

**BUILDING ALBERTA INFRASTRUCTURE & TRANSPORTATION
AS A KNOWLEDGE INTENSIVE ORGANIZATION**

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Abstract

Alberta Infrastructure and Transportation's vision is that the department is a centre of excellence that provides modern infrastructure to support Alberta's growth and prosperity. Department senior executive has defined "a centre of excellence" within the context of Alberta Infrastructure and Transportation to include creating a working environment that encourages and values knowledge and innovation. In addition, the first priority in the department's corporate human resource plan is building capacity through supporting learning and development, and ensuring continuity and knowledge transfer.

Knowledge Management has been described as set of techniques and practices that facilitate the flow of knowledge into and within an organization. It has also been suggested that there are three components in the knowledge cycle: creating new knowledge, managing existing knowledge, and sharing and transferring knowledge. To become a knowledge intensive organization and a centre of excellence, Alberta Infrastructure and Transportation must adopt a coherent, comprehensive strategic approach to all three of these components.

This paper presents the department's strategic knowledge framework that includes;

- Partnering with engineering consultants, contractors, suppliers, academic agencies and regulatory agencies to create and transfer knowledge through initiatives such as;
 - The Centre for Transportation Engineering and Planning (C-TEP) at the University of Calgary.
 - WESTAC, a non-profit association dedicated to advancing the western Canadian economy through improvements in all modes of transportation including ports, airports, terminals, rail and road.
 - The Construction Research Institute for Canada at the University of Alberta.
 - Participation in TAC standing committees and projects.
 - Ad-hoc issue specific industry and government task groups.
- The management of knowledge through;
 - The development of the Transportation Infrastructure Management System (TIMS) and it's associated expert systems for bridge, pavement, network expansion, program management and performance measures.
 - The implementation of an electronic information management (EIM) system.
 - Development of comprehensive policies, standards, procedures and guidelines for design, construction, maintenance and environmental management.
- The transfer of knowledge through;
 - Training and mentoring initiatives. (Described more fully in a companion paper).
 - Internal and external training courses.
 - The establishment of process management committees in construction, bridges, maintenance, land and infrastructure management.
 - Regular conferences, workshops and planning sessions with the Alberta Roadbuilders and Heavy Construction Association and the Consulting Engineers of Alberta.
 - Desktop access to 18 full text and bibliographic databases through the Alberta Government library.

The paper concludes with some observations on the knowledge management challenges and opportunities currently faced by the department.

1. Introduction

The importance of knowledge within organizations began to be recognized in the early 1990's (1) and most organizations, including government agencies, now have some or many of the elements of a knowledge management strategy. Often this is only informally recognized within the organization but some, such as Alberta Agriculture, Food and Rural Development, have established dedicated knowledge management units with responsibilities such as coaching and mentoring staff on more effective ways to collaborate as teams, share knowledge and streamline business processes.

While it is generally recognized that knowledge is more than just information (2) there are many opinions on what it is. One definition is that knowledge is the confident understanding of a subject or information with the ability to use it for a specific purpose (3). Similarly, there are many different opinions on what constitutes knowledge management. A practical approach is that it is "a set of techniques and practices that facilitate the flow of knowledge into and within the organization" (4). Furthermore, it has been proposed that there are three separate phases in the knowledge cycle:

- Creating new knowledge
- Managing knowledge
- Sharing and transferring knowledge

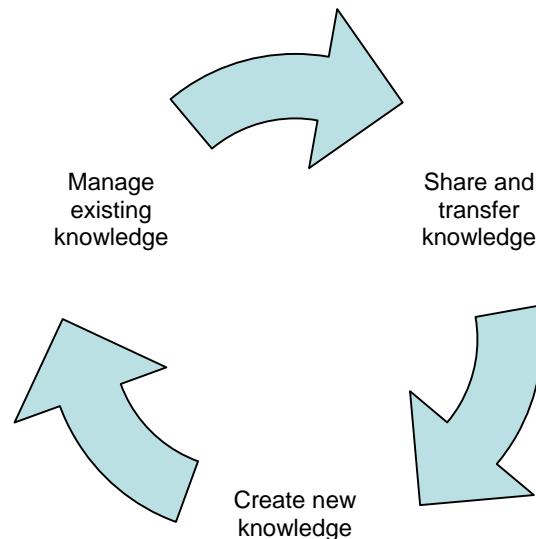


Figure 1 - The Knowledge Cycle (5)

It is also recognized that knowledge is both explicit (typically captured in codes, standards, guidelines etc.) and tacit (intellectual capacity) (6).

