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Authors

McRae, Glenn
Vallett, Carol
Jewiss, Jennifer

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Glenn McRae, University of Vermont

Carol Vallett, University of Vermont

Jennifer Jewiss, University of Vermont

National Center for Sustainable Transportation

The UNIVERSITY of VERMONT
TRANSPORTATION RESEARCH CENTER

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Acknowledgments

Vermont Agency of Transportation Employee Retention and Knowledge Management Study

A National Center for Sustainable Transportation Research Report

October 2018

Glenn McRae, PhD, Transportation Research Center, University of Vermont

Carol Vallett, EdD, Transportation Research Center, University of Vermont

Jennifer Jewiss, EdD, Department of Leadership and Developmental Sciences, University of Vermont

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EXECUTIVE SUMMARY

In 2015, the Vermont Agency of Transportation (VTrans) developed a new strategic plan that included five goals that would support the agency's mission and vision. Goal 5 of the plan is: Develop a workforce to meet the strategic needs of the agency. VTrans leaders were concerned with the loss of employees due to turnover and the subsequent impact of knowledge loss on the operations of the agency. This applied research study used a mixed methods approach in data gathering to help determine the state of employee retention and knowledge management (KM) at VTrans and to provide tools that could help with both retention and KM issues. Key steps in this study involved an organizational assessment of turnover and KM practices at VTrans, a scan of other state DOTs concerning retention and KM practices, and a pilot project to address both issues. With guidance provided by a Technical Advisory Committee (TAC), the decision was made to focus most of the research in specific units of the Highway Division.

Organizational Assessment

Foundational Focus Groups

To create a foundational understanding of employee retention issues at VTrans, an initial set of four focus groups was conducted with 32 individuals, including members of the TAC, employees and supervisors of the Maintenance and Operations Bureau (MOB), and supervisors in the Rail, Information Technology and Materials Lab. Findings from these focus groups were categorized into the following themes:

- Retention challenges vary widely across the agency.
- Recruiting and hiring processes encounter various challenges.
- Generational differences may cause friction within workgroups.
- Caliber of supervision makes a difference.

Turnover Analysis

Aggregate data on employees who left VTrans employment in fiscal year 2016 were analyzed to determine an 11.4% turnover rate and found that:

- 69 individuals left voluntarily due to reasons other than retirement.
- 54% were individuals with less than 5 years of service.
- Exiting employees with less than 5 years of service were concentrated in the 19 to 30 year age category.

On the basis of this analysis, a second set of focus groups was organized with VTrans employees under 35 years of age and with less than 8 years of VTrans employment.

Age and Years of Service Focus Groups

A set of five focus groups were held with 25 early career VTrans employees. Focus group participants were asked about factors that attracted them to VTrans employment initially and why they chose to remain at the agency, as well as factors that might cause them to leave. Overall job satisfaction was discussed along with knowledge management practices and needs. The findings were organized around the following themes:

- Reasons early career employees were attracted to and remain at VTrans
  - Substantial benefits package
  - Work/life balance (time off)
  - Job security
  - Breadth of career or work opportunities
- Reasons for dissatisfaction that might cause them to leave the agency
  - Supervisory issues
  - Perceived low pay compared to the private sector
  - Lack of position specific training

Focus group participants rated their overall job satisfaction on a 1 to 10 scale (10 being the highest possible level of satisfaction). The average rating fell between 7 and a half and 8, with some participants indicating that their rating fluctuates according to their current workload and supervisor. Participants also identified several knowledge management needs, including enhanced knowledge transfer within workgroups and across the agency, as well as quicker and easier access to existing information via an accessible and organized central repository. In addition, they emphasized the need for more communication from agency leaders and managers to share information across various layers of the organization.

Knowledge Management Assessments

The knowledge management assessment of VTrans was conducted between March and May of 2017. The assessment included a brief Litmus Test completed by 48 VTrans managers as well as a more in-depth assessment sent to all members of the Structures and Technical Services units in the Highway Division. Select employees in the Department of Motor Vehicles were also invited to complete the assessment.

The results indicated that managers had high levels of agreement on the following statements included in the Litmus Test, which reflect KM issues within VTrans:

- More than 20% of senior managers are able to retire in the next 5 years.
- One part of the organization does not know what the other part is doing – even if working on a similar task or problem.
- There are no standard ways of debriefing employees, contractors, or consultants.

- The agency generally does not maintain up to date documentation of core business process and procedures.
- It is difficult to find current information that would help improve efficiency.

A total of 124 employees completed the in-depth KM Assessment Survey across the three units included (49% completion rate). The assessment was intended to help identify gaps in or barriers to knowledge management practices and provide a basis for further KM activity.

Survey respondents indicated that although final work products are shared electronically, trying to find needed information is frustrating. As a result, employees most often refer to their own notes or seek information directly from peers and supervisors. Institutional and historical knowledge is seen as most at risk of loss.

To safeguard the agency's knowledge assets, respondents suggested that VTrans:

- Better organize existing electronic resources.
- Develop more knowledge sharing tools, such as templates and clear procedures
- Document infrequently performed tasks.
- Establish a means of helping employees find the right person to answer a question, such as an internal expert locator.

Scan of other State DOTs and KM Practices

During the spring of 2017, a team of University of Vermont graduate students conducted informational interviews with representatives of six state departments of transportation (DOTs) regarding employee turnover, retention, and knowledge management. The students also produced an annotated bibliography concerning KM and KM practices in transportation.

Informational Interviews

Interviews were conducted with DOT representatives from Alaska, Kansas, Missouri, Virginia, New Hampshire, and Connecticut, and produced the following findings:

- Turnover rates in most of these states ranged from 10% to 12%.
- Pay was perceived as the leading reason for employees leaving.
- About half of the states experienced more attrition with younger employees.
- Most of the states offered new hires structured orientation, job shadowing, and job rotation.
- Five of the states implemented KM practices such as document repositories, job aids, and lessons learned documents and workshops.
- States reported that in order for KM to succeed, it was essential that interest in KM emanate from DOT leaders and feature at least one champion at a level that can influence change.

- The greatest barriers to KM included budgetary limitations and issues with organizational culture.

KM Bibliography

The KM bibliography is available in Appendix C of this report and includes readings that address KM in relation to:

- Leadership
- Organizational culture
- Codified versus tacit knowledge
- Communication
- Impact on retention
- Succession planning
- Learning organizations.

Pilot Project

Learning from the organizational assessments was used to inform the design of a retention and knowledge management pilot project. The retention component entailed the development and testing of an exit questionnaire for employees leaving VTrans, while the KM component focused on developing a tool and process for capturing and sharing tacit knowledge.

Exit Questionnaire Pilot

An exit questionnaire was developed and sent to 49 individuals who had voluntarily left VTrans employment between July 1 to December 31, 2017. The questionnaire gathered information on the reasons why these employees joined VTrans, why they eventually decided to leave, and how they would characterize their employment experience at VTrans. A total of 27 individuals completed questionnaires. Although a 55% response rate is higher than that achieved for many surveys, the small number of individuals surveyed and the potential for a non-response bias is a limitation to this study.

- The most common reasons given for joining VTrans were:
  - Health benefits
  - Job security
  - Retirement benefits
  - Time off
- The most frequently mentioned reasons for leaving include:
  - Retirement
  - Quality of supervision
  - Organizational culture

Respondents were also asked what could have been done to retain them as VTrans employees. Responses most frequently pointed to the need for a new supervisor or a change in organizational culture

Knowledge Management Pilot

The final activity of this study was the KM component of the pilot, which was designed to develop:

1) A tool for capturing tacit (or hidden) knowledge, and
2) A mechanism to help store and retrieve this knowledge.

Managers from the Structures and Transportation Systems Management and Operations (TSMO) units selected 8 staff members to participate in this pilot, which included a facilitated workshop for identifying, discussing, and documenting tacit knowledge. The identified tacit knowledge was captured in a Knowledge Exchange (KX) Tool, posted in SharePoint, and tagged in a manner that enhanced retrievability.

Participants in the KM pilot were generally enthusiastic about the workshop process, which helped individuals recognize their distinct areas of expertise and document that knowledge. However, several challenges were identified, including the limitations of using a standardized form and the cumbersome nature of the writing and tagging required. SharePoint was viewed as a problem and unfortunately tagging documents was not seen as a solution to the document search and retrieval issues.

The KM pilot project effectively introduced the idea of tacit knowledge and developed a workshop method for discussing and capturing some of that knowledge. The featured workshop and Knowledge Exchange Tool provide starting points for VTrans managers who wish to initiate KM activities with their staff. These KM resources and others are in Section 7 of this report.

Discussion and Suggested Recommendations

This study advanced understanding of employee retention and turnover issues at VTrans. While younger employees in the early stages of VTrans careers are more likely to leave the organization, the loss of more seasoned employees may have a greater impact on the VTrans knowledge base.

The key findings from this study indicate that people are attracted to VTrans employment because of the employee benefits (health, retirement, time off) and career opportunities. VTrans employees most often leave due to the quality of supervision, dissatisfaction with the organizational culture, or because of retirement. While pay is a factor for some, it is not the overriding reason for employee resignations.

It is important to recognize the limitations of this study. Considering that over 1200 people are employed by VTrans, only a small percentage were included in the focus groups and survey

work, mostly from the Highway Division. While the Exit Questionnaire had an acceptable response rate, the reasons for any possible non-respondent bias are not known.

Nonetheless, this study produced an Exit Questionnaire, which is ready for deployment by the Agency, as well as some KM resources that can be used by unit managers. We also offer the following recommendations for next steps by VTrans to enhance both retention and KM:

Retention

a) Implement the Exit Questionnaire for all employees who leave VTrans.

b) Use some questions from the Exit Questionnaire (those involving onboarding and training) to survey early career employees about these important processes.

c) Review turnover data and Exit Questionnaire data on a regular basis and address identified areas of concern.

d) Consider how to improve the quality of supervision overall and resources available to supervisors. Although VTrans provides training and support to supervisors, this issue might warrant added attention.

Knowledge Management

e) Conduct a review of the use and architecture of the VTrans SharePoint site. Review analytics to determine what employees are searching for.

f) Convene a leadership group to spearhead KM advances and determine what strategies might be most appropriate for the agency.

g) Managers might consider holding introductory KM workshops using the tools developed in this project.

h) Find a home within VTrans for KM efforts, which may require designating an individual with authority and responsibility to move KM forward.

i) Remember that KM involves people, processes, and information technology – all of which are equally important for success.

Improving retention and knowledge management at VTrans is essential for addressing Goal 5 of the agency's strategic plan: Develop a workforce to meet the strategic needs of the agency. Particularly given the high number of retirements expected in the coming years, it will be all the more critical for the agency to hire and retain talented younger employees and effectively transfer knowledge from one generation of VTrans employees to the next.

1 Introduction

During the 2015 Vermont Agency of Transportation (VTrans) strategic planning process, employee retention and subsequent loss of institutional knowledge emerged as critical and interrelated issues. This research project was designed to assess the current state of employee turnover and knowledge sharing through research, both quantitative and qualitative, as well as provide benchmarking data from other state agencies of transportation. Based on this assessment, two pilot projects were developed to test methods and systems that VTrans might adopt to enhance retention and knowledge sharing practices.

This project was guided by a Technical Advisory Committee (TAC) comprised primarily of individuals who were also part of a team working on Goal 5 of the VTrans Strategic Plan: Develop a workforce to meet the strategic needs of the Agency. In pre-project planning, the TAC suggested focusing the research primarily on the Highway Division of VTrans, particularly the Maintenance and Operations Bureau (MOB) including Technical Services and areas of the Project Delivery Bureau. With a few exceptions, members of these groups were the focus of this study.

Protocols for all of the human subject research were developed to ensure that participants were informed of the level of confidentiality offered and consented to the use of the information they shared. These protocols were approved by the University of Vermont Institutional Review Board.

2 Organizational Assessment

Understanding the current state of employee turnover by analyzing employment data was one of the first steps we took to shed light on the perceived retention problems at VTrans. These quantitative data were coupled with qualitative data from focus groups and knowledge management assessments. These sources provided the basis for understanding retention issues in the organization and became part of the foundation for the pilot project.

2.1 Foundational Focus Groups

In the fall of 2016, a total of four focus groups were conducted with TAC members, non-supervisory employees in the Maintenance & Operations Bureau (MOB) workers, and supervisors from the MOB, Information Technology, Materials Lab and Rail units. These foundational focus groups were designed to gather participants' perspectives on employee turnover and its impacts on the agency, along with the reasons people chose to stay or leave employment with VTrans.

A total of 32 VTrans employees participated in this set of focus groups and each session lasted approximately 90 minutes. To create an environment that allowed participants to feel comfortable to speak candidly, we assured them that reports on the findings would not identify individual speakers. With participants' permission, the discussions were audiotaped and transcribed to capture the content thoroughly and accurately. A thematic analysis (*1*) of the qualitative data contained in the transcripts was conducted and quotes that illustrate a variety of participants' perspectives on each theme were identified.

The findings from this initial set of focus groups informed the subsequent research and pilot projects carried out during this two-year project. Preliminary findings were presented to and discussed with the TAC in January 2017. The findings from a small qualitative dataset of this nature cannot be generalized to the entire agency. Rather, the findings, which are summarized below, convey the prevailing views expressed by the participating group of VTrans employees.

Retention Challenges Vary Widely Across the Agency

Focus group participants pointed to several factors that are believed to increase turnover and can vary widely in the degree to which they impact different parts of the agency. Participants indicated that entry-level positions and positions lacking promotional opportunities often experience higher turnover rates. They also identified several units as having higher rates of turnover: the garages/districts, materials lab, IT, and Rail. In addition, retirements were cited as a leading and widespread cause of turnover.

Sometimes, turnover was seen as beneficial, for example, when an employee was not well matched to the position or was "retired in place" and no longer performing adequately. However, focus group participants placed more emphasis on the downsides of turnover and indicated that the negative impacts are exacerbated: a) in smaller workgroups with few remaining members to "take up the slack"; b) when simultaneous vacancies occur within a

workgroup; c) when turnover coincides with peak times of year for the job function; d) after substantial investments were made in training the departing employee; or e) when a high level of experiential knowledge is lost as a result of the employee's departure.

Recruiting and Hiring Processes Encounter Various Challenges

Participants outlined several issues that they believe make recruiting and hiring at VTrans more difficult. They noted that some regions of the state face increased competition for applicants due to a strong local job market. Highly specialized positions were singled out as being particularly difficult to fill due to a lack of qualified applicants. Slow hiring processes were seen as contributing to the loss of good candidates who opted to take another job offer while awaiting an offer from VTrans. Demanding seasonal workloads and on-call responsibilities associated with some positions also were identified as deterring some applicants. In addition, according to some focus group participants, written job descriptions for certain positions do not accurately reflect the work expected, which deters some applicants when they learn more about demands of the job during the hiring process. Starting pay was viewed as a challenge for some positions given that it is often lower than that offered by other employers. Participants emphasized that the benefits and job security are generally better at VTrans, but noted the difficulty of convincing some candidates to look at the compensation package as a whole and take a long-term view that accounts for the full value of State benefits and greater job security.

Generational Differences May Cause Friction within Workgroups

In some cases, generational differences were seen as causing friction within workgroups or between an individual employee and the agency's norms and expectations. Participants described contrasting patterns of behavior they observed in "older workers" and Millennials, and they identified strengths and challenges associated with each of these two groups. Older workers often were credited with possessing substantial experiential knowledge and skills, but more likely to resist change, including learning new technologies. In addition, some older workers seemed more interested in biding their time while awaiting retirement than making a meaningful contribution on the job. Millennials were credited with bringing technological savvy and fresh perspectives to the agency. However, these younger employees tended to seek shorter hours and more flexible schedules, which sometimes put them at odds with older colleagues, supervisors, and longstanding agency norms. In addition, participants noted that Millennials often feel entitled to rates of advancement that outpace their professional development and available opportunities. Supervisors frequently acknowledged the challenge of addressing these generational differences in workgroups and in some cases the resulting friction lowered employee morale and retention.

Caliber of Supervision Makes a Difference

Good supervisors were seen as critical to retaining good employees – and ineffective supervisors were sometimes cited as the reason why people left the agency. Focus group participants strongly stated that the caliber of supervision can "make or break" an employee's experience at VTrans and thus has a major impact on retention rates. Many participants noted that shifting from a technical position to a supervisory role can be difficult, and some

supervisors are not well suited to or prepared for the role. They stressed that being a good supervisor requires "a whole different mindset," leadership skills, and a commitment to developing staff. Participants emphasized that managers who demonstrate care and concern for the people they supervise are highly valued by members of their team and likely to engender loyalty to the agency. Team building on the part of supervisors was also identified as essential for leveraging the contributions of all staff and enhancing employee satisfaction.

2.2 Turnover Analysis

Using Fiscal Year 2016 data and the same methodology as Vermont State Department of Human Resources, an analysis revealed VTrans experienced an overall turnover of 11.4% (on a base of 1224 employees), whereas the total State of Vermont turnover was 12.6% (2). While the VTrans turnover rate was slightly higher than previous years (due to a voluntary retirement incentive) and included all separations (voluntary, involuntary and retirements), what was of most interest to this project were 69 voluntary separations that were not retirements. These voluntary separations included both resignations and transfers out of VTrans to other areas of State employment. The 69 voluntary separations were analyzed looking at various factors such as age, gender, ethnicity, position, and years of service. Some of the analyses were limited due to the aggregate nature of the data. However, what emerged as most interesting was the analysis of voluntary separations by years of service.
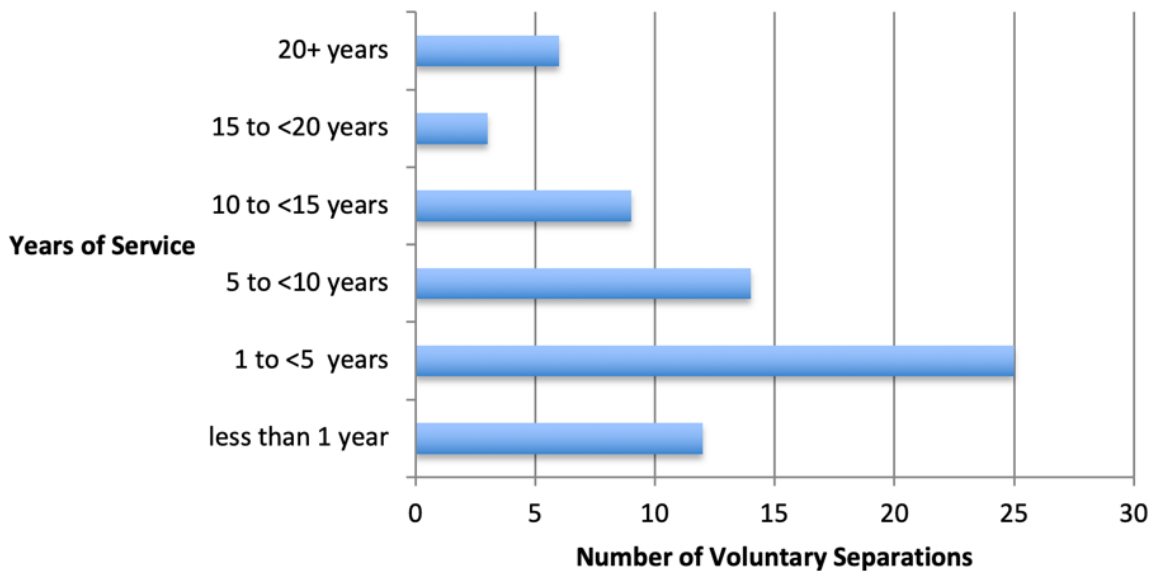
Figure 1. VTrans Voluntary Separations by Years of Service, FY 2016 (n=69)

Of the 69 voluntary separations, slightly over half (37) were individuals with under 5 years of service. A closer look at this group found most of these early separations were individuals who were also on the younger end of the age continuum, with a higher concentration in the 19 to 30 years of age category. This trend is illustrated in Figure 2, which maps by age cohort those who joined and left VTrans.
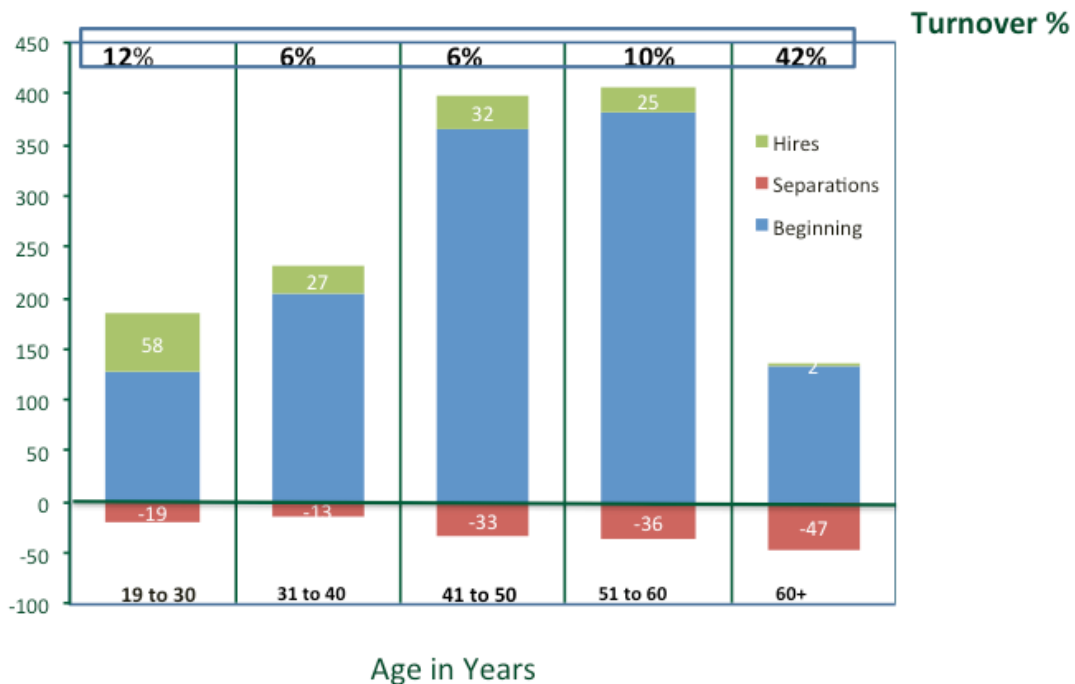
Figure 2. VTrans Employees, Hires and Separations by Age Cohort, FY 2016

On the basis of this analysis, focus groups were organized with VTrans employees under 35 and with less than 8 years of experience at VTrans. The goal was to better understand their reasons for joining the organization and their employment experience in the organization, and also to explore factors that keep them on the job or might spur them to leave. Given the resources entailed in recruiting and training individuals in their initial years in the organization, it seemed essential to understand what attracted this subset of employees to work at VTrans and why some might consider leaving.

2.3 Age and Years of Service Focus Groups

Analyses of VTrans employee turnover data from FY16 determined that younger employees (age 35 or under) in the earlier stages of their VTrans careers (less than 8 years) leave the agency at higher rates than older, longer-term employees. As a result, a set of five focus group discussions were designed to gather the perspectives of younger, earlier career VTrans employees regarding:

- why they choose to work at VTrans,
- the reasons some employees opt to leave the agency, and
- current knowledge sharing practices within the agency.

A total number of 25 employees participated in this set of focus groups, and each session lasted approximately 90 minutes. To create an environment in which participants felt comfortable speaking candidly, the facilitators ensured them that reports on the findings would not identify individual speakers. With participants' permission, the discussions were audiotaped and

transcribed to capture the content thoroughly and accurately. The researchers then conducted a thematic analysis of the qualitative data contained in the transcripts and identified quotes that illustrate a variety of participants' perspectives on each theme.

The findings from the focus groups are intended to inform retention and knowledge management efforts. Preliminary findings were presented to and discussed with the Technical Advisory Committee in July 2017. By design, the findings from a small, qualitative study of this nature cannot be generalized. Rather, the findings are intended to capture and convey the prevailing views and experiences expressed by the participating group of VTrans employees.

Why Younger, Early Career Employees Stay at VTrans

Focus group participants articulated several reasons why they and their colleagues stay employed at VTrans, often comparing the working conditions at the agency to private sector settings. The top two reasons given for remaining at VTrans were the substantial benefits package and work/life balance, followed by job security and opportunities to engage in a variety of work tasks.

The level of benefits provided to employees – including sick leave, high quality health insurance, and a pension plan – was often cited first and foremost as a reason for initially taking a position at VTrans. Once employed at the agency, the benefits package provided a strong incentive to stay.

Participants referenced generous amounts of time off due to holidays and comp time as factors that contributed to work/life balance. Some VTrans positions offer considerably more scheduling flexibility than others. Certain jobs come with demanding on-call responsibilities and/or extremely busy "peak seasons." However, overall, participants expressed strong appreciation for the degree to which VTrans supports work/life balance among its employees.

Job security was raised as a major consideration for many focus group participants, particularly given that seasonal ebbs and flows in certain private sector jobs can lead to lay-offs or pay reductions when business is slow. Working in state government, particularly with union protections, was seen as a "safe bet" compared to the private sector.

Some participants referenced VTrans' broad scope and emphasized the appeal of being able to engage in a wide variety of tasks, either within a given position or by moving into different positions within the agency. Those interested in varied work experiences noted that some comparable private sector positions tend to pigeonhole people into more defined roles and repetitive tasks. Overall, participants appreciated opportunities for advancement within VTrans, particularly if one is willing to "move around the agency" and take positions in various departments and divisions. A number of participants also appreciated the opportunity to more easily transfer to other state government agencies as a result of having "gotten their foot in the door" at VTrans.

Reasons for Dissatisfaction / Leaving the Agency

Focus group participants articulated two primary factors they believe cause substantial dissatisfaction among VTrans employees and prompt some to leave the agency: low pay and supervisory issues. Concerns about levels of pay were fairly straightforward, reflecting a widely held belief that positions at VTrans pay less than those in the private sector. The topic of supervision spanned several issues including the uneven quality of supervision across the agency, some supervisors' reluctance to address performance problems among their staff, and the conviction that managers are not held accountable for their performance as supervisors.

Focus group participants raised several other issues that pertain to employee satisfaction and retention. The job application process and orientation for new employees were confusing to many participants. Some individuals noted a lack of position-specific training or other forms of onboarding. Concerns were also expressed regarding limited opportunities for advancement, as well as a lack of VTrans-supported events and other forms of recognition for employees.

Overall Job Satisfaction

When asked to estimate their current job satisfaction on a ten-point scale, with ten being the highest possible level of satisfaction, participants responded with ratings that ranged from six to ten. The intent of the question was to elicit an estimate rather than a precise numerical rating and prompt discussion on the factors that influence participants' satisfaction levels. The average rating fell between seven and a half and eight: some participants indicated that their satisfaction levels varied based on fluctuating workloads and changes in supervisors.

Knowledge Management

When questioned about knowledge management, many participants identified a critical need to enhance knowledge transfer both within workgroups and across the agency. They often found it difficult and time consuming to locate information on the VTrans intranet. Participants pointed to the need for a central repository that is easily accessible, clearly organized, and up to date. They also wanted managers to foster more communication across departments and VTrans leaders to engage in more direct communication with staff agency-wide.

2.4 Knowledge Management Assessments

In addition to understanding turnover and retention issues at VTrans, another key element to assess was the current state of knowledge use, flow, and sharing in the organization. The knowledge management (KM) assessment consisted of two elements: a brief Litmus Test of managers to quickly gauge KM needs across the agency and a more in-depth KM Assessment Survey. Both instruments were modeled on KM assessment tools included in The National Cooperative Highway Research Program (NCHRP) Report: *A Guide to Agency Wide Knowledge Management for State Departments of Transportation* (*3*).

