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Assessing Knowledge Management

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Assessing Knowledge Management

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Executive Summary

The basic premise of this study is that knowledge is an asset, it has value both to individuals and organizations, and knowledge management should be an integral component of asset management.

A generic, overall framework for asset management illustrated that knowledge is explicitly or implicitly embedded at each item or activity. Moreover, knowledge can take the form of:

a) Explicit knowledge, usually in the form of documentation, or
b) Implicit knowledge, or "know how", involving both documentation and verbal communication, or
c) Tacit knowledge, a human embodiment of experience, skills, judgement and other attributes.

Recruiting and retaining individuals in transportation agencies is the subject of considerable attention. It can and should be a cost-effective endeavour and an asset preservation or enhancement strategy. While there are many dimensions to recruitment and retention, the training aspect has been shown to have a substantive return on investment.

Succession planning involves people, technology and information. It covers explicit, implicit and tacit forms of knowledge and it should be a key part of knowledge management.

Knowledge management, as a subject area and an activity has received major attention in the literature and numerous private and public sector agencies have instituted knowledge management practices in one way or another. However, there is little operational guidance for agencies who wish to incorporate knowledge management within their corporate strategy or business process. Consequently, the following recommendations are directed to this inadequacy:

1. Development of an operational protocol for knowledge management in the area of explicit knowledge, with application/demonstration to a specific item or case study; eg, long life pavements.
2. Development of an operational protocol for knowledge management in the area of implicit knowledge, with application to a specific case study; eg., technical consistency and succession planning in bituminous materials.

1. Introduction

Knowledge is a universally recognized term but it can have different meanings, contexts, applications and usefulness, depending on the organization or individual involved. Certainly knowledge can and generally should be a valuable asset, particularly in the context of asset management systems.

However, asset management has, to date, focussed almost exclusively on physical assets. Knowledge and human resource assets are vital to good asset management and thus there is no reason why the principles of asset management are not equally relevant to these other components.

A joint Ministry of Transportation Ontario (MTO) – Industry Symposium on Feb. 26, 2003 identified knowledge management as the second highest priority item for advancing technology. This well illustrates that knowledge management is a very important area of concern to MTO and its private sector partners.

Following the Symposium, the University of Waterloo was awarded an MTO innovation grant for "Knowledge Management in Transportation". The key objectives of the project were to:

- Develop a definition of knowledge management, and it's context in the asset management framework
- Carry out a literature search as to how organizations manage their knowledge assets on a continuing basis
- Identify the key strategic elements of a knowledge management system (eg., requirements of long term sustainability, periodic monitoring, operational needs, cost-effectiveness, etc.)

The ensuing discussion addresses these objectives and attempts to provide the basic foundation for developing a comprehensive knowledge management strategy in any subsequent projects.

2. Asset Management

Interest in asset management has spread throughout transportation agencies. Over the past few years many initiatives have been directed towards asset management. These include the publication of an "Asset Management Primer" by both the Transportation Association of Canada (TAC) [TAC 1999] and the U.S. Federal Highway Administration (FHWA) [FHWA 1999] as well as the formation of an FHWA office of Asset Management in 1999. Additional initiatives by the FHWA/AASHTO (American Association of State Highway and Transportation Officials) include an Executive Seminar on Asset Management in September of 1996 [FHWA 1997] and a Workshop on Asset Management in December of 1999 [AASHTO 2000]. Through these initiatives, as well as others, many interpretations and definitions of asset management have been developed. The following are sample definitions of asset management:

> "Asset management is a systematic process of maintaining, upgrading and operating physical assets cost-effectively. In the broadest sense, the assets of a transportation agency include physical infrastructure such as pavements, bridges, and airports, as well as human resources (personal and knowledge), equipment and materials, and other items of value such as financial capacities, right-of-way, data, computer systems, methods, technologies and partners" [FWHA 1997]

> "Asset management is a comprehensive business strategy employing people, information and technology to effectively and efficiently allocate available funds amongst valid and competing asset needs." [TAC 1999]

> "Asset management is a business process and a decision-making framework that covers an extended time horizon, draws from economics as well as engineering, and considers a broad range of assets. The asset management approach

incorporates the economic assessment of trade-offs between alternative investment options, both at the project level and at the network or system level, and uses this information to help make cost-effective investment decisions." [FWHA 1999]

These definitions illustrate that while there are commonalities, the scope of asset management varies within and between agencies. Overall, asset management is more of a concept or framework aimed at the cost effective management of assets, as illustrated in the following discussion.

