here (see Resource 3-3). The template helps provide focus and space for each element necessary to write a complete lesson; provides a framework for familiarity by readers; helps to limit lesson size; and includes repetitive elements like the title header at the top of page 2 and the disclaimer in the footer.
- ☐ List the lesson contributors so they may be contacted for questions regarding the lesson topic.

Resource 3-3. Sample Lesson Learned from the Virginia DOT

VDOT

Construction Lesson Learned

August 2012

Installation Considerations for Sheet Piles

Lesson

At least two construction methods for installing sheet piles should be considered when performing constructability reviews for projects using sheet piles. Contractor's bids may be lower when they are provided more flexibility in design. The primary difference between the two methods described below is the increased minimum clearance between electrical distribution and transmission lines and any part of a crane or its load required by the Occupational Safety and Health Administration (OSHA).

VDOT Specification and OSHA Documentation

2007 Road and Bridge Specifications Section 402 – Sheet piles

OSHA Small Entity Compliance Guide for Final Rule for Cranes and Derricks in Construction

Explanation

OSHA regulations require the maintenance of a minimum clearance between electrical distribution and transmission lines and any part of a crane or its load. Installation of sheet piles can result in conflicts with overhead electrical distribution and transmission lines if proper relocation of utilities is not performed before actual construction begins.

One method of installing sheet piling is to drive the first pile to depth, then drive the second pile to depth, then all other piles in the same manner. This method includes using templates instead of leads to align the sheet piles. For a 35'-long sheet pile, the clearance of the crane or its load required to perform the work is equal to the height of sheet piling (35') + the height of hammer, tackle and boom (say 20'), plus the minimum distance required by OSHA: A height of *55' + OSHA requirement.*

Installation Considerations for Sheet Piles

Explanation

A second method for installing sheet piles is to drive the first sheet pile until it is self-supporting (approximately 5') and then insert the next piece of sheet pile by sliding the interlock of the second into the first and driving the second sheet pile approximately 5'. This process is repeated until 4 to 6 pieces of sheet pile are in place and driven to approximately 5'. The contractor then returns to the first pile and drives it to half depth and continues this process with the remaining piles. The contractor repeats this driving process and drives all piles to design tip elevation. This method includes using the adjacent self-supporting piles instead of leads to align the other sheet piles. For the same length of pile (35') as the first method, the clearance of the crane or its load required to perform the work is equal the height of sheet piling after driving 5' (30'), the height of sheet piling (35') + the height of hammer, tackle and boom (say 20'), plus the minimum distance required by OSHA. A height of *85' + OSHA requirement.*

Incorrect assumptions for the required distance clearance required for the placement of sheet piles can result in improper power line relocation and affect the project's critical path, thereby delaying project completion.

Options to Minimize Problems

Constructability reviews should take into account reasonable and normal methods for construction activities, especially where sheet pile installation is a feature of the construction work.

Audience

Area Construction Engineers
Construction Managers Inspectors

Contributors

Stephen Wilson, Fredericksburg Construction
David Steele, P.E., Fredericksburg Construction

For additional information related to Knowledge Codification and Dissemination, see:

- ☐ Video: Knowledge Retention: http://polaris.umuc.edu/de/csi/2010_JayLiebowitz/ppt_syn/retention_full_version.html
- ☐ NASA APPEL Knowledge Sharing Initiative: http://appel.nasa.gov/knowledge-sharing/
- ☐ USAID After-Action Review Guide (Introduction/Technical Guide): http://pdf.usaid.gov/pdf_docs/pnadf360.pdf

4. Succession & Talent Management

Resource 4-1. Guidance for Cross-Generational Mentoring Programs

In today's organizations there is a mixture of employees across multiple generations (e.g., Baby Boomers, Gen X'ers, Gen Y'ers/Millennials, etc.). To maximize collaboration and communication, cross-generational mentoring is a critical component of developing a sound human capital strategy for the agency. This will allow knowledge, lessons learned, and best practices to be transferred across individuals with different experiential backgrounds. Reverse mentoring (junior to senior), in addition to traditional mentoring (senior to junior) can be included as part of the cross-generational mentoring program. Based on the review of the literature, best practices, and industry reports regarding cross-generational mentoring, there are five strategies that agencies can use to implement a successful cross-generational mentoring program:

1. Develop a formal mentor-mentee agreement with roles and responsibilities.
2. Apply a hybrid approach to mentoring with "formal" classroom training and "informal" learning mechanisms.
3. Alternate meetings each month between formal classroom setting and meet-at-lunch get-together.
4. Build mentoring into the Recognize and Reward structure and annual performance review. This can be included as one of several learning and knowledge sharing proficiencies considered as part of the annual review.
5. Encourage "reverse mentoring" in technology-related areas with those Baby Boomers who are willing to be mentored by the Millennials.

1. Develop a Mentoring Agreement

A standard mentoring agreement to use during the mentoring program typically contains the following [1]:

- ☐ The roles, responsibilities, and expectations during the program duration for a mentor and mentee;
- ☐ An action plan completion date;
- ☐ The number of times (frequency) the mentor and mentee will meet;
- ☐ A confidentiality clause between the mentor and mentee;

- ☐ Termination of agreement rules; and
- ☐ Signatures of both the mentor and mentee.