2.4.1 KM Litmus Test

The KM Litmus Test was taken by 48 managers who attended a Spring 2017 quarterly meeting. The instrument includes 11 questions to be answered on a 4-point scale of agree to disagree or "don't know."
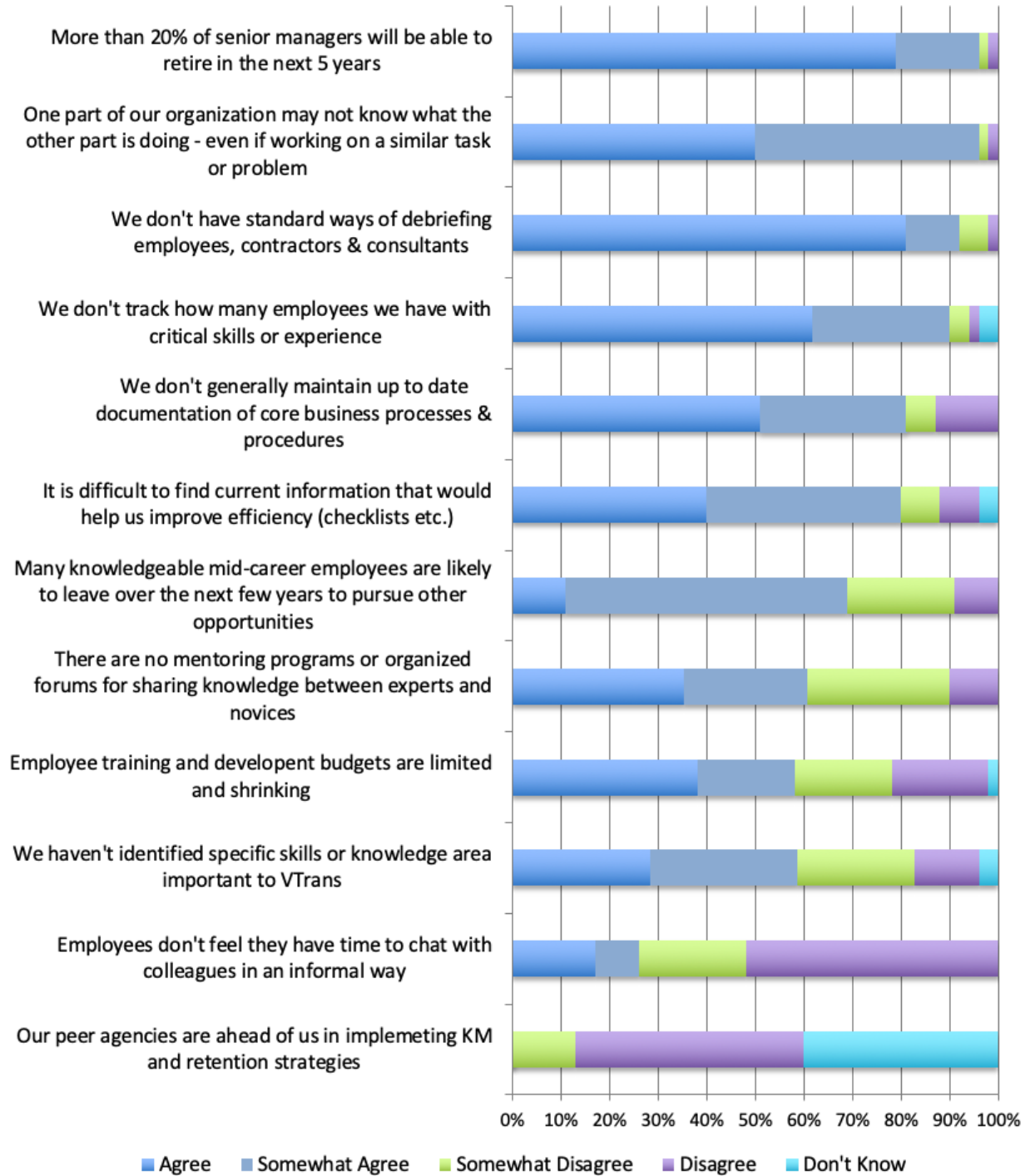
Figure 3. KM Litmus Test Results (n=48)

The results in Figure 3 are organized from highest levels of agreement to the lowest. Note the agreement on upcoming retirements, need for debriefing, documentation, information sharing and critical skills tracking.

2.4.2 KM Assessment Survey

To enhance understanding of the current state of knowledge use, flow and sharing at VTrans, an in-depth Knowledge Management Assessment Tool was used with three organizational areas within the agency. These units included the Structures and Technical Service sections of the Highway Division, along with selected personnel in the Department of Motor Vehicles.

The survey results were intended to help identify gaps in or barriers to information or knowledge practices that might impact the areas under study and also serve as a first step towards building knowledge management strategies in the organization. The results of the assessment tool and other research activities, including the employee focus groups, were expected to inform actions that would positively impact employee retention and knowledge management strategies in VTrans.

The assessment tool was deployed online in May 2017 with 124 individuals across the three units. The response rate was 49% with 61 responses received. The response rate was greatest in the Structures unit with 70% of contacted individuals responding. While the number of completed surveys is adequate for this study, the small number of individuals surveyed compared to the total population of VTrans employees is a limitation of broad applicability of the findings. The complete report for this assessment is available in Appendix A of this document. Key findings of this study are summarized below.

Knowledge Resources, Use and Sharing

Individuals reported most frequently accessing their own notes and procedures, along with some VTrans provided material, as well as turning to their peers or supervisors for information. While the final work products are shared electronically by many employees, attempts to locate needed information are often met with frustration. These attempts included finding the right person who could answer a question or provide help. This disorganization was cited as a primary constraint in accessing or sharing knowledge.

At Risk Knowledge & Knowledge Needs

Institutional and historical knowledge of VTrans operations and decisions was identified as the most at risk knowledge. The "how" and "why" past decisions were made were seen as important to understanding current approaches to projects. Specifically identified knowledge needs included:

- the ability to access electronic data (historical & current) in an organized manner,
- documentation of infrequently performed tasks, and
- an expert locator to help find the right person to answer a question or provide help.

Knowledge Sharing Tools and Knowledge Flow

When asked about knowledge sharing tools, over two-thirds of respondents agreed they could benefit from support (tools, templates, clear procedures) to help them document and share knowledge. When asked about knowledge topics shared, a rich inventory of 70 topics emerged. However, comments in this area touched on similar themes: the need for organized repositories and enhanced communication, along with the need to share process or tacit knowledge.

Considerations

The survey findings suggest that VTrans consider implementing the following KM practices:

- Standardizing documents and knowledge access
- Improving communication for knowledge sharing
- Focusing on tacit knowledge capture and sharing
- Conducting knowledge flow mapping
- Developing leadership for knowledge management planning and implementation

3 Scan of Other State DOTs and KM Practices

During the spring 2017 semester, the TRC researchers engaged a team of UVM graduate students enrolled in Public Administration 302 taught by Professor Christopher Koliba. Students were briefed on the VTrans retention and knowledge management project and were enlisted to undertake two tasks in support of this research. The first task entailed scripted informational interviews with state departments of transportation (DOTs) to gather information concerning employee turnover, retention and knowledge management actions at these state departments. The second task was the production of an annotated bibliography involving knowledge management, particularly in the transportation sector.

3.1 State DOT Informational Interviews

Informational interviews were conducted with contacts from six states, including four state DOTs known to be using knowledge management tools, and two other states located in New England. The people interviewed in these calls were usually involved in the organization's human resources, administrative, or special projects functions.

Questions were asked about employee retention and knowledge management in several domains:

- Employee turnover
- Employee retention efforts
- KM implementation
- KM tools

The contacted states included four, Alaska, Kansas, Missouri and Virginia, that were noted in NCHRP 813: *A Guide to Agency-Wide Knowledge Management for State Departments of Transportation.* The New England states of Connecticut and New Hampshire also were included to gather information from states in the region. Detailed tables of the information gathered during these calls are in Appendix A.B of this report. Summaries are provided below.

3.1.1 Retention Issues & Practices

States reported employee FY' 16 turnover rates ranging from 6% to 30% with most reporting 10 to 12%. This is comparable to the VTrans rate of 11%. Pay was perceived as the leading reason why people left state DOT employment and half of the organizations also experienced higher turnover rates for employees with less than 5 years of service. Most of the DOTs provided structured orientation to new hires along with job shadowing and job rotation. Some DOTs also offered mentoring opportunities and articulated explicit career pathways.

3.1.2 Knowledge Management Practices

Of the DOTs contacted, five had implemented various KM practices while one was considering doing so. Upcoming retirements and increased efficiency or effectiveness were cited as the reasons for KM implementation. The most common KM tools in use by the contacted DOTs

included document repositories and job aids, along with lessons learned workshops and resulting documents. Some DOTs also offered job shadowing for new and current employees, including reverse job shadowing by managers.

Several keys to successful KM implementation were identified by informational interviewees, including KM interest from agency leaders and having at least one champion at a level within the organization that can influence change. Budgetary limitations and issues with organizational culture change are often seen as barriers to successful KM implementation.

3.2 KM Bibliography

An annotated bibliography concerning KM is provided in Appendix C. The main themes featured in the literature include:

- Leadership
- Organizational culture
- Codified versus tacit knowledge
- Communication
- Impact on retention
- Succession planning
- Learning organizations.

The bibliography, as well as other resources compiled by the Transportation Research Board (TRB) KM Task Force (http://trbkm.org/), are offered as building blocks for a KM Learning Community to develop at VTrans. A newly instituted KM committee has been launched within the American Association of State Highway and Transportation Officials (AASHTO) as well.

4 Pilot Projects

The VTrans organizational assessment and knowledge gained from the informational interviews with DOTs were used to inform the design of a retention and knowledge management pilot project. The retention component of the pilot focused on the development of a standardized exit questionnaire that was administered to employees who leave VTrans. The KM component focused on developing and pilot testing a tool and process for capturing and sharing tacit knowledge.

4.1 Exit Questionnaire Pilot

An exit questionnaire for use with personnel voluntarily leaving VTrans employment was developed based on findings from the focus groups and best practices in gathering information from exiting employees (*4*). This exit questionnaire was intended to:

- Collect data from departing employees regarding the reasons they decided to initially join and eventually leave VTrans
- Inform aspects of the employment experience at VTrans including employee onboarding, training, and career development opportunities
- Inform retention practices at VTrans
- Become a standard exit questionnaire that could be used by VTrans in the future (meeting an objective of the Strategic Plan, Goal 5)

The exit questionnaire was sent to 49 individuals who voluntarily left VTrans employment between July 1 and December 31 of 2017. Using established survey methodology (*5*), contact was made via mail by the UVM team and responses were sent directly to the researchers. (The full protocol, report, and copy of the form are included in Appendix D). In total, 27 responses were received, resulting in a 55% response rate. Although this is an acceptable response rate, the reason for non-response from others is not known and represents a limitation of the findings.

Slightly more than half of the respondents (15) were employed by VTrans for over 10 years. For the analysis, the data were disaggregated for respondents with under or over 10 years of service. Figure 4 below displays the most common reasons for interest in VTrans employment.
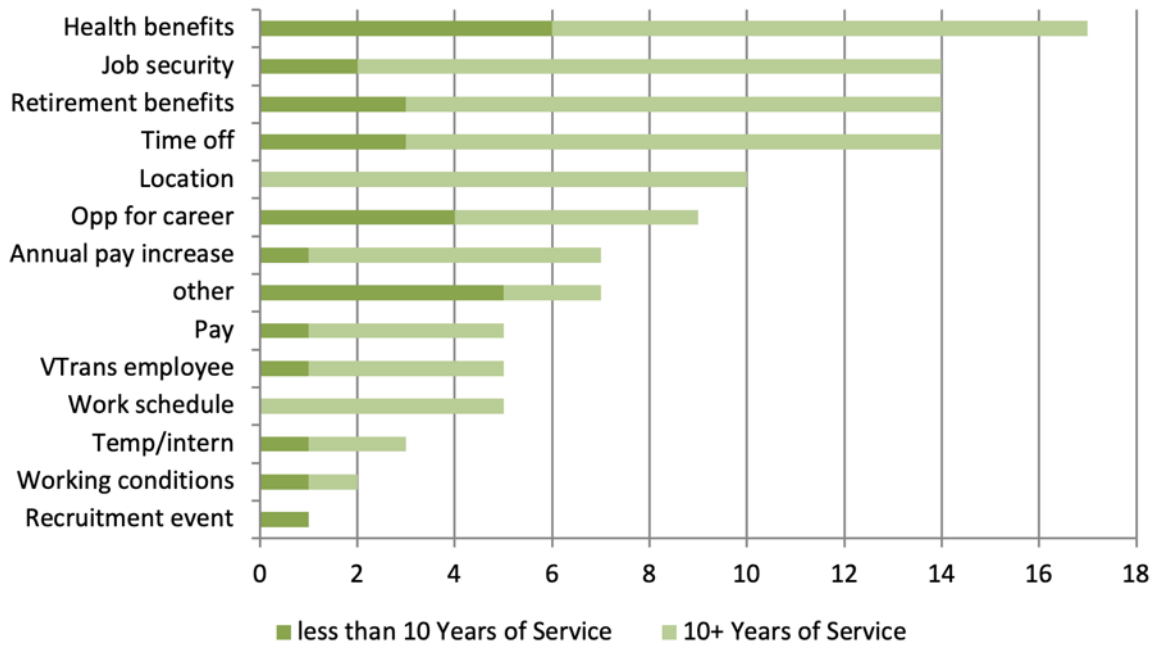
Figure 4. Reasons for Interest in VTrans Employment (n=27)

Note that health and retirement benefits, job security, time off, and opportunities for career advancement were some of the leading reasons for seeking VTrans employment.

Figure 5 shows the opposite side of the coin: common reasons for leaving VTrans.
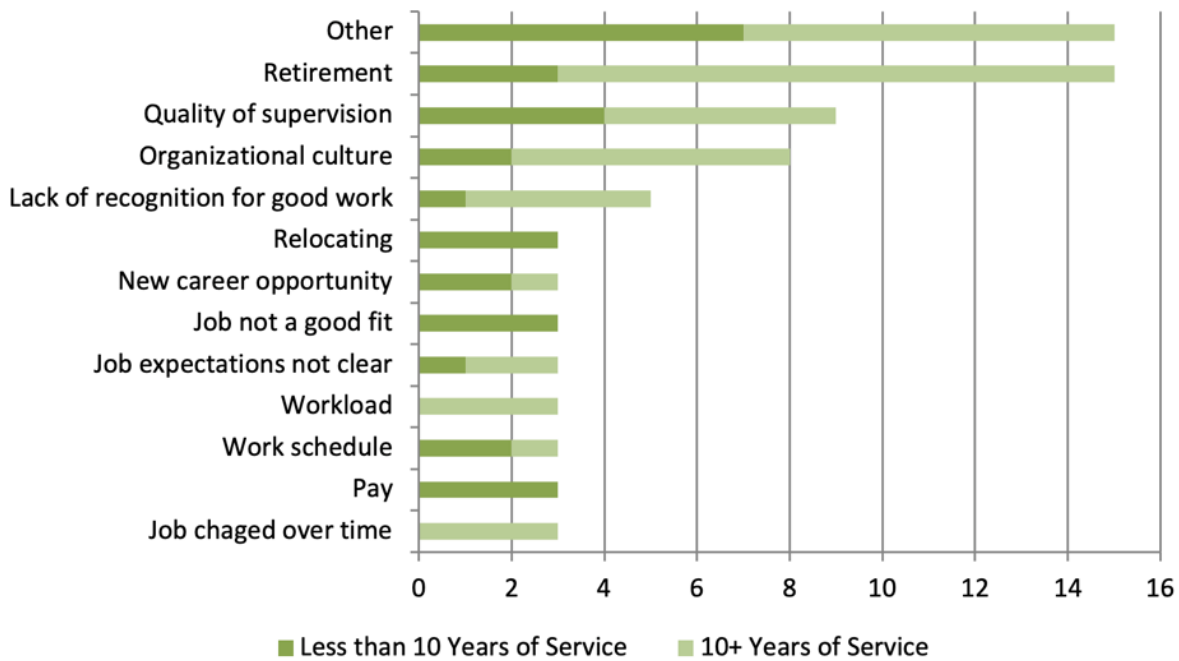
Figure 5. Reasons for Leaving VTrans Employment (n=27)

Retirement, quality of supervision, and organizational culture all ranked high among the reasons why people left VTrans, along with the open-ended "other" category. Responses in the "other" category emphasized: organizational culture (4), quality of supervision (4), and perceived favoritism (6). Note that just three respondents, all with less than ten years of service, chose "pay" as a reason for leaving VTrans employment. Respondents to the exit questionnaire also identified possible retention actions for VTrans.
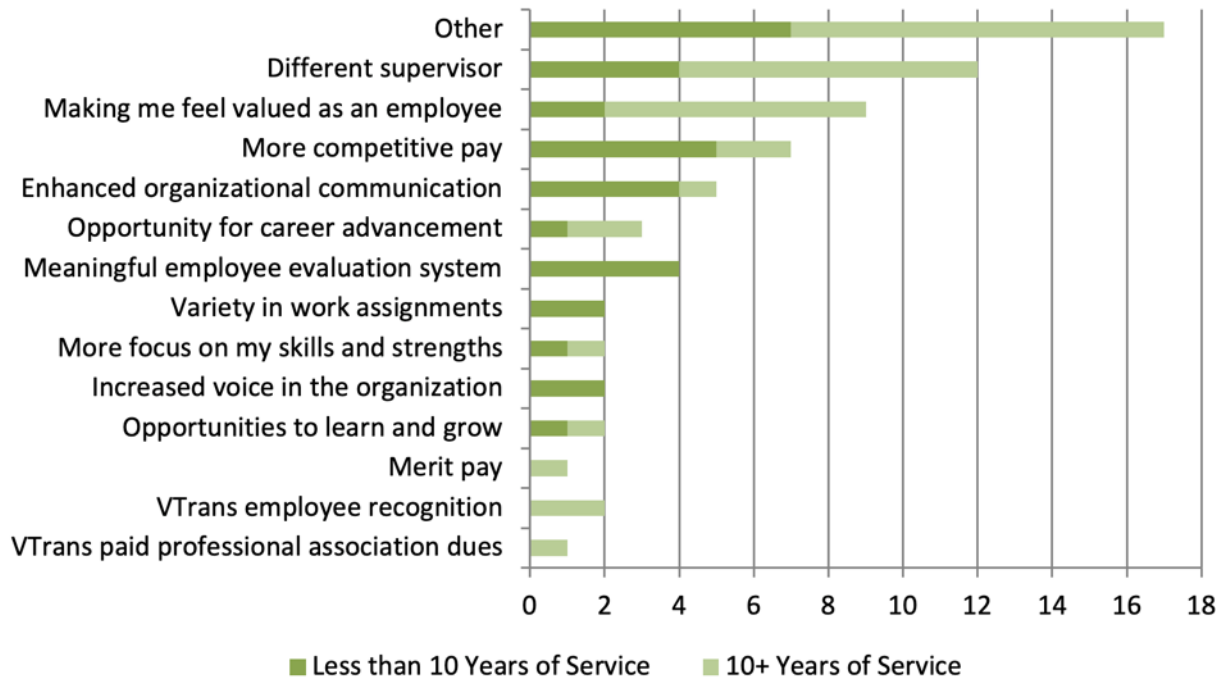
Figure 6. VTrans Steps for Employee Retention (n=25)

Respondents' top recommendations for increasing retention included providing a different supervisor and valuing employees. In addition, many respondents selected the "other" category and referenced the following recommendations in their comments: provide a different supervisor or new leadership (6) and change the organizational culture (5).

4.1.1 Exit Questionnaire Pilot Summary

Use of the piloted form of the exit questionnaire produced information of interest to the TAC and provided a standardized format for collecting data from departing employees. The aggregated, de-identified results can form the basis of a longitudinal dataset that will be useful to determine possible impacts of recruitment, supervision and other organizational practices.

4.2 Knowledge Management Pilot

A KM pilot project was planned as the final activity of this study. The intent was to build on the findings from the VTrans organizational assessment, particularly the KM survey findings, to conduct a small-scale pilot that might address some of the agency's KM needs. After in-depth

discussion with a subgroup of the TAC, the KM pilot project moved forward with the goals of developing:

1. A tool for capturing tacit (or hidden) knowledge
2. A mechanism to help store and retrieve this knowledge

Managers from the Structures and Transportation Systems Management and Operations (TSMO) units selected a total of 8 people to participate in the pilot project.

4.2.1 Participant Activities & Outcomes

An introductory online meeting, held in March of 2018, featured information about KM basics and tacit knowledge. Participants were asked to identify two tacit knowledge topics in preparation for an upcoming in-person workshop. The two-hour workshop, conducted in early April, was designed so participants could identify, discuss, and capture tacit knowledge on a few topics related to their work. Participants were assigned to work in groups of four including the roles of:

- Knowledge owner = serves as the source of the tacit knowledge
- Interviewer = extracts tacit knowledge from the owner
- Recorder = takes content notes in the Knowledge Exchange (KX) form
- Observer = records process questions, comments, and suggestions on the process or form

Participants rotated through all four roles and a debrief session was held after each rotation. As a result of the workshop and subsequent online meetings, 16 KX forms concerning various topics were produced by participants. These forms were tagged with key terms, based on topic (using the online Transportation Research Thesaurus as a guide) and uploaded to a KM pilot page in the VTrans SharePoint repository. Working with the participants and the SharePoint administrator, several iterations of tagging systems were developed and piloted until finally settling on one that included topic, author, and unit. These terms were loaded into the managed metadata term store in SharePoint and participants had an opportunity to try out the search capability. In late June, individual telephone interviews were conducted with five of the seven remaining participants to gather feedback on their experience in the KM pilot project and thoughts about KM practices at VTrans.

4.2.2 Feedback & Evaluation

Participants in the KM component of the pilot were generally enthusiastic about the process used in the April workshop. The rotational method of discussing and capturing tacit knowledge in small groups was seen as beneficial. However, several perceived drawbacks to this approach were identified as the pilot project unfolded. General themes from participant feedback are discussed below and labeled with headings derived from comments made by participants:

It's hard to recognize what you know

Participants acknowledged that the conversational method of interviewing and recording knowledge from a knowledge source (or expert) provided substantial value, since often experts don't recognize their own deep expertise. The workshop method used with participants helped not only document some of tacit knowledge but also informally recognize this expertise. Participants also began to use some common language, e.g. "tricks of the trade," to recognize tacit knowledge.

Engineers are not known as "word people"

Although the Knowledge Exchange form was well received for the most part, writing up tacit knowledge was seen as a challenging. This is not wholly unexpected since tacit knowledge, defined by one participant, as "nothing you would find in a manual," can be more difficult to articulate. The additional step of thinking about a search system via tagging was also identified as challenging and not as intuitive as common online e-commerce sites.

It's hard to have one form that does it all

While a standardized form or template was a distinct need identified in the KM Assessment Survey, there are drawbacks to a one-size-fits-all approach.

We need to hack at the roots of the problem versus the branches

In general, SharePoint is viewed as a problem – if not <u>the</u> problem – with knowledge management at VTrans. One participant noted, "with 300 sites and extra drives, we don't know where to go first." In fact, adding another SharePoint site with the KX forms was met with a general groan from some pilot participants. The use of the SharePoint term store with managed metadata represented VTrans' first use of this SharePoint capability for a specific subject matter intent. This approach was helpful in controlling searches, so results were neither too broad nor too narrow. However, participants sought a search capability that was more familiar, something akin to filters and choices found in online shopping platforms.

More along the lines of mentoring is best

Participants found that working one on one allowed for sharing of nuanced knowledge (the "tricks of the trade") that generally is not written down and cannot be adequately conveyed in writing.

4.2.3 *Knowledge Management Pilot Summary*

The KM pilot project was helpful in several respects. It introduced the idea of tacit knowledge (hidden knowledge, not found in a manual) to the pilot participants and developed a workshop method for recognizing, discussing, and recording some of that knowledge. The development of a form for use within this workshop setting also has value as it helps units or workgroups in VTrans identify, document, and share tacit knowledge. Additionally, the use of SharePoint's term store capability and managed metadata helped with knowledge retrieval. The KX form and

guidelines for use and facilitation of a tacit knowledge workshop are in the Knowledge Management Resources section (Section 7) of this report, as are guidelines for use of the managed metadata (tags) for document retrieval. (The preliminary report on the KM pilot is in Appendix E.) Some units in VTrans may want to experiment with a process similar to that used in the pilot. However, much knowledge transfer, especially tacit knowledge, is best accomplished through other more sustained forms of communication such as that fostered within communities of practice, mentoring relationships, or expert interviews conducted by less experienced colleagues seeking to gain the relevant form of expertise.

The experience of the KM pilot highlights the need for a comprehensive VTrans KM strategy. Leadership is needed from the top, and also within individual units and workgroups, to set direction and demonstrate the agency's commitment to KM. In addition, resources also need to be added to support implementation and ensure that KM activities are not seen as merely additional work for already busy employees.

5 Discussion and Suggested Recommendations

This research project took an evidence-based approach in understanding the state of employee retention at VTrans. In this course of this study, the research team met many VTrans employees who were enthusiastic about their work but also acknowledged challenges they faced within the organization. VTrans employee turnover data supports the fact that younger employees in the early stages of their careers at VTrans are most at risk for leaving the organization. Turnover of this sort drains agency resources devoted to hiring and training employees that leave in short order. In addition, employees who retire accelerate the loss of organizational knowledge. Retaining employees at all stages of their careers and finding methods to enhance knowledge management is essential for supporting Goal 5 of the VTrans Strategic Plan: Develop a Workforce to Meet the Strategic Needs of the Agency.

Key findings of this study indicate that people are attracted to VTrans employment due to various benefits, while they most often leave because of organizational issues. Pay is a factor for some; however, often the quality of supervision is a major reason why some employees exit the organization.

Although employee turnover is an ongoing process in any organization, capturing and sharing institutional knowledge on a continual basis can help lessen the impact of employee departures. VTrans already has some knowledge management practices in place, such as the META project in the Structures Unit of the Highway Division. Employees do share knowledge in written or verbal form, but finding and retrieving this knowledge presents a challenge. The KM pilot developed one way of tagging documents for easier retrieval, but participants were still looking for something that would better target their searches and offer greater ease of use.

It is important to acknowledge the small number of participants in all aspects of this study, as compared to the total number of employees at VTrans. This represents a limitation of the study, but the research team believes that the learning generated by this study is nonetheless applicable to other parts of the Agency.

In evaluating the results and the process from conducting this study, the research team offers the following recommendations for consideration by VTrans:

5.1 Retention Recommendations

a) Administer the Exit Questionnaire to all employees leaving VTrans employment on a regular basis. This will include developing a system to ensure that all resigning employees have an opportunity to complete the questionnaire either in person or on-line. All managers would need to be trained in the use of the questionnaire and the importance of the information collection would need to be emphasized. VTrans might need to consider having a third party administer or collect the data since exiting employees might need the assurance of confidentiality (as in the pilot project) to encourage compliance and candor.

b) Use some questions from the Exit Questionnaire to survey early career employees. The questions concerning reasons for joining VTrans, and perceptions of onboarding and training, could provide useful data within the first six months of a new employees' tenure at VTrans.

c) Review turnover data and the Exit Questionnaire data on an annual basis. Note trends of improvement or new areas of concern. If new areas of concern arise, consider steps to address these.

d) Quality of supervision arose in various forms of data collection as an employee concern. Some employees noted that VTrans has been working to improve the supervisory practices and suggested that further efforts are needed. Consider greater emphasis on the topic of supervision, perhaps involving more in-depth assessment of supervisors' skills in their annual performance evaluation.