Accepting that knowledge management is a set of techniques and practices it is then possible to develop a strategic approach to knowledge management that supports the

goals, objectives and core business of Alberta Infrastructure and Transportation, and addresses all three areas of the knowledge cycle.

Articulating a department-wide knowledge framework allows executive management to assess the alignment of existing initiatives and activities; re-align or abandon them if they do not add value; establish priorities and assign often scarce resources between competing new initiatives; and conduct a meaningful gap analysis to identify future knowledge activities. In other words, the framework allows the application of a rigorous, “engineering model” type approach to knowledge management activities within the department.

In addition, it enables staff, partners and stakeholders to understand the linkages between different initiatives, and to see how they can contribute to and benefit from knowledge related activities.

2. Alberta Infrastructure and Transportation’s strategic direction

Alberta Infrastructure and Transportation’s vision is “*a centre of excellence that provides modern infrastructure to support Alberta’s growth and prosperity*”. In 2004, the executive management team defined a centre of excellence within the context of the then department of Transportation as being recognized for:

- Being the first place that industry, stakeholders and partners look for advice and guidance with respect to innovative approaches to solving transportation issues.
- Providing superior customer service.
- Leading national and international committees on emerging transportation initiatives.
- Being the benchmark against which all other transportation jurisdictions measure their performance.

and maintaining a position as industry leaders by:

- Consistently stretching our performance expectations to meet the needs of our staff, customers, clients, stakeholders and partners in all aspects of our business.
- Continuously identifying, investigating and adopting world-wide best practices in all areas of our business.
- Continuously improving the quality and effectiveness of our programs and services.
- Being early adopters of affordable technology that improves the quality and effectiveness of our services and programs.
- Creating a working environment that encourages and values knowledge and innovation, and that accepts the managed risks associated with change.
- Continuously building our leadership skills throughout the organization.

Priority One of the department’s human resource plan “people first strategies, 2005 – 2008” (7) is building capacity. The plan establishes the following strategies for this priority;

- Support learning and development
- Increase leadership capacity
- Ensure continuity and knowledge transfer

The department held a series of staff involvement sessions across the province in September 2004. All staff was invited to attend one of these sessions. The purpose of the session was;

- To identify what the department's vision and strategic and business plans meant to each and every member of staff.
- How each and every staff contribute to the achieving the department's goals and objectives.
- To gather staff comment and input on what challenges the department faces in becoming a centre of excellence, and opportunities for improvement.

A total of 721, out of a possible 850, staff participated in sessions held in Edmonton, Red Deer, Lethbridge, Calgary and Grande Prairie. Over 3500 individual comments and ideas were captured. Five significant themes emerged from an analysis of these inputs, two of which were directly related to knowledge management (the others covered communication issues and effective reward and recognition);

- Managing knowledge, skills and expertise.
- Quick, consistent, focused and accurate access to information.

These staff involvement sessions are being held again in 2006 for all the 1,700 employees within the combined Ministry.

From the foregoing, it can be seen that Alberta Infrastructure and Transportation has recognized the inherent value of knowledge and the need to be a knowledge intensive organization.

Executive commitment to knowledge management has been demonstrated through its vision and definition of a centre of excellence. Equally importantly, this need has been identified by staff themselves.

3. Knowledge management initiatives

Alberta Infrastructure and Transportation has established a practical knowledge management framework that acknowledges the requirement to be active in all three areas of the knowledge cycle, and supports both explicit and tacit knowledge through the development of tools and the capacity of individuals. The department currently has underway a number of significant knowledge initiatives.

a) Creating knowledge

As stated by Birkinshaw (4) a way of creating new knowledge within an organization is by facilitating the flow of information into the organization. In 2005, transportation staff attended some 20 conferences, symposia and forums throughout North America. Subject matter ranged from particulate emissions standards for heavy construction equipment and plant through risk management, asset management, geomatics to bridge and asphalt technology. Attendance at these events allows staff to interact and learn from their international peers and to identify new practices, procedures and technology that may be applicable to Alberta.

