1 # Knowledge Management as part of Strategic Workforce Development in
2 # Transportation Agencies
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1 **ABSTRACT**
2
3 Organizations facing turnover of employees due to retirements, new demands, budget
4 constraints, and other unforeseen circumstances are at risk for large amounts of critical
5 knowledge walking out the door unless steps are taken to preserve it within the organization.
6 Organizational support of knowledge transfer mechanisms that address both the tacit (unwritten
7 experience) and explicit (codified) knowledge is vital to avoid this loss and to quickly on-board
8 new employees. This submission provides a synopsis of NCHRP Project 20-81 and resulting
9 Report 685, entitled: *Guide to Implementing Strategies to Attract and Retain a Capable*
10 *Transportation Workforce* as it relates to implementing successful KM programs within
11 transportation agencies. This paper also highlights the importance of KM programs in larger
12 workforce development efforts while providing supplemental KM research and lessons learned.
13 Finally, we provide a detailed description of the Virginia Department of Transportation's award-
14 winning knowledge management program.

1 **INTRODUCTION**
2
3   Researchers and transportation leaders alike agree that the industry is experiencing a
4 growing number of challenges related to organizational development and human resources
5 management (e.g., NCHRP 693, 2012; NCHRP 685, 2011; NCHRP RRD 379, in press; *TRB*
6 *Special Report 275*, 2003). AASHTO's influential *The Changing DOT* report depicts state
7 transportation agencies increasingly looking to strategic management practices borrowed from
8 the private sector as a guide for undertaking what is characterized as a "reinvention of
9 government" in response to "continuous, permanent change, as distinct from one-time initiatives
10 (AASHTO, 1998)." An underlying premise of *The Changing DOT* is that DOTs operate in a
11 constantly-shifting business environment, which holds even truer today. Pressure to make
12 government more efficient and more accountable, shrinking gas tax revenues, and a shift from
13 building to maintaining the Interstate system are some of today's biggest external drivers for
14 organizational change in DOTs.
15
16   At the same time, the retirement of the "Baby Boomer" generation has been cited as one
17 of the greatest challenges facing transportation organizations. This issue has been downplayed in
18 recent years due to the recession and the delay of many departures; however, the fact remains
19 that a bubble of retirement-eligible employees is growing and a significant number of senior-
20 level employees will be exiting DOTs over the next 5-10 years. Those eligible to retire, in many
21 cases, are the individuals who possess specialized knowledge and unique experiences that are
22 critical for efficient operation of the organization (Rothwell & Poduch, 2004).
23
24   With these changes, DOTs are at risk of or are already experiencing knowledge loss at a
25 time when they most need efficient access to current and historical knowledge. Thus, moving
26 forward, it will be essential for the transportation industry to proactively invest in organization
27 and workforce development efforts such as knowledge management (KM). KM emerged in the
28 late 1980s and early 1990s as a response to the realization that valuable organizational
29 knowledge, the collective knowledge that makes a company unique, was at risk and that the loss
30 could compromise a company's ability to compete or operate in an increasingly-complex
31 environment. KM is the identification, collection, organization and dissemination of critical
32 knowledge within an organization (Rubenstein-Montano, Buchwalter and Liebowitz, 2001). The
33 goal is to identify what knowledge is needed now and in the future, where that knowledge is
34 located (e.g., people, systems, artifacts, culture, standard operating procedures), who needs it and
35 how to best disseminate or transfer it.
36
37   Organizations facing turnover of employees due to retirements, new demands, budget
38 constraints, and other unforeseen circumstances are at risk for large amounts of critical
39 knowledge walking out the door unless steps are taken to preserve it within the organization.
40 Organizational support of knowledge transfer mechanisms that address both the tacit (unwritten
41 experience) and explicit (codified) knowledge is vital to avoid this loss and to quickly on-board
42 new employees. Tacit knowledge originates with the individual and it is necessary for that
43 knowledge to transfer from person to person to be useful to the organization. Once the
44 knowledge is codified and made explicit, it no longer belongs solely to the individual but rather
45 the organization owns it and can make it available to all employees, which benefits the
46 organization through increased efficiency and effectiveness.