5.2 Knowledge Management Recommendations

a) Conduct a review of the use and architecture of the VTrans SharePoint site. Currently there are three sections to the SharePoint site – VTrans Intranet, Projects External, and Projects Internal – resulting in about 300 different sites. Although SharePoint can be a very useful tool for storing and collaborating on documents, and is often used as a KM platform, the problem of where and how to find documents is substantial. A review with users to determine what can be eliminated and what can be streamlined is a good first step. Also, with the SharePoint Administrator, review monthly search analytics to better understand what employees are looking for. Shortcuts may be available to help employees find what they search for the most.

b) Convene a leadership group that will first learn about KM issues and strategies, and then determine what initial steps VTrans will take to begin implementing KM actions. While some groups within the agency are already implementing KM tools, this practice is not widespread. Also, as discussed in the KM pilot, not everything can be written down. Consider what other KM strategies, such as fostering Communities of Practice (CoPs) or verbal knowledge exchanges with experts, could be employed to help share tacit knowledge.

c) Managers could consider holding introductory KM Workshops, similar to that used in the pilot project, at a department meeting or retreat. This process of sharing and recording tacit knowledge helps draw out that knowledge and also provides for a soft introduction of what KM is and how it benefits the agency.

d) Find a home within VTrans for KM. Agency-wide implementation of KM is too large a project to find success without a person who has both the responsibility and authority to move KM forward.

e) Finally, remember that KM has three components: people, processes, and technology. The technology (in the case of VTrans, SharePoint) is important, but not more important than the people who hold the knowledge or the processes required to share that knowledge.

Improving retention and knowledge management at VTrans is essential for addressing Goal 5 of the agency's strategic plan: Develop a workforce to meet the strategic needs of the agency. Particularly given the high number of retirements expected in the coming years, it will be all the more critical for the agency to hire and retain talented younger employees and effectively transfer knowledge from one generation of VTrans employees to the next.

6 References

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3. NCHRP Report 813 – A Guide to Agency-Wide Knowledge Management for State Departments of Transportation - nchrp_rpt_813.pdf. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_813.pdf. Accessed Aug. 25, 2015.

4. Kulik, C., Treuren, G., & Bordia, P. Shocks and Final Straws: Using Exit-Interview Data to Examine the Unfolding Model's Decision Paths. Vol. 51, No. 1, 2012, pp. 25–46.

5. Dillman, D. A. *Mail and Internet Surveys: The Tailored Design Method*. Wiley, 2011.

7 Knowledge Management Resources

This section contains resources that VTrans managers or unit supervisors may find useful in conducting initial workshops or sessions concerning knowledge management. This includes items from the KM pilot project including guidelines for a KM workshop, the Knowledge Exchange Tool, guidelines for tool use and an overview of managed metadata use in SharePoint. Links to relevant information on KM in transportation organizations are also included.

7.1 Knowledge Management Workshop Process and Tools

The initial Knowledge Management Workshop was held as a kick off to the KM pilot. The facilitator's guide and other step-by-step procedures for replicating this workshop are given below. The Knowledge Exchange Tool was developed for use in the introductory Knowledge Management workshop. This tool can be used by VTrans units as a starting point to discuss and capture both tacit and codified knowledge. A copy of the tool is presented here as a Word document but it can also be modified as a fillable form. Guidelines for the use of the Knowledge Exchange (or KX) tool are also included.

7.1.1 Facilitator's Guide and Workshop Preparation

Workshop Preparation

- Given that the important task of collecting and documenting tacit knowledge is neither easy nor familiar to most folks, consider strategies for setting the stage. For instance, how might you create a retreat-like atmosphere for the workshop that supports participants and makes them feel valued? You know your team best, but refreshments are often helpful and appreciated.

- Consider whether it's feasible and appropriate to prompt team members to begin identifying potential tacit knowledge topics in advance. A week or two prior to the workshop you might ask team members to start thinking about types of tacit knowledge they or their fellow team members hold. (See talking points on tacit knowledge below.) If you send them an email with advance information about the workshop, consider suggesting that they create a file on their computer or print out the email and use it as a sheet on which to jot ideas in the lead-up to the workshop.

- Determine how best to capture information surfaced during the workshop. Laptops works well for taking notes in the KX form. Since participants will be working in groups of three, one laptop per small group is sufficient. Send copies of the KX form to team members in advance to download onto available laptops.

- Consider whether it would be more effective for you to organize participants into pre-arranged groups of 3 for the small group activity or whether to let participants self-organize into small group. A group of 4 can also be used if necessary.

Supplies/Equipment Checklist

- Printed copies of the template (1/participant) for reference in the small group activity
- Placards with the name of the participant role, a set for each group
- Laptops for taking notes in the KX form
- Refreshments, if applicable

Facilitators' Agenda & Potential Points to be Adapted as Appropriate

Welcome & Purpose for the Workshop: Capturing Tacit Knowledge

- Purpose of today's workshop is to tap team members' brains to:
  - Identify types of <u>tacit</u> knowledge held by team members that needs to be captured. Knowledge can be categorized in one of two ways:
    1) <u>Explicit knowledge</u> is more tangible and obvious. Checklists and manuals often document explicit knowledge, which is easier to write down and share.
    2) <u>Tacit knowledge</u> can be described as the "know-how" or "tricks of the trade" we carry in our heads based on our experience – it's what we've learned from the past and are then able to use to make better decisions and be more effective. This personal knowledge is harder to write down and transfer to other people. It gets more at the "how" and "why" of making decision and judgment calls.
  - Each of you has developed valuable knowledge through your work. However, most of us don't sit around thinking about the value of the working knowledge we carry around in our heads.
    - But what if you suddenly vanished? What important know-how or tricks of the trade would vanish along with you? What would your remaining colleagues be wishing you'd written down to make it easier for someone else to step in and do this work?
    - Now shift gears for a moment to look at this issue from a different angle. As you look around the room, consider the tacit knowledge that your colleagues hold.
  - Take a few minutes to jot down notes about tacit knowledge topics that should be captured or revisit ideas you brought in with you today. Please list topics in two columns: 1) types of tacit knowledge <u>you hold</u>, and 2) types of tacit knowledge <u>held by others</u> in the room.

Introduction to the Knowledge Exchange (KX) Form & Workshop Process

- This KX form is based on knowledge management practices used in other organizations, including some DOTs. The content of the form was adapted for VTrans in a project carried out by UVM researchers and piloted with VTrans staff members.

- We're going to divide into small groups and use a round-robin process to elicit and document tacit knowledge from each member of the group – so your colleagues will help you select your topic, elicit the necessary information, and document key points

- Form small groups with 3 people per group. Take a few minutes to discuss the topics you identified. Select one topic for each person to discuss and document in the workshop.

- Everyone will play each of these roles:
  - Knowledge Owner = information source
  - Interviewer = information extractor
  - Note-taker = records information in the KX form
  - An additional role as "Observer" may be added as necessary for 4-person groups

- Determine who will start in each role.

- Recorder: please open the KX Word doc template & save as … [determine a file naming protocol that you'd like your team to use]

Tacit Knowledge Capture Round Robin

- Round #1, then do a quick debrief (10-minute trial run + 5-minute debrief for Qs about the process to discuss as a full group)
- Round #2
- Round #3
- Reminder to send documents to the workshop leader after each round!

Full Group Discussion/Debrief and Next Steps

- Facilitate full group discussion
  - What works? What didn't?
  - What other types of knowledge do you think would be helpful to document with this sort of a tool?
  - How & when might you envision using a KM capture tool like this? With whom?

- Indicate what participants need to do with each of the KX forms created during this workshop
  - Send to a designated point person for posting in an accessible location?
  - How will participants be able to review, revise, and update the files created today?
  - How will your team move forward with the process capturing and documenting tacit knowledge on other topics?

- Closing comments
  - This process highlights the amount of valuable tacit knowledge you all hold.
  - Thank you!

Knowledge Exchange Tool

Date Completed:

1. Topic
(What is this Knowledge Exchange File all about? Add a sentence or two that makes it clear.)

2. What areas (units/sections) of VTrans would be interested in this topic?
(Add the names of groups that would be interested in learning about this topic**.)**

3. Contributor Contact Information

  Name:

  Unit/Section:

  E-mail:

  Cell phone:

  Desk phone:

4. Summary
(A description of the content of this KX file, what is it all about?)

5. How does this process or work get started or how is it initiated?
(Add some information about starting this process. Add names, groups or other steps.)

6. What materials or documents are needed to support this action or information?
(Add material or document needs here. Include information on how to locate needed items.)

7. Share a case or example where this knowledge has been put into use. Include dates, location, PIN, EA number or other useful information.

8. What other resources, such as articles, handouts or videos support learning about this knowledge?

9. How long will this information be relevant? Add an expiration date or date by which it should be reviewed and revised.

7.1.3 Guide to Knowledge Exchange Tool Use

<table>
<tr><td colspan="2" align="center">**Guide to Using the VTrans Knowledge Exchange Tool, v.2**</td></tr>
<tr><td colspan="2">

Thank you for your interest in completing a VTrans Knowledge Exchange Tool. This tool was developed as part of a small knowledge management pilot project aimed at providing guidelines and resources to enhance tacit knowledge capture and sharing at VTrans.

Tacit knowledge is the unwritten knowledge we all have as a result of experience in our jobs. It is often described as "know-how" or "tricks of the trade." This might also be considered the aspects of our work that are not found in a manual or guidebook, but that we've come to learn over time as we developed more expertise and good judgment. Tacit knowledge is a valuable organizational asset.

While it is sometimes difficult to communicate aspects of tacit knowledge, we are hoping to capture the essence of some key topics. The VTrans Knowledge Exchange (or KX) Tool is the first step in this process. The KX Tool was tested with a small group of pilot project participants and is now ready for use with a bit wider audience. Here are some tips for using the tool, based on various sections of the form:

</td></tr>
<tr><td colspan="2">

1. The first step in the process is to think about a topic on which you hold some knowledge that you consider to be tacit knowledge or "tricks of the trade."

2. Once your topic is identified, consider what units inside VTrans might be interested in the topic.

3. You are the contributor. Add all the contact information that is applicable.

4. The summary section is important and can be as long as necessary. (All of the sections on this form will expand as needed; so don't worry about running out of room.) Depending on the topic, the summary may be a few sentences or a few pages. But remember, the key items are the pieces you've learned through experience that are not necessarily written down anywhere else.

5. Section 5 asks about how this work or process is initiated. Sometimes there are specific initiation points or times; other work is ongoing. It can be useful to suggest people or groups to contact at the start of this type of work.

6. In item 6, add any pertinent material that can aid in this work.

7. An example is useful.

8. Item 8 is a place to note any resources inside or outside of VTrans that can be helpful for either learning more or supporting this work.

9. Think about how long this knowledge will be relevant. Some types of tacit knowledge are enduring, while others may change rapidly and need review annually or when other processes change. Add your best estimate of when an update to this topic might be needed.

</td></tr>
</table>

> You can complete the KX tool by yourself, although some people have found it helpful to work with a partner. A partner can help elicit your tacit knowledge by asking clarifying questions and record your answers on the form.
>
> Once the KX tool is complete, please follow instructions from your unit supervisor or the workshop leader regarding saving the KX tool.

7.1.4. Managed Metadata and SharePoint

The KM pilot project used a SharePoint site developed specifically for the pilot to post the Knowledge Exchange tools developed as a part of the pilot. The SharePoint administrator gave permission for use of the SharePoint term store for use with managed metadata for document tagging and retrieval. An overview of this capability in SharePoint and issues related to taxonomies is available from Microsoft: https://docs.microsoft.com/en-us/sharepoint/managed-metadata.

Although several taxonomies were considered for the pilot, the final scheme involved a simple set of metadata involving author name, unit, and topic. The guidelines below were written specifically for the documents in the pilot KM site and for the KM pilot participants.

Steps to Using the KM SharePoint site (sandbox version) for Document Retrieval

1. Please go the KM SharePoint site

    a. https://vermontgov.sharepoint.com/sites/VTRANS/e/kmpilot/sandbox/SitePages/Home.aspx

    b. Click on "Documents" (on right side of the window)

    c. A new window with Documents list will open and this will be in the "Modern Experience" mode so will look a bit different. (See screen shot below)
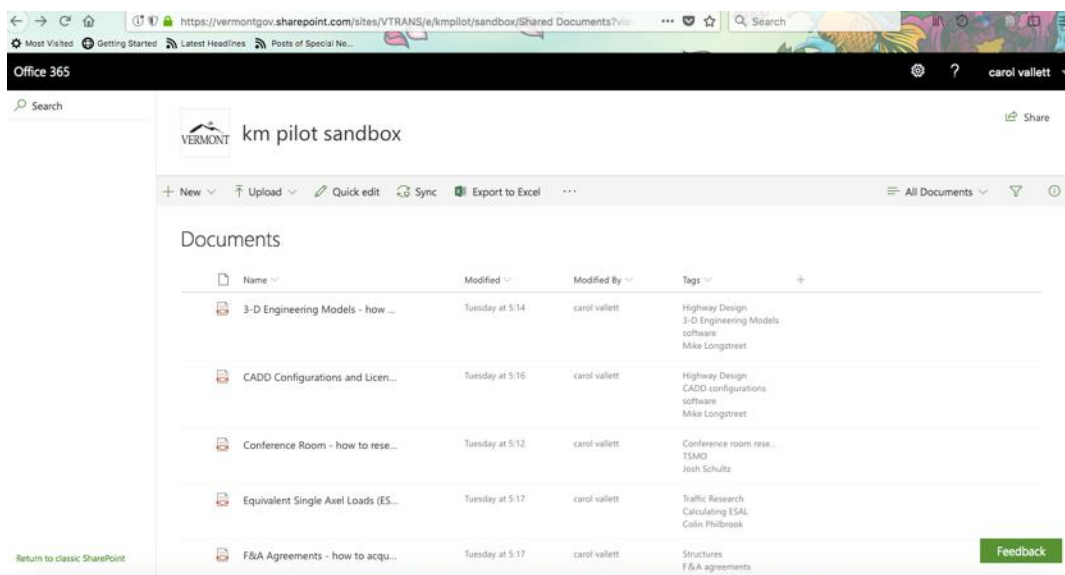
2. There are two ways to search this document library, and I have circled in red both of the entry points for search in the screen shot below.
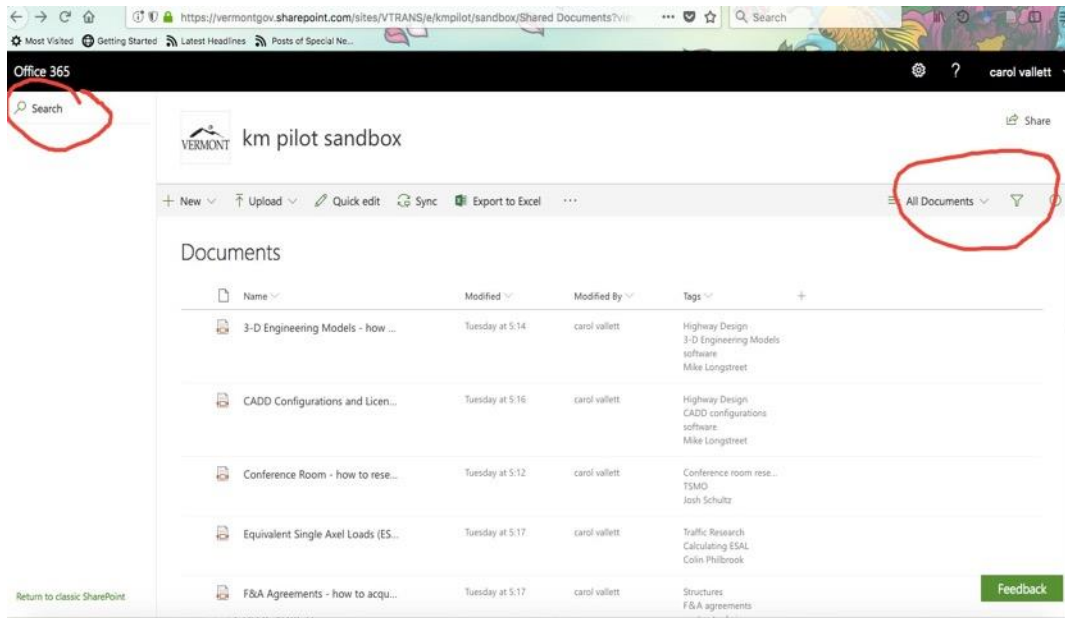
   a. The "Search" bar on the upper left allows for searching on any word that is part of the SharePoint search process. Type the word or phrase but don't hit "return". Up to six results will come up. But, these results might be too broad.

   b. The funnel shaped filter on the upper right, allows for searching on our tags or keywords that were developed.

   c. You will notice that I've modified these tags to just two areas: Unit and Topic. Each will open to show sub-tags. Choose those that are of interest to you and only documents with those tags applied should pop up. You can choose any combination of the two.

   d. Also notice that I've added two columns – one is **Contributor** (the name of the person who contributed the knowledge in this document) and the other is the **Date Added**.

   e. The Contributor column has also been added to the filter process. And the Date Added is a slider. I thought the Date Added column would be useful for reviewing how current a document is and when it might need an update or modification. (This Date Added column currently doesn't show – still a work in progress by the administrator.)

   f. I have hidden the "modified by" and "date modified" columns that were tracking my work. I am not sure if these stay hidden just in my view but I find them not necessary for what we are doing here.

3. Please take a few minutes and play around with our 15 documents. Use both the search bar (upper left) and the filters (upper right) to try and find some documents.

   a. Note that when you open this site, the Filter symbol (shown below) will need to be toggled to get the tags to open.
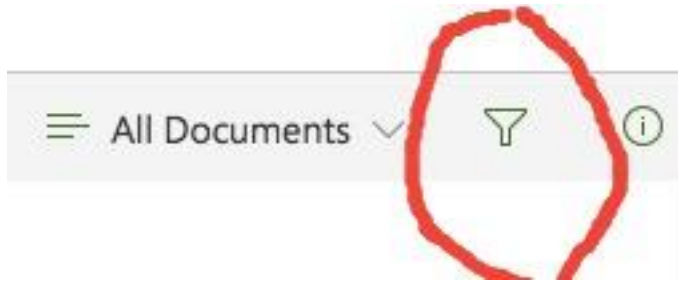
b. Once it is toggled it will open with the first set of tags, Topic and Unit.

c. A list of contributors follows below. Simply check the combination of topic, unit, and contributor and see what you find.

7.1.5 Additional Knowledge Management Sources

The following publications provide more specific information about KM theory and practice in transportation related organizations.

Transit Cooperative Research Program (TCRP) Research Report 194: *Knowledge Management Resource to Support Strategic Workforce Development for Transit Agencies (2018).*

This TCRP report provides a good overview about the need for KM and practical steps for implementation and action plans. There are also many resources provided along with links to other sources of KM tools and resources. The Report is available at: http://nap.edu/24961

NCHRP Research Report 813: *A Guide to Agency-Wide Knowledge Management for State Departments of Transportation (2015).*

This report was the basis for some of the KM assessments used in the VTrans study. It also provides a good introduction to KM and information on what other DOTs are implementing in the area of KM. The Report is available at: http://www.trb.org/Publications/Blurbs/173082.aspx

Heather Hedden, *The Accidental Taxonomist (2016).*

This book provides a practical overview of what a taxonomy is, how one can be constructed and the benefits of use. The author also keeps a blog about taxonomy related work at: http://accidental-taxonomist.blogspot.com/

Transportation Research Thesaurus (online).

This thesaurus (known as the TRT) was developed by NCHRP Project 20-32 to provide a tool for indexing and retrieving of transportation information. It provides for broader and narrower terms and can be useful as the basis of transportation related taxonomy. The TRT is available online along with instructional videos for use of the TRT. It can be found at: http://trt.trb.org/trt.asp

Unilexicon

Unilexicon is a free online tool for building controlled vocabularies. This is very helpful for designing a taxonomy and allows for a graphic representation of terms. A registration for use is required. The tool can be accessed at https://unilexicon.com/

Optimal Workshop

Optimal Workshop offers a number of online tools that are designed to validate information architecture – thus useful with testing taxonomies or classification systems once they are developed. Potential users of an information repository can be given tasks or asked to do the equivalent of electronic card sorting, which provides feedback on the clarity or ease of information retrieval. More information can be found at optimalworkshop.com.

Taxonomy of Intelligent Transportation System Applications

This detailed taxonomy was developed by the U.S. DOT and is a good example of a transportation related taxonomy. It is available at https://www.itsbenefits.its.dot.gov/its/benecost.nsf/images/Reports/$File/Taxonomy.pdf

Also, the ITS Lessons Learned Page is a good example of how this taxonomy can be used to search for topics or documents of interest.
https://www.itslessons.its.dot.gov/its/benecost.nsf/LessonHome

Appendix A: Knowledge Management Assessment Survey Report

<center>

Summary Report

VTrans Knowledge Management Assessment Survey

September 12, 2017

Carol Vallett, Ed.D.

Transportation Research Center

University of Vermont

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Executive Summary

In an initial effort to understand the current state of knowledge use, flow and sharing at VTrans, an in-depth Knowledge Management Assessment Tool was used with three organizational areas inside VTrans. These units included the Structures and Technical Service sections of the Highway Division along with selected personnel in the Department of Motor Vehicles.

The survey results were intended to help identify any gaps in or barriers to information or knowledge practices that might impact the areas under study and also serve as a first step towards building knowledge management strategies in the organization. The results of the assessment tool and other research activities, including the employee focus groups, were expected to inform actions that would positively impact employee retention and knowledge management strategies in VTrans.

The assessment tool was deployed online in May 2017 to 124 individuals across the three units. The response rate was 49% with 61 responses received. The response rate was greatest in the Structures unit with 70% of contacted individuals responding. While the number of completed surveys is adequate for this study, the small number of individuals surveyed compared to the total population of VTrans employees is a limitation of the findings.

Key findings of this study are included below along with suggested recommendations.

Knowledge Resources, Use and Sharing

Individuals are most frequently accessing their own notes and procedures, along with some VTrans provided material as well as turning to their peers or supervisors for information. While the final work products are shared electronically by many employees, there is still a sense of frustration around locating information when it is needed. This included finding the right person who could answer a question or provide help. This disorganization was cited as a primary constraint in accessing or sharing knowledge

At Risk Knowledge & Knowledge Needs

Institutional and historical knowledge of VTrans operations and decisions was noted as the most at risk knowledge. The how and why of past decisions was seen as being important to understanding current approaches to projects. Knowledge needs included the ability to access electronic data (historical & current) in an organized manner, documentation for infrequently performed tasks, and an expert locator.

Knowledge Sharing Tools & Knowledge Flow

When asked about knowledge sharing tools, over two-thirds of respondents agreed they could benefit from the support (e.g., tools, templates, clear procedures) to help them document and share knowledge. When asked about knowledge topics and who they were shared with, a rich inventory of 70 shared topics emerged with a broad array of positions receiving knowledge. However, comments in this area touched on similar themes: the need for organized repositories, enhanced communication and need to share process or tacit knowledge.

Recommendations

- Standardize documents and knowledge access.
  - This could include development of knowledge sharing templates and other aids.
  - Develop expertise within VTrans to catalog knowledge using taxonomy guidelines.
- Improve communication.
  - Enhance communication from leadership and supervisors to staff in their areas.
  - Improve cross-department communications. Include content concerning upcoming projects and project needs.
- Focus on tacit knowledge sharing.
  - Consider additional sorts of mentoring or job shadowing for tacit knowledge transfer. Working with others and understanding what they do helps to build an understanding of judgment and experience needed.
  - Consider Community of Practice or other social network implementation for this purpose.
  - Develop an expert locator based on an area of knowledge. Use this as not just a directory but a cadre of experts willing to serve as mentors or advisors to other employees on an ongoing basis.
- Conduct knowledge flow mapping
  - Consider building on the knowledge flow area of this assessment by conducting interviews with staff members in key areas to produce a knowledge map.

- Determine leadership and oversight for knowledge management initiative.
  - KM success depends on a continual and ongoing management support. Determine where and who will have oversight for this effort.
  - Top leaders in the organization need to make their support known and stress the importance of the effort.

Introduction

As part of understanding the current state of knowledge use, flow and sharing at VTrans, an in-depth Knowledge Management Assessment Tool was adopted and used as a survey with three organizational areas inside VTrans. This in-depth survey assessment was modeled on a knowledge management assessment tool included in NCHRP Report 813: *A Guide to Agency-Wide Knowledge Management for State Departments of Transportation (2015).*

The survey results were intended to help identify any gaps in information or knowledge practices that might impact the areas under study and also serve as a first step towards building knowledge management strategies in the organization. The results of the assessment tool and other research activities, including the employee focus groups, were intended to inform actions that would positively impact employee retention and knowledge management strategies in VTrans.

The results of this assessment are presented here in summary format. However, the data can be analyzed, and where important, has been analyzed based on the three different VTrans units included in the study. Efforts have been made to include figures that depict the data and more details can be provided as needed.

It is important for readers to keep in mind the small number of responses to this tool compared to the overall number of VTrans employees. While still useful as a first step, this presents a clear limitation to the broad applicability of the data.

Methodology

The Knowledge Management Assessment Tool used in this survey work was modified by the researchers and developed as an online survey. The survey was reviewed and tested by staff in the Transportation Research center (TRC) and VTrans and revised as appropriate for enhanced understanding and applicability by the VTrans recipients. The survey consisted of 29 questions, many with multiple parts and some open-ended in nature. The protocol for administering the survey was approved by the Institutional Review Board at the University of Vermont in February 2017.

Following the guidance of the Technical Advisory Committee (TAC) for this project three areas in VTrans were selected to receive this survey. Those areas included two sections of the Highway Division:

- Technical Services section, Maintenance and Operations Bureau
- Structures section, Project Delivery Bureau

All employees in these two sections received email invitations to participate in the survey.

In addition, select employees (n=23) in the Department of Motor Vehicles, determined by the Deputy Commissioner, were also invited to participate.

In late April, Directors of Technical Services and Structures, as well as the DMV Deputy Commissioners, were asked to send emails to their employees giving advance notice about the upcoming survey and asking for participation. This was followed in early May by an email to each participant by the TRC researcher with details about the survey and informed consent information. The email with the link to the survey was sent on May 5, with two reminders sent (May 11 and 22) and subsequently, the survey closed on May 30th.

Results

The overall response rate for this survey was 49%, although the response rate by VTrans group varied widely. Structures had the most robust participation with 70% of individuals using the survey. 50% of DMV recipients responded but just 36% of those from Tech Services used the assessment survey. Participant numbers and response rate by VTrans area are in **Error! Reference source not found.**.

Table A-1. KM Assessment Tool Participants

	DMV	Structures	Tech Services
Total sent	23	37	64
Opened	16	29	46
Responses	12	26	23
Response rate	52%	70%	36%

Of the 61 responses received, 15 are considered partial responses since individuals did not complete the entire survey. Respondents were also able to skip questions if they wished and still move through the survey.

Demographics

The assessment tool did not ask respondents for any personal identifying information. However, years of service (at VTrans), as well as position title and unit, were asked of individuals.

