Applying Knowledge Management
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Coming Next Issue

Feature articles in the November–December issue trace out the history and influence of the Federal-Aid Road Act, which 100 years ago established federal funding to the states for highways; examine national and international policies to reduce the carbon emissions from freight; and present an overview of the revised sixth edition of the Highway Capacity Manual, a key reference, now subtitled A Guide for Multimodal Mobility Analysis. Additional topics include the sharing of operations data among agencies, best practices for stormwater management, geographic information system–based asset management, resource allocation and system performance—and more.

Old Albany Post Road in Philipstown, New York, is listed on the National Register of Historic Places. At the turn of the 20th century, the need for well-maintained roads for mail delivery and in national parks and forests drew attention to the federal government’s role in road building and preservation.
Learning as We Go

Transportation Knowledge, Networks, and Communities of Practice

FRANCES HARRISON, ANDREW LEMER, LENI OMAN, and HYUN-A PARK

In the first century AD, the Roman military leader and philosopher Pliny the Elder authored the first known encyclopedia, *Naturalis Historia*, intended to encapsulate all human knowledge. In the two millennia since Pliny’s work, the scope of human knowledge has expanded tremendously, as have the challenges of keeping track of the artifacts of the efforts to capture, preserve, and share that knowledge: books, pictures, maps, recordings, databases, encoded files, and other information. The U.S. Library of Congress, for example, claims to have more than 162 million items in its collections and to add approximately 12,000 items daily.¹

Knowledge resides with people, who use it to make decisions and guide actions. People may collaborate with others and draw on information available from libraries or other resources. These collaborations and information retrievals may extend beyond a single agency or institution as technology enables the formation of widely dispersed communities of practice. Taken together, knowledge and information about transportation systems, about the agencies responsible for developing and managing these systems, and about the many stakeholders who use and rely on these systems’ services are recognized increasingly as a valuable legacy, an asset to be used for future benefit.

Transportation knowledge management—the means by which an agency builds, sustains, and leverages the know-how and experience of its employees and partners to deliver transportation projects and services and to manage the systems for which the agency is responsible—is the subject of this issue of *TR News*. Knowledge management is an interdisciplinary field that draws on a range of principles and practices, from learning and education to organizational theory and psychology and to document management and computer programming. Trying to discuss knowledge management for transportation agencies or any other particular domain is akin to the fabled task of a group of blind people describing an elephant. Only when the individual perspectives are brought together is an understanding of the whole animal possible.

With the rapid expansion of technologies for communication and information storage, processing, and retrieval, research to develop effective tools and procedures for transportation knowledge management represents a potentially fruitful area. Our aim in assembling the articles presented in this issue of *TR News* is not only to provide an understanding of what transportation knowledge management is and why it is important but also to present emerging research results and innovations that offer improvements in our practices.

We thank the TRB Task Force on Knowledge Management, the American Association of State Highway and Transportation Officials Research Advisory Council’s Task Force on Transportation Knowledge Networks, and Christopher Hedges, Director of Cooperative Research Programs, for their assistance in developing this issue.

¹ [https://www.loc.gov/about/fascinating-facts/](https://www.loc.gov/about/fascinating-facts/)

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A state transportation agency, at its core, is a knowledge organization that specializes in transportation. The way that knowledge is managed determines the success or failure of a state department of transportation (DOT) as it confronts 21st century challenges.

These challenges take many forms. The decline in funding compels agencies to pursue operational efficiencies and to shift from expanding to preserving infrastructure. Many state DOTs are losing experienced staff to retirements. The rapid turnover among young and mid-career employees also contributes to the loss of valuable expertise and impedes organizational effectiveness. Younger generations rely on electronic and online repositories for information, but older generations thrive on face-to-face knowledge exchange. Moreover, transportation users expect expedient customer service and safe, high-quality modes of transportation.

What got us here today will not get us where we need to be tomorrow. That is the reality that drives transportation agencies to innovate, streamline, and maximize the performance of their organizations.

Knowledge management is a formalized set of practices that can help a state DOT improve its organizational and workforce performance in the long term. Any leader of a group of people can apply knowledge management.

Institutional Knowledge

Knowledge management aims to maximize the value from an organization’s human capital. An organization’s systems and processes are only as good as the abilities of the employees engaged in their roles.
These workers possess the institutional knowledge that is a pillar of a high-performing organization. The loss of one of those pillars entails a loss of stability.

An employee may leave an agency after 20 years, but if that person’s accumulated knowledge is not transferred into a legacy record, valuable information is lost. An organization may experience repeated negative incidents that could have been prevented by implementing a lessons-learned process.

Decades ago, many jobs required greater amounts of manual labor, and workers gained their knowledge in stages, through the apprentice–journeyman–master progression. Today, more workers have their hands on computer keyboards and interact electronically with coworkers and systems. Compared with yesteryear, their knowledge is gained less from hands-on experience and more from a reliance on accessible data.

Knowledge has tacit and explicit components. Tacit knowledge—for example, intuition or know-how—is stored in the brain and is difficult to express and document. In contrast, explicit knowledge—such as policies and procedures—is knowledge transformed into recordable information.

Some experts maintain, however, that all knowledge is tacit only, because mentally stored “facts” often vary from person to person and may not translate into identical information when recorded, whether on paper or any other medium. In practice, knowledge management programs may address the creation and application of both tacit and explicit knowledge, as well as other information that employees need to carry out their responsibilities.

**Ten Areas for Attention**

Denise Bedford of the Communication, Culture, and Technology program at Georgetown University has divided knowledge management into 10 focus areas. A leader who wants a smooth-running organization should address each of these areas, which directly align with a typical organization’s needs:

1. **Knowledge leadership and strategy**—Leadership and strategy develop and promote a vision for knowledge management. The vision, the strategy, and the communication serve as transformational agents, through policy guidance and formulation, to shift the organization to value intellectual capital.

2. **Intellectual capital management**—Organizations thrive on the quality of their capital investments. Through knowledge management, human and intellectual capital puts an organization’s knowledge into action. Intellectual capital management therefore invests in knowledge workers, their talents, and their competencies, including the global and virtual workforces.

3. **Communities and collaboration**—To foster a lasting knowledge management process, an organization must allow employees to interact and collaborate freely. Establishing communities and collaborating with workers and managers contribute to inter- and intra-organizational teamwork, encourage professional and social networking, and develop skills in facilitation and in problem resolution. The challenges include designing and implementing the environments and the supporting technologies that foster collaboration.

4. **Culture and communication**—Successful collaboration occurs when an organizational culture reinforces the value of knowledge management. The knowledge management processes align with the organization’s institutions, processes, systems, and goals.

5. **Knowledge operations**—Knowledge operations ensure that the processing of knowledge aligns with the organization’s business goals and objectives.
and is integrated into the organization’s everyday business. Knowledge operations involve decisions, systems, business architecture, and workflow management.

6. Organizational learning—Organizational learning encompasses learning, instructional design, and problem solving. One approach is to treat an organization like a brain that controls the individual members. Under an alternative approach, an organization’s workers create knowledge within their own networks, known as communities of practice.

7. Knowledge technologies—Every organization and its workers rely on sophisticated hardware and software to support the internal systems. A successful knowledge management program similarly relies on technology solutions and applications for the seamless integration of knowledge to support the creation, capture, exchange, discovery, and preservation of knowledge.

8. Knowledge asset management—The overall plan for an organization’s knowledge management is critical for success. The plan addresses the capabilities related to knowledge retention and loss, mapping, diffusion and mobilization, transfer, organization systems, information governance, quality, disclosure, policy, content and records management, and preservation.

9. Knowledge architecture—Knowledge architecture designs solutions to the challenges that arise in knowledge work. The solutions focus on people, how they work, how they think, and how they create and test ideas.

10. Knowledge assessment and evaluation—Organizations are looking for the highest return on investment, for detailed goals, and for benchmarking. Knowledge assessment and evaluation include organizational management, knowledge audits, knowledge metrics, benchmarking, and evaluation.

An organization’s leadership must consider the appropriate relative importance of each of these 10 areas. A variety of organizations have adopted knowledge management practices; each can offer instructive examples.

Domestic Scan

The series of focused site visits featured interviews with managers and decision makers at selected knowledge management programs. Completed in May 2014, the scan explored transportation agency challenges in the next decade, primarily those related to the loss of experienced staff from retirements and workforce reductions.

The scan team studied knowledge management activities in the public and private sectors and reviewed initiatives by select state DOTs—Alaska, Georgia, Kansas, Missouri, Virginia, Washington, and Wisconsin—as well as by several federal administrations—aviation, transit, highway, and NASA—and Canada’s Alberta Ministry of Transportation. Two private-sector organizations, Kraft Foods and Accenture, rounded out the scan subjects.

The evaluation focused on the contribution of knowledge management in overcoming challenges, fostering innovation, and enhancing organizational efficiency and effectiveness to improve the delivery of transportation projects and services despite limited and dwindling resources.

The scan recognized that knowledge management is an evolving practice. In the 1990s and 2000s, information storage was the focus, but the data-driven culture shifted to a people-driven culture. The drive today is to codify and link explicit knowledge to create a central repository of information accessible by an organization’s current and future workforces. This involves addressing the current trends—particularly a younger workforce oriented to online and electronic information.

Scan Results
From a transportation agency CEO’s perspective, three programs studied in the scan stood out as examples of how knowledge management can advance a transportation organization and its employees.
**Virginia DOT**
Virginia DOT faces many of the same challenges as other state transportation agencies: mitigating the loss of knowledge associated with major reductions in the workforce; adapting to meet new demands for service and efficiency; and shifting the mission from construction to maintenance operations, necessitating greater internal and external collaboration.

Virginia DOT established a separate knowledge management office, located in a neutral part of the agency, with the Virginia Transportation Research Council. The office was charged to collect, preserve, and share the institutional knowledge of the agency’s employees for the benefit of current and future projects. The knowledge management program focuses on applied business research and analysis, with established measures and outcomes: return on investment, effectiveness, efficiency, avoidance of duplication, and risk management.

**Kraft Foods**
In the private sector, the scan found that the focus at Kraft Foods was on succession planning. The company’s knowledge book is a codified succession plan for mission-critical positions. Accessible by all employees as an interactive PDF, the document outlines job duties, technical formulas, and chains of command and can be edited as necessary to add updates for current and future conditions (see the article by Nanako Mura in this issue, page 22).

This living document model is workable for other organizations. In 2012 Kraft Foods split into two businesses—Kraft Foods Group for U.S. grocery items and Mondelez International for global snack foods. The knowledge book provided a continuity of technical knowledge during the corporate shift and played a key role in ensuring commercial competitiveness and proper allocation of resources.

**NASA**
Federal agencies are repositories of immense amounts of knowledge. In some cases, the sheer size of the agency may preclude effective knowledge transfer, with negative consequences that can shake the organizational foundations. NASA experienced this during the investigation of the 2003 space shuttle Columbia disaster.

The investigation discovered that the actions leading up to the disaster had not upheld the agency’s four core values—excellence, safety, teamwork, and integrity. The findings revealed a failure to explore all technical expertise, a lack of communication across organizational boundaries, a resistance to enforcing safety checks, and complaints from employees that managers did not acknowledge their observations.

NASA learned from these mistakes. Midlevel managers received guidance on expressing concerns and on speaking up when confronted with potential safety or process issues. “Lessons learned” meetings were convened after incidents to ensure that every employee involved had an opportunity to provide input on what went wrong and on how to prevent a recurrence. The goal was to examine every technical and procedural angle to ensure that the breadth of the agency’s knowledge would be applied to improve safety, technology, and processes.

**A Tool for Prospering**
A CEO understands—or quickly learns—that making best use of an organization’s collective intellect is a key to the organization’s prosperity, whether the organization faces growth or tough times. Knowledge management is a valuable tool for making good use of the corporate intellect. DOTs today are seeking to prosper in a time of reductions in force, retirements, retrenchments, and growth in demand for services; preserving the institutional knowledge of employees, young and old—a central component of knowledge management—presents a way to ensure continuing organizational success.

State DOTs face many fiscal and technological challenges, including a demographic shift in the workforce. Efficiency—a buzzword typically used to justify the search for financial and procedural improvement—also applies to the management of human and intellectual capital. Knowledge management can help.
Knowledge management originated as a discipline in the 1950s. The term sounds simple and intuitive—everyone has knowledge to use and manage effectively. The discipline of knowledge management, however, is complex, interweaving strands from several other disciplines, including economics and intellectual capital, artificial intelligence and knowledge architectures, people and communities, and organization science and culture.

Knowledge management does not have a definition that all academics or practitioners accept. Nevertheless, academics and practitioners agree that the goal of knowledge management is to enable an organization or a community to leverage all of its knowledge assets—the tangible and the intangible—to become more than the simple sum of the parts. In the 21st century, all organizations are striving to become knowledge organizations to remain competitive and relevant in a new and changing economy.

Adopting the Practice
Adoption of knowledge management has occurred at different rates in different economic sectors. The earliest adopters were in the public sector, particularly in the U.S. federal government—notably the Department of Defense, the Nuclear Regulatory Commission, and NASA.

In the 1990s, the private sector took the lead in adopting knowledge management and in defining the practice. Knowledge management has flourished in the oil and gas industry, in the energy sector, in legal firms, across the technology sector, in financial services, in the pharmaceutical and medical sectors, and in manufacturing.
In the past 20 years, adoption of knowledge management has grown internationally, with particular concentrations in Asia, Europe, and the Middle East. The adoption of knowledge management in these regions rivals adoption in North America. The tables of contents of the most recent issues of the *Journal of Knowledge Management* and the *Electronic Journal of Knowledge Management* list authors in South America, Asia, the Middle East, Europe, the United Kingdom, and the United States. The editorial boards of the five top-ranked journals have international membership.