While learning from others is an important activity it tends to be a passive approach. The department also has to initiate and actively participate in research and technology development. The department believes that this is best done through partnerships with other government departments, other levels of government, academic institutions, industry and regional or national organizations such as the Transportation Association of Canada (TAC). The department commits approximately \$5 million/year in four priority areas for its research and technology activities;

- Infrastructure
- Safety
- Intelligent transportation
- Policy

Projects can range from recycled tire rubber asphalt, snowplow rear light enhancement, fatigue management and accessible taxis but the current focus is on intelligent transportation systems including Road Weather Information System (RWIS) deployment, remote controlled weigh station and GPS maintenance tracking.

Alberta Infrastructure and Transportation also supports the need to create and transfer knowledge within the wider Alberta transportation community and the department was instrumental in the formation of research institutes at the University of Calgary and University of Alberta.

The Centre for Transportation Engineering and Planning (C-TEP) at the University of Calgary has a broad membership from consulting engineering companies, public agencies, academic institutions, suppliers and contractors who are actively involved in transportation engineering and planning in Alberta. The Centre;

- Offers seminars, short courses and accredited courses in areas of interest and relevance to the transportation engineering and planning industry in Alberta.
- Identifies, sponsors and coordinates applied research projects in transportation engineering and planning.
- Creates networks with other transportation entities in Canada and beyond to enhance C-TEP's technology transfer and applied research program.
- Encourages students to pursue careers in transportation engineering and planning through involvement with C-TEP activities and C-TEP members.

2005 C-TEP research projects included:

- Study on the Applicability & Effectiveness of Warm Asphalt Technologies in Canadian Applications
- Lane Distribution of Truck Traffic for Pavement Design
- Trip & Parking Generation Rates for Land Use Planning in Small Alberta Towns
- Development of an Alberta Based Collision Prediction Model
- Safety Countermeasures Along Provincial Highways Through Small Towns
- Animal Collision Countermeasures on Alberta Highways
- Enhancement of Stop Control at Rural Highway Intersections

The work is generally undertaken by the private sector and the results are disseminated to C-TEP members.

The Construction Research Institute for Canada at the University of Alberta works with industry, government and engineers to research those areas that will help them to be

competitive and more productive. The Institute's focus is on production management, benchmarking, constructability and value management.

The department continues to be active in both institutes and is a member of the board of directors. At the national level, Alberta Infrastructure and Transportation is committed to participating and contributing to TAC committees and projects.

In addition to applied engineering and construction research the department participates in policy research to address the numerous challenges posed in the areas of passenger, freight and multi-modal transportation, municipal and rural infrastructure, and environmental stewardship. The department is a sponsor of the Western Transportation Advisory Council (WESTAC). Founded in 1973, WESTAC is a forum dedicated to strengthening the Western Canadian economy through improving the region's transportation system. The Council organizes workshops, conferences and meetings to explore relevant issues, and produces publications on topics of importance to the Western Canadian economy. Members include organizations represented by business, labour and government leaders.

The other primary source of knowledge creation is internally within the department. The strategic, business and operational planning process is designed to identify priority areas for improvement and change. Through appropriate prototyping and pilot projects the department develops, implements and monitors new procedures and practices. Initiatives will progress from concept or feasibility studies through to implementation over a number of years.

This is typified by the pavement preservation strategy that was initiated in 2002 to utilize all types of pavement treatments that can be used to maintain, preserve and extend the life of a pavement. In 2005 this strategy had progressed to encompass;

- The roles and responsibilities of regional, technical and program management staff.
- Data collection requirements
- Training
- Life cycle cost analysis
- Preservation guidelines
- Specifications, standards and guidelines

Alberta Infrastructure and Transportation systematically seeks to bring knowledge into the department and encourages the generation of knowledge internally. The next step is to manage that knowledge.

b) Managing knowledge

Managing knowledge is a way to ensure that the knowledge flows throughout the organization and is available to those who need it. Generally, the management of knowledge is directed to explicit knowledge. The department has undertaken three major initiatives to manage its transportation related knowledge.

Transportation Infrastructure Management System (TIMS).

The Transportation Infrastructure Management System (TIMS) is an integrated web-enabled system that supports Alberta Infrastructure and Transportation's business

processes for managing provincial highway infrastructure. It assists the department in getting best lifecycle returns on investments in highway assets through knowledge driven decisions, captures the rationale for investment decisions and preserves department knowledge assets of data, information, practices and processes. Figure 2 provides an overview of TIMS.