People who responded to the survey represent a predominately experienced group of employees. Almost two-thirds (63%) of respondents had five or more years of service at VTrans with the remaining respondents divided almost equally into other categories of service below 5 years with only one respondent being very new to the organization. This service characteristic was similar for employees across all three units. A graph is in Figure A-1.
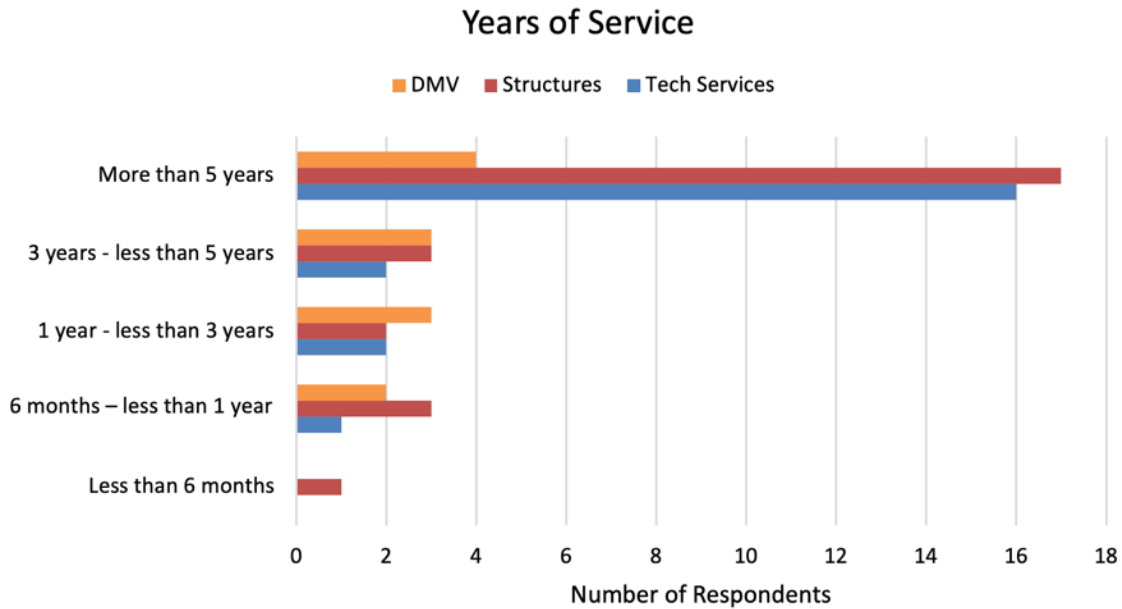
Years of Service

Figure A-1. Years of Service (n=59)

Job positions represented by respondents differed from group to group. Respondents from Structures were predominantly engineers (various titles such as project, design, civil) and also included project managers and technicians. DMV respondents were customer service representatives or supervisors while individuals from Tech Services covered the broadest range of positions including people from technical and managerial positions.

Job Position Titles
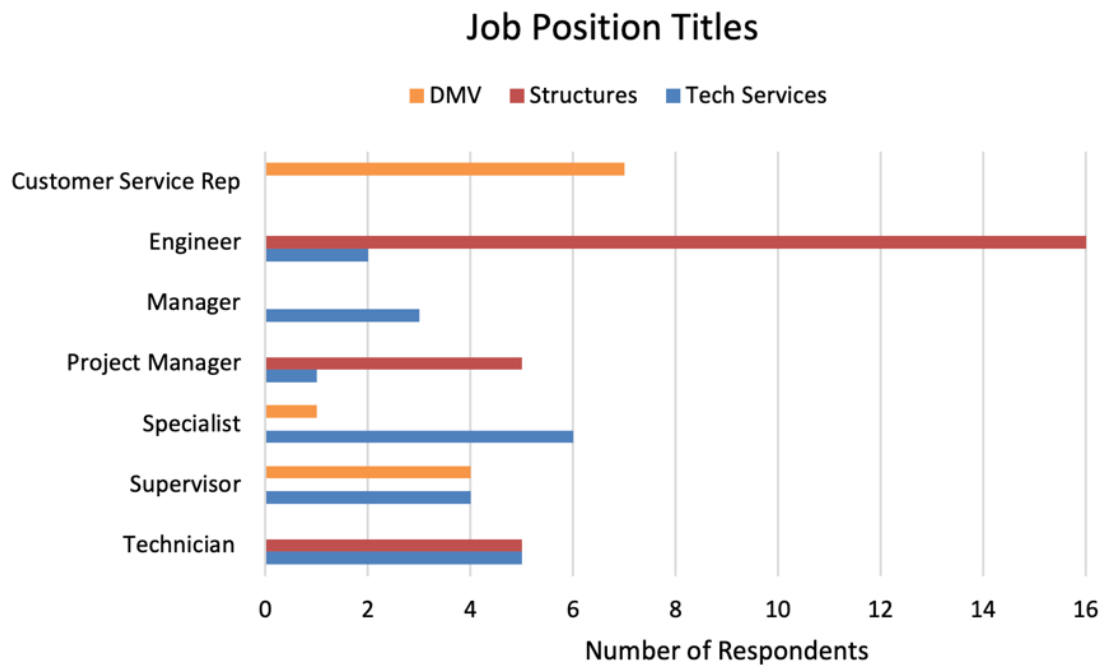
Figure A-2. Job Position Titles (n=59)

Knowledge Resources

Respondents were asked several questions concerning sources of knowledge and the frequency with which they used these sources. These included questions relating to codified sources (e.g., databases, manuals) of knowledge as well as people who served as knowledge sources both inside and outside of VTrans.

Participants were asked how often they used types of resources with choices being daily, weekly, monthly, quarterly, never or N/A. Results are in Figure A-3.
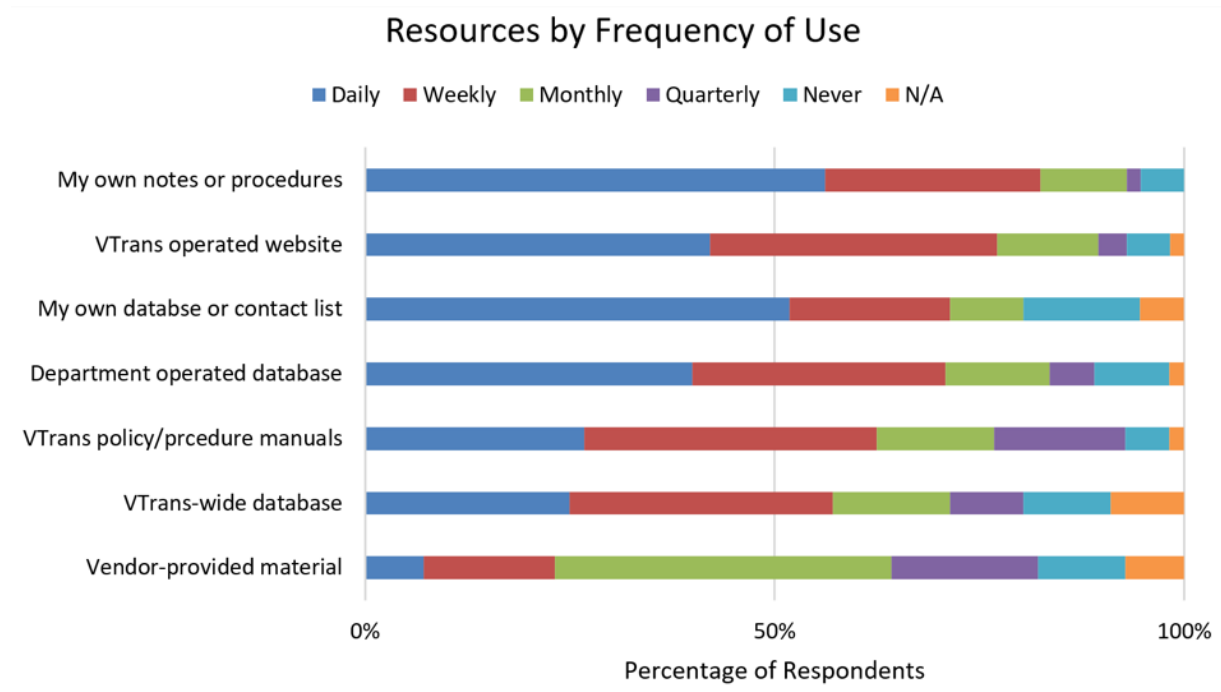
Figure A-3. Resources for Job Information/Problem Solving (n=57)

Note that the most frequently used daily resource, by over 50% of respondents, were their own notes, procedures, databases or contact lists. Personal contact lists or databases were also used frequently as were VTrans websites and department databases.

Subjects were asked to list their top five resources used and to rate the frequency of use. The 191 responses to these open-ended questions were collapsed into two broad categories; resources inside VTrans and those from outside organizations. Many of the top mentioned resources were used by 68% of respondents on a daily or weekly basis. A list of commonly mentioned resources is in **Error! Reference source not found.**.

Table A-2. Frequently Used Resources

VTrans Resources	Outside Resources
Manuals (Structures, Hydraulics, Standards, Work zone Safety)	FHWA (MUTDC, Highway and Performance Monitoring)
Websites (SharePoint, VIPER, CAAD help, DMV Express, VTransparency, VPINS)	AASHTO (construction specifications, "Green Book", SCOWT)
DMV policies database	Vendor or organization product manuals (Econolite, AISC Steel Construction, discussion groups)
Best Management Practices	ATMS 511
Maintenance Activity Tracking System	Google Earth
Traffic monitoring Guide	NOAA weather
Personal notes (lists, spreadsheets)	ITS America
Artemis	NADA website
Automatic Vehicle Classification	Vermont statutes (Title 23, Motor vehicle law
DMV point of sale system	Vermont Agency of Natural Resources (environmental regulations, Vermont Rivers, and Roads Manual
	Vermont Human Resources website

The survey also asked about the frequency with which individuals sought help or guidance from different personnel. Response categories were similar to codified resources in Figure A-3 but without an N/A category. Results are in Figure A-4.

Personnel Resources by Frequency of Contact

Legend: Daily | Weekly | Monthly | Quarterly | Never

Categories (top to bottom):
- A peer or colleague in your department or division (informal)
- Your immediate supervisor
- Subject matter expert (in an area of policy, practice or research)
- Technical or functional expert (e.g., accounting, legal, contract administration)
- A peer or colleague outside your department or division (informal)
- Your department or division head

X-axis: Percentage of Respondents (0% to 100%)

Figure A-4. Personnel Resources for Job Information/Problem Solving (n=56)

It is interesting to note that while peers were a source of information on a more daily basis (46%), supervisors were consulted on a weekly basis by nearly 60% of individuals.

Respondents were also asked to provide titles for up to three people they go to for knowledge or advice in five different areas. These areas were:

- Management and leadership
- Subject matter expertise or content knowledge
- Historical knowledge about VTrans
- Procedural or process knowledge
- General advice

The most frequently mentioned titles by knowledge category are listed in Appendix A.B. While the titles in the aggregate are of some value, analyzing responses by years of service found potential useful knowledge flow patterns. Those with 3 years or less of service turned to their senior colleagues or supervisors for management and leadership advice as well as historical knowledge. However, their peers, perhaps with just slightly more experience, were sources for subject matter expertise or procedural knowledge as well as general advice. For example, an Engineer I would turn to an Engineer II for subject knowledge but their supervisor for management knowledge.

Interestingly, those with more than 3 but less than 5 years of service start to turn to managers, particularly project managers, and supervisors for more subject matter and procedural expertise. Job position analysis revealed a pattern of managers turning to other managers as

sources of knowledge in addition to reaching out to directors and people in leadership positions. Engineers connect with other engineers, peers or sometimes those in a senior manager (project or program) position, for most knowledge needs. For example, an engineer in Traffic Research may be in touch with another engineer in the same area. There was also evidence of cross-department or unit connections with some turning to people in other areas of VTrans.

A total of 45 individuals contributed answers to these questions with 431 total responses across all five knowledge areas. This type of information flow or sharing gathering and analysis could be an excellent undertaking by VTrans using details including names of individuals. This could be a good start in building an understanding of knowledge experts and knowledge networks.

Knowledge Use

Respondents were asked to select all the tasks they performed regularly (daily or weekly) in the course of their job. Results are in Figure A-5.
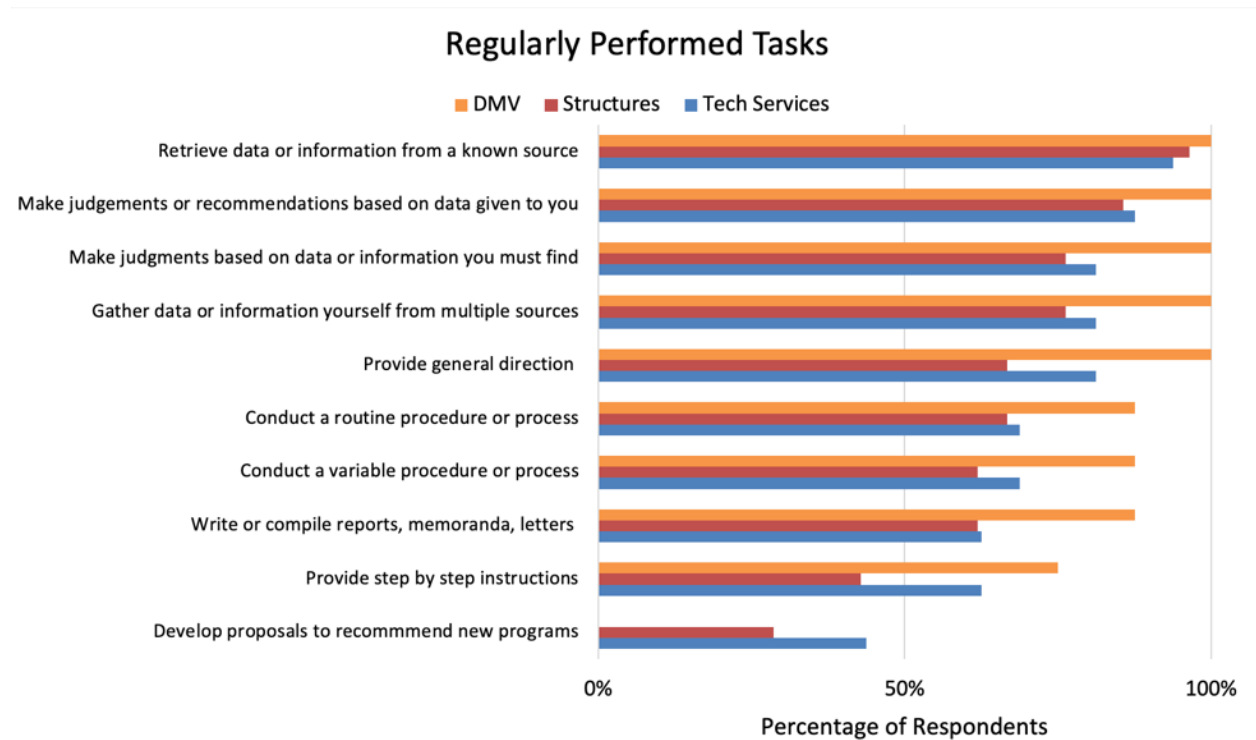
Figure A-5. Regularly performed tasks (n=45)

The assessment also asked respondents to indicate all the methods they typically used to save or shared products resulting from their work. Results by unit are displayed in Figure A-6.

Where Work is Saved

■ DMV ■ Structures ■ Tech Services
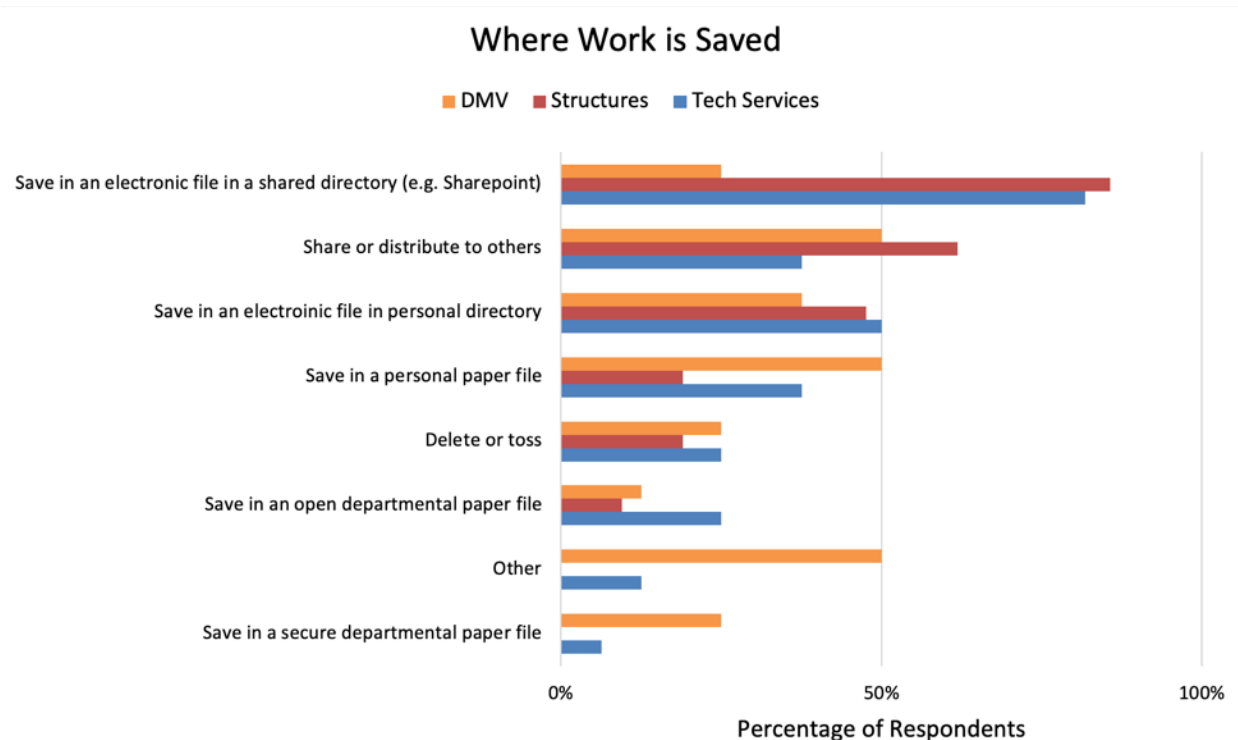
Figure A-6. Destinations for saving work products (n=45)

The "other" category included answers such as saving in a file cabinet, secure shredding of documents or entering into a database. Overall many respondents in Structures and Tech Services are saving work or sharing electronically, while DMV respondents seem to be sharing more directly with colleagues. About 50% of Structures and Tech Services also save in personal electronic files with personal paper files also used by some, especially in DMV.

The assessment also included an open-ended question asking respondents to share an example of when they were frustrated by not having the information they needed to accomplish an organizational task or goal. Of the 30 responses to this question, a third gave examples that related to a lack of documentation or a standard operating procedure for a specific task. This included documentation or plans for existing structures as well as not having documentation for project decisions.

> *"...project or procedure changes are not well documented for all who need to know, or buried in a folder that is near impossible for anyone except management to find. When management sees that a procedure wasn't followed they state 'you should know that, it is right here' but when I go to use it the link is broken or the folder has moved and when I point this out they didn't know."*

> *"Basis of a past decision specific to a project is not documented. Not in a project folder or is something that typically doesn't get documented. Some people are out of the office so I need to wait to talk with them. Sometimes personnel no longer works for VTrans and the history and information are lost."*

" …I need a piece of information regarding a standard practice or guideline that I need to adhere to…it is incredibly difficult to find in the disorganized ocean that is our standards and procedures. Many of our procedures and standards are out of date or just plain obsolete, and many other groups do things differently. Sometimes it is hard to know exactly what direction to go with a project when not all of our information is consistent or consistently practiced."

A second theme often mentioned was the difficulty in locating the right person to answer a question or guide the task.

"Customers who send mail with tracking numbers frequently call wanting to know the status. Sometimes I can see that the transaction has been processed… but other times I come up empty-handed. It is frustrating and time-consuming to call around to try and find the right person to ask the question or obtain the answer from."

Knowledge Sharing

The assessment asked individuals to select the primary method they used to share new knowledge gathered from another source (an article, book, website, meeting announcement, course) or other information that might be useful to VTrans staff. Responses by unit are in Figure A-7.
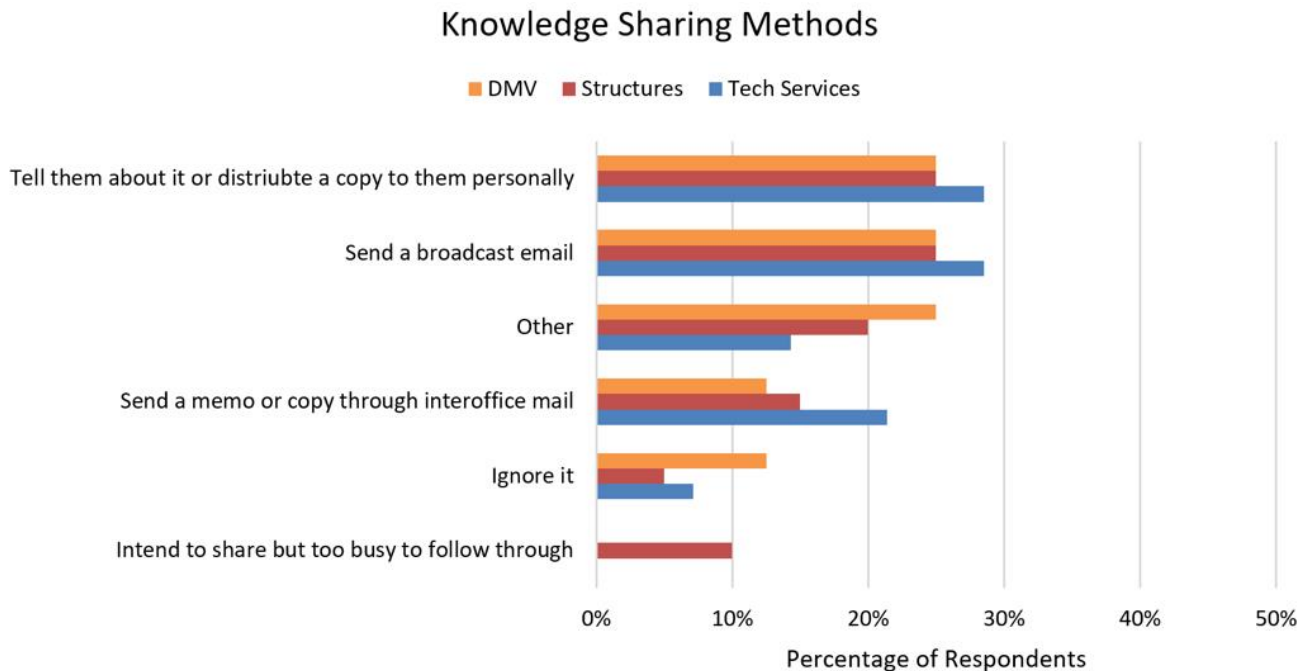
Figure A-7. Methods for sharing new information (n=42)

About 25% of respondents either send the information to individuals personally or send a broadcast email. Responses in the "other" category included sharing methods such as email to individuals or to supervisors who could then chose to share with their employees. Some also

store new information in a public source or in a personal drive in case it is needed later. It was interesting that no single method seems to dominate knowledge sharing and only a small percentage of respondents either ignore new knowledge sharing or feel too busy to share it.

Constraints

Respondents were asked an open-ended question regarding the most significant constraints faced in being able to access or share knowledge. Responses were somewhat similar to those in the previous question about frustrations in locating knowledge. Of the 39 people who answered this question, more than half (23) included a comment related to the disorganization of resources or the difficulty in locating accurate information.

> *"There is little to no consistency in the organization of our larger physical or electronic public library."*

> *"We have lots of information in many different locations. If you don't need it every day, it is easy to forget where it is located. "*

> *"There is not a single repository of information that resources, design tools, guidelines, etc. that exists. There are many and often are not kept up to date. Many individuals have their own knowledge, tools, that they keep on their personal drives and are not able to share it across the department. Many guidelines, links, websites, often change as well making it difficult to keep track."*

Other constraints included time (not enough) and technology frustrations (slow connections and computers). Not having leaders that care about work or knowledge sharing, and not being included in announcements about new projects. Others, however, mentioned they have no frustrations with information or knowledge sharing and are able to get the information they need when they need it.

At Risk Knowledge

The survey also asked an open-ended question regarding critical knowledge at risk of being lost in a department or division due to employee turnover. 37 individuals answered this question, and given the high number of engineering positions in the response pool, many answers were specific in nature while others were much broader.

Institutional knowledge was a common theme mentioned most frequently by respondents. This included not only knowledge of the organization but historical knowledge of past projects, tacit knowledge and why VTrans takes the approaches it does.

> *"History and reasons behind policies, guidelines, and process. These need to be updated over time as needs, goals, personnel, and technology changes. Institutional knowledge and experience (how we overcame obstacles in the past) are typically beyond written procedure, policies, and guidelines. Difficult to capture this knowledge before it is lost."*

> *"Institutional knowledge and mentorship. So much of project management is learned by watching a good experienced one in action. Too many PM's are left to flounder or just*

figure it out. We are starting to develop SOP's but you just can't capture everything. We are starting to move in the right direction but need to get away from thinking we can simply write a book because we can't!"

"There is a lot of little pieces of information that people pick up through experience. While some of this might seem trivial, these tiny details combined are what separates somebody who is well versed and experienced in a subject from somebody who is a novice. This knowledge is what is at risk of being lost and no amount of common libraries or S.O.P's will be able to capture it."

Understanding of processes and procedures was noted as a possible critical loss.

"Almost all tasks associated with process or development of a project is knowledge that is not documented. Technical -Resources and knowledge of specific software - Artemis/CADD."

"Mostly process and procedures, and not really lost, but new people have to figure it out alone rather than a mentoring process - takes much longer."

Other specific areas at risk of knowledge loss included proper work zone procedures, signals engineering, and welding skills.

Training & Tools

Respondents were asked to select all the methods they preferred when they wanted to learn or improve a skill. About two-thirds of respondents preferred self-teaching, training at the VTrans Training Center and learning from a colleague. Results are in Figure A-8.