Transportation practitioners have formally engaged in knowledge management on an international level in the past 20 years through the World Bank, regional development organizations, and global consulting consortia. In addition, the transportation sector has cultivated private- and public-sector knowledge management communities and has established a dedicated community of knowledge management practitioners—in large part through the research, information dissemination, and convening efforts of the Transportation Research Board.

**Business Drivers**

What can the transportation community learn from and contribute to the field of knowledge management practice? A first step is to identify common challenges and opportunities by focusing on the drivers or motivators of business. Common business drivers related to knowledge management include the following:

- Knowledge loss and retention;
- Learning and knowledge creation;
- Incentives for sharing knowledge;
- Managing tangible information for discovery;
- Leadership, strategy, and innovation; and
- Applying knowledge in critical business processes.

**Knowledge Loss and Retention**

Loss of critical business knowledge from attrition, retirement, workforce reductions, and the tendency of younger workers to change jobs frequently is a challenge for every organization. In some agencies, up to 30 percent of the workforce is eligible for retirement within the next five years.

Loss of knowledge is a risk for transportation agencies because practitioners bring academic knowledge to the job and increase that knowledge through practical experiences. Preventing knowledge loss requires ensuring that the knowledge remains in circulation, and continues to be evaluated, validated, or invalidated.

A single, standard approach to elicit and design knowledge for future learning does not work for all organizations. Following are some of the many designs or approaches and their prominent users:

- Directories of expertise—Mitre Corporation, NASA, and the World Bank;
- Capability networks—NASA Glenn and Goodyear Tire & Rubber Company;
- Knowledge books—Kraft Foods and the International Atomic Energy Agency;
- Oral histories—American Battle Monuments Commission;
- Back-to-office and after-action reviews—the Federal Aviation Administration, the World Bank, and the Department of Defense;
- Briefing books—Department of State; and
- In situ coaching and mentoring exercises—the World Bank.

The list of organizations above is selective—many more examples are available in the literature.

**Learning and Knowledge Creation**

In the 1990s, knowledge management practitioners assumed that all of the knowledge ever needed already existed—the task was to find it, make it accessible and retrievable, and make sure that people used it. The flaws in this approach soon became apparent—organizations need new ideas, and sometimes organizations need to forget or unlearn old ideas that no longer have value or relevance.

**New Approaches to Learning**

At the individual, community, and organizational levels, learning is critical to generating new ideas. Learning today differs from learning 20 years ago—
learning is social, situational, and active and can be online in real time or at different times or in person. The design should be relevant for learners and for business, for a multigenerational workforce with varying styles of learning.

Many examples from inside and outside transportation show ways to meet the business challenge. The chemical manufacturing company FMC, a leader in organizational learning, has designed learning programs to support the organization’s business capabilities; individuals discover and are encouraged to build their competencies.

The World Bank has a long history of providing learning opportunities for clients to expand their knowledge and capacities. The World Bank Institute is now called the Open Learning Campus, to reflect a redesigned and reimagined approach to learning.

Organizations like the U.S. Postal Service, the World Bank, NASA, the Federal Aviation Administration, and the American Battle Monuments Commission are creating new learning cultures through learning management strategies. Private-sector organizations, such as the Federal Reserve Banks, "\[Partially cut off\]

Communities of Practice

Organizations like Google and Intel have long understood that competitive advantage is achieved when people share ideas, collaborate, and work in productive team contexts. Collaborative environments and virtual communities of practice foster relationships among geographically dispersed and remote teams.

Communities of practice establish environments for creating and sharing knowledge. Communities of practice have what might be called hard and soft components. The soft components relate to the communities’ culture and ways of working together. The hard components include the environment and the technologies that foster collaboration—whether in a physical or virtual space—as well as the design of the work space or the integration of technologies to create a welcoming virtual environment.

This business driver offers a rich set of experiences. One of the first publicized successful communities of practice was Companycommand.com, established by the Department of Defense. BP was a communities of practice leader in the energy sector in the early days of knowledge management, and communities of practice have become a staple in the oil and gas industry.

Communities of practice are particularly important to organizations whose work is project or mission oriented—for example, NASA has consistently fostered communities of practice and provides working examples at many of the NASA centers. The communities of practice align with the natural project and team structure and support the flow of knowledge among the members.

International organizations have widely adopted communities of practice to enable conversations among experts and novices working on projects around the globe. The World Bank’s use of networks and communities of practice is well known, but use by the Asian, African, and Islamic Development Banks is also noteworthy.

Access and Discovery

The access, organization, and discovery of knowledge are what people most often associate with knowledge management. Organizations produce and acquire vast quantities of codified and tangible information and continuously create new knowledge.

In the 1990s, knowledge management practitioners thought that capturing and preserving every piece of an organization’s information in perpetuity was critical. Lessons learned in the private sector,
however—particularly from legal firms, financial services, the pharmaceutical industry, and the energy sector—revealed the importance of focusing on business-critical information.

Capturing and preserving everything is not possible or effective. The task is to figure out what information is critical for business. Although organizations may adopt standard practices to design systems to manage content—for example, the web, documents, records, social media, and e-mail—each organization must define what is business critical. Technologies to support this task have been around for decades, but designing and building the solution appropriate to an organization is a recurrent challenge.

Transportation agencies must reckon with the complexity of the information environment and a broad spectrum of structured, semistructured, and unstructured sources of data. The environments in which these sources are created and retrieved are also complex. Moreover, the data must be retrievable in the office, in the field, and en route by travelers.

The best models for transportation have comparable levels of complexity—NASA, the National Institutes of Health, the Department of the Navy, the Federal Aviation Administration, and the Department of Energy. Private-sector models would include such organizations as Boeing, Northrup Grumman, Mitre, Lockheed Martin, and Eli Lilly.

Leadership, Strategy, and Innovation

Knowledge management is fundamentally a strategic endeavor to maximize value from an organization’s human capital. This represents a challenge across all organizations, sectors, and geographical locations. Leadership, strategy, and innovation pertain to an organization’s capacity to develop and promote a knowledge vision, to develop a strategy to realize the vision, and to communicate the organization’s commitment to the vision and the strategy.

Organizations and companies that succeed at knowledge management tend to have leaders who lead by example, who act as transformation agents, and who create a culture that encourages everyone to invest in the organization’s success. Leadership is critical in building a culture of trust throughout the organization.

A winning knowledge management strategy clearly ties to and aligns knowledge management goals and metrics with critical business capabilities and outcomes. Organizations with sustainable knowledge management leadership include NASA, the Department of Defense, Goodyear Tire & Rubber Company, FMC, John Deere, the World Bank, Aramco, and Exxon Mobil.

Knowledge in Business Processes

The most effective use of knowledge is within an organization’s core operations and business processes. This aspect of knowledge management draws from business architecture, business process engineering, workflow management, and decision sciences. The focus is on leveraging all forms of knowledge—tangible to intangible—at key decision points.

Business rules experts estimate that more than 50 percent of the data used in business processes is not accurate. Although business process engineering has been around for several decades, knowledge management leverages knowledge design and engineering methods to ensure that the knowledge put to use is accurate and trustworthy.

The improved use of knowledge can advance organizational performance, productivity, agility, and decision making. Guidance outside the field of transportation can come from financial services organizations, the manufacturing sector, and fiscal and monetary policy organizations such as the International Monetary Fund or the system members of the Federal Reserve.

Ready Opportunities

Transportation professionals interested in knowledge management have many opportunities to network with colleagues in the transportation sector and with knowledge management practitioners outside the field. Good practices and new ideas can be discovered within local, state, and national governments in the United States and internationally, as well as in private-sector organizations. Knowledge management continues to evolve as a discipline, and the opportunities to learn from and contribute to its development are many.
Workplace compliments such as “She certainly knows the job!” or “He really knows what he’s doing!” reflect a wide recognition that knowledge is important in getting things done. The causal relationship between knowledge and productivity may be difficult to measure. Nevertheless, a survey of senior European corporate executives by The Economist Intelligence Unit (EIU) found that two-thirds placed business intelligence and knowledge management solutions at the top of their lists of the technologies important to achieving their companies’ strategic goals (1).

Critical to Success

A vignette in the EIU report describes how the global oilfield services supplier Schlumberger scored a first-year net return of $200 million on an investment in a system for capturing and sharing technical knowledge to boost service and sales productivity. Called “InTouch,” the system helped field engineers keep current on the latest output from the corporate technology centers, meet customers’ needs, and rapidly disseminate best practices throughout the organization.

As the name InTouch indicates, the system did more than support the flow of technical information between the corporate and field offices. The system brought staff and customers closer—more in touch—by providing access to the right knowledge at the right time.

Transportation agencies are responsible for the development and support of facilities and systems with service lives that extend into decades and even centuries. For these agencies, knowledge is critical to success—but having the knowledge is not enough to get the job done; people must use their knowledge effectively.

Information resources, such as project files, inspection reports, and libraries, provide support, but what people in an agency know and how well
they collectively apply what they know to doing their jobs determine how effective the agency will be in pursuing its mission. Transportation agencies need to ensure that their workers—staff or contractors—have the knowledge they need and the will to use it.

In the age of the Internet, social networks, and ubiquitous communications, organizations big and small are finding new ways to build and motivate their teams to apply their knowledge profitably.

**Improving Productivity**

Actions to improve productivity can be primarily knowledge-centered or people-centered. Knowledge-centered efforts aim to enhance what people know—for example, through online training in a set of skills or tasks. Knowledge-centered efforts can be context-dependent—directed at a particular task or set of related tasks, or context-independent—aimed at broader skills or knowledge for use in many different ways in the workplace.

Job shadowing, for example, is a knowledge-centered activity that is primarily context-dependent—an individual observes and practices in an authentic context what he or she will be expected to do. In contrast, software training is relatively context-independent—the training addresses the use of a particular software package wherever it may be applied.

People-centered activities aim to enhance the application of people’s knowledge through team-building and fostering positive feelings about the workplace. Providing a health club membership, for example, encourages a staff member’s personal sense of well-being and may reduce health care costs, but the benefit also may incline the staffer to make an extra effort to keep things moving smoothly on the job.

From large corporations to sports teams, experience demonstrates that people-centered and knowledge-centered actions together improve and maintain productivity.

**Key Elements**

As technology-based organizations, transportation agencies tend to focus on knowledge-centered initiatives. Maintaining and retrieving specific information about bridges, pavements, tracks, and vehicles is central to an agency’s mission. But that is not enough, as noted in National Cooperative Highway Research Program (NCHRP) Report 813, *A Guide to Agency-Wide Knowledge Management for State Departments of Transportation*, which lists four key elements of an agencywide knowledge management approach:

- Leadership and direction,
- Collaboration and communities,
- Knowledge codification and dissemination,
- Succession and talent management.

All four elements represent a mix of people-centered and knowledge-centered actions; three of the four clearly put people first.

**Putting People First**

Organizations recognized for innovation and productivity characteristically engage in significant people-oriented efforts and have a positive workplace culture. For example, one of the most spectacularly successful companies in recent years, Alphabet—formerly known as Google—has increased total revenues eightfold in the past decade and has quadrupled stock prices.

For the past 10 years, Alphabet has earned a listing among *Fortune* magazine’s 100 best companies to work for and has led the list seven times (2). *Fortune* quotes one Alphabet employee:

> The company culture truly makes workers feel they’re valued and respected as a human being, not as a cog in a machine. The perks are phenomenal. From three prepared organic meals a day to unlimited snacks, artisan coffee and tea to free personal-fitness classes, health clinics, on-site oil changes, haircuts, spa truck, bike-repair truck, nap pods, free on-site laundry rooms, and subsidized wash and fold. The list is endless.
Boston Consulting Group, a global management consultancy, also top-rated in the 2016 Fortune survey, spent $110 million in the past 10 years to address the burnout problem endemic to its industry. The firm instituted a program called PTO—Predictability, Team ing, and Open Communication—that combines more conventional efforts to balance work and life with attempts to rethink work processes to make the work more meaningful (2). Fortune quotes an employee: “PTO is proof [that Boston Consulting Group] really cares about making our lives manageable and makes sure we don't drop the ball on key life events. This is one of the best things about the company, and it is unique in the industry.”

Revenues at the firm have grown more than 15 percent annually in recent years, and PTO has led to a 74 percent increase in employees reporting the intention to stay at Boston Consulting Group for the long term.

In an interview published by the Harvard Business Review, the late Hall of Fame football coach Bill Walsh observed:

Walsh coached the San Francisco 49ers to three Super Bowl championships in eight years; as Stanford University's head football coach, he moved what the Harvard Business Review characterized as a “moderately talented” team to a national ranking and a win in the Bluebonnet Bowl.

Learning Matters
People are important, but what they know and apply to their work is an organization's fundamental asset. Knowledge is the product of an individual's accumulated experience and interpretation of these experiences.

One of the founders of learning theory, Jean Piaget, termed the process "assimilation and accommodation": we make observations of the world and attempt to accommodate those observations into our knowledge structures. The acquisition of knowledge—learning—happens continuously, through everyday engagement in a workplace, whether on the job, on vacation, or on a coffee break.

On the job, a person confronts a series of tasks and proceeds in an iterative manner, sometimes taking a step back to reconsider, to identify what needs to be done, establish a plan, execute the plan, and afterward perhaps reflect on the outcome. This process can describe getting a cup of coffee, sizing a culvert, planning a meeting, or building a bridge. Whatever the scale, a person usually acts within the context of a group and is influenced by a multitude of social and cultural factors and interpersonal relationships, as well as by individual motivations. According to learning theorists, this context inevitably influences what a person learns.