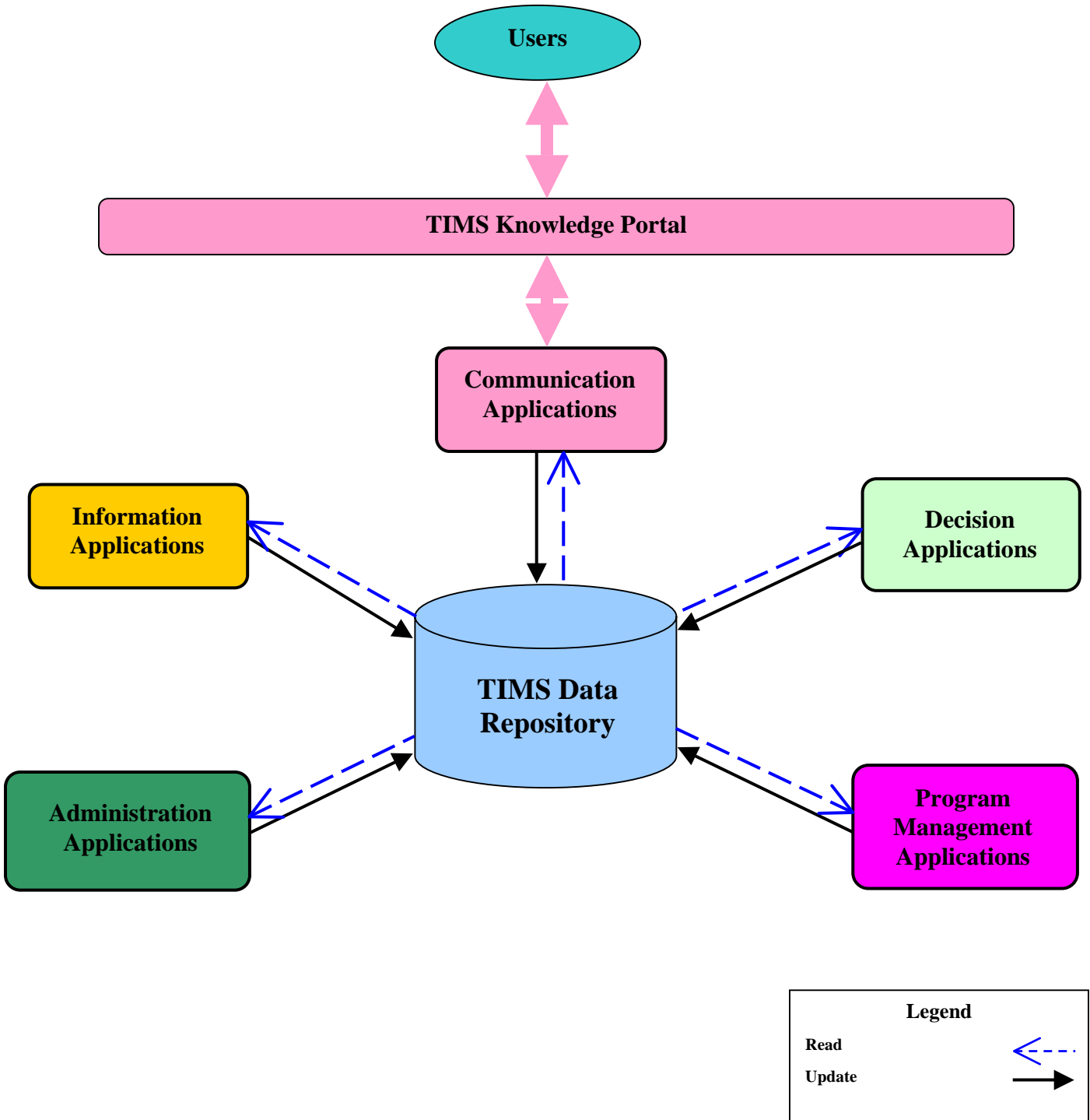


Figure 2 - TIMS Applications

TIMS creates a single, comprehensive, current and reliable source of data and information that;

- Promotes expertise and excellence.
- Enables efficient collection, preservation and updating of business critical information.
- Enables rigorous engineering-economic-evaluations of projects and programs.
- Promotes collaborative problem solving and project execution.
- And provides an effective web-based learning tool.