Preferred Learning Methods

■ DMV   ■ Structures   ■ Tech Services
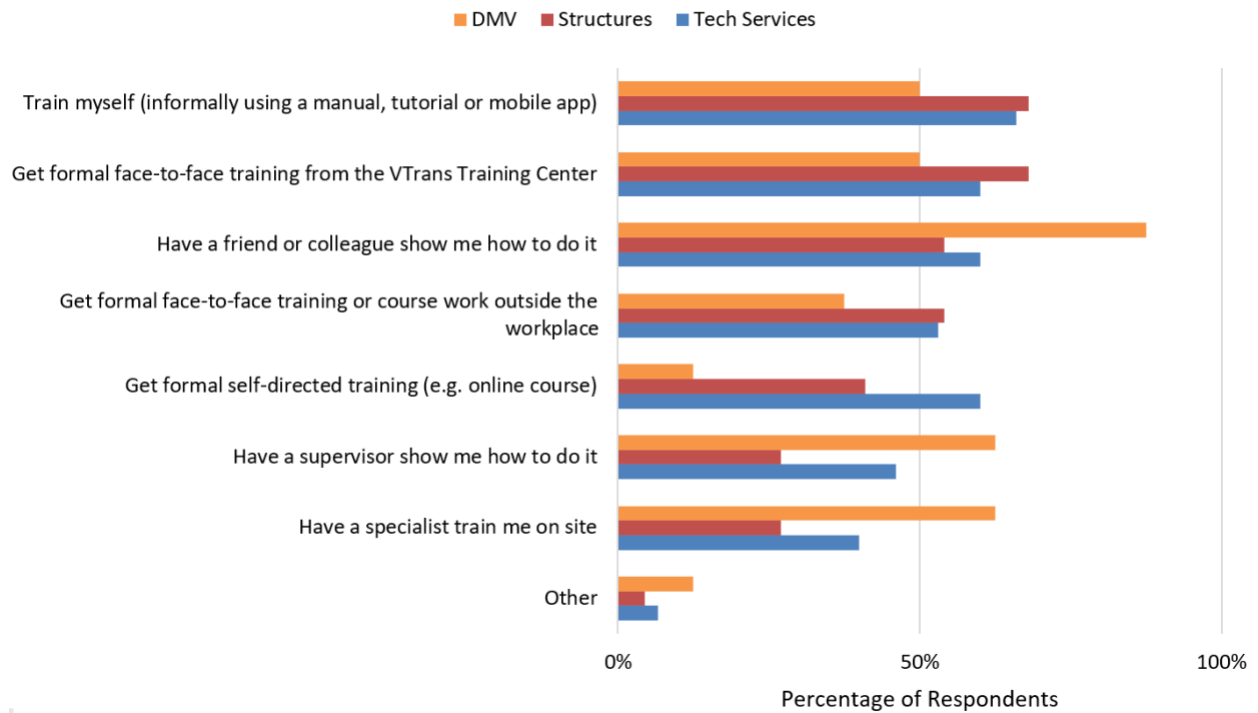
Figure A-8. Preferred learning methods (n=45)

It is interesting that the three leading preferred learning methods are all quite different from each other. This is perhaps not surprising since learning styles can be very individualized.

The survey also asked respondents to indicate the sorts of tools or resources they preferred to use for help in doing their job. Nearly 85% preferred a person they could talk with in real time, followed closely by access to documents, either electronic (77%) or printed (68%). Additional results are in Figure A-9. Use of email and YouTube videos were also mentioned as other resources.

Preferred Tools or Resources
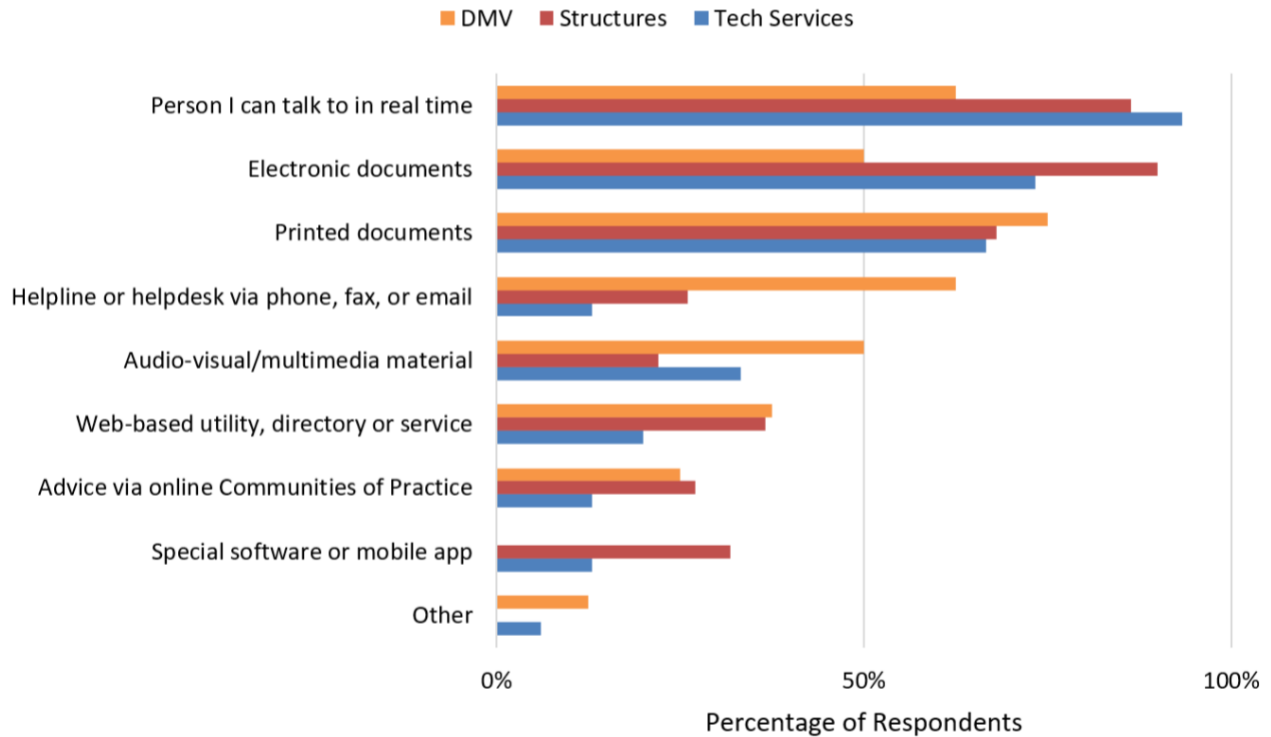
Figure A-9. Preferred tools or resources (n=45)

Knowledge Needs

The survey asked two open-ended questions about knowledge needs that were currently not being met. The first concerned knowledge or information that individuals don't currently have but would like in order to do their job better. 35 individuals answered this question with little in the way of overlap. Comments were categorized by theme into the following six areas.

General training

Need for continuous training, through VTTC or for college credit.

Data Access

Ready and easy access to electronic data including historical project data, reference books, code books, sign asset database. A suggestion was also made to improve the organization of electronic files. Need for electronic expert locator was noted. Documentation for infrequently performed tasks was needed.

Administrative needs

This included information and training on budgeting and finance, communication and general administrative aspects.

Human Resources

Multiple comments about more need for training in the HR aspects of roles, including dealing with difficult employees and management of temporary employees.

Computer skills

Improved skills need in keyboarding, CADD, database use.

Specific technical knowledge

Smart Work Zones mobility, Hydro CAD, soil type, storm water permitting, troubleshooting (Stack Overflow), subterranean conditions.

The second question in this section asked about specific information or knowledge that VTrans currently does not have but should have in order to execute its mission, improve effectiveness and serve customers with excellence. 28 people answered this question and response categories are somewhat similar to those found in individual knowledge needs.

Administrative and knowledge needs

Management with technical knowledge, communication skill enhancement, budget based decision making, data organization, eliminate duplicate documents, methods to share knowledge of experienced engineers.

Computer skills

File and document management, keyword data access.

Human Resources

Job shadowing opportunities, promote professional people management, rewards for good performance.

Specific technical knowledge

Procedures based on statutes, traffic management training for all modes of transportation,3D modeling skills, automatic traffic sign recognition on ARAN vehicle.

Knowledge Tools

In addition to knowledge needs, a question was asked for levels of agreement regarding various knowledge management tools.
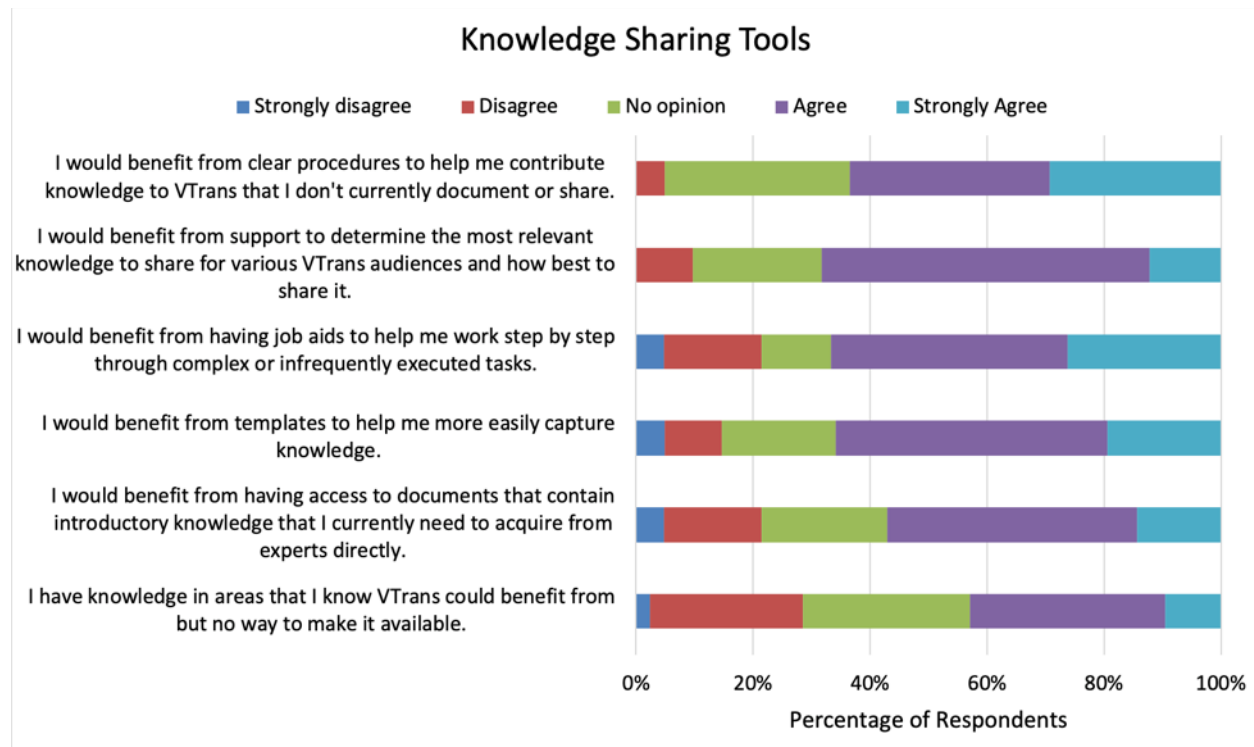
Figure A-10. Knowledge sharing tools (n=42)

Items with the highest level of agreement concerning support for knowledge sharing include the need for clear procedures, relevant knowledge determination, job aids, and templates for knowledge capture.

Knowledge Flow

The KM assessment asked respondents to imagine they had won a knowledge sharing award and to list the top five categories of knowledge shared and the positions of staff members with whom they shared this knowledge. These were open-ended questions with 29 people responding with one or more items.

Responses were analyzed by unit (DMV, Structures, Tech Services) and organized into charts depicting the knowledge topic shared and who (by position) the knowledge was shared with. These tables are in Appendix A.B of this report. It is remarkable that nearly 70 knowledge topics were mentioned including general organizational knowledge (communication skills, meeting facilitation) and specific technical items such as licensing procedures or work-zone set up. An analysis like this could be a model for a more in-depth analysis of knowledge networks across segments of the organization.

Knowledge Flow Improvement

Respondents were also asked to comment on how knowledge flow in their areas could be improved. 27 individuals offered suggestions on how the knowledge flow could be improved. Themes noted are:

Communication

Seven people included a comment about the need for improved or enhanced communication. This encompassed items such as interpersonal and email communication, aimed at keeping the messaging for VTrans clear.

> *"Improved interpersonal communication would help ensure all parties to an issue have had an opportunity to have their perspectives heard."*

> *"The message from management to workers sometimes seems to get lost or skewed in ways that create conflict."*

> *"Available to all, posted in a permanent place as opposed to being passed around. Too many memos passed around so information is not easily obtained."*

Organize document repositories

Five individuals mentioned the need for better-organized documents, better retrieval methods and improvements to existing databases.

> *"Well organized interface to access the wealth of information that we currently have. Documenting lessons learned and also developing a mechanism for adding this experience as additional information to the appropriate documents (policies, guidelines, procedures)".*

> *"Standardize all files so that similar information between projects is always located in the same place."*

Mentoring/Shadowing

Several people mentioned the need for more formal mentoring or job shadowing. This also included what was referred to as "open conversations".

> *"Include some active mentoring other than just meeting regularly. More like shadowing."*

> *"Have an open conversation on how to do it instead of the one individual's 'this is how we will do it' and keep it to themselves buried deep in some subfolder only known by them."*

Standard Procedures/Processes

Having, and sharing, standardized procedures or processes was also suggested as an improvement.

> *"The creation of standard operating procedures."*

"Technical knowledge is well shared currently via design aids, design manuals, and intrapersonal relationships/discussions. Process knowledge is contained exclusively within a handful of people at the top of the organization and is not shared."

Final Respondent Comments

Respondents were provided an opportunity to make any final comments and 13 individuals chose to do so. Comment themes are:

Learning

Different aspects of learning and training were touched on by the comments.

"Staff up with the latest trends, construction methods, and procedures so that the Agency can compete in the world."

"Gaining knowledge or at least the care to attempt it would be a drastic improvement."

"Improve contract administration knowledge and hurdles"

"The biggest problem is not knowing there is something that needs to be learned."

"Our biggest challenge is training new employees. On the job training takes time and typically there is no short cut to actual on the job training under a skilled supervisor."

Knowledge Management

Comments were cautionary about KM issues and implementation.

"If too many guides are established it will cause people to lose the ability to think for themselves rather than exercising thought and reasoning through a problem. The engineer's most useful tool is their own judgment."

"This survey is another way to seem like it is fixing a problem while it is actually a department tool to make people think they have some say. But they will go along with what they have been doing. I've seen this before."

"We do need to change the mentality of 'that's the way we've always done it' and we have made HUGE strides in the past 5 years or so under some leadership. But we don't" need to change for the sake of change."

Leadership & Communication

Several comments touched on the need for competent and skilled leaders as well as ongoing communication.

"Leaders are often in meetings and then ask staff below them to answer questions or produce talking points…. This generation of leaders passes it off and the feeling exists that we are a bit on our own when it comes right down to it."

"There is a lot of failure to follow through."

"Need better more knowledgeable supervisor."

"Talk to each other as we are on the same team."

"Better internal communication."

Conclusion

This assessment tool study served to provide a limited first step in understanding knowledge practices in a few select VTrans units. Overall, those who responded were thoughtful and thorough, although some expressed more discouraging views regarding knowledge or management practices at the Agency. The findings from this assessment provide several potential leverage points for VTrans in knowledge management practices.

Personal Notes

In general, those who responded are using a variety of resources while completing their work, with many relying not only on VTrans sources but their own notes and contacts. And while most share their work in accessible electronic spaces, there is still a high degree of reliance on personal electronic or paper files. Finding a path for moving these personal notes into shared space offers a potential to improve codified knowledge sharing and possibly a start to sharing of tacit knowledge.

Disorganized Online Resources

Many respondents provided detailed information about the resources inside and outside of VTrans that are used for job completion. The list was truly impressive and it is clear that many VTrans guides and information exists online in electronic format. However, the comments about the disorganization of existing resources is one that needs to be addressed. This may be the most important constraint to knowledge sharing. Confusion over where and how to find needed information discourages use. Addressing this knowledge clean-up of sorts may involve charging someone inside VTrans with cataloging documents or at least developing a system for information sharing using taxonomy or key words.

Institutional & Tacit Knowledge

While many specific aspects of some work and related knowledge at VTrans were mentioned as possibly being at risk, the rich institutional knowledge of processes, procedures and, and as one respondent noted "little pieces of information that people pick up through experience" is most at risk for being lost. This is not just historical but provides that tacit institutional knowledge which is often beyond written policies or procedures. This provides an opportunity for tacit knowledge capture from experienced individuals. Consider establishing some Community of Practices or other social learning opportunities to help transfer this tacit knowledge.

Knowledge Networks

The knowledge sharing and the flow of that knowledge provides an interesting and rich picture of the various topics and individuals who share knowledge. This information, (Appendix A.B) if

repeated via either survey or interviews, using personnel names and positions, and coupled with information on where staff goes for specific topic knowledge (Appendix A.A) would be a good start on mapping knowledge networks in VTrans and beyond. This could also help identify individuals regarded as experts in their area.

Leadership and Communication

Leadership is needed for success in knowledge management and transfer. VTrans leaders will need to demonstrate that knowledge management is important for organizational growth and innovation. Communication was noted in many areas of the survey as an organizational feature that needed improvement. Primarily comments indicated a need to hear more from leaders, supervisors and peers and could possibly be summarized by the comment of: "Talk to each other as we are on the same team."

These findings provide several possibilities for enhancing KM practices at VTrans. It seems that employees are capturing and sharing knowledge, but supports need to be put in place to help them with these efforts. Codified knowledge sharing supports such as clear procedures and templates for knowledge sharing could be developed and put in place with guidelines for usage. However, the knowledge organization issue would need to be addressed for this effort to be successful. Tacit knowledge capture could be addressed with the establishment of Community of Practices by discipline across departmental lines or other types of social networks. But with these or other actions, KM will need an organizational home in VTrans and a champion for the effort.

Appendix A.A: VTrans Personnel and Information Resources

	Colleague	Director/ Deputy Director	Engineer (colleague)	Engineer (senior or lead)	Manager	Super-visor	Project Manager	Section Chief	Technician	Admin Services Coordinator /Assistant
Management & leadership		+	+	+	+	+	+	+		
Subject matter expertise	+		+	+	+	+			+	
Institutional/historical knowledge	+			+	+	+	+			+
Procedural/process knowledge		+	+	+	+	+	+		+	
General advice	+			+	+	+	+	+		+

Appendix A.B: DMV Knowledge Topics and Sharing

Table A.B-1. DMV Knowledge Topics and Sharing

	Branch Co-workers	Customer Service	Project Managers	Supervisors	Examiners	Lean Team
Communication skills		+		+		
Positive attitude/strengths Based approach		+		+	+	
Using resources		+				
Adaptability		+				
Keeping organized	+					
Plate/title information, Registration rules		++		+		
Work flow			+			+
Refund process						+
System functions		+				
Suspensions		+				
License		+				
CDL requirements	+					
Foreign applicant eligibility	+					
Exam procedures	+					
Restricted license procedures	+					
School bus driver requirements	+					
IRP procedures		+				
License		+				
CDL requirements	+					
Foreign applicant eligibility	+					
Exam procedures	+					
Restricted license procedures	+					
School bus driver requirements	+					
IRP procedures		+				

Table A.B-2. Structures Knowledge Topics and Sharing

	Co-workers	All of Structures	Project Managers	Managers	Project Design Engineers	Civil Engineers	Technicians	Engineers New to group	Highway Safety & design staff	Consultants
Communication skills			+							
People skills, respect & empathy	++				+	+				
Respectful attitude		+								
Meeting facilitation		+								
Presentation skills		+	+							
Pathways to Supervision knowledge			+		+	+	+			
Decision-making			+							
Experience from previous employment	+	+	+	+	+	+	+			
Computer expertise	+					+				
File management/ Archival sciences		+	+	+	++	++	+			

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	Co-workers	All of Structures	Project Managers	Managers	Project Design Engineers	Civil Engineers	Technicians	Engineers New to group	Highway Safety & design staff	Consultants
Computer program debugging					+	+	+			
Standard operating procedures			+		+	+	+			
Plan generation manual					+	+	+			
Scoping process								+		
Scopes for consultants			+							
Structures design manual					+				+	
Adjusting project schedules			+	+	+					
Basics of welding, fabrications, drawings					+	+				
Create digital terrain model from LIDAR data							+			
InRoads basics						+	+			
Construction expertise	+			+	+	+		+		

	Co-workers	All of Structures	Project Managers	Managers	Project Design Engineers	Civil Engineers	Technicians	Engineers New to group	Highway Safety & design staff	Consultants
3D Engineered Modeling					+	+	+	+		
Specialty bridge item specifications					+	+				
Drafting basics							+	+		
Design expertise								+		
Finite element analysis modeling					+					
Design tool for LRFD steel girder bridge					+					+
Field knowledge	+									
Construction closure schedules					+					
Design tools and tables for concrete decks and overhangs					+	+				+
Factsheets			+		+	+	+			

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	Co-workers	All of Structures	Project Managers	Managers	Project Design Engineers	Civil Engineers	Technicians	Engineers New to group	Highway Safety & design staff	Consultants
Standard abutment typicals and bridge end detail Library					+	+	+			
Structures Engineering instructions					+	+				

Table A.B-3. Tech Services Knowledge Topics and Sharing

	All	Exec Staff	Project Mgrs	Engin-eer	Techni-cians	Traffic Ops	Traffic Design	SW Bridge Team	Road Crews	MOB Staff	Inspec-tors	Contractors /Temps	Public/ Towns
Communication skills	+							+	+	+			
Team work						+	+						
Agency structure										+			
Public/Private partnerships		+											
ROW revenue generation	+												
Practices from other states	+												
Best management practices-Training								+	+				
Strategic plan implementation								+	+				
Intersection design							+						
Signal operation						+	+						
Work zone safety & mobility			+		+								
Traffic control plan					+							+	
MUTCD					+							+	
Work zone set-up					+							+	
Work zone inspection			+	+	+						+	+	
Cleanup and remedial strategy				+	+								+
Waste management strategy				+	+							+	+
Bridge repair procedures								+					
Safety procedures and plans								+	+			+	

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Appendix B: State DOT Information Interviews Report

Summary Report

Retention and Knowledge Management Data Calls

June 13, 2017

Transportation Research Center

University of Vermont

Introduction

During the Spring 2017 semester, the TRC researchers had the opportunity to work with UVM graduate students enrolled in Public Administration 302 taught by Professor Christopher Koliba. Students were briefed on the TRC retention and knowledge management project and were enlisted to undertake two tasks in support of this research project. The first involved production of an annotated bibliography involving knowledge management particularly in the transportation sector. The second item entailed scripted calls with six state departments of transportation (DOT) to gather information concerning employee turnover, retention and knowledge management actions at these state departments.

What follows below are summary tables from the data calls. Telephone calls were conducted with individuals from six states, including four state DOTs known to be using knowledge management tools, and two other states located in New England. Several additional states were contacted but for various reasons, calls were not conducted. The individual interviewed in these data calls were usually involved in the department's human resources, administrative or special projects areas.

Questions were asked about employee retention and organizational knowledge management in several domains:

- Employee turnover
- Employee retention efforts
- KM implementation
- KM tools

The following tables display the results for each state interviewed along with summary comments. The states contacted include four who were noted and included in NCHRP 813: *A Guide to Agency-Wide Knowledge Management for State Departments of Transportation.* These four states are: Alaska (AK), Kansas (KS), Missouri (MO) and Virginia (VA). Also included are the New England states of Connecticut (CT) and New Hampshire (NH).

Employee Turnover

Contacts were asked to estimate their DOT employee turnover rate for FY' 16, if the rate differed from the previous year and if certain positions or roles in the organization saw higher rates of employee turnover. They were also asked reasons why people leave DOT employment. Table B-1. Displays the responses to this line of inquiry.

Table B-1. Turnover rates and reasons

	AK	CT	KS	MO	NH	VA
FY' 2016 turnover rate	12%	10%	Not sure (no raises in 8 years)	~10% - 12%	~30%	6%
Change in turnover from prior year	Steady between 10%-14% (50% retirement eligible)	Lower	Same (people leaving but positions not filled)	Higher	Same (56% are retirement eligible)	Same
Higher turnover for employees with less than 5 years of service	Yes	No	Not sure (younger leave due to no raises)	Not sure	Yes	Yes
Turnover positions/areas of concern	Varies	No	Equipment Managers	Maintenance & field operations	Maintenance	Entry level operators and road crews
Reasons for leaving:						
Pay	No	Yes	Yes	Yes	Yes	Yes
Career advancement	Not sure	Yes	No	Yes	No	Yes
Benefits	No	No	No	No	No	Yes
Work-life balance	Yes	No	No	Yes	No	Yes
Flexible work hours	No	No	No	Not sure	Yes	Yes
Other reasons for leaving DOT employment	Move out of state employment or out of state	Move to other state agencies		Move to municipalities, less work & more pay	Pay is greatest reason	Various, relocations or other jobs

Employee Retention Efforts

Agency contacts were asked to respond to a list of actions they implemented to retain employees and reduce turnover. Reponses by state are in Table B-2.

Table B-2. Retention Efforts

	AK	CT	KS	MO	NH	VA
Structured orientation	Yes	Yes	Yes	Yes	Yes	Yes
Mentoring	Yes	No	Yes	Yes	No	No
New hire network	No	Yes for engineering	No	No	No	No
Job rotation	Yes	Yes	Yes	Yes	Not sure	Yes
Realistic job previews	Yes	Yes	No	No	No	No
Job shadowing	Yes	Yes	Yes	Yes	Yes	No
Explicit career pathways	Yes	Yes	Yes	Not sure	No	No
Address compensation differences with private sector	Yes (generous leave and benefits)	No	No	No	No	No
Other actions	Commissioner does abundant communication via multiple channels. Encourages feedback & innovation	Trainings offered				Core development program for some groups
Impact of efforts?	Improved retention. People like the state strategy of generous benefits.	Not sure. Budget cuts loom.	Improved retention. Flexible time has helped turnover.	Not sure. No baseline to measure against.	Improved retention	No sure, not measured

KM Implementation

DOT contacts were also asked if their departments had implemented or were considering implementing KM, what the reasons were for implementation or consideration. Responses are in Table B-3.

Table B-3. Reasons for implementing KM strategies

	AK	CT	KS	MO	NH	VA
Implemented or considering KM?	Yes-implemented	Yes-implemented	Yes-implemented	Yes-implemented	Consider-ing	Yes-implemented
Reasons for KM:						
Impending retirements	Yes	Yes	Yes	Yes		Yes
Staff reductions or cuts	No	Yes	Yes	No		No
Improved efficiency/effectiveness	Yes	Yes	Yes	Yes		Yes
Succession planning	Yes	No	No	Yes		Yes
other		Retirements caused look at best practices	Started KM 8 years prior due to retirements	Innovation	56% eligible to retire	Need transfer of knowledge in face of retirements

KM Tools Used, Barriers and Success Factors

DOT representatives were also asked to indicate what common KM tools or strategies were in use or being considered for use in their organizations. General comments were also sought about success factors and barriers to KM implementation. Results are in Table B-4.

Table B-4. KM Tools, barriers and success factors.

	AK	CT	KS	MO	NH	VA
Communities of Practice	Yes	Yes	Yes	considering	No	No
Knowledge mapping or organizational network analysis	Yes (early stages)	No	Not sure	considering	Yes (early stages)	No
Lessons learned	Yes	Yes	Yes	Not sure	No	Yes

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	AK	CT	KS	MO	NH	VA
Process mapping	Yes	Yes	No	Yes	Yes (early stages)	Yes
Mentoring	Yes (informal)	Yes (informal)	Yes (limited)	Yes	No	No
Expert interviews	No	Yes (used for training)	No	Not sure	No	No
Document repositories	Yes (Pinnacle)	considering	Yes	Yes	Yes (early stages)	Yes
Job aids	Yes (for routine processes)	Yes	Yes	Yes	No	Yes
Job shadowing	Yes	Yes (potential employees & students)	Yes (limited)	Yes	Yes (for new employees)	Yes
Other KM tools or strategies	-Goal is for each leader to identify 3 people who can step into a specific role if needed. -Leadership development program (see more information in final summary for AK)	Created a manual of best practices. Rotational program available for current employees.		Databases or SharePoint serve as document repositories. Building an inventory mgt system to help with KM transfer.	Foundations of Supervision training for all new managers.	Training from senior level managers.

	AK	CT	KS	MO	NH	VA
KM barriers	Culture change of continuous improvement	1)Budget 2)Union rules 3)Technical tools	1)some are hesitant to share knowledge 2)current administration not well liked	1)Budget 2)organizational culture – conservative and hard to change	Turnover in management has slowed process down.	1)Some people are hesitant to change 2)Budget
Success factors	Having a champion at a level that can influence change. Being active with AASHTO, working with other DOTs.	Executive team very committed to KM. Provides leadership from the top.	Early KM success because of a champion at the top (Secretary of Transportation)	Retirements and cuts have driven the need for KM and preparation for the future.	Buy-in from staff, especially executive staff.	Senior executive staff are very interested in KM and pushing this forward.