1
2   This submission provides a synopsis of NCHRP Project 20-81 and resulting Report 685,
3   entitled: *Guide to Implementing Strategies to Attract and Retain a Capable Transportation*
4   *Workforce* as it relates to implementing successful KM programs within transportation agencies.
5   This paper also highlights the importance of KM programs in larger workforce development
6   efforts while providing supplemental KM research and lessons learned. Finally, we provide a
7   detailed description of the Virginia Department of Transportation's award-winning knowledge
8   management program.
9
10 **SUMMARY OF RESEARCH**
11
12   In this section, we provide an overview of our research for this submission. The bulk of
13 the research described was conducted as part of NCHRP Report 685. Results of this effort
14 demonstrate that the workforce development life-cycle is comprised of numerous inter-related
15 human resource management processes and that knowledge management systems are a vital
16 aspect of successful workforce development efforts. KM programs are vital since they are
17 necessary to capture critical institutional data which then feeds other processes. For example, the
18 data captured in the knowledge management system can be used to identify the applicants with
19 the right skills, to train staff (i.e., developing internal staff skills and leadership development), to
20 improve or inform performance appraisals (i.e., anticipating & managing performance issues), to
21 prepare individuals for promotion to leadership positions (i.e., promoting existing staff and
22 succession planning), and more.
23
24 To execute NCHRP 685, we conducted the four core tasks that are described here:
25
26 *Task 1: Conduct Literature Review to Understand Critical Workforce Development Issues and*
27 *Functions.* The goal of the literature review was to develop a deeper and broader understanding
28 of the issues and proven solutions used to recruit, develop, and retain a capable transportation
29 workforce. The literature review was structured to identify and assemble information from
30 published and unpublished research, technical reports, conference presentations, and case
31 studies. The review included a comprehensive analysis of over 170 sources, which included
32 numerous workforce articles from the transportation literature as well as a review of materials
33 from related industries. Once this information was analyzed, 15 critical and interrelated
34 workforce functions were identified through the literature review.
35
36 Exhibit 1 provides an overview of the transportation workforce pipeline and illustrates that the
37 15 critical and interrelated workforce functions identified through the literature review support
38 the entire workforce development life-cycle.
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Exhibit 1
Overview of Transportation Workforce Pipeline with
Critical and Interrelated Workforce Development Functions
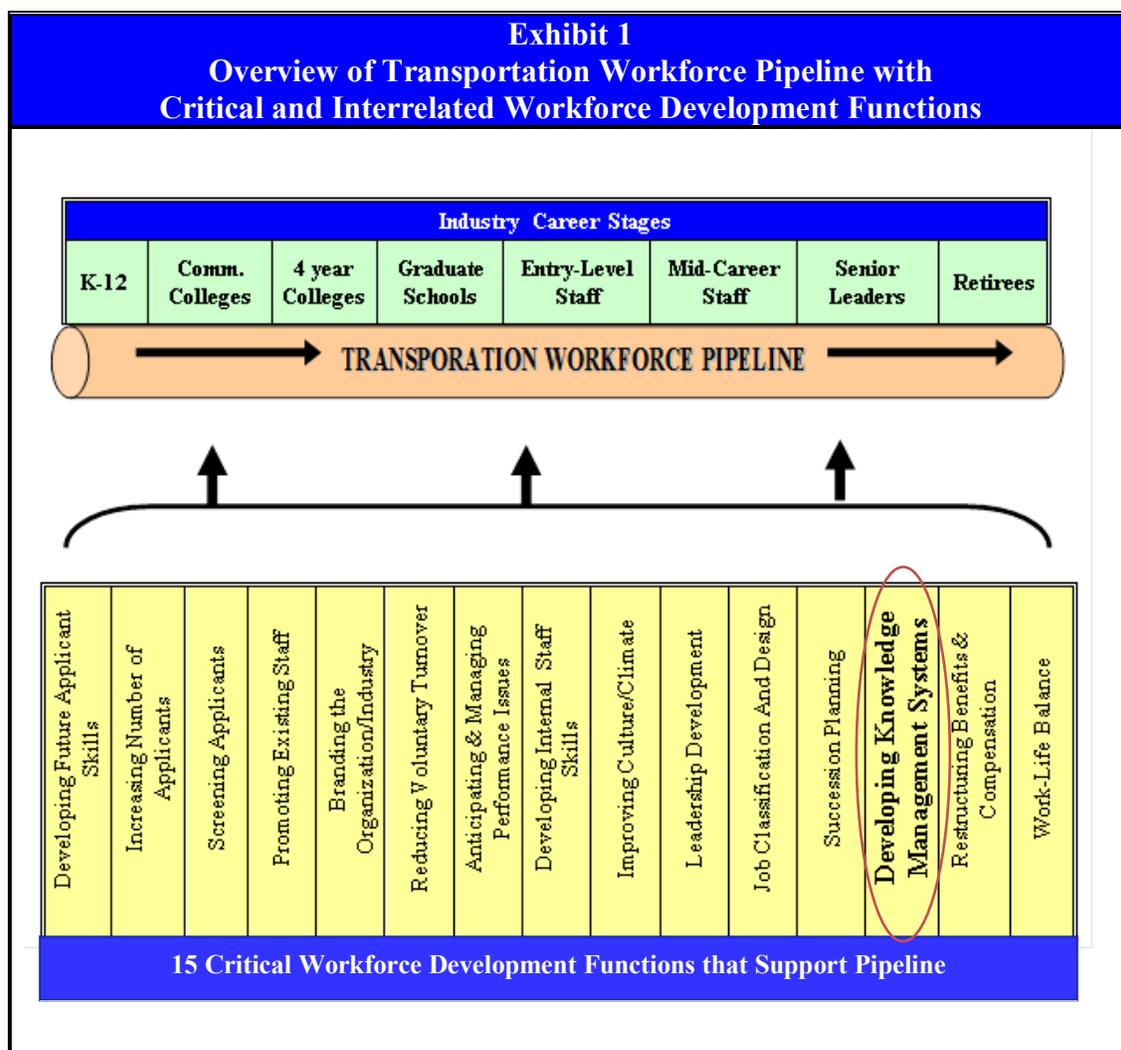
2
3 Please note that the NCHRP 685 literature review findings underscore that developing KM
4 systems is equally critical to many other workforce development functions that often receive
5 more attention and resources such as screening applicants and leader development. Given these
6 findings, it is important for transportation organization to more fully understand KM's value and
7 how to implement KM programs.
8
9 *Task 2: Conduct Benchmarking Study to Gain Detailed Understanding of Workforce*
10 *Challenges and Current Strategies.* The objective of Task 2 was to build on the literature review
11 results by collecting qualitative data. This involved conducting focus groups with over 30
12 professionals who make HR decisions inside and outside of the transportation industry. Through
13 this process, we collected more detailed information regarding the challenges facing agencies,
14 current workforce strategies and techniques, and practical tools that may be applied by
15 transportation agencies.
16
17 Input from industry leaders during the focus groups emphasized the importance of investing in
18 all functions of the workforce development lifecycle. Results also underscored the relevance and