2.1 Framework for Asset Management

A "Generic Asset Management System", put forward by [FHWA 1999], is shown in Figure 1. While it is termed a "System", it is really a framework because a system should be an operational entity.

Included with Fig. 1 are some of the key questions which are associated with the system components. It is stressed in [FHWA 1999] that the specifics of any given system would have to suit the agency involved and that any asset management system should be flexible enough to respond to changes in any variables.

Actually, asset management is a process which involves three basic and interrelated levels, strategic, network or system wide and project or site specific, as subsequently described. Fig. 1 incorporates elements of all three levels but does not indicate any boundaries for these levels.

Asset management can conveniently be viewed as functioning at three distinct levels:

- Strategic level where various social, political, economic and environmental factors are considered, public input occurs, long range financial forecasts are carried out and desired or specified levels of service (LOS) and safety for the system or network as a whole are defined as well as cost estimates to meet the LOS and safety targets. Current and future asset values should be established.
- Network or system wide level where alternative programs are considered, performance estimates are made and life cycle cost analysis (LCCA) are used to determine an optimal program for given budget(s) or funding.
- Project level where LCCA and other relevant factors are used to identify and implement the most economically effective alternative for a project/link/site specific area.

All three levels must fit within the agency's business scope and/or plan to be acceptable, useful, practical and understandable. For example, the City of Edmonton articulated a "Corporate Business Plan" (June 26, 2001, available on their web site) and their infrastructure strategy fits within that plan [Siu and Cloake 2001].

An overall framework for asset management has been defined in a TAC project, as illustrated in Figure 2 [Cowe Falls and Haas 2000]. It has some similarities to the framework of Fig. 1 and is stated to be "--- generic in nature and allows flexibility to accommodate individual agency needs, resources and policies", as has been the approach for many years in pavement management

systems. However, it explicitly recognizes the valuation component, in contrast to Fig. 1. This is considered to be an essential element of any asset management system in the TAC approach. Moreover, it identifies the strategic and network levels as distinct. A third level, project or site specific is only identified in Fig. 2 but is subsequently considered in more detail.