Communities of Practice
For these theorists, situated learning is inseparable from the context of the team, the group, the community. This insight led to the concept of communities of practice. Coined by social anthropologists Jean Lave and Etienne Wenger, the term refers to groups of people who share expertise, concern, and passion for something they do and who learn how to do it better through their regular interaction and joint enterprise.

Often misunderstood as groups of people work-
ing together on a project, a community of practice reflects the shared desire of the group’s members to work together to develop a shared vision, often with its own terminology. The approach has gained popularity because it offers practical steps for an organization to build and mobilize a knowledge base to enhance productivity, by melding people who know what they are doing into teams that do their jobs exceedingly well.

Lessons in Team Building
Readers familiar with transportation agencies may want to exclaim, “Let’s get real!” about the likelihood of workers’ perks like those at Alphabet and Boston Consulting Group. Three prepared organic meals a day, unlimited snacks, and artisan coffee would attract uncomfortable attention to an agency and its leadership. Transportation agencies operate primarily in the public sector and without the resources and freedom that private companies enjoy in personnel management.

Nevertheless, agencies compete for talent with private-sector counterparts—often in the same markets—for younger workers and for experienced staff. Leading private-sector organizations offer useful lessons about team building and the application of people-oriented knowledge management practices.

Like most transportation agencies, Southwest Airlines is an organization that has a broad range of job descriptions and responsibilities that require diverse technical proficiencies: pilots, gate agents, mechanics, baggage handlers, financial staff, and more. The company has maintained steady profitability in a tough industry and consistently appears on Fortune’s top-100 list.

Southwest flies only one type of aircraft and has developed ways to ensure that the planes spend less time on the ground. One analyst has identified three ingredients in the company’s “secret sauce”: organizational practices that build relationships between managers and frontline employees and among employees; a work environment that emphasizes shared goals, shared knowledge, and mutual respect; and communication techniques that are frequent, timely, and focused on solving problems (4). These people-oriented activities encourage employees to develop, apply, and share their knowledge in a community of practice.

Organizational practices at Southwest Airlines build employee relationships, expand skill sets, and encourage communication among managers and frontline staff.

Online shoe retailer Zappos describes its organizational culture in 10 core values and emphasizes “living the brand” through situated learning and team building.
Core Business, Core Values

At online retailer Zappos, now part of Amazon, customer service is the core of the business; the company works to ensure that new hires will adopt and maintain that focus, starting with two sets of hiring interviews (5). First, the manager and team review for relevant experience, technical ability, and fit within the unit; then the human resources department conducts a second interview to gauge the candidate’s fit in the organization’s culture, which holds 10 core values:

1. Deliver wow through service.
2. Embrace and drive change.
3. Create fun and a little weirdness.
4. Be adventurous, creative, and open-minded.
5. Pursue growth and learning.
6. Build open and honest relationships with communication.
7. Build a positive team and family spirit.
8. Do more with less.
9. Be passionate and determined.

According to the company’s CEO Tony Hsieh, the employees are “living the brand.” Every new employee—accountant, software developer, or fulfillment manager—goes through the same four-week training program as a call center representative, followed by two weeks of taking calls from customers.

At the end of that first week, the company makes an offer to the entire class: Zappos will pay each person for the time already spent in training plus a $2,000 bonus to quit immediately if he or she does not want to continue. This is situated learning, team-building, and culture in action, up close.

People Hold the Knowledge

Transportation agencies can learn to use management tools that are more people-centered and to shift their culture to attract younger generations and adapt more nimbly to the changing business environment. For example, on its staff recruitment web page, Tennessee DOT asserts:

Our mission…is simple—to be the best…[DOT] in the nation. For the past two decades, Tennessee’s highway system has consistently ranked among the top five in the nation. The biggest reason for [Tennessee] DOT’s lasting success is our people,…over 4,000 talented individuals who work in a variety of functions across the state. (6)

The specific character and environment of each agency will influence the application of the lessons of team-building and mobilizing knowledge to sustain the organization’s productivity most effectively. The Transportation Research Board’s Cooperative Research Programs continue to explore ways for agencies to select and tailor knowledge management actions for their particular situations; the leadership of each agency must ensure that the best practices are in place to develop the team and motivate the members.

Entrepreneur and environmentalist Paul Hawken has stated: “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.”

References

Supporting Strategic Change with Knowledge Management

Washington State’s Work in Progress

LENI OMAN

The Washington State Department of Transportation (DOT), like its counterparts in many other states, is in the process of change. The agency is drawing on techniques known as lean management and knowledge management to design new, more efficient ways of working, to maximize the use of staff knowledge, as well as of data and information.

Washington State DOT received a grant from the Federal Highway Administration’s Accelerated Innovation Deployment (AID) demonstration program to help support this effort. The project is titled Deploying Practical Solutions Using Lean Techniques and Knowledge Management; the deliverables include the following:

- A high-level state map of the business process for managing and improving the multimodal transportation system under the practical solutions approach,
- A knowledge architecture that identifies the capabilities for delivering the updated business process,
- An information architecture that identifies the data and information that the knowledge workers need to conduct the business process,
- A knowledge book that captures the operational knowledge for a selected business function, and
- Recommendations for a learning culture to support the continual improvement of the practical solutions approach.

Aerial view of the Washington State Department of Transportation’s (DOT’s) SR-520 Bridge Replacement and High-Occupancy Vehicle project. The agency uses the principles of lean management and knowledge management to oversee the state’s large, multimodal transportation system.
The project was initiated in June 2015, and completion is slated for fall 2016. Washington State DOT has contracted with the Lean Transformation Services unit of the Washington Department of Enterprise Services to help develop the high-level business process map and subsequent lean improvement activities. A team led by Spy Pond Partners, LLC, is developing the knowledge and information architectures, the knowledge book, and the recommendations for a learning culture.

Practical Solutions
Washington State DOT has initiated the practical solutions approach to support lower-cost solutions so that more problems can be addressed systemwide. The approach is data-driven and uses community engagement and collaborative decision making to manage assets and improve the performance of the multimodal transportation system at the least cost and with awareness of the local context.

Operations and demand management solutions in general cost less than capital solutions. In practice, Washington State DOT considers operations and demand management solutions before capital improvements.

Washington State DOT has promoted community engagement, low-cost solutions, and multidisciplinary collaboration for many years. Historically, the DOT’s initiatives have proceeded independently by modes, and improvements in operations and demand management have developed separately from capital improvement.

The practical solutions approach builds on this experience, considers the community and environmental contexts more comprehensively, and aligns multimodal and lower-cost solutions. The transition to the practical solutions approach and an increase in employee turnover are disrupting old processes and patterns of knowledge transfer and information management. The development of systems management practices and the revitalization of training, therefore, are key components in implementing the practical solutions approach.

Although the AID practical solutions project is a work in progress, the approach appears promising as a way to facilitate a shift from workflows that are highly siloed—that is, insulated—and from standards-based methodologies to workflows that increase creativity and interactivity. The products from this project will allow the opportunity to examine organizational involvement in deploying practical solutions and will target opportunities to improve and streamline the flow of knowledge and information to support the updated expectations and business process.
Evolving Lean Culture
Applying knowledge management practices to practical solutions is an example of the agency’s evolving lean culture. Like lean culture, this project examines a network of activities that affect what employees do and how employees work. The practical solutions approach describes how to manage and improve the multimodal transportation system to increase value for customers; the knowledge management practices efficiently align knowledge and information to support that endeavor.

Practical solutions employ data-driven, structured problem solving to clarify a business need—a performance gap—and to identify specific methodologies for evaluating options to minimize cost and waste. Lean solutions, practical solutions, and knowledge management practices rely on collaborative engagement and encourage innovation to improve practices continually.

Mapping Business Processes
Washington State DOT has several business process maps that document workflows for specific functions or combinations of functions. Nevertheless, the agency has lacked a common business process for the development and management of the multimodal transportation system.

Collecting and combining the business process maps did not adequately represent the full business process because of workflow changes after recent downsizing and reorganization. In addition, the business processes did not fully support the integrated decision making envisioned under the practical solutions approach.

Organizations involved in seven functions of the business process participated in meetings on policy setting, planning, programming, design, construction, operations, and maintenance. The meetings included representatives from all modes, and the focus was on the functional steps in the process, not on organizational responsibilities.

The meetings developed a baseline description of the suppliers, inputs, processes, outputs, and customers—or the SIPOC—for each function. Information was collected about the improvements, including opportunities, questions, issues, and concerns related to integrating the practical solutions approach. The discussions highlighted points of common understanding, as well as the variations in practice. Participants received a summary of the outcomes from these meetings for review.

After the meetings, nearly 100 representatives from the functional areas participated in a three-day workshop to develop an integrated business process map. Representatives from each functional area presented the draft SIPOC and the improvements to each function. All attendees participated in a “gallery walk,” a revolving review and discussion of the draft process maps for each function. A facilitator recorded the proposed changes and comments for each process map.

The cross-functional review clarified connections and identified gaps or improvement needs in the process. Participants commented that what they learned about the needs of other organizations would help in setting expectations and in supporting other functions.

On the second day of the workshop, participants reviewed a draft of the combined business process map developed from the results of the gallery walk. Participants agreed that the business process map should represent the future, not the current status. On the last day of the session, participants accepted the final draft of the combined future state map and discussed recommendations for prioritizing improvements.

Performance Framework
A separate activity in fall 2016 developed a performance framework for practical solutions. The performance framework identified the following workflow: set policy directions, manage assets, identify needs, assess alternative strategies, refine solutions, assign resources, design funded solutions, and implement the solutions.

This performance framework then was merged into the state’s integrated business process map for the future. The primary change was to move operations and maintenance activities between setting policy directions and identifying needs. In this way, improvements could flow from the performance gap between the policy objectives and system performance and asset condition.

The draft business process map has provided a useful framework for discussing and refining process improvements. The map serves as a living document, continually updated as Washington State DOT develops the process elements.

Concrete pouring is a task that requires careful teamwork and training.
Construction processes were included among the business process maps.
Mapping Capabilities

People implement processes—and consume, analyze, and create information. Understanding the operational knowledge—the know-how—involving in implementing a process is important in designing a successful strategy for change.

The information gathered through the business process development meetings contributed to the design of a high-level knowledge architecture, including the creation of a capability model. A capability model describes the fundamental activities needed to accomplish the high-level business process; the model, however, does not describe how the work is done.

The capability model identifies functional needs, not organizational structure. The capabilities include the people resources and the knowledge, data and information, equipment, facilities, and the like. Representatives of the business functions reviewed the draft capability model in interviews, and refinements were made.

Each capability is supported by subcapabilities. To demonstrate how the capability model can clarify the activities in the business process, two subcapabilities were selected. Interviews with subject matter experts collected information about activities involved in capital project scoping and in design processes, including the data and information to accomplish these activities.

A draft is in development to capture the roles of the organizations involved in each of these capabilities. The document will identify the organizations that are responsible, accountable, supportive, consulted, or informed in each capability.

The capability model provides a foundation for understanding the competencies needed and the interactions of the organizations involved. The model also provides a foundation for assessing opportunities for improvement, the resources needed, and the risks of knowledge loss.

The AID practical solutions project is describing the capabilities needed for the future state business process, drawing from the knowledge of subject matter experts familiar with the current process. The capability model has identified potential gaps and overlaps in activities. The working document will be refined as the processes and the capabilities are refined.

Mapping Information Flow

Data and information resources are used across the business process. Several of these resources support specific activities, but their relationship to other activities is often unexamined.

The practical solutions project is reviewing the data and information needed to support the business process and the data and information resources that are used—the databases, repositories, applications, and the like. This information will support the creation of a high-level information architecture to help the department design resources that ensure employees have access to the right data and information at the right time and in the right format.

Early findings indicate opportunities and challenges. Some information used throughout the life cycle may have similarities, which may lead to opportunities to streamline collection and management.

Variations in the terms that describe business activities can present a challenge for work across disciplines and organizations. For example, business units use such words as strategy, solution, and project in different ways. This can result in agreements that mean different things depending on the interpretation of the words. Language is organic and not controllable—nevertheless, care is needed in defining words that are critical to the core business functions.

The project is developing a practical solutions glossary and an enterprise taxonomy framework to support searching and navigating data. Controlled taxonomies describe the relationship of terms and support the ability to retrieve relevant information over time.

For example, the terms and acronyms used for intelligent transportation have changed—IVHS, Intellidrive, VII, V2V, connected vehicles. Are these synonymous or different? Are some subordinate to others?

Taxonomies also support automated work flow. For example, the routing of payment approvals through an accounting system relies on look-up tables that operate behind the scenes. The ability to find the most relevant data and information and to direct work flow accurately relies on the management of key terms.

Capturing Operational Knowledge

In January 2016, the retirement forecast data for Washington State DOT indicated that nearly 20...
percent of the employees were fully eligible for retirement and nearly 40 percent were eligible for either a reduced or full benefit. Agency retirees may exit the workforce as early as age 55.

As a result, Washington State DOT anticipates losing a significant portion of its workforce in the next five years. Capturing institutional knowledge is critically important for continuity and for retaining key facts about historical program development. Washington State DOT is working with the consultant team from Spy Pond Partners to develop and test a knowledge book following the steps outlined by Jean-Louis Ermine in *Method for Analyzing and Structuring Knowledge (MASK)*. The method uses six models to capture operational knowledge of a subject. Crash analysis is the subject of the pilot knowledge book.

**Enabling a Learning Culture**

Washington State DOT has begun to implement practical solutions, but full deployment will take several years and will require new policies, methodologies, and practices. A collaborative approach that integrates decision making for operational, demand management, and capital solutions across modes and transportation system ownership is a vast enterprise. A learning culture is critical to the continual evolution of practice and the successful deployment of the multimodal vision.