1   criticality of KM. It was during Task 2 that the Virginia Department of Transportation's
2   (VDOT's) Knowledge Management (KM) program was identified as a successful program.
3   Results indicated that VDOT's KM program was a model for other DOTs and had successfully
4   integrated with other VDOT human resource functions.
5
6   ***Task 3: Conduct Case Study Analysis of Successful Workforce Practices.*** In Task 3, results
7   from the first two tasks were analyzed and 25 successful workforce development programs were
8   identified across the 15 workforce functions listed in Exhibit 1. It was determined that each of
9   the 25 programs provided valuable examples and guidance to human resource professionals and
10   hiring managers in the transportation industry. To fully understand the intricacies of
11   implementing and managing the practices, in-depth cases studies were conducted on each of the
12   25 practices. Based on our research, it was determined the VDOT KM program should be
13   included as part of the Task 3 case study analyses.
14
15   The VDOT KM case study is highlighted later in this paper. Like all the case studies, the
16   information presented for the VDOT case study is organized into six broad topic areas: 1.
17   Organizational and Interviewee Background Information, 2. Practice Background, 3.
18   Maintenance, 4. Evaluation, 5. Transferability, and 6. Conclusions.
19
20   ***Task 4: Develop Report 685 Guidebook of Effective Workforce Strategies including***
21   ***Knowledge Management Chapter.*** Based on the research described above, a guidebook of
22   effective workforce strategies was created. The guide included a complete chapter on knowledge
23   management challenges and strategies. It also summarized all research conducted, described the
24   methodology employed in all project tasks, provided project results, and offered effective
25   strategies for building a capable transportation workforce across the other workforce functions
26   noted in Exhibit 1. Key findings offered in the guidebook related to knowledge management are
27   described in the next sections of this submission and will be highlighted at the TRB conference.
28
29   **PROJECT RESULTS: KM CHALLENGES AND STRATEGIES**
30
31   Research results indicated that there are numerous knowledge management challenges facing
32   transportation organizations and these challenges are interconnected with other important
33   workforce processes. Exhibit 2 provides an overview of five KM challenges identified through
34   NCHRP Report 685 supplemented by additional research for this submission.
35