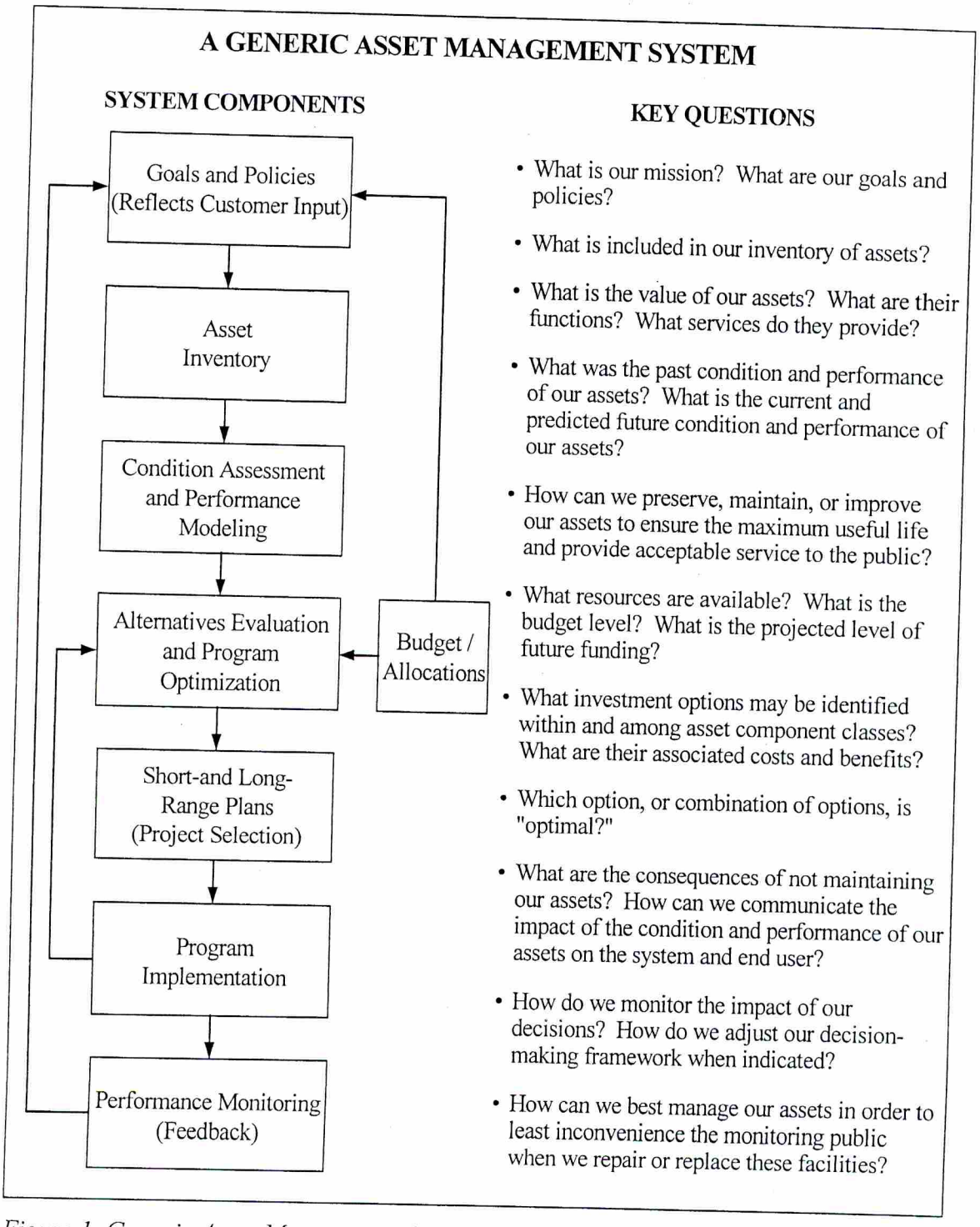

Figure 1 Generic Asset Management System Components and Key Questions

[FHWA 1999]