The AID practical solutions project serves as a case study for the agency’s strategy for multidisciplinary engagement. Project participants were surveyed to gain an understanding of the current state of multidisciplinary engagement and to elicit suggestions for improvement. The results from the survey, the information collected through development of the business process map, and the observations of process improvement activities have provided resources to understand the cultural aspects of the management and improvement of the transportation system.

A workshop with representatives from functional areas and from training and development activities in the department discussed ways to stimulate learning. The spirit of inquiry, inclusiveness, and active dialogue are hallmarks of learning cultures. Washington State DOT is working with the consultant teams to examine current practices and to develop recommendations for strengthening the department’s learning culture.

**Supporting Strategic Change**

Organizations are continually changing in response to such variables as customer interests, the availability of supplies and funding, improvements in technology, evolutions in practice, and workforce capabilities. Although dynamic in nature, organizations often are treated as static systems, addressing new needs by making small modifications to current functions. This approach supports stability and predictability but lacks sensitivity to changing circumstances and inhibits transformation.

Managing and improving the transportation system has become more complex and has resulted in specialization for many disciplines—adding complexity to business processes. This specialized expertise is important to decision making—it can assist in gaining consent and in understanding the final decision.

Many transportation management activities require multidisciplinary engagement across business units. Independent, networked practices have arisen over time to address specific business needs, but these often become silos of activity.

Understanding the interactions of the business process as a whole and the flow of knowledge and information within the multidisciplinary working environment helps identify and leverage points for improvement. The understanding also can serve as a blueprint for strategically targeting improvements and introducing initiatives for change.

**Knowledge Economy**

By understanding the interactions of the practical solutions business process and the knowledge and information flow within its multidisciplinary working environment, Washington State DOT is beginning to describe its own knowledge economy. This information will help in targeting improvements strategically and in navigating initiatives for change. By understanding its own social system, Washington State DOT can strengthen its capacity as a high-performing, responsive, and nimble organization.
Preserving Institutional Knowledge Through Knowledge Books

Models, Insights, and Impacts

NANAKO MURA

Every day for the next 13 years, an average of 10,000 baby boomers will retire from the workforce. As a result, organizations are experiencing losses of core technical knowledge, critical relationships, and valuable know-how that have helped to drive innovation, to achieve efficiencies, and to resolve issues.

Organizations often do not realize the extent of the loss of knowledge until after an expert leaves, and by then, the matter is too late to address. Reliance on documentation is often insufficient, because the most valuable knowledge is in a person’s head.

Data from the U.S. Bureau of Labor Statistics suggest that replacing these experts may be much more difficult because of the projected slowdown in workforce growth. To address the loss of institutional knowledge, organizations must proactively identify knowledge areas that are critical to business continuity and must employ effective ways to capture knowledge and to transfer methods before the experts leave.

Kraft Foods identified institutional knowledge at risk and used the Method for Analyzing and Structuring Knowledge (MASK) to capture critical tacit knowledge and to structure the knowledge into accessible knowledge books. Over a five-year period, Kraft underwent significant changes, including

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mergers, spin-offs, technical center relocations, restructuring, and retirements.

With these transitions, years of knowledge could be lost—in many cases within months. Between 2010 and 2016, with support at all levels, including the CEO, Kraft employed the MASK method to create more than 25 knowledge books across core technology areas.

**Critical Knowledge**

The first task was to identify key technical knowledge areas that are at risk, recognizing that not all knowledge is critical and needs to be captured. Capturing noncritical knowledge can be detrimental, diluting the value of critical knowledge and making critical knowledge more difficult to find.

The general principles were communicated to senior leaders. Knowledge at risk falls into one or more of the following categories:

- **Mission critical**—the knowledge is linked to the organization’s current and future strategy, goals, and plans;
- **Core competency**—the knowledge is highly developed within the organization and is a source of competitive advantage and significant benefits;
- **Tacit**—the knowledge is not readily available or easily expressed and understood in documentation; and
- **Rare**—only one or two experts have the knowledge, and few, if any, experts are available externally.

**Knowledge Mapping**

Before 2015, Kraft identified critical knowledge areas reactively—after a retirement or a reorganization—and often the time was insufficient for eliciting and modeling experts’ knowledge. Since then, the company has proactively identified knowledge areas at risk by charting a knowledge map of the research and development.

A knowledge map is a visual representation of knowledge and how it is structured within the organization. The map indicates the critical knowledge needed to support current and future business at a high level. Figure 1 (below) gives an illustrative example, a knowledge map for a dairy technology.

Brief interviews with experts defined the high-level, core knowledge areas a scientist or engineer must possess in a particular category or business to support existing and future strategies and goals effectively. At minimum, one expert or one manager rated

![Knowledge Map Example](Image)

**FIGURE 1** An illustrative knowledge map of dairy technology, reflecting the high-level knowledge areas that a scientist in an organization may need to know to support a cheese business. Each area is color coded later to indicate the criticality of the knowledge.
each knowledge area against the factors in Table 1 (below). Color codes were assigned to each knowledge area, based on the responses.

After the process of identifying and color coding all the knowledge areas, topics with “rarity” coded red or yellow were prioritized for the creation of knowledge books, following the MASK model. Topics rated difficult to learn and difficult to apply and coded yellow or red were assessed in terms of the risk of losing the experts in the next three to five years. If the risk was high, those areas were next in priority for knowledge books.

**TABLE 1 Criticality Rating Areas and Rating Factors in Selecting a Knowledge Area for Capture**

<table>
<thead>
<tr>
<th>Criticality Area</th>
<th>Rating Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rarity</td>
<td>Number of experts</td>
</tr>
<tr>
<td></td>
<td>Availability and quality of documentation</td>
</tr>
<tr>
<td></td>
<td>External expertise</td>
</tr>
<tr>
<td></td>
<td>Availability of training</td>
</tr>
<tr>
<td>Usefulness</td>
<td>Alignment with business and technical strategy</td>
</tr>
<tr>
<td></td>
<td>Application to other categories and technology platforms</td>
</tr>
<tr>
<td></td>
<td>Maturity of the knowledge area and availability of alternative approaches</td>
</tr>
<tr>
<td>Difficulty to learn</td>
<td>Availability of networks</td>
</tr>
<tr>
<td></td>
<td>Level of tacit knowledge</td>
</tr>
<tr>
<td></td>
<td>Level of experiential learning required</td>
</tr>
<tr>
<td></td>
<td>Level of change in the knowledge area</td>
</tr>
<tr>
<td>Difficulty to apply</td>
<td>Depth and complexity of knowledge required in application</td>
</tr>
<tr>
<td></td>
<td>Level of external influences (e.g., regulatory, environmental)</td>
</tr>
<tr>
<td></td>
<td>Potential negative effects from lack of mastery</td>
</tr>
</tbody>
</table>

**MASK Models**

Jean-Louis Ermine developed the MASK process for knowledge engineering at the Commissariat à l’Énergie Atomique (CEA), the French atomic energy commission, in 1993. Since then, the method has evolved through practical application by other organizations, such as Kraft.

The MASK process maintains that a corpus of knowledge—or knowledge system—can be reflected through six fundamental points of view. These points of view, displayed in models, provide the basic structure for building out the knowledge books.

- **Concept model.** The concept model classifies key topics or concepts known by the expert; examples from the Kraft context include types of defects, cheese types, or types of measurement. The model for each concept incorporates unique insights and learning acquired through years of experience in that area.

- **Activity model.** The activity model reflects the processes used within the organization—for example, business, formulation, or manufacturing. The model is a cognitive reflection of how the experts apply knowledge at each step as they work through the process.

- **Task model.** The task model outlines the expert’s reasoning in formulating a conclusion, a recommendation, or information—for example, in data analysis, data generation, risk assessment, or troubleshooting. The model reflects steps that are iterative, sequential, parallel, or conditional in reaching
the desired output.

- **Phenomena model.** Kraft used this model most often to describe scientific events—such as fat crystallization, foam generation, or taste perception—that an expert may want to manipulate. The model reflects the impacts of internal and external triggers on the events and shows how these impacts can be promoted or inhibited.

- **History model.** A description of the history or timeline of the knowledge can explain changes and developments—for example, understanding the history of cream cheese formulations for food service applications can be useful in developing formulations for current and future customers.

- **Evolution model.** Used in combination with the history model, the evolution model explains the choices made by the experts to adapt their knowledge as the context has evolved over time.

**MASK Process**

The MASK process was implemented in four sequential steps. Except for the final step of sharing, the process was carried out one-on-one with each expert; this kept the focus on the expert's knowledge and facilitated the elicitation by limiting the influence of fellow experts. The process works best when the interviewer does not take notes but audiotapes the discussion to keep the conversation moving quickly and to ensure that all details are captured.

1. **Scoping.** In the scoping step, the expert identifies the topics and concepts to be covered. Topics typically include outputs or products, processes, and activity areas within the experts’ job responsibilities. Knowledge recipients review the scoping document and often add topics of interest. The scoping exercise typically requires no more than two hours.

2. **Elicitation and modeling.** All elicitation interviews are audiotaped, to ensure the accurate capture and modeling of the knowledge and information. MASK modeling experts recommend that the interviewer should be a generalist, not a specialist in the area of knowledge under study. An expert within the domain may make assumptions and introduce bias about what is already known and what does not need to be known; this bias could lead to critical omissions of content.

   The focus of the elicitation is less on the what, which is often contained in the specifications, but more on the why and the context. As interviews progress, experts are able to view their knowledge structured within the models. This allows them to elicit additional content as they see gaps in the models or opportunities to expand the models.

   Elicitation and modeling typically requires three to four months but depends on experts’ availability for interviews and on the breadth and depth of the knowledge area.

3. **Validation.** Validation is a critical step—experts must carefully review and confirm the content. This step often takes the most time, because the expert needs uninterrupted time—usually one to two days—to review detailed technical content.

4. **Sharing.** The finished product should be shared with and used by knowledge recipients. Each knowledge book should have an identified champion responsible for socializing the knowledge book, building awareness of its contents, and integrating its

**FIGURE 2** The finished knowledge book is delivered as a PowerPoint document. The user navigates to desired content through the embedded links from the table of contents.

(Source: N. Mura)
use within the workflow of business. The champion also is responsible for identifying opportunities to build on the knowledge book as new learning is gained.

Impact
The completed knowledge book is delivered as a PowerPoint document (Figure 2, page 25), with a table of contents and embedded links that help the user navigate to desired information quickly. The links, which require viewing in presentation mode to be active, have made the books extremely user friendly, facilitating rapid adoption.

The knowledge books have been a valuable resource for employees new to the knowledge area—the books have accelerated the time to come on board and have reduced the time spent searching for information. Employees have used the knowledge books to train, troubleshoot, understand concepts, and gain access to technical information.

These books have had positive effects for the experts also. The experts see the models as a mirror of their knowledge, and this instills a deep sense of pride, as well as recognition from senior leaders. The experts recognize that they generate a wealth of knowledge, often in seemingly random efforts, and the knowledge book helps to structure and to visualize that knowledge in ways that make it more useful to the organization.

Success Factors
The quality of a knowledge book largely depends on the willingness and ability of the expert to share deep technical knowledge, as well as on the skills of the knowledge engineer in applying the MASK method in modeling the knowledge. The experts chosen for the knowledge books should be recognized in their field, internally and externally; this ensures a content that is rich, as well as authoritative.

Even when complete, a knowledge book does not guarantee success in the transfer of knowledge. In the words of Kahlil Gibran, “A little knowledge that acts is worth infinitely more than much knowledge that is idle.”

The knowledge book has no value unless it is used by recipients. The book should have an identified champion responsible for socializing the book, raising awareness, and identifying opportunities to integrate the book into the work processes of the organization. Workers should develop the habit of researching the available knowledge.

Senior leaders should proactively create and support an environment for sharing and reusing knowledge. They must acknowledge and advocate the books and recognize those who have shared their expertise. Senior leaders also must provide the right information technology infrastructure, with security measures, to make the knowledge books accessible to the entire organization.

Finally, any knowledge capture and transfer initiative should be part of an overarching knowledge management strategy and should be aligned closely with an organization’s master strategy. Without a strategy, knowledge programs become one-off activities that fail to maintain or elevate an organization’s capabilities.

Acknowledgment
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Resources
Leading In, Leading Out, and Leading from Behind
Knowledge Management at Alberta Public Service

COLLEEN DELANY

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A massive wildfire near Fort McMurray, Alberta, Canada, in the early summer of 2016. Emergencies call for leadership and a willingness to take on new roles.

From May to July 2016, the province of Alberta, Canada, experienced one of the worst natural disasters in its history. A massive wildfire consumed hundreds of thousands of hectares, forcing approximately 80,000 people to evacuate from Fort McMurray and surrounding areas.

Responses to emergencies often reveal leaders throughout an organization. Staff from across the Alberta Public Service (APS) stepped up to take on new roles and volunteered to support evacuees and the wildfire recovery efforts. In addition, Albertans opened their homes and donated their time, and the Red Cross collected a record level of donations to support relief and recovery.

Why does an emergency push people to take on leadership roles they may not usually assume? People see an immediate need and perceive the risks in a different way—the immediate need for help outweighs the risk of trying something new and possibly failing.

What is known or thought about an immediate problem and about the situation, the context, and the capabilities for response influences judgment about the risks. Even if knowledge management is not a stated goal, individual and organizational knowledge are brought to bear on the task.