The system is based around a corporate data repository that contains data such as;

- Structures (Bridges, Bridge culverts, Sign Structures, Watercourse Training Structures, Ferries and Low Level Crossings) and related sub-components (abutments, piers, superstructures, pipes and girders) including load capacities.
- Roadways and intersections, control section network, roadway width and surface.
- Roadway traffic data including peak, daily and monthly volumes and level of service.
- Satellite Images
- Digital Videologs

There are three engineering decision support systems that use this data through a series of decision trees, deterioration curves and prediction models to produce recommended work activities on a particular infrastructure element with the need year. The engineering decision support systems are the Bridge Expert Analysis and Decision Support application (BEADS); Highway Pavement Management Application (HPMA) and the Network Expansion Support System (NESS) for system safety and capacity improvements.

Each engineering decision support system looks at the infrastructure inventory independently and recommends work activities that are then assembled into potential projects. This process is known as “rationalization”. The rationalization component of TIMS looks at all the recommended work activities on a particular segment of the network and creates rational projects along with a current cost estimate and delivery year. It will also incorporate any socio-economic requirements.

Optimization then applies the constraints – budget, industry capacity, geographic distribution – to develop the best set of projects for the next 3-5 years based on long-term value. These decision and program management applications form key knowledge support tools within TIMS and are illustrated in Figure 3.

TIMS is a concerted effort by the department to capture and manage existing knowledge about the Alberta provincial highway network and its ongoing behaviour and performance to assist in the effective management of the system.