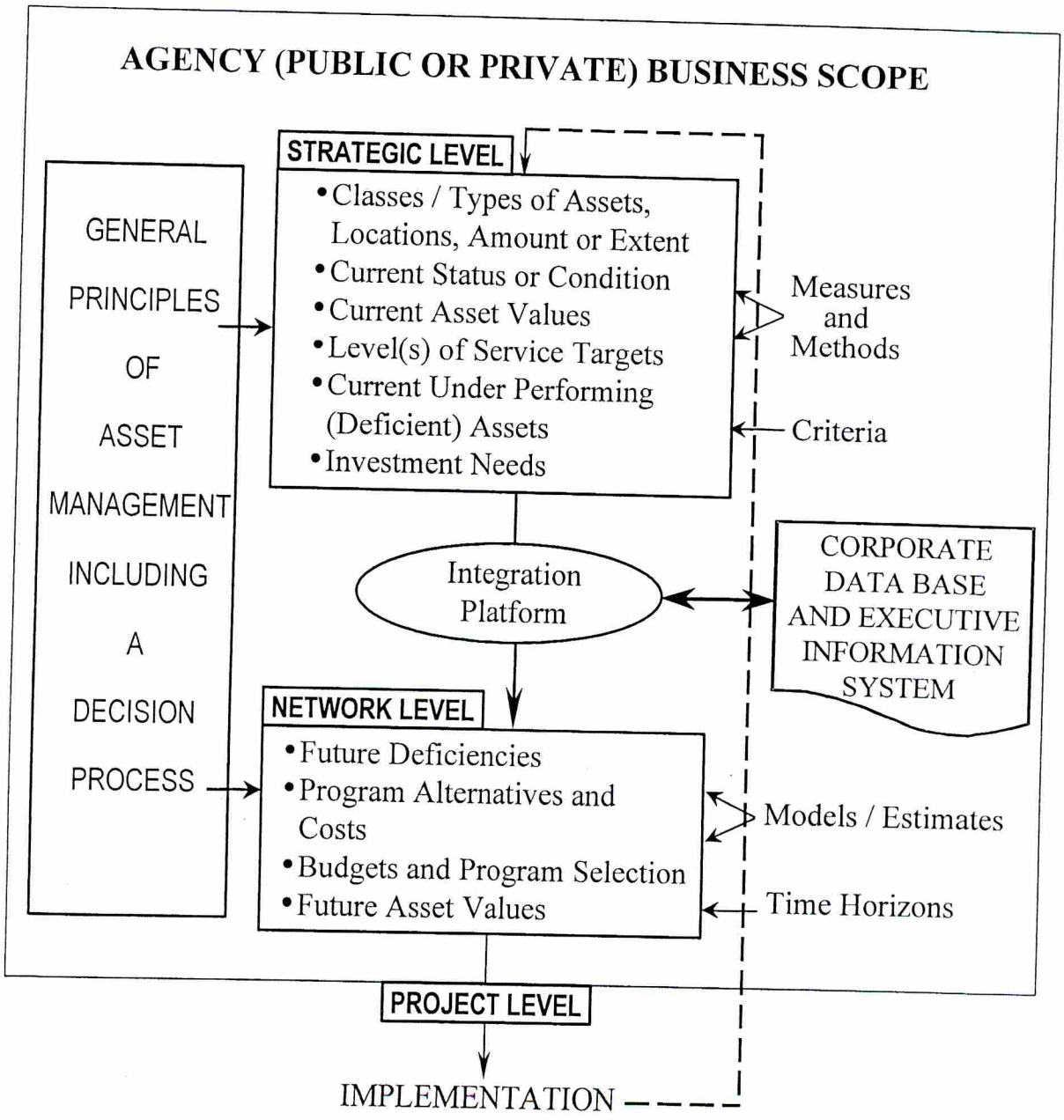

Figure 2 Overall Framework for Asset Management

Adapted from [Cowe Falls and Haas 2000]

The framework of Fig. 2 is largely based on experience with infrastructure and asset management systems. It recognizes or incorporates agency goals and policies in the "Business Scope" noted in the framework.

The framework of Fig. 2 is also generic in that the strategic level could incorporate all the component management systems of the agency (Pavement Management, Bridge Management, Maintenance Management, Traffic and Safety Management, etc.), with the network level being (generically) applicable to any of these component systems. To effect a proper integration between the strategic level and the component systems requires an integration platform, which has been identified in Fig. 2. This requirement has been discussed in detail by [Haas, Cowe Falls and Tighe 2004].

2.2 Context for Knowledge Management

Asset management has focussed almost exclusively on physical assets. However, people and knowledge can be equally valuable assets, and thus should be included in any comprehensive asset management system. In fact, an MTO – Industry Sponsored Symposium on New Asphalt Technology Implementation, Feb. 26, 2003, identified knowledge management as the second highest priority [MTO 2003].

Referring back to the Fig. 2 framework for asset management, knowledge is explicitly or implicitly embedded in each item or activity at all three levels. For example, the strategic level first identifies "Classes/Types of Assets, Location, Amount or Extent", and these can of course be physical assets, but they can also be in the form of documents representing an accumulation of knowledge in the organization. As another example, again at the strategic level, "Current Asset Values" can be assigned to both physical assets and knowledge assets. Still another example is "Investment Needs", which certainly can be assigned to knowledge assets. In essence, the Fig. 2 framework could well be applicable in it's entirety to knowledge management.

First, however, knowledge and knowledge management as subjects of considerable attention in the literature, aside from the current and conventional view of asset management, need to be reviewed. This is provided in the following discussion.

3. Knowledge

In order to define knowledge management it is first necessary to define knowledge. Although there are many varying definitions of knowledge, a widely accepted definition is that of Davenport and Prusak [1998]:

> "a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knower. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms."

> In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms."

Thus, knowledge can be viewed as an organizational resource produced and held by community members, directed towards attaining the goals of the entity. But why is it important for an organization to treat knowledge as any other asset and implement a system for managing its knowledge?

In order to be successful in business, an organization must stay a step ahead of its competitors by continually coming up with new strategies and innovations in an efficient manner. This occurs through knowledge creation. Milner [2000] believes that "knowledge creation occurs when multiple individuals with varying backgrounds, perspectives and motivations share" knowledge. To create knowledge, one must first possess knowledge, for knowledge is created through recirculating existing knowledge amongst a group in an attempt to add value through innovation. Thus, the more knowledge an organization possesses, the greater is its potential for knowledge creation. It is a very common belief that the knowledge an organization possesses is embedded in its employee's minds. The former view that information contained within books, journals, and research papers is knowledge no longer holds true, but this is of course arguable. In order for information to become knowledge one must take the time to read, manipulate, and communicate it to other members of a community [Al-Hawamdeh 2002]. Thus, only information residing in the human mind is truly knowledge and the moment it leaves the mind or is documented it is nothing more than information. Hence, to decrease the quantity of knowledge lost in an organization it is of increasing importance in today's knowledge-based economy to have a well utilized knowledge management system in place that preserves existing knowledge and promotes the creation of new knowledge.

Similar to asset management, there are many varying definitions of knowledge management, reflective of the needs of different organizations. Each definition takes a slightly different approach or stance on the subject. For example, Mentzas et al. [2003] believe the term knowledge management refers to "a broad collection of organizational practices and approaches related to generating, capturing and sharing knowledge that is relevant to the organization's business". Similarly, Desouza [2002] views knowledge management as "an ongoing process of sharing individual intellectual know-how and experiences with an entity that results in effective and efficient attainment of the entity's goals". Arora [2002] believes that knowledge management means managing intellectual capital by applying three basic objectives: "leveraging the organization's knowledge; creating new knowledge or promoting innovation; and increasing collaboration and hence enhancing the skill level of employees". Finally, Malhotra [1998] states that knowledge management "embodies organisational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings".