Appendix C: KM Bibliography

Annotated Bibliography Regarding Knowledge Management and the VTrans/TRC Retention Project

Introduction

Knowledge management (KM) can be interpreted in a wide variety of ways, to fit a wide variety of situations, but a comprehensive review of the literature of the field reveals some of its broad, concrete characteristics. With regards to its real-world implementation, KM can generally be divided into practices that capture knowledge within information technology (IT) systems and practices that facilitate the interpersonal exchange of knowledge. Similarly, the bulk of sources reviewed broadly categorize knowledge itself as either "explicit" or "tacit." Explicit knowledge, such as facts and data, is amenable to being shared throughout an organization via IT systems, whereas tacit knowledge – the practices and meanings that make up an organization's culture – is imparted person-to-person and through collaboration.
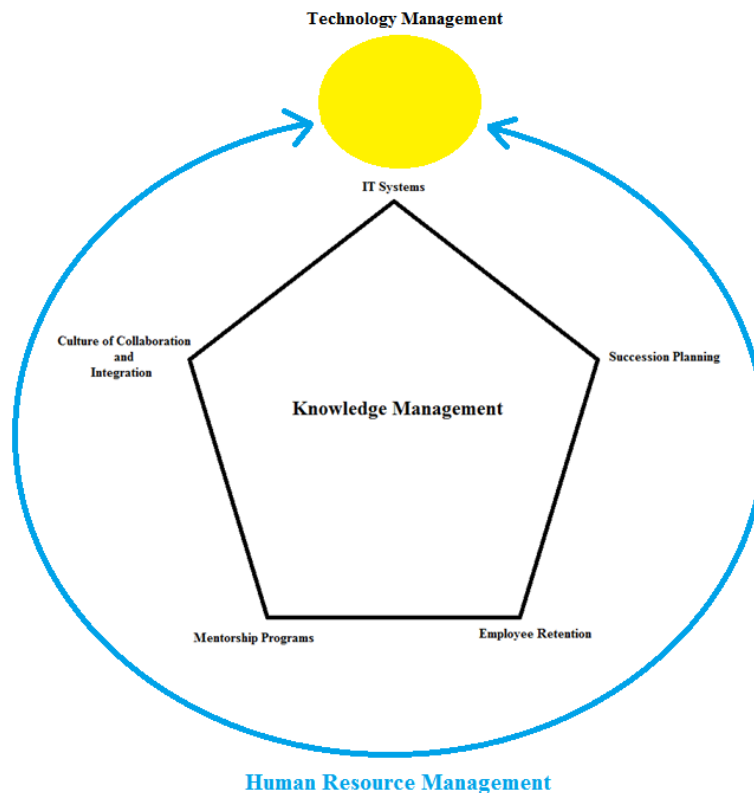
Figure C-1. Knowledge Management as Human Resource Management

The concept of KM became prominent largely because of advances in IT systems that emerged during the 1990s and, as a result, many practitioners initially associated it with the reification of

explicit knowledge within applications and databases. As the field matured from a fad into a discipline, additional theoretical and academic research indicated that the IT aspect of KM was typically less important than the implementation and integration of KM practices into organizational culture. Subsequently, succession planning, mentorship, and employee retention initiatives were identified as being crucial to the success or failure of KM programs and together they form a synergistic, multifactorial human resource management philosophy that many major companies have implemented with varying degrees of success.

Many of the sources reviewed for the annotated bibliography discuss the organizational leader's critical role in the integration of KM programs into the organization's culture, which includes significant engagement during both the design and implementation phases. First, the leader must assess their organization, determine its needs, and select the right combination of approaches. Second, they must ensure that these approaches are embraced by the organization and make astute adjustments as necessary. Several of the sources reviewed utilize case studies to reinforce the importance of this attentive approach and warn that leaders who take a passive approach to incorporating new KM practices are likely going to get poor results.

Finally, several sources illustrate the importance of external societal factors and how they impact knowledge management programs. Economic booms and busts can not only limit the resources available to design IT systems, but also might exacerbate employee retention or workforce morale issues that contribute to attrition. These sources point out that a shrewd organizational leader needs to consider both internal and external factors when considering KM programs.

Annotated Bibliography

Concepts in Knowledge Management

Alavi, M. & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly, 25*(1), 107 - 136.

> This paper describes the conceptual foundations of KM and how KM can be applied in organizations. It also offers a history of the term "knowledge," how it has been studied, and the potential roles of information technology. A unique aspect of this paper is the discussion of knowledge taxonomies, including examples. The authors assert that, due to its subjective nature, there is no single or perfect approach to developing KM systems. The paper notes the importance of recognizing the complexity, vast resource requirements, and underlying tools and approaches of KM processes, which vary in type, scope, and characteristics. By drawing on various capabilities of information technology, KM can offer different types of support, extending beyond current conceptions KM.

Baskerville, R., & Dulipovici, A. (2015) The theoretical foundations of knowledge management. The Essentials of Knowledge Management. John S. Edwards (ed). London: Palgrave, 47-91.

This article examines the theoretical underpinnings and ways in which various fields of study have informed the development of KM. These fields include the analysis of organizational culture, structure and behavior, information technology/management, and traditional human resources management, among others. The authors discuss the possible future trajectories that may be followed in the development of KM. This piece illustrates the varied and complex theoretical framework from which modern field of "KM" was developed, and it may be useful for those who are looking for an overview or explanation of the broad variety of topics and fields included within KM.

Armistead, C., Meakins, M. (2002). A framework for practicing knowledge management. *Long Range Planning*, 35. 49 - 71.

The authors begin with a brief discussion of the growth of "knowledge based" organizations, then identify three core dimensions that are critical to the performance of KM programs that arise from the nexus of practice and theory. The dimensions identified by the authors are the role of explicit vs. tacit knowledge, the collective aspect of knowledge, and the context in which new knowledge is created. With these dimensions as a lens for analysis, the authors briefly discuss seven different companies with KM programs and the various ways in which the dimensions relate to the organizations. They use these case studies as a way to flesh out their KM Approaches Framework and highlight the trade-offs between approaches that are discussed for each company.

Choi, B. & Lee, H. (2003). An empirical investigation of KM styles and their effect on corporate performance. *Information & Management, 40*(5), 403-417.

Using a sample of 54 firms, this study explores how KM styles affect corporate performance. The authors emphasize that their focus is corporations' success, not that of non-profits or government agencies. The authors noted that most studies fail to address the empirical relationship between KM styles and corporate performances. KM methods were categorized into four styles: dynamic, system-oriented, human-oriented, and passive. One finding is that companies using a passive style show little interest in KM, while system-oriented companies put more emphasis on codifying and reusing knowledge. Another important finding is that regardless of KM style, KM will remain high. However, it is difficult to determine the value of KM because KM is indirectly related to costs. The authors conclude that a dynamic KM style integrating explicit with tacit-oriented methods is found to result in better performance.

Davenport, T. H., De Long, D. W. & Beers, M. C. (1998). Successful knowledge management projects. *Sloan Management Review,* 39(2), 43–57, Winter 1999.

The authors begin by discussing the differences between KM as a theoretical discipline and its practical application in organizations. They then explore a number of examples of KM programs to determine what sets them apart and what criteria are useful in assessing the efficacy of KM projects. They identify eight key factors that allow companies to create and manage knowledge effectively and conclude that the

consideration and optimization of those dimensions is critical to ensuring successful KM. This is a practitioner's piece, covered in the trade journal of one of the leading business schools in the country. Although it touches upon the theoretical dimensions of KM, its recommendations are largely practical in nature.

Hansen, M.T., Nohria, N. & Tierney, T. (1999). What's your strategy for managing knowledge? *Harvard Business Review,* 77, no. 2 (March–April 1999): 106–116.

The authors begin with the observation that there are numerous approaches to KM applied by different companies and consultants. This is their basis for dividing KM strategies into two categories: the codification strategy, that involves recording information within an information technology system, and the personalization strategy in which knowledge and practices are conveyed through direct person-to-person interaction. They go on to discuss the strengths and weaknesses of each approach and how they're employed by various industry leaders. They conclude that an organization should focus on one approach, with the other in a minor supporting role (the authors estimate that it should be an 80% - 20% split) and provide some criteria for how an organization should choose the approach that is right for them. Finally, they argue that KM needs to be integrated with the other operational components, a responsibility that mostly lies with the leadership of the organization.

Prusak, L. (2001). Where did knowledge management come from?" *IBM Systems Journal 40*(4), 1002 - 1007.

The author first argues that KM is not just a new corporate trend, but rather was created by practitioners in response to the needs of their organizations. He notes that globalization, the expansion of information technology infrastructure, and the popular "knowledge-centric" model used in many companies have made its application more important than ever. The author goes on to briefly outline the theoretical underpinnings of KM that are grounded in economics, sociology and, psychology, as well as its practical underpinnings in information technology research and studies of human capital. The article concludes with a brief discussion of the future of KM, which the author feels will either result in the complete integration and assimilation of KM into business practices or its misapplication as a justification to reorganize or downsize companies, as befell the concept of re-engineering. Overall, the article gives a brief survey of the field that is better covered by other texts, though his conclusion is valuable.

Spender, J.C. (2006). Getting value from knowledge management. *The TQM Magazine*, *18*(3), 238 - 252.

The author begins with the premise that not all KM projects are alike because they work with different typologies of knowledge, each with its own idiosyncrasies that must be managed in specific ways. The author categorizes KM systems as dealing with data (raw information), meaning (what the information means), and practice (how the meaning is applied). These concepts are linked together through a theoretical framework. The

author asserts that different businesses deal in differing degrees of each type of knowledge and that the more "intangible" elements of knowledge, like meaning and practice, are more difficult to structure within a KM system. Finally, he concludes that, while KM systems that improve data storage are useful, managers must remember that the meaning and application of that data are equally important in the success of the KM project and the organization. This article contains good practical information on KM and its implementation.

Lucier, C. & Torsilieri, J.D. (1997). Why knowledge programs fail: a CEO's guide to managing learning. *Strategy and Business*, *9*.

The authors begin with an overview of the short, mid, and long-term impact of KM systems in companies that they have reviewed and note that many fail to have the lasting effects their proponents hoped for. The authors argue that ensuring the successful implementation of a KM program depends on designing the program with specific business objectives in mind. Lack of focus on specific business objectives, incomplete design of the program, and lack of continuous involvement from leadership hinder success. They conclude with an explicit enumeration of how organizational leaders can overcome these obstacles in order to ensure successful implementation and application of a KM program. This article is highly practical, having been written by a senior analyst at one of the top advising firms in the nation. What it lacks in theoretical discussion, it more than makes up for with its applicability.

Moffett, S., McAdam, R, & Parkinson, S. (2003). An empirical analysis of knowledge management and applications. *Journal of Knowledge Management 7*(3), 6 - 26.

The authors use a quantitative methodology to demonstrate the importance of balancing the technical KM apparatus with an operational culture that embraces its use. The authors also note that, beyond just internal factors, "macro-environmental" factors (e.g. social, economic, technological developments) also play a role in the overall impact of KM systems. This article is empirically based and its findings are valuable, though perhaps tepid.

Alvesson, M. & Karreman, D. (2001). Odd Couple: Making sense of the curious concept of knowledge management. *Journal of Management Studies*, 38(7), 995 -1018.

The authors begin with the observation that the emergence of KM as an organizational priority was a result of developments in information technology systems. They argue that knowledge is "irascible," comprised of equal parts data, processes, and meanings and therefore the concept of KM is fundamentally something of a contradiction. The end result of this tension is that KM is less about simply designing and imposing the use of systems that house knowledge and more about integrating general KM practices into organizational culture. This early article discusses many of the same criticisms of KM that are still unresolved today, while also noting that the field itself should be regarded with a healthy dose of skepticism.

Knowledge Transfer in KM Systems

Kulkarni, U. R., Ravindran, S. & Freeze, R. (2006). A Knowledge management success model: Theoretical development and empirical validation. *Journal of Management Information Systems, 23*(3), 309–347.

> This paper analyzes and explains a successful KM model. Expanding on existing work in the field, the authors focus on creating a "formal empirical model with organizational factors" that can complement technology already used in KM. Essentially, this study focuses not only on the supply side of KM, but demand, as well. An important piece of the study is the identification of the organizational factors that enable the sharing of knowledge and reusing of it, going past the cultural pieces from previous studies. The results of this study show that organizational factors involving people are just as important as the technology that supports KM initiatives. The paper also notes the importance of senior management taking on the role of knowledge leaders, not just coaches. They have to come up with important ideas as well, rather than just giving orders. It's important to reward the proper use of KM, and make sure human resources are not only in the picture but ensuring it is properly being implemented.

Murray, S. & Peyrefitte, J. (2007). Knowledge type and communication media choice in the knowledge transfer process. *Journal of Managerial Issues, 19*(1), 111-133.

> The authors explore ways in which the utilization of varied media can affect successful organizational knowledge transfers. The article begins by exploring and summarizing the theoretical framework undergirding the study of KM with a special focus on the topic of knowledge transfers. The authors explore the significance of the individuals within the organization who are transferring knowledge and labels these individuals "knowledge providers." The authors assert that the relationships knowledge providers maintain with knowledge recipients within the organization are critical for the success of many methods of knowledge transfer. The authors also present results of an empirical analysis of a survey of members of a healthcare organization regarding which methods of knowledge transfer are most effective in various scenarios. When discussing the results of this study, the authors focus on differences found between "rich media" and "lean media" in terms of their effectiveness in knowledge transfer. The authors suggest that "rich media" (i.e mentorship relationships, meetings and taped presentations) are generally preferred in knowledge transfer as opposed to more traditional forms of knowledge transfer through "lean media" (i.e. written documents, hand-outs).

Griffith, T. L. & Sawyer, J. E. (2009). Multilevel knowledge and team performance. *Journal of Organizational Behavior, 31*(7), 1003 -1031.

> This article summarizes the results of a large-scale study of organizational team-based KM and performance. The authors explore how both explicit and tacit organizational knowledge can best be shared. Results from the study suggest that both explicit and tacit knowledge transfer within teams can be significantly augmented by increasing levels of inter-departmental communications. Increasing team/departmental

communications also allowed teams made of primarily new employees to quickly attain high levels of performance. Additionally, improving team communications was demonstrated to overcome shortfalls in knowledge transfer techniques, as team members in highly communicative departments were quickly able to attain the knowledge that they had not received through formalized training processes. The authors also assert that successful knowledge transfers are positively associated with performance and measures of customer satisfaction.

Knowledge Management in Transportation

Poister, T. H. & Harris, R. H. (2000). Building quality improvement over the long run: Approaches, results, and lessons learned from the PennDOT Experience. *Public Performance & Management Review, 24*(2), 161–176.

> This article focuses on developing quality management programs in government agencies, specifically focusing on PennDot (Pennsylvania Department of Transportation). PennDOT is known as an "innovative, results-oriented, well-managed" agency, but it took years of internal development to transform the organization. Through sustained commitment and experimentation, PennDOT became a leader in quality management, but is at a crossroads in terms of next steps. The authors argue that by using the "Baldrige-based assessment process", PennDOT can take the department to the next level by closing performance gaps and integrating various "result-oriented management strategies." PennDOT, although it has room to improve, the authors suggest it can be a leader for other state level transportation agencies in how to turn a once dysfunctional bureaucratic agency into one that is productive with a healthy work culture.

Halikowski, J. S. (2016). Knowledge management. *TR News, 305,* 4–7.

> The author, Director of Arizona's Department of Transportation, Phoenix, asserts that "a state transportation agency, at its core, is a knowledge organization that specializes in transportation" (p. 4). He goes on to argue that a transportation agency's ability to successfully capture and use institutional knowledge will determine how effective it is at meeting society's future transportation needs. After defining KM, Halikowski lists ten focus areas for improving KM that address issues of leadership, organizational culture, communication, organizational learning, and infrastructure. He then reports on results of the 2014 *U.S. Domestic Scan on Advances in Transportation Agency KM* to support his claim that KM is key to success. The Virginia Department of Transportation, Kraft Foods, and NASA are presented as examples of different approaches of gathering, storing, and using institutional knowledge to improve efficiency and effectiveness.

Kent, P., Mester, L., Steudle, K., Thayer, S., Van Port Fleet, M. & Van Portfliet, R. (2016). Developing a knowledge management practice: One state's experience. *TR News, 305*, 32–35.

> Employees of the Michigan Department of Transportation share how an electronic KM system has helped the agency remain nimble in spite of increased demands and constrained budgets. Beginning in 1991, the agency has developed systems to integrate

electronic collection, organization, and dissemination of employee knowledge into its program and project development. It has also established communication routines for staff working in offices across the state. Performance management is also now integrated with the KM system, and to ensure a common base of knowledge, every employee is required to complete the Workforce Development Program Foundational Curriculum. The article includes highlights of what is working well, and only alludes to implementation challenges.

Oman, L. (2016). Supporting strategic change with knowledge management. *TR News, 305*, 17–21.

Oman, Washington State Department of Transportation's Knowledge Strategist, describes how his agency has used federal grant funding to build capacity to respond to evolving transportation needs and a changing workforce through a project called Deploying Practical Solutions Using Lean Techniques and KM. The practical solutions approach, a systems perspective for planning and problem-solving that integrates community input with environmental concerns and transportation employee expertise, requires both comprehensive and integrated collection of employee knowledge across transportation modes in the department. The Washington State Department of Transportation is focused on developing an organizational culture open to learning and responsive to customer needs, and has developed a performance framework. Efforts are underway to map capability needs and information flows. Also under development is a "knowledge book," a record of what current employees know before they leave service. The author highlights the complexity of gathering and using knowledge to support organizational learning and responsiveness to customer demands.

Bedford, D. & Harrison, F. (2015). Leveraging environmental scanning methods to identify knowledge management activities in transportation. *Journal of Knowledge Management, 19*(3), 579–592.

Environmental scanning was used to identify KM activity in the transportation sector. Developing "amplifying questions" to define the scope of KM practices helped to identify six transportation "business drivers" for KM. (Both business and government transportation departments were included in the scan.) The drivers are: managing intellectual capital; knowledge use in key processes; information asset management; teams and collaboration as platforms for knowledge development and sharing; organizational learning and human resources; and the role of leadership and strategy in KM systems. The report concludes with suggestions for developing KM practices in the transportation sector, including prioritizing KM as a central organizational function, engaging organizational leaders in KM, and education the transportation community about the value of KM. The article includes some examples of KM practices, but is primarily concerned with the environmental scanning as a methodology.

Knowledge Management and Workforce Changes

Rusaw, A. C. (2004). How downsizing affects organizational memory in government: Some implications for professional and organizational development. *Public Administration Quarterly, 28*(3/4), 482–500.

> Rusaw's focus is downsizing in government organizations, and what it means for professional and organizational development. Many federal agencies have not been able to properly fulfill their duties due to inadequate staffing resources, which perpetuates public dissatisfaction. When talking about how downsizing affects organizational learning, the author points out that experienced employees "are links between top management's vision for planned change and actual outcomes". One solution to these problems is KM, specifically as an organizational learning form. Using KM helps offset the depletion of social capital in the form of employees, essentially replacing humans with automation. The article highlights that KM is effective, but it is not a total substitute for tenured employees. It is also important to utilize an effective employee retention strategy proactively.

Bradshaw, D. L. (2001). Succession Management Strategies in Public Sector Organizations. *Review of Public Personnel Administration*, 21(2), 114-32.

> This article outlined the current issues that prevent public sector organizations from implementing and successfully using efficient succession management programs. It addresses the common understanding that current systems for developing future public managers have been largely serendipitous, and there is a growing gap of leadership talent in public service. It's important to note that the article also looked at current successful programs, including the Minnesota Department of Transportation. In 1990, that department began a program for leadership development that utilized a voluntary organizational assessment process where employees self-identified for a "cascade review" process, which resulted in their selection of a leadership pool. The authors used three focus groups of 48 public service leaders to get their opinion on current succession management programs and what can be done in the future. Only seven of the 48 leaders involved indicated that their organization used some sort of employee development process. The article pointed to internal barriers to leadership development in the public sector: organizational culture, low priority, insufficient resources, inadequate rewards for initiative/risk, limited mobility, and lack of role models. They argue that human resource professionals are vital in implementing any type of successful strategy.

Reeves, T. (2010). Mentoring programs in succession planning. *State & Local Government Review, 42*(1), 61-66

> Reeves covers the rationale behind best-practices in succession planning within governmental bureaucracies. Succession planning will be increasingly important in the near future due in part to impending waves of "baby boomer" retirements, and effective succession planning can be implemented within bureaucracies. Reeves asserts

that it is not just knowledge of programs, rules, and procedures that must be passed to new employees, but also soft skills and abilities. It is these skills and abilities that can be more easily passed along through implementing a mentorship program. Reeves then gives a brief overview of types of mentorship programs along with a list of bureaucracies that have successfully implemented these programs. Reeves offers a list of challenges that are specific to bureaucratic organizations including how to implement mentoring programs in times of recession and resource scarcity.

Helton, K. A. & Jackson, R. D. (2007). Navigating Pennsylvania's dynamic workforce: Succession planning in a complex environment. *Public Personnel Management, 36*(4), 335–347.

In this follow-up article to a case study on changes in Pennsylvania's workforce, the authors, Director of the Commonwealth of Pennsylvania's Bureau of Workforce Planning and Director of the Pennsylvania Management Associate Program, present details on implementation of succession planning best practices. Their model for succession planning is comprised of six stages: identify functions and positions likely to open; identify competencies; conduct competency analysis gap; design learning opportunities to fill gaps; develop and maintain a talent pool; and continually reassess and track progress. Tools developed to implement this the model include a retirement projection tool, an employee mobility program (to track employee entry and exit across state agencies), and annual agency workforce and succession management plans. The authors argue that KM is critical in succession planning and describe a web site for storage and retrieval of records across the state. The article includes useful examples of successful personnel development programs.

Cardy, R. & Lengnick-Hall, M. (2011). Will they stay or will they go? Exploring a customer-oriented approach to employee retention. *Journal of Business and Psychology, 26*(2), 213-217.

The authors explore employee retention efforts through the framework of treating employees as "customers" of the organization in order to increase employee satisfaction. The authors first acknowledge the high costs of high employee turnover and continual training demands. They then review factors which can increase employee retention, including quality of supervision, the culture of the organization and availability of professional development opportunities. The authors advance what they call the "employee equity model" in which employees' time within an organization is viewed as equity that the company should work to maximize. The authors assert that this is done through treating employees as customers who evaluate the organizational processes and structures, "brand" of the agency, and external relationships that are related to the company. The authors conclude by recommending various avenues for future research as it relates to customer-oriented employee retention.

Allen, D., Bryant, P. & Vardaman, J. (2010). Retaining talent: Replacing misconceptions with evidence-based strategies. *Academy of Management Perspectives, 24*(2), 48-64.

The authors' purpose is to fill a gap in the academic literature regarding evidence-based employee retention strategies. They begin my listing five common misconceptions

regarding employee retention efforts and then presents evidence-based strategies to counter these misconceptions. For example, one such misconception is that employees leave positions because they are dissatisfied with their job. The authors argue that evidence suggests that less than half of leaving employees cited job dissatisfaction as the primary motivator for their decision to seek other employment. Other employee retention-related misconceptions cited by the authors include questions of proper compensation, adequate management, common retention strategies and what level of employee turnover is truly acceptable in an organization. The authors include rich descriptions of additional research and provide multiple sources of evidence as they dispel these common misconceptions. The article is one of the most readable pieces on the subject and the authors draw upon a vast library of other research to support their assertions.

Droege, S. B. & Hoobler, J. M. (2003). Employee turnover and tacit knowledge diffusion: A network perspective. *Journal of Managerial Issues, 15*(1), 50–64.

> The authors address employee retention as it relates to dissemination of tacit knowledge, defined as "…intuitive, difficult to express, gained through experience, and shared with others through interaction" (p. 54). Using social network analysis, the authors propose that higher levels of employee collaboration are associated with higher levels of tacit knowledge diffusion. They argue that managers can promote tacit knowledge diffusion by intentionally building connections across units or departments and encouraging information sharing. Organizations can also establish systems that reward employees contributing to specific knowledge gathering initiatives.

COMMITTEE, A. K. M. S. O. T. A. W. S. (2011). Committee Report: Knowledge management for addressing workforce issues. *Journal (American Water Works Association), 103*(8), 44–50.

> This report by the KM subcommittee of the American Water Works Association is designed as a guide for water utility leaders. The authors identify dynamic workforce challenges as a key reason to develop KM systems. Emphasizing that successful KM systems consider people (organizational culture), processes (information capture, storage, and retrieval), and technologies (which ones and they are used), the authors propose that establishing a KM system begin with a needs assessment process that assesses each of these dimensions. Results should then inform development of a KM system customized for the particular context. In addition to examples of KM approaches in use, six KM tools are discussed: mentoring and apprenticeships; in-house staff training programs; competency-based training; communities of practice; intranet-accessible resources; and use of video for knowledge capture.

Knowledge Management and Learning Organizations

Cook, S. D. & Brown, J. S. (1999). Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. *Organization Science, 10*(4), 381 – 400.

The authors draw a distinction between knowledge as an independent construct or possession and "knowing," which is akin to the application of knowledge or practice of doing something. They first outline four distinct categories of knowledge (individual, group, explicit, tacit), then create an epistemological framework to explore the practice of applying knowledge. They conclude that "knowing" or the act of applying knowledge is achieved by bridging the four distinct categories of knowledge and synthesizing them in practice. The authors then discuss three case studies and conclude that each organization has its own emergent style of applying knowledge and this practical application is equal in importance to the knowledge itself. This is one of the most important theoretical articles on the subject with almost 1000 cross citations.

Frayne, C. A. & Lantham, G. P. (1987). Application of social learning theory to employee self-management of attendance. *Journal of Applied Psychology*, 72(3), 387 - 392.

This article highlights the findings of a study monitoring self-management of attendance in blue-collar, unionized state government employees. Low job attendance is a chronic problem is organizational settings, costs 30 billion dollars, disrupts work schedules, increases costs, and decreases productivity. The authors noted the difference in blue-collar and white-collar work flexibility, in that the former usually has a stricter schedule in terms of say, taking two hours off work to take a child to a medical appointment. The study took two groups of 20 employees and put them in a control and variable group, respectively. The variable group had to participate in a 12 hour training program and report on their attendance, which helped them train in self-accountability. The authors find that absenteeism decreased in the variable group, and argue that those who do not come to work regularly need support to cope with internal and external pressures that keep them from going to work. Also, it is important to note that there is a limitation of both the attendance and the absenteeism measures is that they ignore the distinction between voluntary and involuntary absenteeism.

Yang, K. & Melitski, J. (2007). Competing and complementary values in information technology strategic planning: Observations from ten states. *Public Performance & Management Review, 30*(3), 426–452.

This study analyzes strategic planning in information technology in public administrations from ten different states using the competing values framework. According to the authors, developing and implementing a good "strategic information systems planning" (SISP) is essential for managing any public organization. Despite its importance, states have struggled to implements SISPs. This study utilizes "lexical content analysis" to compare the frequency of keywords in the various states' plans. The authors also propose alternative ways to assess value orientation in IT management.

Kang, S., Morris, S. & Snell, S. (2007). Relational archetypes, organizational learning, and value creation: Extending the human resource architecture. *The Academy of Management Review, 32*(1), 236-256.