Exhibit 2 Industry Challenges related to Developing Knowledge Management Systems	
Lack of Leadership Support	Organizations are challenged with obtaining buy-in from leaders regarding new KM initiatives. Research indicated that Human Resource representatives sometimes struggle to find ways to indicate the bottom line impact of reactive knowledge management or simply letting institutional knowledge leave with employees exiting the organization.

Exhibit 2 Industry Challenges related to Developing Knowledge Management Systems	
Difficulties facilitating Knowledge Transfer	Results indicated that organizations are challenged with finding a way to facilitate transfer of knowledge from baby-boomer workers who are retiring to younger workers if a strategic process has not been implemented by the agency. When knowledge transfer does not occur and an employee leaves an organization, the individual filling the position will take longer to become as productive as the original employee due to a learning curve with the process of coming on board. This leaves employers constantly "reinventing the wheel," thus costing valuable resources such as time and money.
Fleeting Institutional Knowledge	Research indicates that loss of institutional knowledge associated with the baby-boomer retirement has been compounded by the trend of many DOTs using contractors to complete projects. Thus, less and less institutional knowledge exists with a given DOT's workforce.
Perceived Cost of KM	The perceived cost of knowledge management can be a major challenge for their organizations. Typically, organizations are faced with providing first-rate training on an extremely limited budget. Participants indicated that it is particularly difficult to obtain funds to develop employees in executive and management roles because the senior employees are expected to hit the ground running once hired.
Failure to Update Knowledge and Information Once Captured.	The sheer volume of knowledge that exists within any agency and the rapid pace of technology advancements often lead to knowledge management challenges. Research suggests that agencies struggle to keep knowledge that has already been captured current and organized because this aspect of KM requires additional resources. In addition, employees who struggle to stay up-to-speed with new KM systems and technologies may feel out of touch and find it difficult to access critical information.