In a broad sense, knowledge management could be defined as a process of leveraging and utilizing available knowledge to achieve innovation and produce results. From this broad view of knowledge management it is apparent that there are two predominant perspectives, the product and the process approach [Mentzas et al. 2003].

The product approach views knowledge as an object to be captured, distributed, measured, and managed. This approach encourages the preservation of records and artefacts using means such as databases, archives, networks, and repositories. Although slightly dependent on the product approach, the process approach focuses more on promoting, monitoring, encouraging, nurturing, and guiding knowledge creation and distribution through knowledge communities. These communities can communicate through many different means including discussion boards, e-mail, messaging services, and white-boarding [Mentzas et al. 2003].

Although the product approach is more traditional than the process approach in its views of knowledge management, many firms have recently opted to direct more of their knowledge management focus towards a more process based perspective. However, in doing so there must be assurance that knowledge management strategies still incorporate both perspectives. To function profitably, the product approach requires the process approach to provide it with fresh knowledge while the process approach requires the product approach to provide it with existing knowledge. In the transportation field both approaches are essential in order to achieve a properly functioning knowledge management system.

The idea of viewing knowledge management from two differing yet related perspectives, as a product and as a process, highlights its vastness. Recognizing the broad range of possibilities knowledge management presents, the necessity for some form of framework that segregates it into components becomes apparent. The framework most commonly used and perhaps best suited to the transportation industry consists of three components: explicit knowledge, implicit knowledge, and tacit knowledge.

Explicit knowledge is quite widely defined as documented information. This form of knowledge is stored within information management systems making it widely accessible to those who require it. Explicit knowledge is articulated through written language and hands itself to the idea of viewing knowledge as a product.

Implicit knowledge can also be termed 'know how' and refers to a form of knowledge that can be expressed and articulated. This form of knowledge can be transferred through both documentation and verbal communication.

Tacit knowledge is the most difficult form of knowledge to capture as it is created while humans interact with both those around them and their environment. The majority of tacit knowledge is contained within the human subconscious making it extremely difficult to articulate and transfer. In order to manage this fragile knowledge an organization must manage the body it is contained within, its employees.

A characterization distinction between the different components of knowledge management based on the type of knowledge sharing occurring organizational communities was devised by Ernst and Young. They believe a relationship exists between the organizational reach of a group (global versus local) and its level of cohesion between members (low versus high) [Mentzas et al. 2003]. As seen in Figure 3, the more local a group is, the higher is its level of cohesion and the greater is its aptitude for creating and distributing tacit knowledge. Inversely, the more global a group is, the lower is its level of cohesion which leads more towards explicit knowledge.

Implicit knowledge falls in the middle of the organizational reach scale, allowing for a moderate level of member cohesion.

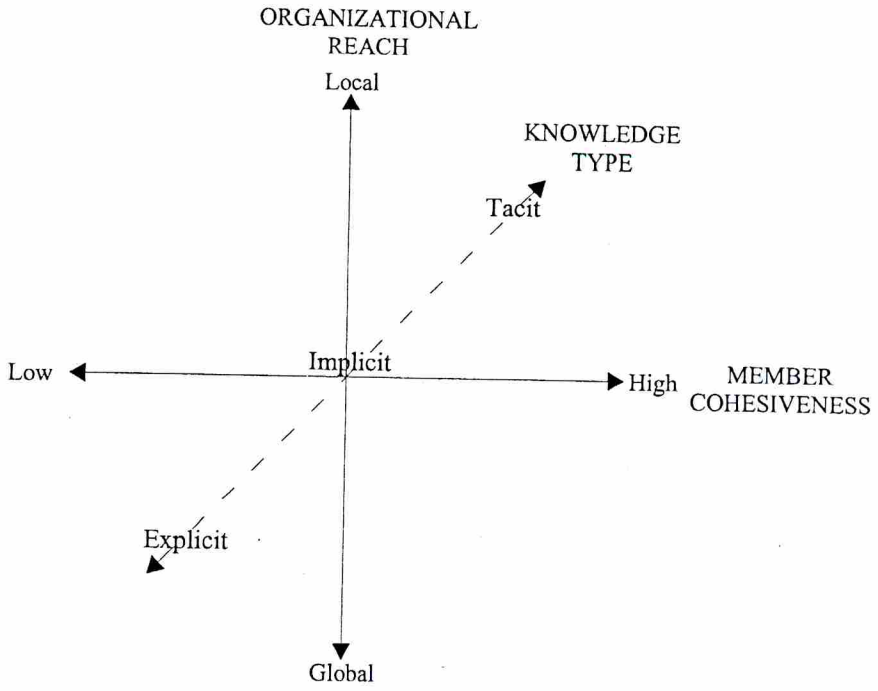

Figure 3 - Impact of organizational reach and member cohesiveness on knowledge [Mentzas et al 2003]