This agreement can be included in one's Individual Development Plan [1]. It is also important to have evaluation points during the mentoring process. In 2010, the US Office of Personnel Management mandated that Kirkpatrick's model (Kirkpatrick Partners, http://www.kirkpatrickpartners.com) must be used by all federal agencies. In Kirkpatrick's model, there are 4 levels of learning: Level 1: Reaction (engagement, relevance, customer satisfaction); Level 2: Learning (what was learned?); Level 3: Behavior (applied learning to on-the-job performance?); Level 4: Results (leading indicators, desired outcomes). Agencies should apply this model, or a similar one, to evaluate the effectiveness of their mentoring program at 6- to 12-month intervals during the mentoring process.

Also, an orientation program should be created for both the mentor and mentee. Orientation is usually a half to a full day. It can include a workshop or session on tools and techniques to begin and enhance a mentoring relationship. Exercises during the orientation should allow mentors and mentees to practice the tools and techniques presented to them [1].

2. Use Both Formal and Informal Learning Techniques

The "formal" classroom training could include "do's and don'ts" through war stories/organizational narratives, hot topic tutorials, before/during/after-action reviews with case studies, group projects to encourage active learning and collaboration, and interactive computer-based simulations (to take advantage of the "video game" generation).

"Informal" learning mechanisms include online communities of practice (CoPs), Mentoring blogs, project team wikis; Knowledge Map on the intranet (FAQ→Answers →Documents→Web sites→People/Depts), use of e-learning and social networking sites, online video tutorials, Wikipedia for the agency, "agency" book (e.g., NASA has "Spacebook"—Facebook for internal NASA employees), and online mentoring if in different geographic locations.

3. Alternate Meetings Between Formal Classroom Setting and Meet-at-Lunch Get-Togethers

The research shows that Millennials like both formal classroom training and informal learning approaches. Both approaches, per Recommendation Two, should be used. By alternating the formal-informal learning settings, this will capture the interests of the Millennials so the mentoring doesn't fall into a rut. The informal

learning mechanisms, as previously highlighted under Recommendation Two, should be utilized throughout the mentoring program to enhance the enthusiasm of the Millennials, per their collaborative and network-centric learning styles. This will also provide a continual mentoring and knowledge sharing process between not just the designated mentor and mentee, but through knowledge exchanges with other mentees, peers, and mentors at the agency.

4. Build Mentoring into the Recognition and Reward Structure and Annual Performance Review

As an example, Merkle Inc. (one of the leading customer relationship marketing/data mining companies—www.merkleinc.com) started Merkle University as an internal mechanism to promote learning and knowledge sharing. Each employee, even the executives, must teach a certain number of hours within the internal Merkle University, as well as take a certain number of hours of courses from others within Merkle University. This requirement is part of the annual performance review process and is also built into the company's recognition and reward structure.

According to the literature, extrinsic motivators (rewards) are temporary and intrinsic motivators (recognition) are more lasting and permanent. For the Millennials and others, recognition is often more important to them than actual rewards (although, rewards like getting time off from a day of work for good performance resonates well with the Millennials, too). Mentors and managers should send an email to their mentees and employees, respectively, within 24 hours of the mentee/employee doing something "good" for the organization. In terms of recognition, Fluor, for example, celebrates its knowledge communities during its annual "Knowvember" campaign [2]. The World Bank has used learning and knowledge sharing proficiencies as part of its annual performance review to promote a continuous learning organization.

5. Use Reverse Mentoring, Too

When most organizations think of mentoring, they usually think of the senior (by age) employee mentoring the junior employee. However, there are various technology areas, for example, where the younger employee (Millennial) could mentor the older employee (Baby Boomer). Agencies should use both regular and reverse mentoring with the caveat that all parties must be willing to be engaged in either the regular or reverse mentoring. In all cases, there must be interpersonal trust and respect for mentoring to take place.

Companies like GE, Siemens, and Procter & Gamble use reverse mentoring widely, particularly in technology areas.

If these five strategies are followed, agencies should have an enhanced mentoring program that will take into account cross-generational mentoring issues and techniques. This will ultimately lead to creating and nurturing a knowledge sharing culture for building the next generation of agency engineers and managers and instilling continuous learning within the agency for organizational success.

References

1. US Office of Personnel Management (2008), Best Practices: Mentoring, Washington, DC, September.

2. Ball, K. and G. Gotsill (2011), Surviving the Baby Boomer Exodus: Capturing Knowledge for Gen X and Y Employees, Course Technology/Cengage Learning.

Resource 4-2. Sample Desk-Side Review Interview Questions

1. What are the top 10 questions people ask in your area? What documents are available to help answer these questions? What people could provide answers to these questions?
2. Please describe the main business processes used in your area. Then, provide some helpful hints/tips/lessons learned based on your experience in terms of navigating through each of these processes.
3. What is the most difficult decision you have had to make in your current position? How did you reason through this process?
4. What are the top 5 lessons you have learned that you would want to pass on to your successor?
5. Knowing what you know now, if you could travel back in time to when you started in your current position, what advice would you have given yourself?
6. Talk aloud as you step through a typical scenario that involves an everyday type of decision that you need to make. This may be a reasoning process that takes 15 minutes or so to describe.
7. If you were developing a succession plan for your department, what are the critical components that you feel should be covered?

For additional information related to Succession & Talent Management, see:

- ☐ United States Office of Personnel Management – Best Practices: Mentoring: https://www.opm.gov/policy-data-oversight/training-and-development/career-development/bestpractices-mentoring.pdf
- ☐ United States Office of Personnel Management Practitioner's Guide – Talent Management - http://www.opm.gov/policy-data-oversight/human-capital-management/reference-materials/practitioner%E2%80%99s-guide/talentmanagement.pdf
- ☐ Alberta Government Human Services, Succession Planning – Retaining Skills and Knowledge in Your Workforce: https://alis.alberta.ca/pdf/cshop/successionplanning.pdf

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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