The response to the Fort McMurray fire suggests answers to several questions related to traffic safety.
How can an agency elevate the issue of collision-related injury and death so that people perceive an immediate need to act? How can a transportation agency ensure that traffic safety leaders, internal and external, have the skills and capacity to act? How can an agency accomplish these goals in an environment with frequently uncertain, or even diminishing, financial and human resources?

Leading In
Values and Competencies
Looking inward to the organization is a good start. APS has invested thought and effort into building a leadership and competency model with shared values and with elements that align with each other (see Figure 1, left). At the center are the APS values:

- Respect—APS fosters an environment in which each individual is valued and heard.
- Accountability—Employees are responsible for their actions and for contributing to the effectiveness of the public service.
- Integrity—APS employees behave ethically and are open, honest, and fair.
- Excellence—APS uses innovation and continuous improvement to achieve excellence.

The APS competencies build on these shared values. The focus is on behavioral competencies related to how the work is done, as distinct from technical competencies, such as specialized knowledge. The seven competencies are grouped into three types:

- Thinking competencies—systems thinking and creative problem solving;
- Achievement competencies—agility and the drive for results; and
- Relationship competencies—developing networks, bringing people together, and developing individually and as a group or team.

A transportation agency may easily focus on technical skills and knowledge and may become overwhelmed in details and processes. Shifting the focus and working to become more agile, to perceive the larger system, and to build collaborative environments is a powerful way to deal with the uncertainties that are part of working for government.
Leadership

APS does not identify leadership as a competency but considers leadership a combination of knowledge, skills, abilities, and behaviors. In their book, The Leadership Challenge, James Kouzes and Barry Posner noted five practices of exemplary leadership:

- Modeling the way,
- Inspiring a shared vision,
- Challenging the process,
- Enabling others to act, and
- Encouraging the heart.

APS seeks to apply these practices in building each of the competencies.

APS approaches leadership as a set of skills and behaviors that anyone can learn, practice, and improve. Taking on a leadership role does not require a person to be a “born leader” or to be someone who is strong in all the leadership practices or who holds positional or hierarchical power. The goal is to build a culture that develops a leader in every chair—so that staff at all levels feel empowered to step into leadership roles within their working units, on project teams, or on committees.

Aligning Elements

The alignment of the model’s elements can be powerful. For example, a manager may decide to focus on improving in the relationship competency of developing his or her own skills and those of others. Talking with staff to find out what they want to learn and improve draws on the core value of respect, because of differences in skills and interests. Further, supporting staff in developing skills requires the leadership practice of enabling others to act.

APS has incorporated the elements of the model in the performance management system, in recruitment advertisements, and in job descriptions. The model is not just a nifty infographic but part of how APS works.

Leading Out

With a strong model in place, internal APS traffic safety leaders are building skills and capacity and can look outward to partners and stakeholders. The Office of Traffic Safety in Alberta Transportation is responsible for implementing the province’s Transportation Safety Plan (TSP). The next iteration of the TSP will adopt Vision Zero—the goal of zero fatalities and serious injuries on Alberta’s roads.

Working toward Vision Zero requires all road users to share responsibility for road safety. In terms of the APS model, everyone will need to develop competency in systems thinking. The challenge is great, because many view collisions as an accompanying cost of the transportation system. How can the Office of Traffic Safety help people realize that fatalities and serious injuries on Alberta’s roads are not inevitable and not acceptable and that traffic safety requires their immediate action?

Education and Awareness Campaigns

APS tries to increase public awareness of traffic safety through education and awareness campaigns. When the first TSP was introduced, the Office of Traffic Safety created a TSP Calendar that focuses on a different priority safety topic each month, to coordinate education and enforcement activities across the province.

For example, the priority topic for November is pedestrian safety—with the change to daylight savings time, pedestrian commuters are more likely to


Pedestrian safety is the subject of public safety messages from the Alberta Office of Traffic Safety in November, when statistics show more pedestrian collisions because of shorter days and adverse weather.

Alberta’s Transportation Safety Plan promotes driver awareness of animal crossings.
A Canadian National Police Service officer—in his role as a regional traffic safety consultant—conducts an Operation Lifesaver session on rail safety for students.

walk in the dark; adverse weather can make them less visible, and drivers may be less able to stop quickly in icy conditions. Collision statistics for the province show a high number of pedestrian collisions in November. Although pedestrian safety is not the only topic for focus in November, it provides a common theme for safety messages, enforcement blitzes, and other events. This greatly increases the exposure of Albertans to the message.

Community Partners
The Community Mobilization Strategy, another key in implementing the TSP, supports community partners in taking on leadership roles to identify local traffic safety priorities and to develop solutions appropriate to their communities. APS provides support through regional traffic safety consultants (RTSCs), who work in and with communities to build their capacity to address traffic safety.

For example, an RTSC can work with a community to identify people for training in the proper installation of child seat restraints. After the training, community members can run workshops or perform child seat safety checks. In this way, the community increases its capacity to address child seat safety. The community mobilization program speaks directly to the shared responsibility and collective action required for Vision Zero.

In addition, grants through the Alberta Traffic Safety Fund support community-based traffic safety initiatives consistent with TSP priorities. Projects have brought together the various elements of the community mobilization program. For example, a recent grant project involved four communities that planned community art contests on alcohol-impaired driving. Enforcement stakeholders in each community judged the entries, and the winning pieces were developed into billboards erected in the communities during the TSP Calendar's impaired driving month (Figure 2, above, left).

Leading from Behind
With models and tools to support internal and external traffic safety leaders, APS can consider a shift from leading the traffic safety charge to supporting community action on traffic safety. The shift is in line with the internal model, which emphasizes the leadership practice of enabling others to act, and is appropriate in an environment of uncertain resources.

Fostering Networks
Successful community mobilization depends on developing and fostering networks. APS is investigating the concept of partnership brokering, helping communities and stakeholders form partnerships with each other. Recently, for example, a multicultural organization applied for a grant to develop a traffic safety information session for new Canadians. An RTSC connected the organization with another multicultural organization that already had developed a similar program for new Canadians within its community.

Although working with different ethnic communities, both organizations were dealing with similar challenges and receiving similar questions about learning to drive in a new country with different rules in a different language. The experienced organization was both willing and able to mentor the new grant ap-

FIGURE 2 Commemorative poster given to an art contest winner, showing the original artwork submitted in the small box and the final billboard art above.

A Canadian National Police Service officer—in his role as a regional traffic safety consultant—conducts an Operation Lifesaver session on rail safety for students.
plicant, share lessons learned, and form a new connection with another stakeholder. This offers a new model for organizations that need to act on traffic safety—building the skills successfully through interorganizational partnerships.

**Adapting Messages**

Other lessons learned are helping APS to frame traffic safety in a way that helps people perceive that traffic safety requires personal responsibility. For example, the well-known message “Speed kills” recently changed to “Speed doesn’t always kill.” At first, this seemed to imply that speeding was an acceptable behavior—but the new message speaks instead to the lifelong implications of an injury in a collision.

This messaging aligns with the work of health and injury prevention stakeholders in the province, who have identified collision reduction as a health and wellness priority. By letting go of some assumptions about safety messaging and taking the lead from health partners, the new message has increased the buy-in from stakeholders who are more interested in health and wellness than in the rules of the road.

**Intragovernmental Partnerships**

Another example of a shift in perspective occurred as a result of increased requests from remote communities for helping new drivers pass the knowledge test required for a learner’s license. Many need a driver’s license for employment, and the issue at first appeared to fall under the purview of the Alberta Ministry of Labour. But stakeholders pointed out the safety concern—community members who are unable to obtain a license often continue to drive, jeopardizing safety.

With an organizational model that embraces agility, creative problem solving, and challenging the process, and with a precedent for asking stakeholders to partner with and learn from each other, the APS Office of Traffic Safety needed to forge new partnerships with other departments in government. Why hesitate to partner with Labour—or with other government departments—to address a challenge?

Stepping back and taking the lead from stakeholders can increase the department’s success.

**Looking Ahead**

Specialized training and experience prepare APS employees to do their specific jobs, but all may be called on to work outside of the comfort zone of day-to-day assignments—for example, in the extraordinary emergencies of the Fort McMurray wildfire. All employees need to look for ways to lead in, lead out, and lead from behind.

If all employees take on all the leadership roles they can—and encourage stakeholders to do the same—the effect on reducing collision fatalities and serious injuries could be amazing. This can involve something as complex as organizations mentoring each other to address local community challenges or something as simple as each person making a commitment to refrain from one unsafe driving behavior each day.

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A billboard changing the familiar message of “speed kills” to emphasize health and wellness.

Alberta Animal Rescue Crew Society officers retrieve a cat from a home in Fort McMurray after the mandatory evacuation from the 2016 wildfire.
The authors are with the Michigan Department of Transportation. Kent is Administrator, Intermodal Policy Division; Mester is Chief Administrative Officer; Steudle is Director; Thayer is North Region Engineer; Van Port Fleet is Chief Operations Officer—Chief Engineer; and Van Portfliet is Director, Bureau of Field Services, and Superior Region Engineer. Steudle is immediate past Chair of the TRB Executive Committee.

One of the commercials in the “Pure Michigan” series begins with the words “handed down.” Soothing music and enticing images accompany those words, and the ensemble brings to mind a time when life was simpler, maybe sweeter, and certainly slower paced.

But that is not the world on most days. The majority of transportation professionals today are working to address stagnant or falling revenues, aging infrastructure, increased transportation demand, workforce turnover, and technological change. These efforts cannot proceed at a slow pace.

Running Leaner

Stagnant or falling revenues, in particular, have prompted transportation officials to seek more economical solutions by partnering with the private sector or by reducing the size of the agency’s workforce. Some state departments of transportation (DOTs) have been trimming their budgets for many years; others have only felt the pinch lately. But today most are running much leaner than before.

Michigan DOT has been running leaner for nearly two decades. The agency’s workforce is half the size it was when highway construction was at its peak in the 1970s. Michigan DOT has weathered at least three waves of early retirements in the past two decades—in 1997, 2001, and most recently 2011—as well as three reorganizations. Michigan DOT has not hired a new employee under the old-style pension system since the spring of 1997. The workforce today is smaller and more “portable” than in the past.
Michigan DOT began outsourcing approximately half of its project design in the 1990s. Coupled with computer technology, outsourcing has allowed the agency to sustain a smaller workforce while still keeping up with a larger annual program. As a result of conscious efforts to encourage innovation and to communicate best practices across the department, staff continue to find ways to operate more efficiently and cost-effectively every day.

Although these cost-cutting measures clearly have contributed to efficiency, knowledge can be lost. To prevent losing the knowledge once handed down by longtime employees, Michigan DOT undertook an effort to capture that knowledge as an integral part of the programming and project development processes. Although the agency at the time did not call this knowledge management, it was—the steps taken align closely with the knowledge management practices applied today.

Data Management
The start of Michigan DOT’s knowledge management efforts accompanied a new approach to data, relying on the management systems first required by the Intermodal Surface Transportation Efficiency Act of 1991. When the federal requirement expired, Michigan DOT chose to complete its data management systems, intending to collect one set of data, stored centrally, and to encourage staff throughout the department to use the single database.

This ended the development of silos of data controlled by an individual and shared only on a need-to-know basis. The departmentwide approach to data management has informed later decisions that have advanced the agency’s knowledge management efforts.

Decentralized Expertise
The department reorganized in 1997, decentralizing to bring transportation expertise closer to all customers. The effort was not without challenges—the relocation of staff placed their experience and expertise at a remove from central management, raising concerns about consistency and alignment.

Effective decentralization clearly required improvements in communication and a conscious effort to manage knowledge. The department therefore established several teams to ensure alignment across the organization. At first, the teams met often and for long periods, establishing and incorporating good habits of communication, but as cross-region communication became ingrained, the teams found a rhythm.

The department’s quarterly and somewhat unwieldy Management Team meetings gradually evolved into shorter monthly meetings of a smaller subset, called the Leadership Team. Monthly Operations Executive Staff meetings—involving a cross-section of region and central office engineering and planning managers—gradually became bimonthly meetings. The Region and Bureau Management Team—involving a broad set of engineering managers—continues to meet monthly. All the meetings follow a regular agenda, and the minutes are circulated widely throughout the department and are available on the intranet to keep interested staff informed.

A one-day annual Highway Operations Alignment Conference expanded in scope to include managers and staff-level “rising stars” from all parts of the department to share big-picture information on Michigan DOT’s—and the state’s—progress and direction and to showcase best practices and innovations. The updated version of the conference replaced a more costly, multiday leadership conference, which had provided many of the same knowledge management and leadership opportunities across the organization.

Performance Management
Employee performance management plans are becoming a more integral part of the agency’s knowledge management efforts. With these plans, every full-time employee has a set of specific performance factors and receives an annual assessment of performance with regard to those factors; afterwards, a new plan is developed for the following year.

The assessment replaces a cumbersome paperwork exercise that was hard to track and therefore easily avoided or overlooked. The performance plans are part of a computerized template that is readily com-
The course’s content ranges from the basic—for example, Michigan DOT culture, file management, and time sheet completion—to legally required training, such as preventing discriminatory harassment or wearing personal protection equipment. Also included is qualitative instruction in ethics, integrity, conflict resolution, and team building.

The program addresses 14 categories of knowledge, most of which are presented in a variety of course options and in a variety of formats, from classroom-style to videos or interactive electronic instructional accessible from an employee’s desk. Veteran employees were able to review their course histories and to claim credit for similar courses completed in many of the more basic categories. All employees, however, had to complete the legally required courses.

A shorter, follow-up curriculum was developed for supervisors and managers, to cultivate understanding and consistency in labor relations and supervisory responsibilities. In all, the Michigan DOT curriculum provides a variety of ways for all employees to gain the information they need to be effective in a new job or a new location.