3.1 Explicit Knowledge

Of the three components of knowledge management, explicit knowledge is the most commonly considered and lowest valued aspect of knowledge management [USDA 2001]. It is "reusable in a consistent and repeatable manner…It exists as a physical or virtual entity that can be measured, identified and distributed" [Snowden 1999]. The main difficulties faced by explicit knowledge arise from its shear magnitude and the daunting task of keeping it up to date. A common mistake made when managing explicit knowledge is to treat it as an object rather than an activity [Al-Hawanden 2002]. Storage locations for explicit knowledge include computer networks (Internet and intranet) and central library bodies. It must be remembered that technology is simply a facilitator that transmits and exchanges information, not a knowledge manager. Technology is only one of three explicit knowledge components, the carrier. Both a language and means of expressing knowledge and coded potential knowledge are essential [Mentzas et al. 2003].

3.1.1 Internet

According to the Massachusetts Institute of Technology, "fact-based knowledge doubles every 18 months….and by 2010 it will double about every four weeks" [Manley & McFallen 2003]. One of the contributing factors to this rapid knowledge increase is the Internet, an online storage warehouse for an enormous volume of rich documented explicit knowledge, which greatly increases the quantity of knowledge shared both within and outside an organization. Both

employees and the public can gain access to overwhelming amounts of science-based knowledge through the Internet [USDA 2001]. The Internet allows published information to be available instantly, it is widely accessible, universal, and easy to use. Its downfall, however, is that the explicit knowledge it contains varies widely in quality and is poorly organized [Skyrme 1997]. Many Internet users suffer from information overload, yet struggle to find useful knowledge. The Internet fails to serve its purpose when the cost of gathering knowledge from it outweighs the benefits its users seek.

3.1.2 Intranet

When the personal computer was first introduced into the office expectations were high but the results were disappointing. Computers prevented sharing, collaboration, cooperation, communication, and prevented members of groups from knowing what each other was doing. However, this has changed with the introduction of the intranet, a "network within an organization that uses Internet technology to enable users to find, use, and share documents and Web pages" [Dunne & Horgan 2001]. Intranets untangle the snarl associated with finding the most up-to-date knowledge by capturing explicit knowledge from around the world in a documented format. It ensures employees on the other side of the world have access to the same information available to people two doors down the hall. Intranets have very aggressively begun to replace central filing systems by giving employees access to work-related documents from their personal PC, while taking up much less space than traditional filing cabinets. They also encourage knowledge sharing and design collaboration, while providing e-learning.

A well supported, planned, organized, and managed intranet can save a company time and money. However, an intranet that is unsupported by management and lacking an organizational framework can be quite problematic, lowering employee productivity and wasting valuable time. This should not serve as a deterrent, for a properly implemented intranet can be significantly beneficial, especially to organizations with deep knowledge assets [Manley & McFallan 2003].

3.1.3 Central Library Body

There is little support for a paperless office, but rather one with less paper. The same holds true for central libraries. The belief that central library bodies are growing obsolete is far from the truth. Unlike the web, libraries are more of a catalogued knowledge source that provides coherent, organized, validated, and authenticated explicit knowledge in a manageable and beneficial form [Hawkins 2000]. Libraries are still of great value to an organization, even with all the advancements in technology, but the nature of the service they provide is changing. This change involves transforming libraries into portals to explicit knowledge not available elsewhere [Surmacz 2002]. This includes vast amounts of scholarly, intellectual, and aesthetic knowledge not available on the Internet and Intranet due to various reasons including their size, age, and the limitations of online copyrights.