1
2   Our research also indicates that agencies have used several strategies to address these challenges
3   and successfully manage their institutional knowledge. Exhibit 3 provides an overview of five
4   KM strategies identified.
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Exhibit 3	
Industry Strategies related to Developing Knowledge Management Systems	
Create People-Focused Knowledge Management Systems	During the past decade, the focus of knowledge management (KM) initiatives has shifted from a strategy of capturing data and explicit information in portals and databases to a strategy of promoting knowledge sharing among people (Cross, Parker, Prusak, & Borgatti, 2001; Davenport & Prusak, 1998; Parise, 2007). The main advantage of a people-focused strategy is that it enables the sharing of more relevant inferred knowledge, such as employees' experiences, know-how, and other similar or complementary expertise that cannot be captured in documents (Parise, 2007).
Implement Communities Of Practice	Some organizations use "communities of practice," where every individual in the state who performs a unique function or provides a certain service to one local area comes together with other individuals doing the same tasks in other locations in the state. They share ideas, give presentations, solve problems and develop relationships. They meet in person and online to discuss initiatives and at times influence the direction of policy that directly affects the way they perform their tasks. It is important to keep these meetings structured and well- facilitated. This is different from a department meeting where attendees perform different tasks but work in the same geographic location.
Use Job Rotation	Almost all of the focus group participants, both public and private sector organizations, cited the use of job rotation programs within their organizations. Job rotation is a developmental approach where an employee works consecutively through a series of positions to develop skills and obtain a broad exposure to the organization. Rotational assignments are often given to help prepare employees and managers for the responsibility of a higher level position. Working on several different projects provides these employees with a better understanding of the how the organization works as a whole. This also helps to spread institutional knowledge. Most organizations that have job rotation programs reserve it for high performers who are selected by a group of managers to be part of the program.

Exhibit 3	
Industry Strategies related to Developing Knowledge Management Systems	
Engage Employees in Knowledge Transfer	For newer employees, organizations have begun to implement a second orientation session around six months after employees are hired to go over more of the organization's history, objectives and goals, as well as re-emphasizing benefit enrollment, corporate policy and security compliance. This helps to reinforce knowledge transfer as organizations have found that there is only a finite amount of information employees can handle when they are starting a new job but that they are more likely to retain organizational information after a few months of learning their new job. For more tenured employees, organizations have found ways to connect front line personnel directly with executives. This can be accomplished through anonymous web portals or face-to-face interviews known as "Stand-Up" or "Town Meetings." In some cases, representatives of corporate leadership travel from one office to another holding focus groups or interviews where, without their immediate supervisors, employees can provide feedback on the work environment, leadership and climate of that office.
Link Knowledge Management to Succession Planning Efforts	Organizations conduct succession planning that ranges from simply creating career paths to a formal selection process where candidate pools are groomed for certain positions. Formal succession programs involve management teams identifying individuals who have shown qualities that indicate the potential for strong leadership and have had excellent performance in their current position. These programs involve tailored processes such as training, problem solving activities, assessments, mentoring and testing that are in addition to the selected employees' normal duties. Research suggests that knowledge capture can inform the content and design of these process to ensure they align with the 'real' needs of the agency.

1
2   In the next section, the detailed VDOT KM case study is presented. The case study provides an
3   excellent example of how one transportation agency implemented a comprehensive knowledge
4   management program to address internal challenges similar to those described in this section and
5   to incorporate many of the industry strategies identified above into one comprehensive practice.
6
7   **PROJECT RESULTS: VDOT KM PROGRAM CASE STUDY**
8
9   The Virginia Department of Transportation (VDOT) was founded in 1906 as the
10   Department of Highways to engineer and construct Virginia's primary roads, transforming mud
11   routes into a modern roadway network. In the 1950's, this mission was expanded to successfully
12   participate in the construction of the interstate highway system. Today, however, transportation
13   needs can no longer be met by simply building more roads, and yet there is an ever increasing
14   demand for transportation capacity and efficiency. VDOT must shift its mission from roadway

1 construction to maintenance and system operations, which requires tremendous collaboration
2 between previously distinct internal agency functions, with exterior state agencies, and with
3 private industry partners. Finally, VDOT's population is aging; the hierarchical organization
4 which served so well the demands of the first century must change in order to meet the needs of
5 the new, but the transition depends on successfully integrating new strategies with experienced
6 practices. Simply put, massive organizational change must be managed in a way to meet new
7 demands and increase efficiency.

8   VDOT currently has about 7,500 employees, of whom approximately 30% are eligible
9 for retirement within the next five years. The agency experienced a loss of knowledge in the
10 mid-90's during two statewide workforce reductions, cutting 20% of total staff in less than 5
11 years, impacting productivity and effectiveness. To prevent a recurrence of knowledge loss, the
12 agency created a Knowledge Management Division in late 2003 to address critical knowledge
13 identification, collection, organization and dissemination.