E-Construction

Much of the knowledge once captured in paper documents and archived and accessed in libraries and file rooms is now generated, stored, and accessed digitally. Michigan DOT therefore initiated the e-construction process, a paperless approach to the administration of design and construction.2

After the success of four pilot projects in 2013, the department quickly mandated the procedure for all construction projects. Many hurdles arose in digitizing the process and in sharing document management software with private-sector partners at no cost—such as legal concerns, technology upgrades, and


2. [https://www.youtube.com/watch?v=HAbYggnyB8](https://www.youtube.com/watch?v=HAbYggnyB8).
and Federal Highway Administration approval—but all were resolved.

E-construction relies on mobile devices in the field to access electronic construction plans and proposals, manuals and guides, filing systems, document submittals, fillable forms, and automated document workflows. The process enables digital payroll transmittals, relies on digital design plans, and requires digital signatures. New users receive training online via a Wiki site, and construction manuals have been converted to e-books to be more accessible for all employees; in addition, updates to the manuals are more timely and cost-effective.

The e-construction process saves money for Michigan DOT and for its contractors but also offers benefits from a knowledge management perspective. The open and transparent document management system allows users to access project documentation on a desktop, laptop, or mobile device. Michigan DOT is able to capture and retain information from all parties involved in a project, from design through construction, in the field or in the central office, in a single data repository that everyone can access from any location.

Process Documentation
Michigan DOT applies knowledge management to more than construction. The Bureau of Transportation Planning has undertaken a thorough effort to encourage staff to document their processes. Large-scale efforts, such as the development of the State Long-Range Plan or Michigan DOT’s Five-Year Program, require lengthy step-by-step documentation, but even smaller efforts—such as planning for carpool parking lot improvements—are documented in some way.

Having a documented set of processes is now a requirement for the processing of any staff reallocation or promotion. The bureau stores the documented processes digitally on a network drive available to any planning staffer who needs to understand the steps in a given planning process. The step-by-step information about current processes can aid in developing new processes as the need arises.

New Efforts
Most recently, Michigan DOT has begun to develop and share knowledge related to real estate acquisition. For transportation agencies, real estate acquisition requires a specialized body of knowledge—expertise not easily found at a career fair, but cultivated within the organization.

A departmental reorganization in 2011 reassigned and relocated some real estate professionals among the central office and the seven region offices. The changes also shifted or privatized important process responsibilities to mitigate the effects of the workforce reductions. In the years following, inconsistencies surfaced from region to region; improvements were needed in documentation and communication.

A presentation on knowledge management at a Transportation Research Board Annual Meeting inspired an experiment in the agency’s real estate business area. Guided by the information in National Cooperative Highway Research Program Report 813, A Guide to Agency-Wide Knowledge Management for State Departments of Transportation, the initiative seeks to develop a knowledge management strategy and implementation plan. The step-by-step approach involves working directly with the department’s real estate professionals and has included an employee survey. The goal is to reinforce knowledge management principles to create a sustainable organizational culture.

Conscious Steps
Handed down—in the past, knowledge that was handed down, or across, relied on time, tradition, and a paper trail to build a gradual understanding over years of experience and activity. The rapid pace of modern life undercuts that tradition in ways that can be devastating without planning and preparation.

The technological tools to ease that transition are available, but technology alone will not suffice. Taking conscious steps to capture and manage knowledge and to share it widely has helped Michigan DOT survive and thrive despite budget cuts, downsizing, and rapid employee turnover. In Michigan, ever since Henry Ford’s moving assembly line, adoption of the latest technology to expand the ability to move the world is a long-standing tradition, handed down for generations. That is pure Michigan.

https://www.youtube.com/watch?v=y_9XCy2IQ2w


Advancing Transportation Knowledge Management Through Research

Projects Develop Guidance and Tools

ANDREW LEMER AND FRANCES HARRISON

Transportation agencies, like all large organizations, operate within a continually evolving business environment. Agency personnel at all levels are challenged to respond to change in their missions, in the work needed to fulfill their missions, and in the expectations of their many stakeholders. Knowledge—its acquisition, creation, retention, and use by individuals, groups, and the organization as a whole—is fundamental to success.

Since ancient times, philosophers have pondered the nature of knowledge—what we know and how we know it. As business and trade have become global in scale and our capabilities for information storage, processing, retrieval, and communication have expanded immensely, knowledge increasingly is recognized as a tangible asset—a resource to be used like other tools and materials in producing goods and services, improving lives, and contributing to future well-being.

A Distinct Discipline

That recognition has given rise to knowledge management as a distinct discipline that draws on information science, human resources, and a range of other domains. Such luminaries as Nobel Prize–winning economists Friedrich Hayek and Herbert Simon and management gurus W. Edwards Deming, Peter Drucker, and Peter Senge have made seminal contributions to the field.

Adapting and extending the work of these and other leaders in the field of knowledge management to the specific problems of transportation agencies present multidisciplinary research challenges. Although any organization may apply knowledge management, transportation agencies are in a subset of organizations responsible for the stewardship of large systems of physical facilities. These responsibilities engage extensive groups of stakeholders who are not part of the organization but have an interest in the organization’s and the system’s performance.

Effective knowledge management helps ensure that people have the knowledge they need—when they need it—to make good decisions and to accomplish their tasks. Knowledge management practices and tools promote the capture, preservation, and sharing of knowledge in the face of such challenges as staffing, technology evolution, disaster recovery, and more.
Advancing Practices and Tools
The Transportation Research Board (TRB) and its Cooperative Research Programs (CRP) have worked for more than a decade to advance knowledge management practices and tools that transportation agencies can use (see box, page 38). Individual research projects target particular areas of application but are tied together within a broad strategic context (Figure 1, right).

Knowledge management embraces a range of disciplinary areas of research and practice, including information management, document management, employee learning and development, human resource management, and organizational development. These distinct specialties inform and provide practical tools for understanding and utilizing knowledge management in pursuit of an organization’s mission.

Much of TRB’s work has aimed at producing guidance for transportation agency leaders on assessing their organizations’ capabilities, solving specific types of problems, and setting up and managing mission-directed programs. Some of the research has been exploratory, designed to enhance understanding of the character and value of an agency’s knowledge assets and to optimize the use of those assets to improve the agency’s performance and that of the transportation system.

Establishing Terminology
A fundamental principle learned from multidisciplinary research and practice is that knowledge is tacit; it resides ultimately in the minds of individuals who act alone and in groups to use their knowledge in decision making and action. This knowledge can be transferred to others through teaching, mentoring, the written word, pictures, and the like, but only to a limited extent and always imperfectly.

The artifacts of efforts to capture and record knowledge—for example, books, articles, maps, plans, films, and recorded narratives—are information that may be stored and organized, and perhaps used by others to learn and apply the knowledge.

Establishing clear and consistent terminology is an important research objective. For example, each person has an understanding of “knowledge,” “information,” and other terms frequently used in the practice of knowledge management, but the understanding of these terms may vary from that of others because each person brings a unique mix of background, training, and experience. In addition, a word’s meaning often depends on the context—for example, the meaning of the word “crane” changes when spoken by a bridge engineer or a bird watcher.

Participants in TRB knowledge management research projects have recognized the need to adopt clearly stated definitions to support effective communication. Staff and contractors of the National Cooperative Highway Research Program (NCHRP), for example, have begun informally to assemble a common glossary of knowledge management–related terms from projects, to ensure that the terms are used in the same way in all reports and to encourage consistent usage among transportation professionals (see box, page 39).

The online Transportation Research Thesaurus (TRT) is a more formal tool, used by TRB staff and consultants to support the indexing and retrieval of content for transportation practitioners.¹ The TRT presents a controlled vocabulary that lends structure

¹ http://trt.trb.org/trt.asp?
Selected TRB Resources on Knowledge Management

Publications
National Cooperative Highway Research Program (NCHRP)
Report 636, Tools to Aid State DOTs in Responding to Workforce Challenges. www.trb.org/Main/Blurbs/161795.aspx.

Projects in Progress
NCHRP Project 17-75, Leveraging Big Data to Improve Traffic Incident Management
NCHRP Project 20-24(95), Ensuring Essential Capability for the Future Transportation Agency
NCHRP Project 20-97, Improving Findability and Relevance of Transportation Information
NCHRP Project 20-103, Guidance for Development and Management of Sustainable Information Portals
NCHRP Project 20-104, Capturing and Learning Essential Consultant-Developed Knowledge Within Departments of Transportation
NCHRP Project 20-107, Construction Project Staffing Strategies for Effective Program Oversight
NCHRP Project 20-108, Guide to Sustaining a Culture of Innovation Within Departments of Transportation
TCRP Project F-23, Projecting Workforce Replacement Needs for Benchmark Transit Occupations—Knowledge Management as Part of Transit Agency Strategic Workforce Development
Leading the Way
Transportation agency leaders have recognized the importance of knowledge and information management in their agencies’ mission. State agencies in California, Virginia, and elsewhere have established knowledge management programs and have appointed staff to such positions as knowledge resources director and knowledge management officer. More agencies are following these early adopters and are applying CRP products in their activities.

The NCHRP Project 20-24 panel—consisting of chief executives of state agencies—is sponsoring research to provide strategic guidance on enhancing the aggregate value of an agency’s knowledge assets and the return on investment in information and human resources systems. Panel member John Halikowski, Director of the Arizona Department of Transportation, judged the topic sufficiently important that he volunteered to lead the reconnaissance team seeking out leading-edge knowledge management practices under NCHRP Project 20-68A, U.S. Domestic Scan Program (see article, page 4).

Project Categories
The products of completed and ongoing CRP knowledge management research projects generally fall into six main categories:

- Guidance on knowledge management processes and practices, tools, and expertise needed to derive the greatest benefit from application in an agency;
- Guidance on content management functions, policies, tools, and processes such as records retention, storage, and retrieval, and improving findability;
- Documentation and presentation of lessons learned and case studies from agencies’ experience to support learning, mentoring, and teaching;
- Guidance and tools for maintaining institutional memory and retaining critical knowledge;
- Guidance and tools for improving, documenting, and assessing the performance of business processes, such as project delivery, resource allocation, and system performance management; and
- Guidance and tools for characterizing personnel expertise and matching that expertise to application requirements.

Valuable Assets
Along with roads, bridges, transit lines, and other physical assets, a transportation agency’s knowledge and use of that knowledge have an effect on economic and social well-being. As agency leaders increasingly understand the role and the importance of knowledge as one of the essential assets their agencies must manage, these research products provide help and support. The payoffs of TRB’s knowledge management research will continue to accrue through the application of the research results and improved management of these valuable assets.

Some Key Terms in Knowledge Management

**Content.** Information objects stored in a variety of formats and available for retrieval, reuse, and publication. Content includes text, images, office documents, graphics, drawings, web pages, e-mail, video, audio, and other rich media assets. (Source: Adapted from Association for Information and Image Management [AIIM].)

**Data.** Representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or computers. (Source: AIIM.) Example: a crash record.

**Findability.** The art and science of making useful content easy to find—for example, applying metadata, taxonomies and other organizing tools, and search technologies. (Source: AIIM.)

**Information.** Data and documents that have been given value through analysis, interpretation, or compilation in a meaningful form. (Source: AIIM.) Example: A map showing high crash locations.

**Information governance.** The accountability for the management of an organization’s information assets to achieve its business purposes and to comply with relevant legislation or regulations. (Source: adapted from AIIM.)

**Knowledge.** The basis for a person’s ability to take effective action or make an effective decision. Example: a safety professional’s understanding of what countermeasures would be appropriate in different situations.

**Transportation information management.** The means by which an agency efficiently plans, collects, creates, organizes, uses, controls, stores, disseminates, and disposes of transportation information and ensures that the value of that information is understood and fully exploited.

**Transportation knowledge management.** The means by which an agency builds, sustains, and leverages the know-how and experience of its employees and partners to deliver transportation projects and services and to manage the systems for which the agency is responsible.
Gregory T. Giaimo
Ohio Department of Transportation

Gregory Giaimo manages the Travel Demand Modeling program at the Ohio Department of Transportation (DOT). A registered professional engineer, Giaimo has worked at Ohio DOT for 25 years on assignments such as travel demand forecasting models, origin–destination (O-D) surveys and transportation planning analysis.

Giaimo did not start out in travel demand modeling, however. He studied aircraft structure vibrational analysis and received a master’s degree in civil engineering from Ohio State University but was put off by “nightmares of differential equations” and left the field, he recalls. “One day while being berated on my poor broom-handling technique in a New Jersey warehouse, I decided I had better get back into engineering—fast.” He started at Ohio DOT as a travel demand forecasting modeler, and became fascinated by the field of study.

“Travel demand modeling appealed to me because it used both the engineering and computational skills I developed in school, with a large dose of geography and psychology—two of my favorite subjects,” Giaimo notes.

In 1994, he took the helm of the Ohio Roadside Origin–Destination (O-D) Survey Program. Because the program had lapsed for 20 years, Giaimo came up with new methods, hired and managed data collection consultants, and managed data processing staff. Since then, the O-D survey program has incorporated more than 700 one-day survey locations and is researching an upgrade to archived GPS and cell phone data.

Since 1998, Giaimo has served as contract manager and project manager for the development of the Ohio Statewide Travel Demand Forecasting Model. The model is the most advanced of its kind, incorporates econometric, land use, activity allocation, short- and long-distance personal transportation, and visitor, freight, and nonfreight commercial vehicle movement models. Giaimo developed the models scope of services and brought on a consultant team; he now oversees the application in a variety of purposes, such as in the statewide freight plan, the Access Ohio Statewide Long-Range Plan, and an investigation of the traffic impacts of shale gas industry expansion.