3.2 Implicit Knowledge

Implicit knowledge falls between explicit knowledge and tacit knowledge in its level of value. Similar to tacit knowledge, it is embedded in the mind of an individual. However, unlike tacit knowledge, implicit knowledge can be made explicit through verbalization [Wilson 2000]. There are many different approaches to managing this form of knowledge including mentoring

programs, communities of practice, and network based user help services. Mentoring is a dynamic professional relationship that promotes the exchange of knowledge, experience, and skills to enhance personal growth [NYS DOT 2003]. Whether it is in the form of a monthly lunch date or a weekly email, these programs have seen great successes in many areas of industry and the academic world. A community of practice is an employee forum that transforms the water cooler gathering into a more formal and organized meeting that incorporates the free flow of knowledge within an agglomeration of people [Arora 2002]. Network based user help services operate within an organization to link employees with questions or problems to employees with knowledge on the subject who otherwise would not be a realized resource.

3.2.1 Mentoring

Mentoring is a "dynamic, evolving partnership where a caring person invests time and know-how to enhance another person's growth, knowledge or skills. Mentoring responds to critical needs in the life of that person in a way that prepare the individual for greater career satisfaction, productivity and achievement" [USGS 2003]. Mentoring programs pair a mentor, someone with skills and experience within an organisation, with a protégé, a new member of the organisation, in a formalised one-on-one paring that bridges the hierarchy gap between the two. The pair meets on a regular basis to discuss various work related topics including the arrangement and goals of the organisation as well as possible career opportunities. These relationships are not only important to the two parties involved, but also to the company, facilitating collaboration and establishing networks of knowledge [Tighe & Haas 2003].

In knowledge based companies it is imperative that everyone have access to the same knowledge. Mentoring programs are becoming well recognised for providing an inexpensive means by which to "pass down corporate wisdom and experience, while keeping employees satisfied, challenged and, most important, loyal" [Harding 2003]. They also serve as confidence boosters for incoming employees, providing encouragement, reassurance, and moral support not typically received from other sources within the organisation. [Barsion 2002].

When establishing a mentoring program a couple of simple details could easily make or break the program. First off, both parties must be open to the idea of having a mentoring relationship. Companies can use incentives such as picking up the lunch tab, praise, or even promotion to evoke enthusiasm in the program and encourage people to become involved. Making the program too formal is a second common mistake. For some, a mentoring relationship that extends beyond the traditional bounds of a work relationship towards friendship, social support, and acceptance can be of great value to both the protégé and the organisation, especially in the long term [Beans 1999].

Mentoring relationships don't simply serve to benefit proteges. Mentors can also benefit from the experience. When Jack Welch, former CEO of General Electric Co. instituted a formal mentoring program, knowledge exchange was a two way street. Welch ordered his top 500 managers to pair up with a younger employee, even an entry-level worker in a mentoring relationship. In addition to younger employees acquiring corporate knowledge from their mentor, proteges helped to improve their mentor's technical expertise, including computer and Internet skills [Harding 2003].

3.2.2 Community of Practice

To address knowledge generation and sharing within an organisation many companies are turning towards communities of practice. Communities of practice take self organised groups that naturally communicate well in an organization due to their common work practices, interests, or aims (coffee room comrades or lunchtime discussion groups) and encourages them to become a "collaborative structure that facilitates the creation and transfer of knowledge" [Mentzas et al. 2003]. By introducing a regular system of interchange the aim is to formalise the internal dynamics of the community in an attempt to gain insight, accelerate problem solving, and encourage knowledge development and reuse. Communities increase the probability of knowledge transfer by providing a forum for employee sharing [Araro 2002].

The first step in developing communities of practice is to find existing communities and make them visible to themselves and the rest of the organisation [Allee 2000]. There is no need to recreate the wheel when it already exists. However, communities should not be viewed as a quick fix. They "take time to blossom, to build trust, and competence. They also require leadership, someone in charge of facilitating/communicating, feeding the process, being responsive to assure that answers are provided" [USDA 2001]. Much greater success occurs when involvement is voluntary, not assigned. When a sense of ownership and undertaken responsibility exists within community members there will be much more support and funding of the efforts [FHWA 2000]. The lifecycle of a community of practice is not defined by project deadlines, but by the value of the knowledge it creates and exchanges within its membership [Allee 2000]. When a community is no longer of use to its members it will cease to exist.

Although it may seem counter productive at first glance, communities of practice work best when members do not all share the same perspective, but when some complexity and conflict exists within its membership. Bringing people together who possess a different mind set can greatly improve a community's productivity by introducing many different perspectives and approaches to the discussion aimed at reaching a common solution [Arora 2002].

It is important to distinguish between communities of practice and other organisational structures. In teams, people complete tasks and take care of projects. In networks, relationships are formed. In communities, people share and develop knowledge that allows them to do other tasks [Wenger 1998]. The normal human instincts of desiring a sense of purpose and needing to know what others know is one of the strongest links hold communities together [Allee 2000].