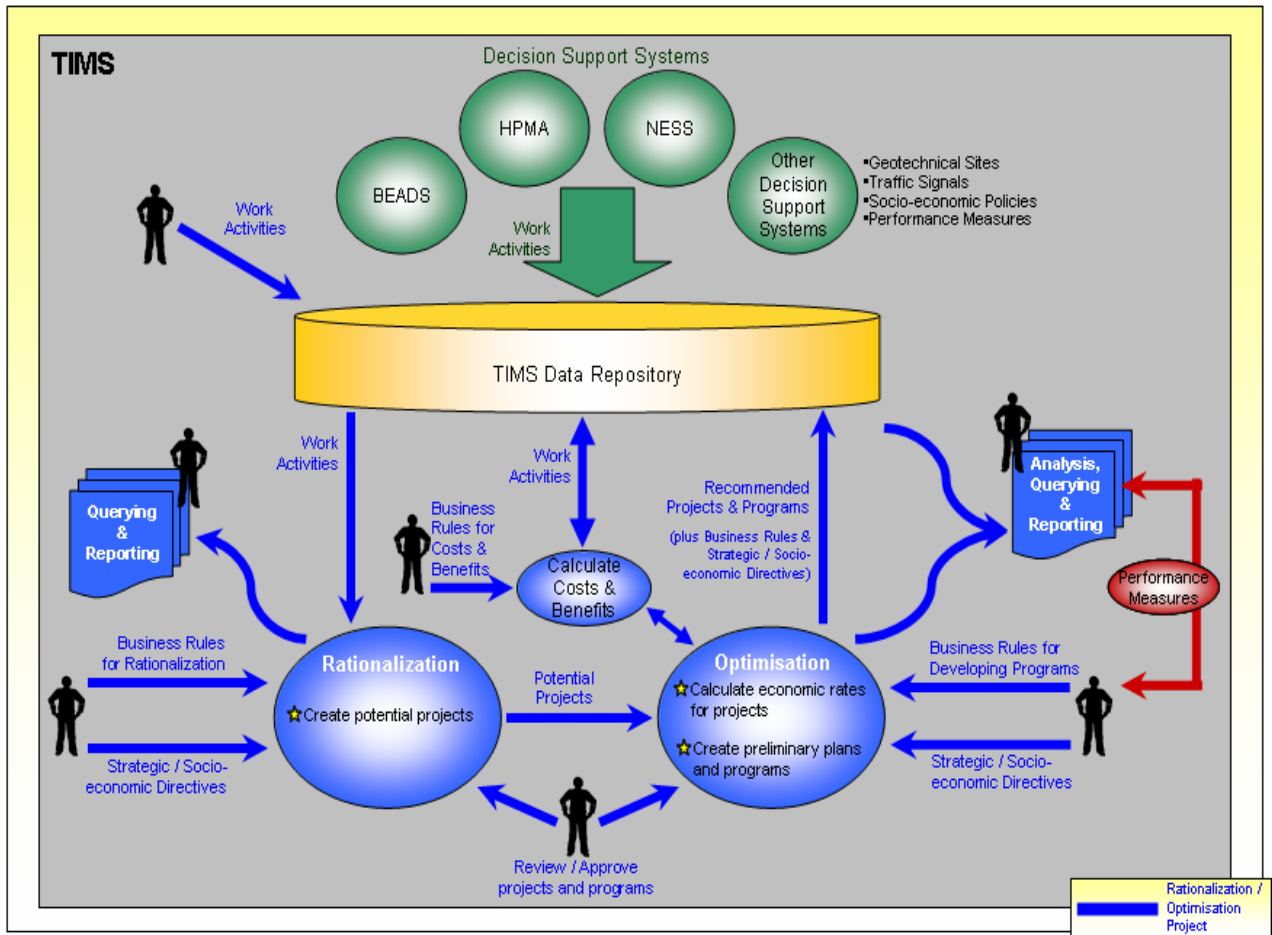


Figure 3 – Knowledge Support within TIMS.

Electronic Information Management (EIM)

The Enterprise Information Management (EIM) is an electronic document management system that is currently being implemented across the department. The EIM Portal provides dynamic collaboration and knowledge sharing between individuals and teams within the organization. It has integrated document management capabilities that provide functionality such as audit trails, permissions, version control, generations, approvals, and dynamic aliases, all stored in a scalable repository. It also provides for the integration all of engineering drawings, diagrams, and other documents into the repository. The department has selected to use LiveLink by Open Text.

To date, over 88,000 bridge drawings and images are available on-line, as well as hundreds of aggregate pit plans, roadway intersection plans and airport plans. With wireless technology the drawings can be viewed at any location across the province. Over the next few months the inventory of available documents will be expanded to cover a broad spectrum of the department’s business from traffic safety to legislation.

Manuals and Guides

The traditional forms of capturing existing knowledge through manuals, standards, policies and procedures remain an integral part of managing the department’s

knowledge. Like many government agencies the department has assembled a comprehensive set of documentation over the years. Alberta Infrastructure and Transportation has over 40 publications available on the web covering most aspects of highway and bridge planning, design, environmental, geotechnical, project and construction management, contract administration, specifications, testing, operations and maintenance.

The internet and intranet can be used to improve access to these documents. With the advent of Alberta's "SuperNet" and wireless connectivity, these documents are now available to any user, anywhere in the province at any time.

These documents are continuously being revised and updated, usually in partnership with the Consulting Engineers of Alberta (CEA) and the Alberta Roadbuilders and Heavy Construction Association (ARHCA), and national bodies such as TAC, to reflect the latest developments in industry knowledge. Between major updates of any particular document, the department will issue bulletins for minor changes and modifications.

c) Sharing knowledge

Over the last ten years the department has developed a close partnership with the CEA and ARHCA. Working together the three parties have been able to implement a number of initiatives aimed at sharing knowledge within the Alberta transportation infrastructure community.

Explicit knowledge is shared through training courses on technical subjects that may be organized by the department, ARHCA or CEA. These courses are usually open to all members of the tri-party partnership (consultants, contractors and department staff). In this way insights and knowledge can be shared during the courses. C-TEP also offers a broad range of technical seminars.

The department, CEA and ARHCA have also taken steps to share implicit knowledge and experience. Together, they have developed a set of on-the-job training and mentoring initiatives.

- Transportation Infrastructure Career Development Program. A program aimed at civil engineering students where participants engage in 4 or 6 month assignments with a contractor, engineering consultant and the department.
- Mentoring Program. Technical staff from the department, consultant or contractor work for a few weeks with a different employer.

These and other initiatives, specific to the department, are discussed in detail in a companion paper by Tim Hawnt, Alberta Infrastructure and Transportation.

The partnership has also put in place a project debriefing process that takes place at project completion where senior representatives of the contractor, consultant and department meet to discuss lessons learnt during the project. There is a strategic priorities group consisting of executive management from the three parties that meets on a regular basis to establish and monitor common initiatives, and an operations committee of subject experts that addresses technical issues and concerns.