“I’m a middleman—I have to move between very mundane, specific practical applications and very abstract philosophical considerations,” Giaimo comments. “I get to interact with a lot of bright researchers and consultants who know everything about some things, which frees me to know something about everything.”

Giaimo also has served as staff specialist in economic impact modeling, researching and implementing methods to conduct economic impact analyses with results from an integrated statewide land use and transportation model. He served as an adviser for all household survey and model development efforts in Ohio, including the first statewide, smartphone-based household survey and the first-ever GPS-only household surveys in Cincinnati and Cleveland. He developed the computational processes in the state’s simplified highway forecasting tool, as well as automatic procedures to integrate travel model results with the Motor Vehicle Emissions Simulator, new ways to implement model volumes adjustments in project design, methods to estimate volumes on low-volume local roadways, and other statewide analysis tools, such as the Congestion Management System and Highway Performance Monitoring System forecasting process.

“When I first started in travel demand modeling research 25 years ago, the field seemed somewhat stale, likely because of a ‘finish the Interstate’ mentality; that is, new and better forecasting tools weren’t really necessary, since a plan was already in place,” Giaimo observes. “Since then, the need to manage our transportation system at an ever-finer level—and the new technologies to do so—has driven the need to innovate.”

Giaimo currently is technical adviser on Ohio DOT’s overhaul of how traffic forecasts are generated and used in highway design, along with ongoing duties managing travel demand models and travel surveys.

“For much of our business, traditional forecasting approaches work just fine. It’s when you attempt to manage the system in new ways—particularly those that affect different users in different ways—that newer methods come into their own,” he notes.

Giaimo joined the Transportation Research Board Standing Committee on Statewide Multimodal Transportation Planning in 2004 and the Standing Committee on Transportation Demand Forecasting in 2005. He chaired the two groups’ Joint Subcommittee on Statewide Travel Demand Forecasting for nearly a decade. Giaimo also is a member of the Standing Committee on Transportation Planning Applications.

“I think the challenge will be learning to make travel behavior models live within a world of copious amounts of real-time travel data that inform initial conditions,” Giaimo observes.
Catherine T. Lawson
State University of New York at Albany

Director of the Albany Visualization and Informatics Lab (AVAIL) at the State University of New York at Albany (Albany), Catherine T. Lawson builds web-based, open platform tool suites for multimodal analysis. The applied data science environment at AVAIL combines data stewardship, rigorous data analytics, and the ability to generate, harvest, and display machine-readable data with a spatiotemporal perspective.

“More and more, today’s transportation systems run on data,” Lawson observes. “It’s time to use these data to analyze, monitor, and plan for our transportation needs of the future.”

Lawson also serves as Director of the master’s program in regional planning and as Chair and Associate Professor in the Department of Geography and Planning at Albany. She also is an affiliated faculty member of the Department of Informatics, the College of Engineering and Applied Sciences, and the College of Emergency Preparedness, Homeland Security, and Cybersecurity. She received a bachelor’s degree in accounting and economics from Western Washington University in Bellingham and two master’s degrees, in economics and urban planning, as well as a PhD in urban studies and regional science from Portland State University in Oregon.

After working as a professional planner with the Bureau of Planning for the City of Portland, Lawson joined the staff at Albany, first as assistant professor of geography and planning, then as associate professor and interim chair of the department, which she still leads.

“I always enjoy giving a lecture on Thomas Harris MacDonald, one of the first transportation professionals to focus on the role of research,” Lawson observes. “He began his journey while still a student and his drive to improve transportation for all is an inspiration for undergraduate and graduate students today.”

Lawson’s transit research includes a web-based bus transit modeling suite for New Jersey Transit, using application programming interfaces from the U.S. Census Bureau and general transit feed specifications (GTFS) to forecast bus ridership. Her AVAIL research team also built translation software for the Metropolitan Transit Authority to integrate GTFS and bus real-time feeds across the entire New York City network.

Lawson’s laboratory currently is developing a tool suite for the New York State Department of Transportation that uses the National Performance Management Research Data Set integrated with the Highway Performance Monitoring System (HPMS) and other data sets to provide traffic performance metrics. AVAIL also developed a visualization and data analytics tool suite using archived weigh-in-motion, HPMS, and continuous counts data, supported by the Federal Highway Administration (FHWA) and the states of Texas, Pennsylvania, Connecticut, North Carolina, Michigan and Ohio.

Lawson introduces her graduate students to data as an asset for their future transportation careers. “While still a student myself, I recognized the untapped value in archiving operations data and the potential for using these data to inform policy,” she recalls. She now oversees the Advanced Institute for Transportation Education Program at Albany and served as a member of a joint initiative between FHWA and the Transportation Research Board (TRB) to develop the Archived Data Users Services. The initiative devised strategies to encourage equipment vendors to use common data specifications and formats, to challenge transportation professionals to think creatively on future data uses, and to educate the workforce on data quality and preservation techniques.

“Now these resources are available for data scientists to build web-based tool suites for the transportation workforce simultaneously across modes, providing a broad understanding of activities in a multimodal environment,” Lawson notes.

Lawson chaired the Standing Committee on Urban Transportation Data and Information Systems, which received a TRB Blue Ribbon Award for contributions to urban transportation data collection, analysis, archiving strategies to support urban transportation data, and promoting new subcommittees. She currently serves on the Public Transit Group Executive Board and on the Data and Information Systems Section. She also chairs the Joint Subcommittee on Transformative Trends in Transit Data and was a member of the Expert Task Group on Long-Term Pavement Performance (LTTP) Traffic Data Collection and Analysis and is on the Expert Task Group on LTTP Special Activities. Most recently, Lawson was a member of the planning committee for a joint TRB and Health and Medicine Division workshop, Exploring Data and Metrics of Value at the Intersection of Health Care and Transportation, which brought together public health and transportation professionals to explore data needs.
To bring together stakeholders from diverse backgrounds and to increase the number of underrepresented minorities in transportation research, in Transportation Research Board (TRB) activities, and at the Annual Meeting, TRB has administered the Minority Student Fellows Program since 2010. The program provides support for students and faculty mentors, selected from 14 minority-serving institutions across the United States, to present their research at the TRB Annual Meeting in Washington, D.C.

Approximately two-thirds of the fellows come from engineering departments, particularly civil engineering, as well as from urban and regional planning departments and other fields including supply chain management and airway science. Of the 83 students who have completed the program, 54 percent are men and 46 percent are women; 54 percent are African-American, 33 percent are Hispanic, and 5 percent are Native American. Approximately half of the fellows have been master's degree students, 42 percent undergraduates, and 8 percent PhD candidates.

Fellows at the Annual Meeting
Before the TRB Annual Meeting, fellows work closely with their faculty mentors to develop a research project and paper, beginning at least six months before the paper submission date on August 1. Among the research topics for the most recent group of fellows were pedestrian safety, the state of high-intensity bus service in the United States, driver behavior in reduced-visibility conditions, and the service life of hot-mix asphalt.

For many fellows, this is their first time preparing a paper for an audience beyond their professors. According to several students, critiques of their papers from different peer reviewers allowed them to include viewpoints that were not initially evident to them and to improve the overall clarity and presentation of their research. A few of the fellows’ papers were accepted for publication in the Transportation Research Record: Journal of the Transportation Research Board. Less than 20 percent of all papers submitted to TRB for publication are accepted to the Record.

Most fellows present their research in poster sessions at the Annual Meeting, with the remainder at lectern sessions and committee meetings. In a follow-up survey of former fellows, some admitted to being
nervous about interacting with experts in their field and worried about being unable to answer questions from other attendees. All reported a positive experience, from gaining confidence in presentation skills to realizing that attendees were eager to learn about their research. Some also made plans to collaborate with other researchers on future projects.

In the survey, one fellow commented that “receiving positive criticism of my research during my poster presentation gave me ideas for improvements to my paper and led to me having an award-winning paper at another transportation conference.” Another fellow noted that “feeling vulnerable and ready for criticism during the poster session helped me develop my presentation skills and confidence, and provided me with a sense of achievement after my presentation.”

On the opening day of the Annual Meeting, fellows attend a reception in their honor to meet each other and to hear presentations from guest speakers. In 2016, the speakers included Federal Highway Administration (FHWA) Deputy Secretary Victor Mendez, FHWA Director of Technical Services Amy Lucero, Maritime Administrator Paul (Chip) Jaenichen, and 2012 Minority Fellow Curtis Bradley of the Massachusetts Department of Transportation. Other events are a luncheon and an evening reception hosted by FHWA for the Eisenhower Fellows Program, as well as the TRB Chairman’s Luncheon.

**Career Connections**

Recalling her experience in the Minority Fellows Program, one participant noted that she made a connection that allowed her to secure a summer internship. Another fellow reported that he sought out FHWA staff to talk about careers at the agency. The program introduced several fellows to transportation disciplines they did not know existed.

“The most beneficial parts of the program were learning how to network with professionals from across the world and seeing the different practices that are implemented in various parts of the United States and then to compare those practices to the ones I have grown accustomed to in my home state,” one fellow noted.

“This opportunity gave me a firsthand experience of the great impact that transportation has on society,” another commented. “I believe these experiences cemented my desire to continue in the field of transportation through my academic and professional career.”

Some fellows also have joined the Young Members Council’s Mentoring Program, which matches them with a veteran Annual Meeting attendee in their field.

**Beyond the Annual Meeting**

As minority student fellows begin their transportation careers, TRB seeks to increase their involvement in its more than 200 committees and task forces, providing the opportunity to organize Annual Meeting sessions and workshops and topic-specific transportation meetings and to developing problem statements for transportation research projects. Approximately a dozen fellows are now friends or members of committees; nearly all note that they joined to develop skills or knowledge for their professional development and to network with other professionals. Some fellows also have been invited to serve on panels for National Cooperative Highway Research Program projects.

“I did not know there were so many committees designed to assist anyone in furthering their career,” one fellow observed in the survey. “I don’t believe that access to these networks would have occurred to me if I hadn’t attended the Annual Meeting.”

Surveyed fellows now hold careers in the private sector; at academic institutions; and in federal, municipal, regional, special purpose agencies, and state government, as transportation planners, traffic engineers, bus operation specialists, logistics managers, and more.

**More Information**

Support for the TRB Minority Student Fellows Program from FHWA enabled rapid growth, from five fellows in 2010 to 21 fellows in 2017. The South Coast Air Quality Management District in Diamond Bar, California; the North Texas Council of Governments in Arlington, Texas; and consulting firm Stantec have funded specific student–faculty mentor pairs from schools in their areas. Representatives from these organizations meet with the fellows they sponsor and discuss career tracks at their organizations.

TRB welcomes organizations and individuals interested in supporting the program, through either targeted or general donations.

For more information about the TRB Minority Fellows Program, contact Karen Febey at 202-334-2829 or at kfebey@nas.edu.
Five Years of the Six-Minute Pitch
A Transportation Startup Challenge

SHANA JOHNSON

The Six-Minute Pitch is one of the best-attended sessions at the Transportation Research Board Annual Meeting. In the session, which is sponsored by the Young Members Council, four transportation entrepreneurs are selected from a pool of applicants to pitch their new transportation technology product or service—in six or fewer minutes—to a panel of transportation industry entrepreneurs and investors.

The pitches are judged on commercial viability and on whether they address a critical transportation challenge. Judges treat each presentation as an individual investment and must decide immediately after the presentation and discussion if they are “in” or “out,” providing immediate feedback on the market potential, business model, and the incorporation of innovative technologies or techniques.

Since its debut at the TRB 92nd Annual Meeting in 2013, the Six-Minute Pitch has seen growing applications and attendance. At the 2017 event, winners will receive a prize valued at approximately $1,200—a one-year membership to the 1776 Union, a global entrepreneur support platform. All participants receive exposure and feedback for their ideas, and the winning submission typically receives media coverage.

In the past 4 years, the Six-Minute Pitch has showcased many successful early-stage transportation technology companies. The winner of the 2016 contest was TotalPave, a Canadian pavement technology startup that enables municipalities to collect standard pavement condition data relating to the Pavement Condition Index and the International Roughness Index, by using off-the-shelf smartphones. Since winning the Six-Minute Pitch, TotalPave founder Coady Cameron and colleagues have been working with local Canadian municipalities to refine the technology.

“People have reservations about sharing their business plan or idea because they convince themselves it won’t work or are paranoid someone might steal their idea,” Cameron comments. “If you don’t take it out of your basement, that’s where it’ll stay.” The panel of judges at the 2016 event included Sean O’Sullivan of SOSVentures and Chris Thomas and Gabe Klein of Fontinalis Partners.

Previous Six Minute Pitch winners have included Transfix, which provides tools for interstate truck drivers to plan their trips, manage their loads, and get paid quickly, and TransitScreen, which offers real-time availability and schedule information for a suite of sustainable transportation modes.

For more information on the upcoming Six-Minute Pitch event at TRB’s 96th Annual Meeting in January 2017, please visit www.sixminutepitch.com.
Development of Guidelines for Uniform Service Life Design for Bridges

Bridge owners rely on subjective evaluation of practices to identify and assess design alternatives for improving the service life of highway bridges. Although the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design Bridge Design Specifications contain requirements for strength design and some serviceability checks, comprehensive guidelines are not available for bridge service life design.

Modjeski & Masters, Inc., has received a $280,000, 30-month contract [National Cooperative Highway Research Program (NCHRP) Project 12-108, FY 2016] to develop proposed AASHTO guide specifications for the service life design of highway bridges.

For more information, contact Waseem Dekelbab, TRB, at 202-334-1409 or wdekelbab@nas.edu.