This article discusses ways in which various dimensions of relationships between the employee and the organization can be used to tailor approaches to organizational KM. The relational dimensions identified by the authors include structural relationships, affective relationships and cognitive relationships; these relational models are then used to explore various organizational styles including the cooperative, entrepreneurial and independent. The authors then review various evidence-based techniques and approaches that can best work within each of these relational realms and within differing organizational cultures. These techniques include trans-specialist development and incentive-based learning opportunities among other techniques designed to increase employees' human capital.

Thomas, J., Sussman, S. & Henderson, J. (2001). Understanding "strategic learning": Linking organizational learning, KM, and sensemaking. *Organization Science, 12*(3), 331-345.

This article concerns the role that strategic learning can play in the implementation of effective KM processes within an organization. The authors assert that effective knowledge generation and subsequent assimilation within various levels of the organizational structure are key to organizational success. The types of knowledge generated and assimilated run along a continuum of explicit and tacit forms of organizational knowledge. The authors also explore the role that technological interventions can play in aiding knowledge transfer, especially in the case of organizational structures that are spread out over geographical distance. These technologies range from passive knowledge transfer techniques (ex. videos or electronic documents) to collaborative knowledge transfer techniques (ex. an organizational message board). The authors also explore the ability of technology to organize large volumes of information for effective knowledge transfer through the use of simple mechanisms including hyperlinked documents. This article contains some helpful information regarding organizational learning, though the writings on technological approaches is somewhat out-of-date due to the current ubiquity of information technology like databases, electronic documents and data sharing.

Brown, S. & Lemer, A. (2016). Knowledge, teams, people, and transportation agencies. *TR News,* 305, 12–16.

The authors, one the Chair of the National Cooperative Highway Research Program Project Panel on Development of a Guide for Transportation Technology Transfer and a the other a Senior Program Officer for Cooperative Research Programs at the Transportation Research Board, summarize their main points with a quote from entrepreneur and environmentalist Paul Hawken: "'Good management is the art of making problems so interesting and their solutions so constructive that everyone wants to get to work and deal with them'" (p. 16). They argue that in the push for KM, it is just as important to consider how people in organizations access and use information as it is to gather and made information available. Positive, supportive organizational culture, exemplified by companies such as Alphabet and Boston Consulting Group, is key to encouraging individual learning, which can lead to organizational learning. They argue

that organizational learning is enhance when employees work in communities of practice, focusing multiple perspectives and knowledge bases on one mission or project, similar to models used at Southwest Airlines and Zappos.

Camarena, S. (2014). Leveraging the synergy of learning and KM. *Public Manager, 43*(1), 16–19.

> The author, Chief Knowledge and Learning Officer at the Federal Transit Administration, shares her agency's experience with merging the learning and development team with the KM functions. The new team's goal was to transform the agency into a "knowledge sharing organization" (p. 17). A concise team mission statement and creative marketing helped the team engage employees in facilitating strong employee networks. Strategies include mentoring programs, informal lunches with organization leaders, and collaborative brainstorming sessions. The article concludes with a recommendation to more closely link KM with human resources management, and reinforces Brown and Lemer's (2016) point that KM is linked to organizational culture and communities of practice.

Moynihan, D. P. & Landuyt, N. (2009). How do public organizations learn? Bridging cultural and structural perspectives. *Public Administration Review, 69*(6), 1097–1105.

> Moynihan, author of *The Dynamics of Performance Management*, and Landuyt, at publication time the Director of the Institute for Organizational Excellence, also address the importance of accounting for both knowledge infrastructure (information systems) and an organizational culture conducive to organizational learning. Using results from a 2004 survey of Texas State agencies in which 34,668 employees responded to the Survey or Organizational Excellence, they found that presence of "learning forums" is most predictive of perceived organizational learning. Learning forums are defined as "…organizational routines in which employees seek to examine and discuss information and consider what it implies for subsequent action (Moynihan, 2005)" (p. 1099-1100). Other important predictors in of perceived organizational learning are mission orientation, decision flexibility, and resources adequacy.

Dawes, S. S., Cresswell, A. M. & Pardo, T. A. (2009). From "need to know" to "need to share": Tangled problems, information boundaries, and the building of public sector knowledge Networks. *Public Administration Review, 69*(3), 391–402.

> Researchers from the Center for Technology in Government at the University at Albany, State University of New York, outline 13 lessons learned from their research on public sector knowledge networks in New York. They argue that the most significant barrier to KM in most public organizations is organizational culture that limits information dissemination on a "need to know" basis. Useable knowledge networks are more are more likely in, or between, organizations where the culture encourages trust, information sharing, and construction of shared understanding of what knowledge means. Their framework for classifying types of knowledge networks on the dimensions of knowledge focus and type of network (range of units or organizations involved) is useful for identifying the potential challenges a that any particular network might face.

While not specific to workforce retention or agencies of transportation, the 13 lessons learned are valuable guides for anyone establishing or restructuring a KM system.

Zhang, J. & Dawes, S. S. (2006). Expectations and perceptions of benefits, barriers, and success in public sector knowledge networks. *Public Performance & Management Review, 29*(4), 433–466.

Researchers from Clark University and the Center for Technology in Government at the University at Albany, State University of New York, report findings from their mixed-methods study of seven knowledge-networking projects. This study is part of the work that informed findings reported in Dawes, Cresswell, and Pardo (2009) discussed elsewhere in this annotated bibliography. The cases they studied were projects that involved public sector knowledge networks. They report that participants found these networks to be less useful, and also less difficult to establish, than anticipated. In fact, projects generally had more success establishing effective knowledge networks than meeting project goals. Barriers to successful knowledge networks included legal and policy constraints, technology access and support, and organizational structures and cultures.

Knowledge Management and Public Administration

Mohsennasab, M. H., Nezhad, G. A., & Abtahi, S. H. (n.d.). Knowledge Management In Government Organizations.

This paper discusses how KM can be used and applied in government settings. It does employ standard American English syntax, and is likely translated from another language. The paper attributes globalization, "citizen-orientedness", contribution, and "knowledge-orientedness" as factors that are making organizations more likely to apply KM. The paper also notes the discrepancies between how government organizations suffer from insufficiencies, while private sector organizations that face the same issues perform better. In terms of private sectors getting ahead, the paper notes that historical studies have shown that techniques such as Business Process Reengineering and Total Quality Management have grown in successful private sector companies and KM is to follow. A reason that government organizations haven't been adaptable to KM is that individuals are not eager to share their knowledge with others and only want to apply it to their personal goals. Also, usually government structures are inflexible hierarchies, and are not able to react against sudden environmental changes, the flexibility that KM needs to thrive.

Henry, N. L. (1974). Knowledge management: A new concern for public administration. *Public Administration Review, 34*(3), 189–196.

This article, written in 1974, focuses on KM as a new frontier in American public administration, as the integration of IT began to develop in public policy. The article discusses three laws, the latter two more recent at the time: Copyright Law of 1909, Fair Credit Reporting Act of 1970, and the Freedom of Information Act of 1966. The author

predicts the future of KM in public policy. This article highlights the importance of not only KM acceptance by public administration, but also how KM can use public administration.

Willem, A. & Buelens, M. (2007). Knowledge sharing in public sector organizations: The effect of organizational characteristics on interdepartmental knowledge sharing. *Journal of Public Administration Research and Theory: J-PART, 17*(4), 581–606.

> This article highlights the importance of interdepartmental knowledge sharing in public sector organizations. Buelens investigates particularities of organization design in public organizations using data from questionnaires sent to more than 90 different public sector organizations in Belgium. In this study, the authors differentiate between three types of public sector organizations: government institutions, public sector institutions, and state enterprises. The author hypothesizes, and expects, low levels of intergovernmental sharing. Essentially the results did not reveal negative bureaucratic effects on knowledge sharing, even when limited to cooperative episodes in government institutions. In the study's results, lateral coordination was very important for the effectiveness of knowledge sharing. When studying identity, the results found that government institutions had less of a solid identity, which the authors believe might increase knowledge-sharing problems.

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Appendix D: Exit Questionnaire Report

Vermont Agency of Transportation

Retention Project V-TRC 16-5

June 26, 2018

Carol Vallet, Ed.D.

Transportation Research Center

University of Vermont

Introduction

During the course of the VTrans Retention project, the TAC raised privacy concerns with the originally planned data collection process involving interviews with past VTrans employees. As a result, at the April 2017 TAC meeting, the research team proposed the development and piloting of an exit questionnaire to be sent to VTrans employees who had recently left the agency. This new direction would address several objectives:

- Collect data concerning decisions by departing employees to both join and leave VTrans

- Inform aspects of the employment experience at VTrans

- Develop a standard exit questionnaire which could be used by VTrans beyond this project (meets an objective of the Strategic Plan, Goal 5 Task team)

- Pilot the use of this exit questionnaire to help inform retention at VTrans

The TAC endorsed this proposal and the research team subsequently began development of the questionnaire and protocol for implementation.

Development

Over the course of several months, the researchers developed an exit questionnaire, TAC members reviewed it and further editing was made until a 15 question, and a 4-page survey was approved in September 2017. Subsequently, the protocol for deploying the survey was also endorsed by the TAC (and approved by the UVM Institutional Review Board).

The protocol is outlined below:

1. A paper copy of the exit questionnaire packet was prepared by the UVM researchers and included
    a. Letter from the researchers
    b. Information sheet
    c. Questionnaire

     d.   Stamped return envelope addressed to researchers at the Transportation Research Center at UVM

     e.   Token payment ($2 bill) as suggested by established survey research methods

2. VTrans HR sent to UVM a list of names of employees who voluntarily left full-time employment at VTrans (excluding temporary employees). UVM prepared packets of materials for each employee and coded each survey with a random 5-digit code. A spreadsheet linking names to codes was kept in a secure location by the primary UVM researcher.

3. UVM delivered packets to VTrans for mailing by HR.

4. Completed questionnaires were sent directly by respondents to UVM.

5. Approximately one month after the initial mailing, a reminder letter was sent to non-respondents inviting them to complete the survey via online link.

6. UVM compiled results.

Implementation

After approval of the document and protocol, UVM worked with HR to secure names of recipients for the packets. It was agreed as an initial group to include VTrans employees who had voluntarily left between July 1 and September 30, 2017. This list was transmitted to UVM and 29 individuals were included in this initial group.

Packets were prepared by UVM and delivered to VTrans in late October. The material was mailed in mid-November and as of the end of 2017, 12 responses were received. Reminder letters were sent in February 2018 to those who had yet to respond. This included a link to complete the questionnaire online.

The second set of packets was sent in February to the next group of individuals (20) who had voluntarily left VTrans employment between October 1 and December 31, 2017. Reminder letters for non-respondents in this group were prepared and sent to HR for distribution in April 2018.

Results

In total, 27 completed questionnaires were received from a pool of 49 individuals resulting in a 55% completion rate. It is important to remember that although the response rate is acceptable, the reason for non-response from others is unknown. The response rate is a limitation of the findings.

Who Responded

Respondents were asked to indicate their length of employment at VTrans, title, and unit of most recent position.
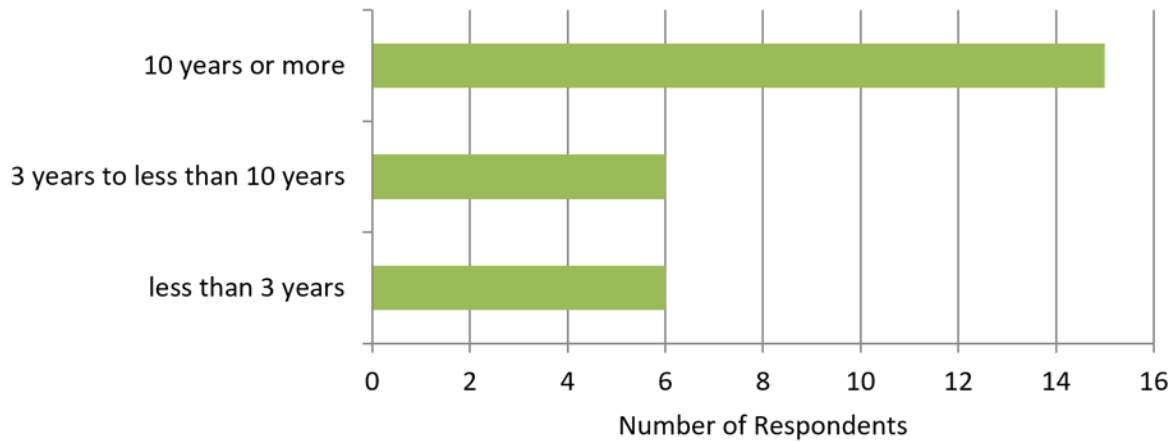
Figure D-1. Years of Service (n=27)

Roles of respondents were categorized as (in descending order):

1. Maintenance workers
2. Administrators
3. Managers
4. Engineers/technicians

The respondents primarily represented the Highway and DMV units along with other responses such as Finance & Administration, AOT or VTrans. Note that slightly more than half (15) of respondents had over 10 years of service with VTrans and 15 respondents also indicated retirement as their reason for leaving VTrans employment. However, there is not a 1:1 match of individuals in these two groups. Three of those who selected retirement as a primary reason for leaving, had less than 10 years of service with VTrans, possibly because they transferred to VTrans from another area of state employment. An additional three individuals had 10 or more years of service but left employment without retiring.

Reasons for Joining VTrans

Respondents were asked what drew their interest and prompted them to seek employment at VTrans. A list of 14 options (including "other") was presented and respondents were asked to check all that apply.
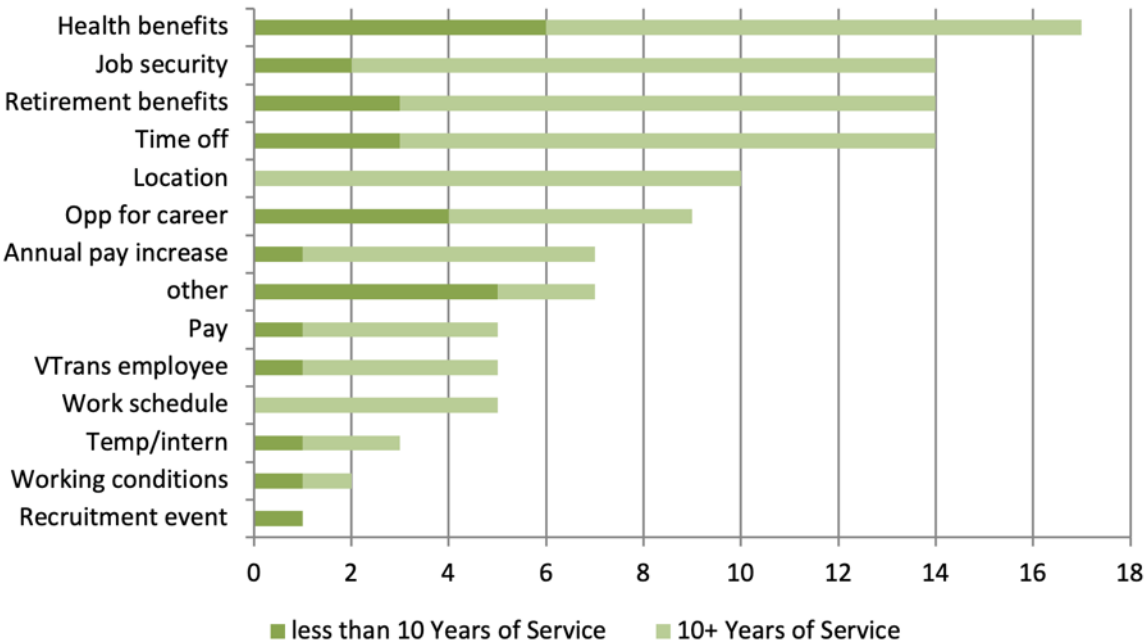
Figure D-2. Reasons for Interest in VTrans Employment (n=27)

The "other" reasons for joining VTrans were:

- Needed a job (3)
- Liked this type of work (2)
- Transferred in from another position with the State of Vermont (2)

While health benefits, job security, retirement benefits, and time off were leading factors in employment interest overall, these factors were more heaving weighted by longer serving employees. Although some longer-term employees were attracted to VTrans employment because of work schedule and location (5 and 10 respectively) none of the employees with less than 10 years of service included these reasons for their interest in VTrans employment.

The questionnaire then asked a series of six questions concerning the following topics:

- The degree of realistic job presentation during the application process and hiring
- Helpfulness of the onboarding process
- Level of technical training
- Level of job-specific safety training

- Level of career development activities or opportunities
- Level of supervisory training (if appropriate)

Responses to each question were on a 1 (lowest) to 10 (highest) scale. Results for each question, segmented by years of service, are in Figure D-3.
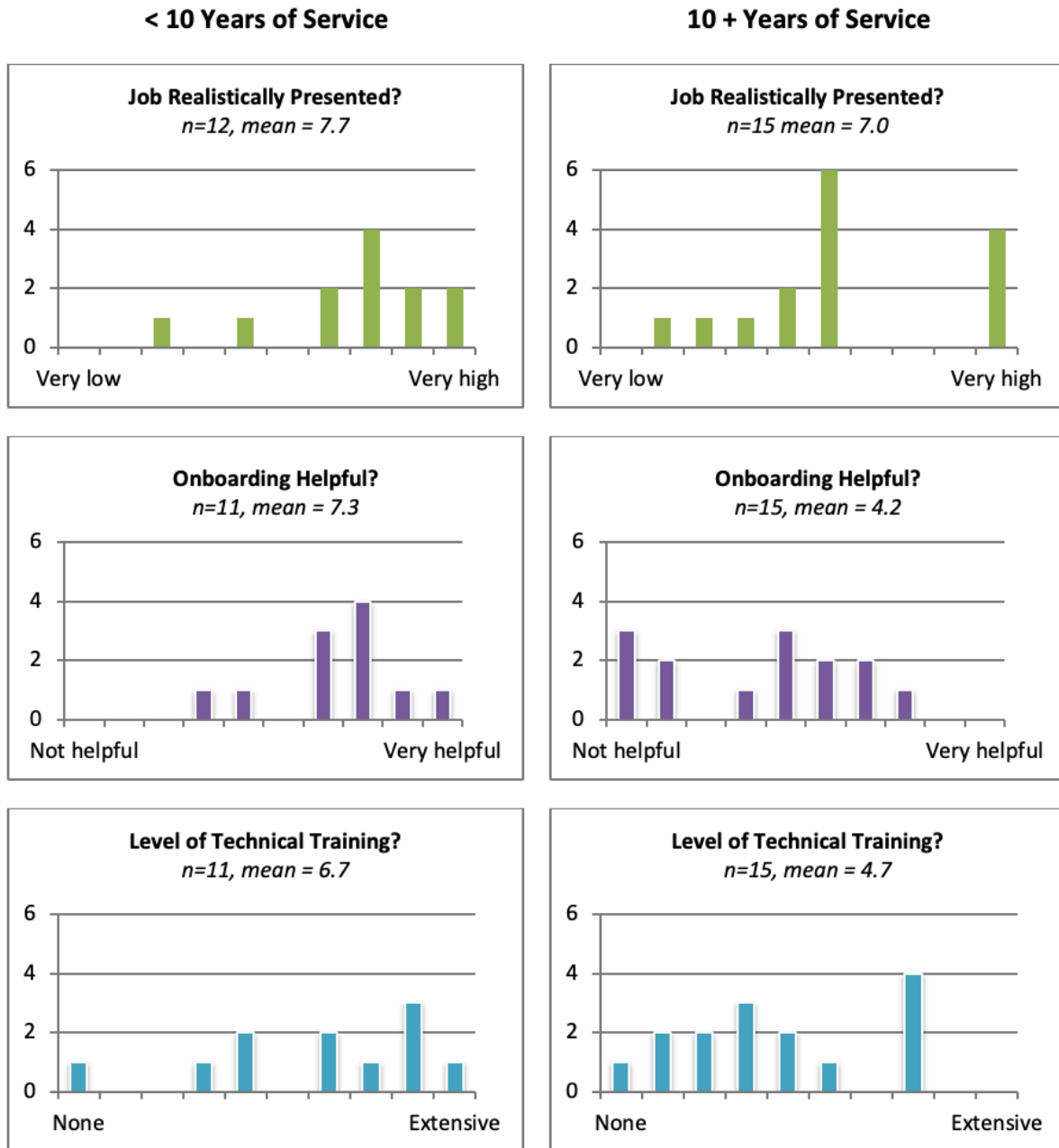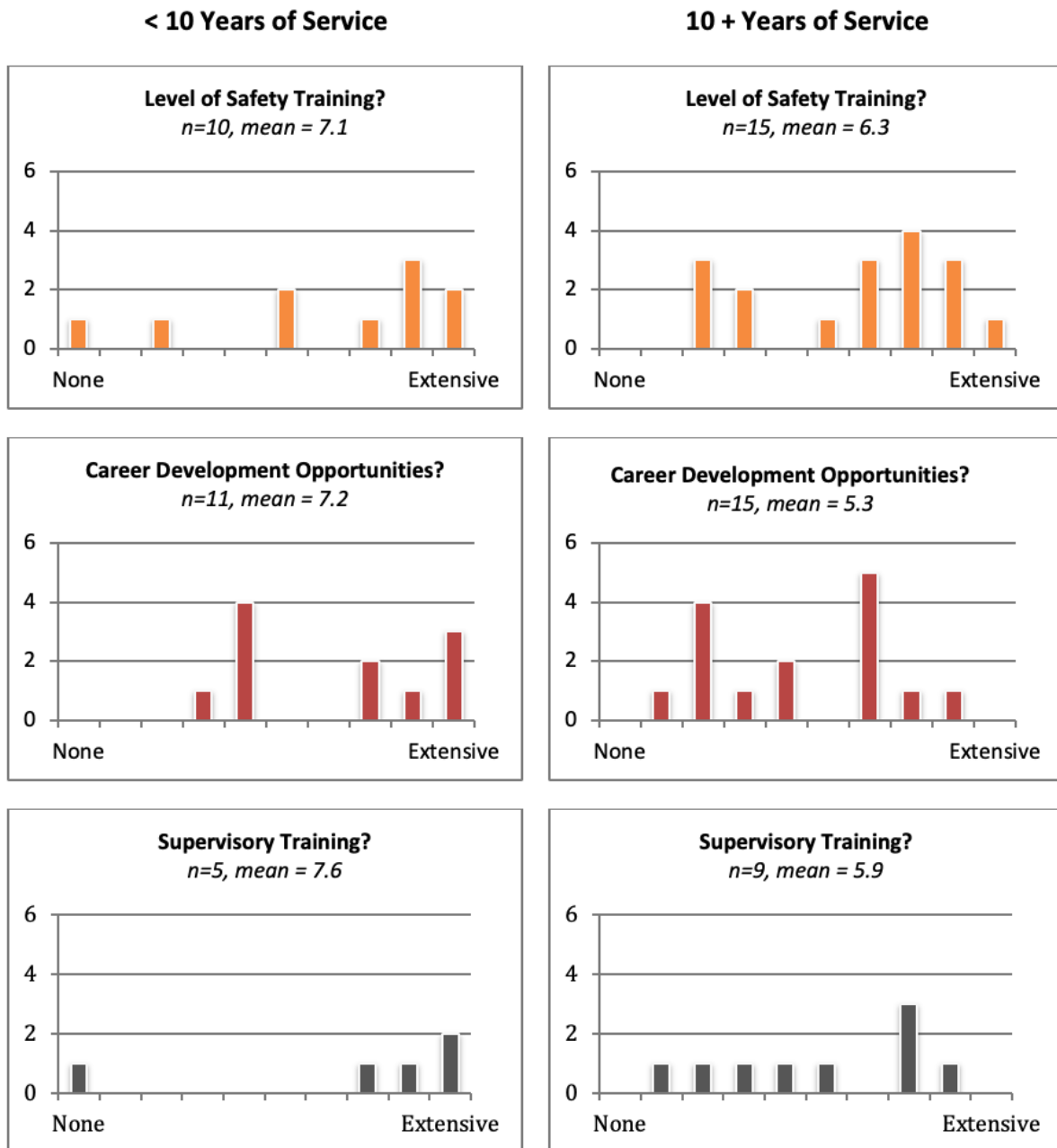
Figure D-3. Perceptions of Various VTrans Experiences

The differences in perceptions based on years of experience are interesting to note. While those with less than 10 years of experience rated each category higher, the differences were more distinct in a few areas. The mean for onboarding, technical training, and career development opportunities in particular were rated two points or more lower by those with 10 or more years of experience. This may, especially for onboarding, reflect organizational change in focus over the years.

Reasons for Leaving VTrans

Survey respondents were also asked to indicate all the primary reasons why they left VTrans employment. Responses to this question are in Figure D-4.
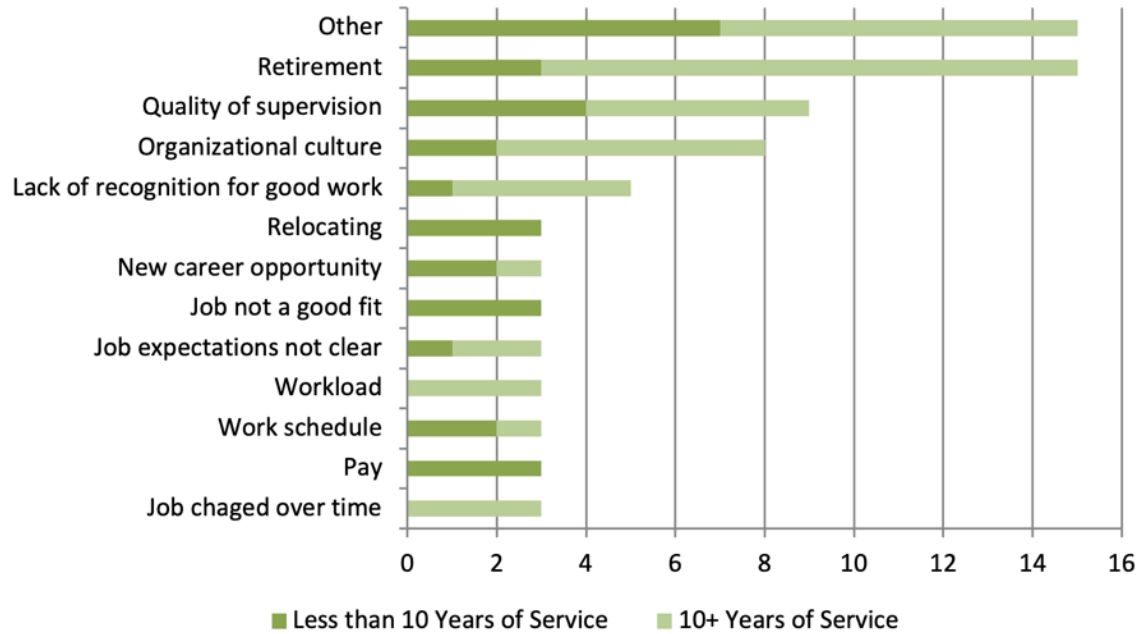
Figure D-4. Reasons for Leaving VTrans Employment (n=27)

Responses to the "other" category were open-ended and categorized into several themes.

- Favoritism (6)
- Organizational culture especially concerning communication (4)
- Quality of supervision or leadership (4)
- Personal reasons (3)
    - Medical
    - Educational (return to school)

It is interesting to note that only 3 people, all with less than 10 years of service, chose "pay" as one of the reasons they left VTrans employment.

Some quotes from this question include:

> "Unless you were part of leaderships' inner circle, [people] found themselves doing most of the minor chores, less chance for advancement."