14   Preparing for the future loss of staff starts with the premise that we need to re-think and
15 encourage knowledge transfer in the agency. VDOT's program focuses on the transfer of tacit
16 knowledge: identifying knowledge held by individuals or groups, and sharing that knowledge
17 with other individuals or groups, in order to improve how business processes are approached,
18 considered, or handled. The transfer of knowledge is evidenced when a change in performance of
19 the organization results. In order to enhance the agency's access to the expertise and knowledge
20 of its staff, its organizational memory, we have fostered organizational change by encouraging
21 knowledge sharing by staff. People who are used to accessing and sharing information are better
22 prepared to deal with change. The working definition of knowledge management at VDOT is:
23 "Implementing ways to better utilize the expertise that we have—people and information—to
24 improve ongoing processes and procedures and to retain critical knowledge". This includes the
25 following approaches:

26   • Getting the right knowledge to the right people at the right time
27   • Identifying, capturing, organizing and disseminating critical institutional knowledge
28   • Establishing networks between people to share knowledge
29   • Sharing lessons learned and best practices to avoid reinventing the wheel
30   • Knowing the why behind decisions and actions
31   • Knowing what we know
32   • Supporting change management
33   • Identifying the intangible assets of the organization
34
35   One of the KM Division's critical goals then, was to foster both high sociability and
36 solidarity. High sociability facilitates employees' willingness to seek knowledge from peers and
37 to be a source to others. High solidarity ensures that employees share and support common goals
38 that benefit the organization as a whole. Employees must perceive organizational leadership to
39 be supportive of and recognize employees who share and that there is no favoritism. At VDOT
40 all of these have been publicly embraced and communicated to employees allowing success in
41 the program.

42   There are many tools and techniques available to promote knowledge capture, sharing
43 and organization. Below are some that have been used successfully implemented by the Virginia
44 Department of Transportation.
45

1   **Communities of Practice:** A Community of Practice is a group of people who deepen their
2   knowledge and expertise by interacting with each other and who share that collaborative
3   knowledge with others in the organization. Organizations support the transfer of tacit knowledge
4   from one employee to another through communities of practice to create redundancy and embed
5   the knowledge within procedures and routines. Communities provide employees with access to
6   experts and experience, to mentor new employees and to convert tacit knowledge to explicit so
7   that the organization can retain and leverage it. VDOT defines communities of practice as a
8   critical tool to create networks and share knowledge that have resulted in new tools and changes
9   in processes.
10
11 **Knowledge Mapping:** VDOT defines knowledge mapping as a tool to help us identify areas of
12 need for succession planning and to build networks. Access to experts within the organization is
13 important to problem solving, building the knowledge base of employees and innovation. By
14 sharing knowledge with others, the demand on the time of experts is lessened freeing the expert
15 to focus on high value projects. It also supports the redundancy of knowledge within the
16 organization ensuring that knowledge does not walk out the door. In addition, knowledge of
17 these networks and expertise can be used to provide new employees with access to necessary
18 knowledge to perform work tasks. When the network is disrupted due to retirements, downsizing
19 or restructuring, or when management is unaware of the existence of the network, access to
20 organizational knowledge and expertise by new staff or staff placed in new roles is blocked.
21 *Organizational Network Analysis:* VDOT uses UCINet, an organizational network analysis
22 (ONA) program, along with a web-based questionnaire developed by the University of Virginia.
23 This tool is used to map knowledge sharing amongst a group of individuals providing managers
24 with a visual image of how employees connect and how knowledge is transferred amongst them.
25 *Interviews:* When the knowledge held by an individual employee is critical to the organization
26 and is not widespread, we also conduct interviews to identify deeply held knowledge and an
27 understanding of the employee's networks.
28
29 **Lessons Learned:** As part of a Knowledge Management pilot, VDOT's Construction Quality
30 Managers Community of Practice implemented an agency-wide construction lessons learned
31 initiative in April 2007 to encourage a culture of sharing knowledge by construction field staff.
32 Its purpose was to capture lessons from previous experiences that are shared across the agency.
33 The community reviews the lessons for best practices that result in changes in processes,
34 procedures and contract language. The pilot was recognized by the American Association of
35 State Highway Officials Performance Improvement Committee with a Trailblazer Award in
36 2009. Below is the template we use along with pointers and tips:
37
38 **Process Mapping:** Part of identifying critical organizational knowledge is to know how and
39 where it is embedded, and process mapping is a tool that can be used to bring that out. It is a
40 means to encourage knowledge sharing and to develop new and innovative approaches. It is also
41 a method that can be used to help forget old habits and how we have always done things in order
42 to be more effective in the new environment. Process maps can also help decrease dependence
43 on memory (past experiences, practices and attitudes) of how things were done and make that
44 knowledge widely available. VDOT uses a process that brings together experts to help map out
45 the process and to provide supporting documentation for that map that clearly outlines steps and