Guide Specifications for the Construction of Chip Seals and Microsurfacing

Chip seals and microsurfacing frequently are used as preservation treatments on flexible pavements. Although the design, materials, and construction practices of chip seals and microsurfacing are well documented, no nationally accepted guidance is available for their construction.

Shuler Consultants, LLC, has received a $150,000, 18-month contract (NCHRP Project 14-37, FY 2016) to develop recommended guide specifications for the construction of chip seals and microsurfacing.

For more information, contact Amir N. Hanna, TRB, at 202-334-1432 or ahanna@nas.edu.

Guide for Timing of Asphalt-Surfaced Pavement Preservation

Pavement preservation provides a means to maintain and improve the functional condition of a highway system and for slowing deterioration. Highway agencies employ a variety of treatments for the preservation of asphalt-surfaced pavements. The performance of the restored pavement depends not only on the type of maintenance treatment but also on the pavement structure and condition when the treatments are applied; however, these relationships are not well documented.

AMEC Foster Wheeler Environment & Infrastructure, Inc., has received a $299,964, 24-month contract (NCHRP Project 14-38, FY 2016) to develop a guide for identifying the timing for preservation treatments of asphalt-surfaced pavements.

For more information, contact Amir N. Hanna, TRB, at 202-334-1432 or ahanna@nas.edu.

TRB MEETINGS CALENDAR

October

31– Nov. 1 Partners in Research Nov. 1 Symposium Detroit, Michigan

December

1–2 10th University Transportation Center Spotlight Conference: Bicycles and Pedestrians Washington, D.C.

2017

January

8–12 TRB 96th Annual Meeting Washington, D.C. www.trb.org/AnnualMeeting

February

2–3 Planning for Shifting Trade Workshop* Tampa, Florida

March

12–15 Geotechnical Frontiers 2017* Orlando, Florida

20–23 10th International Conference on Managing Fatigue in Transportation* San Diego, California

April

10–12 International Congress on Transport Infrastructure and Systems* Rome, Italy

May

8–10 5th International Conference on Roundabouts Green Bay, Wisconsin

14–18 16th TRB National Transportation Planning Applications Conference Raleigh, North Carolina

17–18 Innovations in Freight Data Workshop Irvine, California

TBD 5th Urban Street Symposium* Raleigh, North Carolina

June

4–8 3rd North American Symposium on Landslides* Roanoke, Virginia

Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar, or e-mail TRBMeetings@nas.edu.

*TRB is cosponsor of the meeting.
Modernizing Freight Rail Regulation
Special Report 318
This congressionally requested report examines the future role of the Surface Transportation Board in overseeing and regulating the service levels and rate offerings of railroads, particularly as they become revenue adequate. According to the study committee, while the U.S. freight railroad industry has become modernized and financially stable since the Staggers Rail Act of 1980, some of the industry’s economic regulations have not kept pace and should be replaced with practices better suited for today’s modern freight rail system—for example, a more reliable screening tool is needed for rate disputes, and merger review authority could be transferred to antitrust agencies.

2015; 190 pp.; TRB affiliates, $57.75; nonaffiliates, $77. Subscriber categories: railroads; freight transportation; policy; economics; law.

Statistical Methods and Highway Safety Performance
Transportation Research Record 2515
Topics explored in this volume include a safety analysis of freeway segments with random parameters, modeling crash rates for a mountainous highway with refined-scale panel data, the safety impacts of a statewide centerline rumble strip installation program, and more.


Handbook of Teen and Novice Drivers: Research, Practice, Policy, and Directions
This volume offers a comprehensive review of teen and novice driver research, from psychology, human factors, ergonomics, and transportation engineering to medicine and public health. Research, methods, current knowledge, and programs related to teen and new drivers are presented, along with a website that offers downloadable training programs, simulator scenarios, and other materials.

2015; 88 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber category: safety and human factors; education and training.

Truck and Bus Safety; Roundabouts
Transportation Research Record 2517
Safety impacts of access management features near roundabouts, a multicriteria assessment of crosswalk locations, and a simplified method for comparing emissions in roundabouts and at signalized intersections are among the topics explored in this volume.

2015; 104 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber categories: safety and human factors; operations and traffic management; vehicles and equipment.

Human Performance, User Information, and Simulation 2015
Transportation Research Record 2518
Authors present research on the effects of guide and logo signs on freeway driving behavior, an evaluation of the minimum forward roadway glance...
duration, driving simulator fidelity and emergency driving behavior, and more.

Pedestrians 2015
Transportation Research Record 2519
Topics explored in this volume include a new model for pedestrian platoon crossing time at a signalized crosswalk, an assessment of leading pedestrian intervals, and whether good walkability can expand the size of transit-oriented developments.
2015; 188 pp.; TRB affiliates, $55.75; nonaffiliates, $77. Subscriber categories: pedestrians and bicyclists; safety and human factors.

Bicycles and Motorcycles 2015
Transportation Research Record 2520
Information related to bicycles and motorcycles—including electric bicycle use and mode choice in the Netherlands, rumble strip gaps for high-speed bicycles, and design guidance for bicycle lane widths—is presented in this volume.
2015; 184 pp.; TRB affiliates, $57.75; nonaffiliates, $77. Subscriber categories: pedestrians and bicyclists; safety and human factors.

Highway Design 2015
Transportation Research Record 2521
Electronic stability control and reductions in fatal longitudinal barrier crash rates, a quantitative method for assessing the deterioration of wood guardrail posts, and proposed horizontal curve and vertical grade encroachment adjustment factors are among the topics explored.
2015; 194 pp.; TRB affiliates, $53.25; nonaffiliates, $71. Subscriber categories: design; safety and human factors; hydraulics and hydrology.

Structures
Transportation Research Record 2522
Authors present research on mitigating fatigue in cantilevered overhead sign structures, full-scale testing and performance evaluation of rockfall concrete barriers, and a case study of Niayesh Highway Tunnel in Iran.
2015; 168 pp.; TRB affiliates, $53.25; nonaffiliates, $71. Subscriber category: bridges and other structures.

Pavement Management, 2015: Volumes 1–3
Transportation Research Records 2523, 2524, and 2525
Effective systems for rating pavement condition, urban travel time reliability analysis with consumer GPS data, and backcalculation with an implanted inertial sensor are among the topics examined in these volumes.

A Guide to Agency-Wide Knowledge Management for State Departments of Transportation
NCHRP Report 813
Authors present guidance for state transportation agencies on adopting an explicit strategy for knowledge management—techniques for preserving, enhancing, and deploying the knowledge of an organization’s employees—and implementation methods.
2015; 94 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber categories: administration and management; data and information technology; education and training.

Data to Support Transportation Agency Business Needs: A Self-Assessment Guide
NCHRP Report 814
This volume provides methods for transportation agencies to evaluate and improve data management practices and the value of data for decision making.
2015; 126 pp.; TRB affiliates, $50.25; nonaffiliates, $67. Subscriber categories: administration and management; data and information technology.

Short-Term Laboratory Conditioning of Asphalt Mixtures
NCHRP Report 815
Procedures are presented along with associated criteria for laboratory conditioning of asphalt mixtures to simulate short-term aging.
2015; 186 pp.; TRB affiliates, $57.75; nonaffiliates, $77. Subscriber categories: construction; materials; pavements.
Influence of Geotechnical Investigation and Subsurface Conditions on Claims, Change Orders, and Overruns
NCHRP Synthesis 484

Documented are the extent and types of claims, change orders, and cost overruns from subsurface conditions for state departments of transportation, and ways agencies can reduce these effects.

2016; 67 pp.; TRB affiliates, $41.25; nonaffiliates, $53. Subscriber categories: geotechnology; highways.

Converting Paved Roads to Unpaved
NCHRP Synthesis 485

This synthesis examines the relatively widespread practice of converting paved roads to unpaved roads. Outcomes and conversion techniques are explored.

2016; 88 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber categories: highways; materials; maintenance and preservation; operations and traffic management.

State Practices for Local Road Safety
NCHRP Synthesis 486

This synthesis explores state programs and practices that address local agency road safety—and the changes associated with them since the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the use of new approaches to local road safety.

2016; 186 pp.; TRB affiliates, $57.75; nonaffiliates, $77. Subscriber categories: highways; operations and traffic management; safety and human factors.

Commercial Ground Transportation at Airports: Best Practices
ACRP Report 146

This report covers best management practices to ensure the provision of safe, comfortable, easy-to-use, and efficient commercial ground transportation service. ACRP Web-Only Document 25 contains appendixes that include an annotated bibliography, a list of participating airports, and more.

2015; 155 pp.; TRB affiliates, $53.25; nonaffiliates, $71. Subscriber categories: aviation; passenger transportation; terminals and facilities.

Climate Change Adaptation Planning: Risk Assessment for Airports
ACRP Report 147

Guidance is offered on the specific impacts climate change may have on airports. An electronic assessment tool, Airport Climate Risk Operational Screening (ACROS), is included on a CD-ROM with the print version of the report.

2015; 128 pp.; TRB affiliates, $57.75; nonaffiliates, $77. Subscriber categories: aviation; environment; planning and forecasting.

Airport Safety Risk Management Panel Activities and Outcomes
ACRP Synthesis 71

This report compiles information and tools that help Part 139 airports conduct safety risk assessments (SRAs). The appendixes include several tools and templates, including a quick reference guide and a template for the SRA briefing.

2016; 120 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber categories: aviation; security and emergencies.

A Guidebook on Transit-Supportive Roadway Strategies
TCRP Report 183

By identifying consistent strategies to help improve transportation network efficiency, this guidebook offers ways to improve bus speed and reliability on surface streets while addressing the needs of other roadway users such as motorists, bicyclists, and pedestrians.

2016; 200 pp.; TRB affiliates, $25; nonaffiliates, $18.75. Subscriber categories: pedestrians and bicyclists; public transportation; operations and traffic management.

Use of Automotive Service Excellence Tests Within Transit
TCRP Synthesis 120

This synthesis explores how transit bus maintenance personnel view the ASE certification program and summarizes perspectives on improving ASE certification acceptance and participation.

2016; 89 pp.; TRB affiliates, $15; nonaffiliates, $20. Subscriber categories: maintenance and preservation; public transportation; vehicles and equipment.

Intercity Passenger Rail in the Context of Dynamic Travel Markets
NCCRP Report 4

This volume offers an analytical framework and models to improve understanding of how current or potential intercity travelers make the choice to travel by rail.

2016; 124 pp.; TRB affiliates, $50.25; nonaffiliates, $67. Subscriber categories: passenger transportation; planning and forecasting; railroads.
INFORMATION FOR CONTRIBUTORS TO

TR NEWS

TR News welcomes the submission of manuscripts for possible publication in the categories listed below. All manuscripts submitted are subject to review by the Editorial Board and other reviewers to determine suitability for TR News; authors will be advised of acceptance of articles with or without revision. All manuscripts accepted for publication are subject to editing for conciseness and appropriate language and style. Authors receive a copy of the edited manuscript for review. Original artwork is returned only on request.

FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, marine, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, security, logistics, geology, law, environmental concerns, energy, etc.). Manuscripts should be no longer than 3,000 words (12 double-spaced, typed pages). Authors also should provide charts or tables and high-quality photographic images with corresponding captions (see Submission Requirements). Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes, whether they pertain to improved transport of people and goods or provision of better facilities and equipment that permits such transport. Articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by one or two illustrations that may improve a reader’s understanding of the article.

NEWS BRIEFS are short (100- to 750-word) items of interest and usually are not attributed to an author. They may be either text or photographs or a combination of both. Line drawings, charts, or tables may be used where appropriate. Articles may be related to construction, administration, planning, design, operations, maintenance, research, legal matters, or applications of special interest. Articles involving brand names or names of manufacturers may be determined to be inappropriate; however, no endorsement by TRB is implied when such information appears. Foreign news articles should describe projects or methods that have universal instead of local application.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality illustrations, and are subject to review and editing.

BOOKSHELF announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, and ISBN. Publishers are invited to submit copies of new publications for announcement.

LETTERS provide readers with the opportunity to comment on the information and views expressed in published articles, TRB activities, or transportation matters in general. All letters must be signed and contain constructive comments. Letters may be edited for style and space considerations.

SUBMISSION REQUIREMENTS: Manuscripts submitted for possible publication in TR News and any correspondence on editorial matters should be sent to the Director, Publications Office, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, telephone 202-334-2972, or e-mail jawan@nas.edu.

◆ All manuscripts should be supplied in 12-point type, double-spaced, in Microsoft Word, on a CD or as an e-mail attachment.
◆ Submit original artwork if possible. Glossy, high-quality black-and-white photographs, color photographs, and slides are acceptable. Digital continuous-tone images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi. A caption should be supplied for each graphic element.
◆ Use the units of measurement from the research described and provide conversions in parentheses, as appropriate. The International System of Units (SI), the updated version of the metric system, is preferred. In the text, the SI units should be followed, when appropriate, by the U.S. customary equivalent units in parentheses. In figures and tables, the base unit conversions should be provided in a footnote.

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Join more than 12,000 transportation professionals at the Transportation Research Board's 96th Annual Meeting, January 8–12, 2017, at the Walter E. Washington Convention Center in Washington, D.C.

The program covers all transportation modes, with more than 5,000 presentations in nearly 750 sessions addressing topics of interest to policy makers, administrators, practitioners, researchers, and representatives of government, industry, and academic institutions. More than 250 exhibits will showcase a variety of transportation-related products and services. Many sessions and workshops focus on the spotlight theme for the 2017 meeting, Transportation Innovation: Leading the Way in an Era of Rapid Change. The full 2017 program will be available online in November 2016.

Plan now to attend!

For more information, visit www.trb.org/AnnualMeeting.