> "Supervisor not held accountable. Too much of a good old boy network."

> "At times, co-workers not engaged, expectations not clear, quality of supervision, organizational communications & culture."

"Current supervisor lacks knowledge or interest in the job."

Knowledge Sharing

Respondents were asked to check all the ways they shared knowledge while at VTrans. Responses are in Figure D-5.
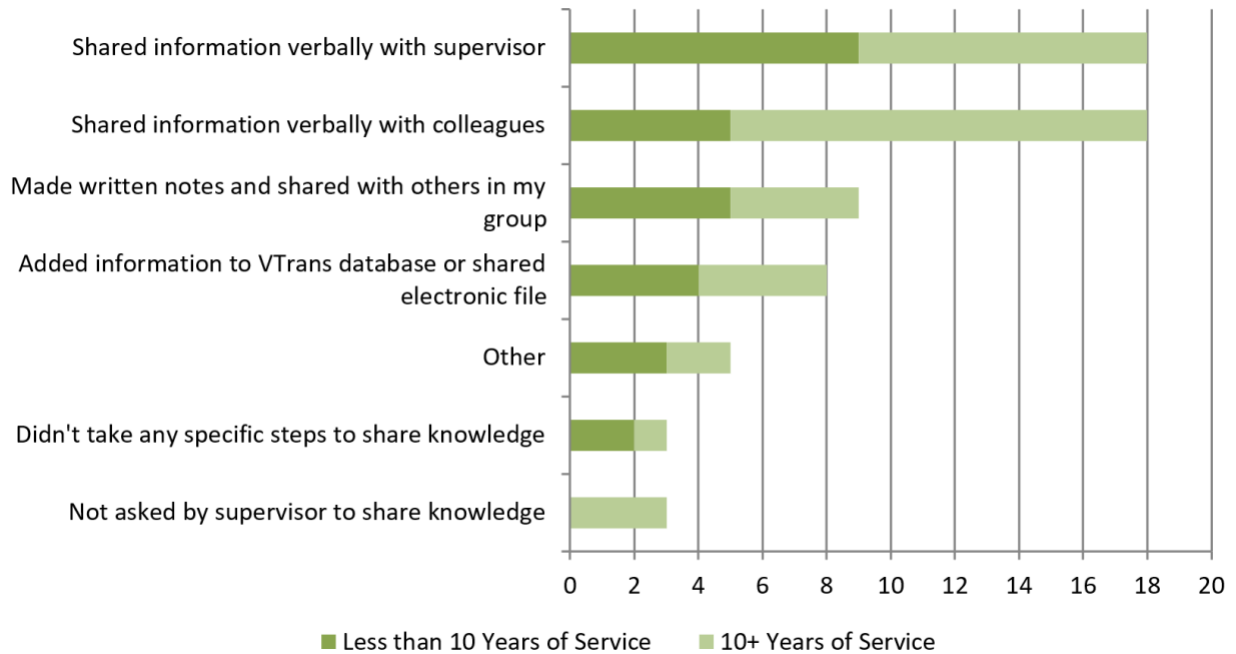

Figure D-5. Knowledge Sharing Actions (n=27)

Knowledge sharing is more generally verbal rather than in written form. The answers in the "other" category generally spoke to a change in practice over time, primarily knowledge that was shared no longer being sought by or shared with others.

Possible Steps for Employee Retention

Respondents were asked to select all options, from 16 possible steps, that VTrans might have taken to help retain them as employees. An open-ended "other" category was also an option. Results are in Figure D-6.
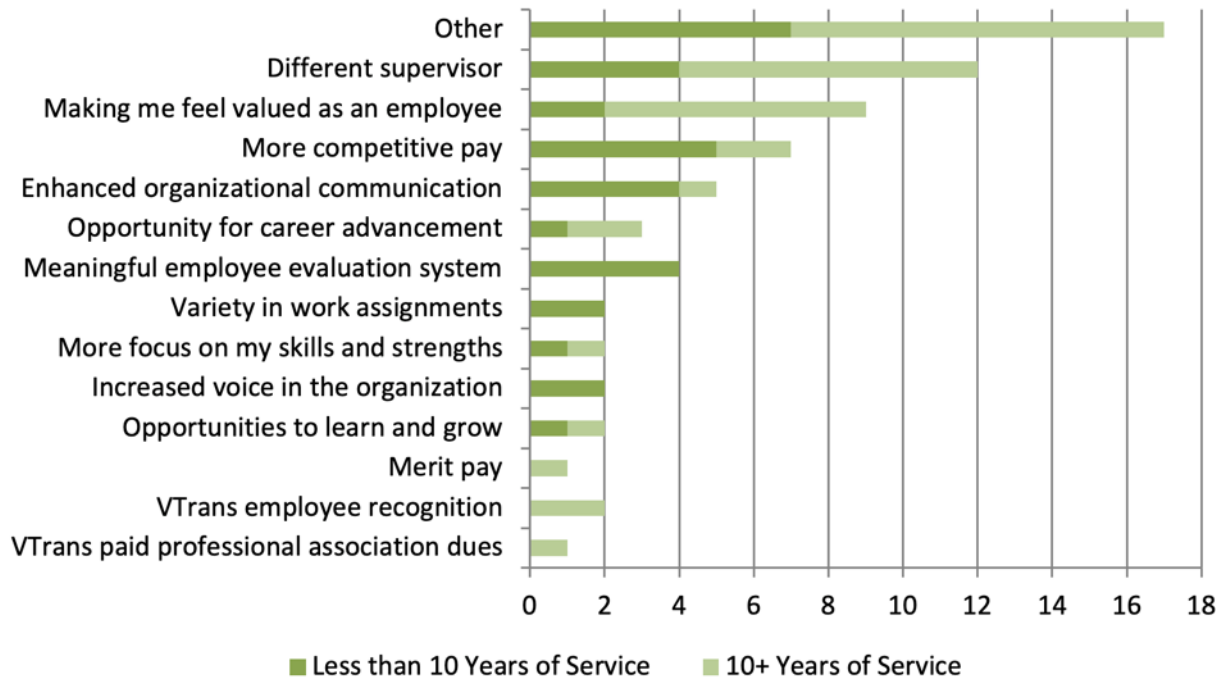
Figure D-6. VTrans Steps for Employee Retention (n=25)

Responses in the "other" category were categorized into the themes of:

- Provide a different supervisor or new leadership (6)
- Change organizational culture (5)
  - Organizational values not in alignment with personal values
  - Hold employees accountable
- Nothing could have been done, it was just time to retire (4)

Note that issues around supervisors are enhanced when considering the open-ended responses that also mentioned supervisory issues. This cut across both the most experienced and newer employees.

It is also interesting to note that "more competitive pay" was selected by only 7 of the 25 responses to this question.

Positive Aspects of VTrans Employment

Respondents were asked to comment on "What aspects of your VTrans employment did you value or enjoy the most? What does VTrans do right as an organization and employer?" All but four respondents answered this open-ended question. Themes that emerged included:

- Enjoyed friendships with co-workers
- Teamwork across the Agency was seen as a strength
- Teamwork in workgroup was valued
- VTrans was viewed as a great place to work
- The type of work and summer work was noted as a plus
- On the job training, affirmative action policies, respect for the individual and opportunities for advancement were all seen as positive organizational aspects

Some applicable quotes include:

"I had a great relationship with my supervisors and I felt that my roles and expectations were clearly laid out. My supervisors created a productive and enjoyable work environment."

*"Working with a group of great people, unfortunately, I had four changes in supervisors throughout my career. I felt like I was starting all over each time."*

"Variety of work, opportunity to advance, the noble purpose of providing a transportation network and representing the taxpayers and doing so with conviction."

"I had great co-workers who supported each other. Our chief was caring and engaged."

Recommend VTrans Employment?

The survey also asked if respondents would recommend employment at VTrans to a friend. Results are in Figure D-7.
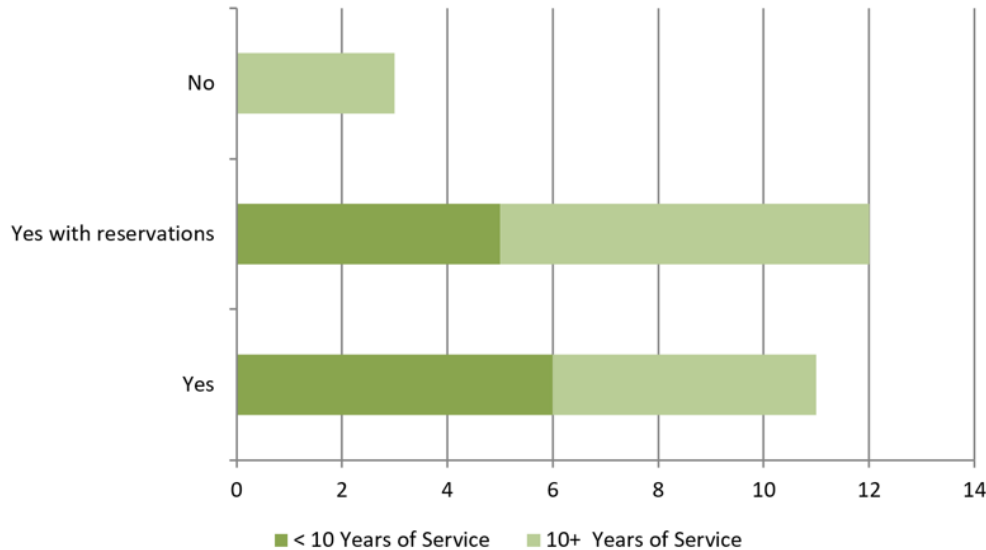
Figure D-7. Recommend VTrans Employment to a Friend (n=26)

While only three people would not recommend VTrans employment, it is notable that of the 23 who would recommend VTrans employment slightly over half had reservations with that recommendation.

Final Thoughts and Suggestions

20 of the 27 respondents choose to add other thoughts about their experience at VTrans including suggestions for enhanced retention. Most of the themes echoed in responses include those captured in other parts of the questionnaire. However, a few of note include:

- Favoritism among supervisors was mentioned several times especially using the terms of the "good old boy network" (5)
- Too many or incompetent supervisors (3)
- Enforce policies and accountability (3)
- Salary compression/pay for performance (3)

Summary

This initial use of the Exit Questionnaire provides some evidence concerning why people are attracted to VTrans employment and why they leave the organization. The State of Vermont benefits package, especially health insurance, is of particular interest to those choosing VTrans employment. Perceived job security also ranks high as an attractive aspect of VTrans employment. While these are all useful for VTrans to know, it is important to remember that

since these are State employment benefits, employees are able to move to other parts of State employment and still retain these benefits as well as their years of service.

Employees indicate that they have left VTrans for a great variety of reasons with retirement ranking high as on the list. However, aspects of supervision and organizational culture cannot be overlooked as reasons for departure. Some focused attention on these aspects, particularly supervision quality, could provide great benefit to VTrans.

As mentioned in the April 2018 TAC meeting, some of the questions concerning perceptions of employment experiences at VTrans (

< 10 Years of Service   10 + Years of Service

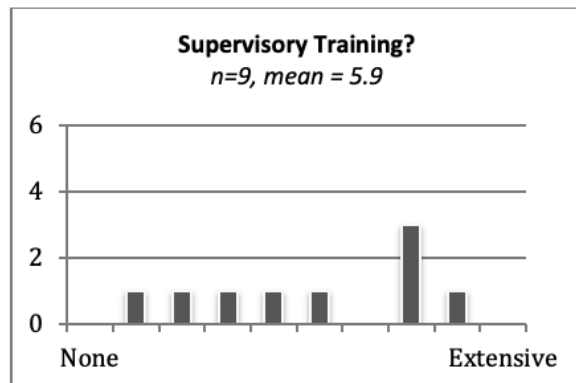Level of Safety Training? n=10, mean = 7.1

Level of Safety Training? n=15, mean = 6.3

Career Development Opportunities? n=11, mean = 7.2

Career Development Opportunities? n=15, mean = 5.3

Supervisory Training? n=5, mean = 7.6

Supervisory Training? n=9, mean = 5.9
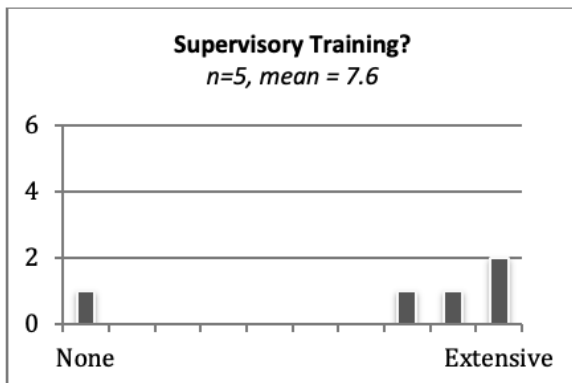
Figure D-3) would be appropriate to use at certain points while an employee is still part of the organization. For example, the question concerning helpfulness of onboarding may be appropriate at the end of the first year of employment. This would provide feedback to the group conducting onboarding as well as giving a new employee a sense of voice in the processes of the organization.

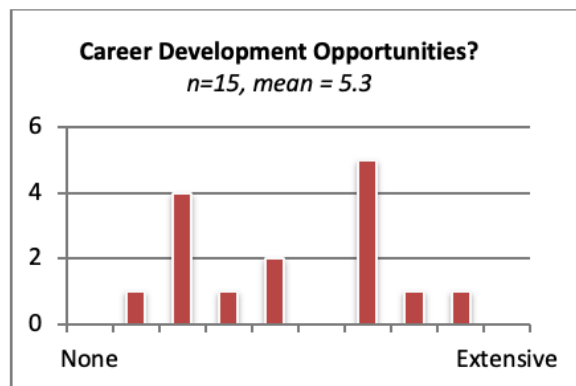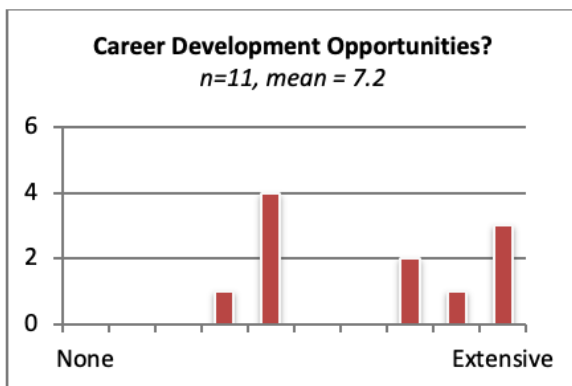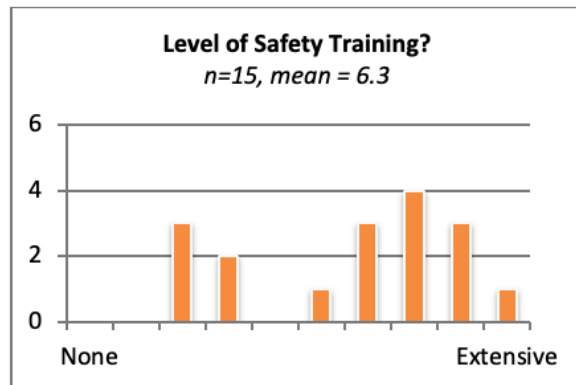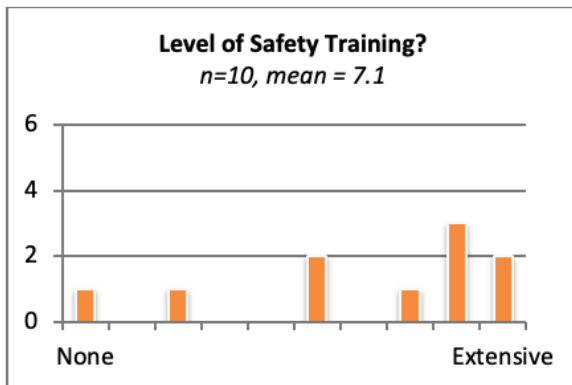As mentioned in the introduction to this report, the response rate, while acceptable, is still a limitation to this study since only 27 individuals are represented in the data. As VTrans begins to implement the exit questionnaire on a regular basis, increasing numbers of respondents will enhance credibility and value of the data.

Next Steps

This Exit Questionnaire is ready to be used by VTrans as part of the employee exit process. VTrans will need to make several key decisions on the deployment of the questionnaire including:

- Timing of questionnaire use (during the exit process or several weeks later).
- Method of data collection (online, paper, or either method depending on circumstances).
- Person or unit responsible for questionnaire deployment (supervisor, HR, other).
- Unit responsible for collection of the data and data analysis. Data could be collected by HR and analyzed quarterly by a committee or a group.
- Use of the data (would the data be sent to supervisors, reported to VTrans in some format or reported on in other ways).

A copy of the exit questionnaire used in this study is below. A Word file without UVM logo and introductory information will be sent to the TAC for VTrans use in the future. The online survey, in SurveyMonkey format, can also be sent to a VTrans SurveyMonkey account for ease of implementation. Contract information for the VTrans SurveyMonkey account will be needed for this transfer.

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This questionnaire is composed of 15 questions on four pages. Please answer each question as best you can. Feel free to add more comments on the final page. Thank you.

NCST

1. What drew your interest and prompted you to seek employment at the Vermont Agency of Transportation? (check all that apply)

- ❑ Pay
- ❑ Health benefits
- ❑ Job security
- ❑ Time off (sick, personal, vacation)
- ❑ Was a temporary worker or intern
- ❑ Opportunities for career growth
- ❑ Other

- ❑ Working conditions
- ❑ Work schedule
- ❑ Location
- ❑ Retirement benefits/pension
- ❑ Annual step (pay) increases
- ❑ Recommended by VTrans employee
- ❑ Recruitment event

If "other" please explain:

_____

_____

2. To what degree was the job realistically presented to you during the application and hiring process?

1= very low degree, 10=very high degree. Circle your choice on the scale below.

Very Low   Very High

1   2   3   4   5   6   7   8   9   10

3. Onboarding is the process of welcoming and orienting new employees into an organization and providing them with the tools, resources, and knowledge to become successful and productive.

Please rate how helpful you think the VTrans *onboarding process* was for you.

1 = not helpful, 10 = extremely helpful. Circle your choice on the scale below.

Not Helpful   Very Helpful

1   2   3   4   5   6   7   8   9   10

4. Please rate the level of *technical training* (that which pertained specifically to your work) you received when you were first learning to do your job.

1= no training, 10=extensive training. Circle your choice on the scale below.

No Training   Extensive Training

1   2   3   4   5   6   7   8   9   10

5. Please rate the level of *job-specific safety training* you received while employed at VTrans.

1= no training, 10=extensive training. Circle your choice on the scale below.

No Training   Extensive Training

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

---

6. Please rate the level of *career development activities or opportunities* available to you while employed at VTrans.

1 = no career development, 10 = extensive career development. Circle your choice on the scale below.

No Career Development   Extensive Career Development

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

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7. IF you were a supervisor, please rate the *level of supervisory training* you received while employed at VTrans. (Please skip this question if you were not a supervisor.)

1 = no training, 10 = extensive training. Circle your choice on the scale below.

No Training   Extensive Training

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

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8. What are the primary reasons you left VTrans employment? (Check all that apply.)

❑ Relocating	❑ Retirement
❑ New career opportunity	❑ Pay
❑ Changing careers	❑ Benefits
❑ Length of commute	❑ Personal reasons
❑ Quality of supervision	❑ Lack of challenging work
❑ Job not a good fit for my strengths	❑ Lack of resources (e.g., materials, equipment)
❑ Job not as presented	❑ Job changed over time
❑ Job expectations not clear	❑ Lack of recognition for good work
❑ Workload	❑ Organizational communication
❑ Work schedule	❑ Organizational culture
❑ Infrequent job performance feedback	❑ Few opportunities to learn and grow
❑ Lack of personal, caring connections	❑ Agency mission not personally important
❑ Co-workers not engaged in work	❑ other

If "other" please explain:

_____

---

9. During your time at VTrans, what steps did your supervisor ask you to take to share your knowledge or information about your work? (Check all that apply.)

❑ Shared information verbally with my supervisor	❑ Shared information verbally with my colleagues

NCST

- ❑ Made written notes and shared with others in my group or department
- ❑ Added information to a VTrans database or shared electronic file
- ❑ I didn't take any specific steps to share knowledge or information
- ❑ I was not asked by my supervisor to share knowledge or information.
- ❑ other
- ❑ Not applicable

If "other" please explain:

---

10. What steps, if taken by VTrans, might have led you to remain a VTrans employee? (Check all that apply.)

- ❑ More competitive pay
- ❑ VTrans employee recognition
- ❑ VTrans paid professional development
- ❑ VTrans paid professional association membership dues
- ❑ Variety in work assignments
- ❑ Mentoring from experienced employees
- ❑ Enhanced organizational communication
- ❑ Meaningful employee evaluation system
- ❑ Opportunity for career advancement
- ❑ Different supervisor
- ❑ Merit pay
- ❑ Increased voice in the organization
- ❑ More focus on my skills and strengths
- ❑ Making me feel valued as an employee
- ❑ Other
- ❑ Opportunities to learn and grow

If "other" please explain:

---

11. What aspects of your VTrans employment did you value or enjoy the most? What does VTrans do right as an organization and employer?

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12. Would you recommend employment at VTrans to a friend?

- ❑ Yes
- ❑ Yes with reservations
- ❑ No

13. How long were you employed at VTrans?

- ❑ less than 6 months
- ❑ 3 years – less than 5 years
- ❑ 6 months – less than 1 year
- ❑ 5 years – less than 10 years
- ❑ 1 year – less than 3 years
- ❑ 10 years or more

NCST

14. What was the title and department associated with your most recent VTrans position?

Title: _____

Department: _____

15. Please add any other thoughts you have about your experience as a VTrans employee, including suggestions for increasing employee retention.

_____

Thank you for completing this questionnaire. Please be sure to use the enclosed envelope to return this form to UVM. Your time and effort are greatly appreciated.

Appendix E: Knowledge Management Pilot Preliminary Report

Vermont Agency of Transportation

Knowledge Management Pilot Project

Preliminary Report

July 3, 2018

Glenn McRae, Ph.D. - Carol Vallett, Ed.D. - Jennifer Jewiss, Ed.D.

Transportation Research Center

University of Vermont

Introduction

A knowledge management pilot project was planned as the final activity of 703 - VTRC 16-5: *Assessing VTrans employee retention: who stays, who leaves and what to do about it.* The findings from the overall research project including focus groups, benchmarking studies and the knowledge management assessment tool survey provided the basis for the direction of the pilot project.

During the last quarter of 2017, researchers and the TAC discussed two different types of pilot projects and decided a KM pilot that could be sustainable by VTrans might best serve both the retention issues and related knowledge transfer needs of the Agency. In a subsequent conversation with a small sub-group of the TAC, the discussion considered a KM pilot that addressed some of the recommendations in the KM Assessment survey - in particular, the need for the development of items such as an expert locator, standardized knowledge sharing templates, or a system for locating current documented knowledge. This approach also addressed KM issues raised in the retention focus groups.

Based on this information the pilot project moved forward with the goals of:

1. A tool for capturing tacit knowledge and
2. A mechanism to help with retrieving tacit knowledge.

Project Timeline, Activities and Outputs

The overall work plan for this pilot project was developed by the researchers to help guide project activities. A first step in the plan was the selection by the TAC of the units who would participate in the pilot. Structures (of the Highway Division) and the Transportation Systems Management and Operations (TSMO part of Technical Services) units were selected as the two groups who would each identify four participants to join the pilot project. A timeline of the actual pilot project activity and outcomes follows in Table E-1.

Table E-1. KM Pilot Project Activities & Outputs

Month	*Activity*	*Outputs*
January	• Researchers met with Matt Lofgren, the VTrans SharePoint administrator for a walk through of the VTrans SharePoint capability and overview of some specific sites. Matt also provided a brief look at META, the knowledge sharing pages in the Structures unit. • The researchers also met with UVM librarians for a discussion about taxonomy development.	• Knowledge Management SharePoint site and sandbox site set up with UVM access. (https://vermontgov.sharepoint.com/sites/VTRANS/e/kmpilot/SitePages/Home.aspx) • The Accidental Taxonomist (Heather Hedden) recommended and put into use by the UVM researchers.
February	• Managers in Structures and TSMO identified participants. • Each unit recruited four participants, most with long-term employment at VTrans. • The participants were welcomed and sent introductory material about the retention project and knowledge management. This was in preparation for an online meeting scheduled in March	• Introductory material and agenda prepared before March meeting.
March	• A one-hour online meeting was conducted with participants on March 13. This session included introductions of the participants and research team and covered the basics of KM especially tacit knowledge. • Participants were given the assignment of identifying two topics of tacit knowledge from their own work experience and to come prepared to our workshop in April ready to work with these topics. • Additionally, a Structures staff member with UVM conducted a brief online overview of the Structures META site later in April. • UVM was given access to read items on the META pages.	• Orientation material in PowerPoint.
April	• The two-hour workshop was held with participants on April 9th. • Working in groups of 4 (mixed between units) the participants used a round-robin method of knowledge sharing using a first draft what was called the "Knowledge Exchange Tool" (KX tool). • Participants provided feedback on the tool and the process and completed forms were sent to the researchers. • Feedback from participants after the working session was positive and encouraging.	• PowerPoints developed for the April 9 meeting captured the working session outline and instructions. • Knowledge Exchange Tool (v1) was developed for the April meeting • A revised Knowledge Exchange Tool (v2) was created for use after the April meeting. • 16 complete Knowledge Exchange Tools were

Month	Activity	Outputs
	• The participants were then asked to work in pairs (outside of the KM pilot meetings) to use a revised KX tool with new tacit knowledge topics. These were back to UVM by April 30th.	received covering 15 distinct topics.
May	• UVM researchers worked to catalog the 15 KX documents received in the first two rounds of form usage and took first steps in developing taxonomy or tagging format for the items received. (This taxonomy was based on the Transportation Research Thesaurus http://trt.trb.org/trt.asp?) • In early May, an online meeting was held with the SharePoint administrator to answer detailed questions about the Term Store and Managed Meta Data capabilities. • The 15 forms were then uploaded to the SharePoint site and tagged with the developed taxonomy terms. • An online meeting was held with participants on May 10th to review the work to date and receive feedback. • Participants were asked to use the KX forms with another colleague who was not a part of this project. • By the end of May due date, one additional form had been received.	• Summary Table of KX Tools completed. • One additional KX form added to the Summary and SharePoint site. • Draft taxonomy for KX Tools developed • Guide for KX Tool use and tacit. knowledge definition are developed.
June	• Fourth and final online meeting with participants was held on June 7. (Attendance was impacted due to Davis Building relocation and unexpected field work) • Review and discussion of the tagging system and SharePoint site. • Based on feedback, a new tagging system was developed (with multiple tags including contributor, unit, topic, and date). • Working with the SharePoint administrator, the KM sandbox site was deployed in the "Modern Experience" mode that allowed for greater use of tagging and filters. • Participants were asked to schedule individual or two person phone conversations with UVM during the last two weeks of the month. • Pilot ended on June 29th.	• Agenda and PowerPoint sides for June 7 meeting. • Revised taxonomy or tagging system developed and added to SharePoint site. • KM sandbox site is revised in "Modern Experience" and new tags added. (https://vermontgov.sharepoint.com/sites/VTRANS/e/kmpilot/sandbox/Shared%20Documents?viewpath=%2Fsites%2FVTRANS%2Fe%2Fkmpilot%2Fsandbox%2FShared%20Documents). • Guideline for using the KM SharePoint site is developed. • Feedback from participants is captured and is in the body of the final report.