1   accountability. The maps should attach processes across separate functions providing a clearer
2   picture of how the agency operates.
3
4   **Assessment, Outcomes and Measurement:** The Knowledge Management program has
5   conducted an assessment each year since its inception (formalized in 2006). The assessment has
6   looked at both qualitative and quantitative data to measure progress, accomplishments and
7   challenges. These criteria were adopted from the research which showed that successful projects
8   had 1) a link to economic performance or industry value; 2) technical and organizational
9   infrastructure; 3) standard, flexible knowledge structure; 4) a knowledge-friendly culture; 5) a
10   clear purpose and language; 6) a change in motivational practices; 7) multiple channels for
11   knowledge transfer; and 8) senior management support. We tracked the number of projects
12   (communities, lessons learned, knowledge mapping and other) initiated, specific products
13   resulting from these projects, ROI, perceptions of the program by employees and leadership,
14   development of a knowledge transfer infrastructure, techniques and tools, and the changes in
15   culture.
16
17   Based on its success using the tools described above, the VDOT KM Program was a finalist for
18   the Harvard Innovations in Government award (2008). As a result, VDOT received a $10,000
19   grant to build a tool kit that may serve as a useful tool to other agencies. The toolkit provides
20   details of the KM Program such as "Here's how we did it," "Here's how we run our
21   communities," "Here's how we do the lessons learned, the knowledge mapping, and the
22   prioritization," and "Here's the different tools you can use to help you do this type of program."
23
24   **SUMMARY**
25
26   The field of knowledge management is rapidly attracting attention due to its importance in the
27   workforce development life-cycle of any organization. Knowledge management systems can
28   range from simple electronic library and file systems, to search engines and query tools, to
29   decision-making tools. One of the key aspects of the success of any knowledge management
30   system is the ability of a novice to use the system successfully and add to it in an efficient and
31   effective manner. However, organizations are so big and complex that it's difficult to know how
32   to assess if a new KM solution is needed, where to begin, and how to align KM processes to
33   specific human capital objectives.
34
35   Rubenstein-Montano, Buchwalter and Liebowitz (2001), provide "eight key indicators that a
36   knowledge management initiative is needed: 1) the average age of employees is senior; 2) lack of
37   a mentoring program between experts and novices; 3) little funding for development and
38   training; 4) lack of time for informal knowledge sharing; 5) loss of knowledgeable employees; 6)
39   lack of capture and documentation of knowledge; 7) lack of knowledge about what other
40   departments do; and 8) large amounts of time spent looking for information." If an organization
41   is deficient in one or more of these areas, KM should be strongly considered.
42
43   Other agencies can certainly learn from the strategies offered in NCHRP Report 685 and the
44   processes set in place at VDOT; however, the details of a KM are culture-specific and the
45   capacity to adopt such a comprehensive program varies, so modifications need to be made by
46   adopting agencies. This presentation will offer guidance to attendees in providing good initial

1 KM efforts and making modifications during discussion of the challenges, strategies and
2 successful processes highlighted above.
3
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