The partnership also holds a construction conference in the spring of each year. The conference is organized by the CEA and is highly successful with over 500 delegates

attending. The Minister's Award for Transportation Innovation is presented at the conference. This award recognizes those innovative people in the transportation industry who plan, design, construct, operate and maintain the highway network within the Province of Alberta. The recipients demonstrate excellence in technical or process innovation focusing on roads, bridges, safety, policies or procedures. The award is intended as a way to celebrate and share innovations.

Based on input received from department staff during the 2004 consultation sessions, Alberta Infrastructure and Transportation joined the Alberta Government Library pilot project to provide all government staff with desktop access to 18 full text and bibliographic databases. In addition, specific internet resources selected to support the department include;

- On-line journals
- American Society of Civil Engineers
- Canadian Standards Association
- Civil & Structural Engineering Resource web
- Institute for Research in Construction
- Transportation Safety Board of Canada
- National Transportation Library (US)
- Ultimate Civil Engineering directory

In the fall of 2004 the department completed a review of some of its internal committees and rewrote the charters for process management committees in the technical areas of bridges, construction, infrastructure management, land and operations. These committees have representation from each region and central office. Part of the mandate of the committees is to;

- Promote the consistent application of policy, standards and practices through process definition and information sharing.
- Promote best practices and innovation through information sharing
- Develop and promote strong communication, relationships, collaboration and teamwork.

These types of knowledge sharing activities complete the loop to knowledge creation by promoting discussion and debate, resulting in improvements and new ideas.

4. Knowledge management challenges and opportunities

In November 2004, the departments of Infrastructure and Transportation were merged to form Alberta Infrastructure and Transportation. The department is responsible for the provision and support of effective and safe transportation, public buildings, and environmentally safe water and wastewater infrastructure. Over 1,700 employees are responsible for supporting over 13 million m² of health, post-secondary and school facility space, over 20 million m² of government owned or leased space, 150 major water management facilities, as well as the 30,100 km provincial highway network and 3,800 bridge structures. The department has offices in 18 cities or towns throughout the province.

The merger could have resulted in disruption to the knowledge initiatives underway but executive leadership quickly confirmed the vision and core business of the department.

While there have been challenges in successfully integrating such a large and diverse organization, many of the knowledge initiatives have gathered momentum throughout the transition. This demonstrates that initiatives that add value to the core business of the department continue to have support at all levels even during periods of organizational change.

The combined department also offers new opportunities for increased knowledge creation and sharing. For example:

- Streamlining environmental management provides opportunity for sharing on knowledge on the handling and disposal of hazardous materials.
- A new advanced facility technology area has been formed with spin off potential for transportation technology.
- Sharing of experience on approaches to alternative project delivery.
- Best practice sharing on standards and specifications.
- Unification of ICT systems to enable easier collaboration.
- Increased opportunities for staff rotation and development.
- Extension of partnerships with construction, engineering and architecture associations.

5. Conclusion

The amount of knowledge that is contained within a large government organization such as Alberta Infrastructure and Transportation is staggering. Without a well designed strategy the management of this knowledge can be overwhelming. A truly knowledge intensive organization has a comprehensive and coherent knowledge management strategy. The strategy is championed at the senior executive level and it must directly support the core business of the organization. A well articulated knowledge management strategy enables staff, partners and stakeholders to understand, participate in and benefit from the initiatives within the strategy.

An effective knowledge management strategy should give equal weighting to creating, managing and sharing knowledge; and should balance the development of information technology and other tools to support knowledge management (explicit knowledge) with individual capacity development through learning and mentoring (tacit knowledge). Knowledge management is not a project to be completed but rather techniques and processes that must be embedded within the organization.

Alberta Infrastructure and Transportation has the vision of being a centre of excellence in the provision of modern transportation infrastructure. Inherent in this vision is the recognition of the value of knowledge and the need to be a knowledge intensive organization. The department has successfully advanced a number of transportation related knowledge initiatives over the last five years in all three areas of creating, managing and sharing. The merger of the former departments of Infrastructure and Transportation, and the subsequent restructuring of the organization provides new challenges in integrating different tools and processes but offers great opportunities for leveraging knowledge and expertise across the department and to/from our partners.

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