3.2.3 Network Based User Help Services

Although there are many names for network based user help services including 'Expert Networks' and 'Interchange', their goals are quite similar, "to put people with problems in touch with people with solutions" [Griffith 1995]. These services provide formalised capabilities for workers in the field to locate and consult with internal topic experts on a complex or unfamiliar subject simply and easily [Slater 1998].

At CAN, an insurance giant, the system applied is simple but successful. An employee posts a query onto the network. Employees with expertise in the area receive e-mail notification that a

question has been asked related to their area of knowledge. Once the expert(s) respond to the question their response is returned to the employee who posted the query and added to the company's archive of questions and answers. This last step is quite important to prevent experts from being overwhelmed with the same question over and over again. CAN views this approach as a "high-tech geographically neutral water cooler that enables access to thousands of people" [Santosus 2002].

There are many other approaches to providing employees with a network based user help service. These include 'who knows what' directories, well established communication channels to subject experts, and elaborate systems to capture frequently asked questions [Wiig 2000]. However, the most complicated part of network based user help services is not developing it, but persuading employees to use it, especially subject experts. Before the service will be successful the mindset 'knowledge is power so hoard it' must be replaced with 'knowledge is power so share it and it will multiply' [Allee 2000].

3.3 Tacit Knowledge

The most valuable, but most difficult to maintain aspect of knowledge management is tacit knowledge. It is embedded in individuals experience and sense of judgement and includes "insight, hunches, intuition and skills that are highly personal and hard to formalize" [Mentzas et al 2003]. Tacit knowledge is "something we know, possibly without the ability to explain…Human beings are the storage medium of tacit knowledge. When the storage medium is an individual then it is vulnerable to loss" [Snowden 1999]. Much tacit knowledge is lost when experienced employees leave an organization. Thus, storing tacit knowledge in a community, not just in a single individual, reduces its vulnerability to being lost as well as enhancing its potential for reuse. Organizations whose workforce consists mainly of mature employees are especially vulnerable. Efforts to maintain tacit knowledge include phased retirements, advisory teams, and employee retention strategies. Phased retirement encourages employees eligible for immediate retirement to remain with the organization on a part time basis to allow the organization to continue to draw from the employee's knowledge and expertise [FHWA 2000]. Advisory teams, although less involved, operate under the same premise as phased retirement, encouraging retired employees to remain connected to the organization and bring back their knowledge through informal gatherings [USDA 2001]. Employee retention strategies are mainly directed towards maintaining employee satisfaction by providing employees with higher wages, more training, increased work schedule flexibility, additional benefit packages, and a state of the art work environment [FWHA 2000].

3.3.1 Phased Retirement

In order to prevent a decrease in an organization's level of knowledge when a knowledgeable employee retires, many companies are encouraging their employees eligible for immediate retirement to consider taking a phased retirement. Phased retirements allow employees to cut back to a part time schedule while still remaining active in the company [FHWA 2000]. Employers can continue to draw from these employees vast pool of knowledge for special projects, mentoring programs, or to training their replacement [Tighe & Haas 2003]. Universities, industry where knowledge transfer among employees is difficult, and organizations where a large portion of the workforce is approaching retirement are leading the way, being the

most open to the idea of phased retirement. In some instances organizations are finding that the part time salary of the retiree and a younger full time employee's salary is equivalent to the retiree's former salary [Gale 2003].

When the United States Federal Highway Administration presented employees eligible for retirement the opportunity to take a phased retirement the results were favourable. Positives included "retention of skills to cover recruitment cycles, the ability to transfer knowledge and mentor younger/newer employees, the potential for a more focused use of expertise from a person devoid of other day-to-day responsibilities and the promotion of a family-friendly environment" [FHWA 2000]. Other employers are finding that those employees who choose to take phased retirements work because they want to, not because they have to [Gale 2003]. Thus, they are more reliable, have stronger work ethics, are friendlier, and build stronger relationships with fellow employees and customers.

Phased retirements are also attractive to employees, allowing them to ease into retirement at a more gradual pace. They also give employees eligible to retire the opportunity to feel things out and ensure they are ready to retire at that point in their career. Depending upon pension plans, phased retirement can also serve to add a little more financial cushioning to employees retirement savings without requiring them to continue to work on a full time basis [Gale 2003].

3.3.2 Advisory Teams

When someone retires, they retire from the job. They don't lose interest in the profession they have been involved with for years. Advisory teams, otherwise known as discussion groups, are a simple, but successful way to build bridges between current employees and retired employees and capture the knowledge that would otherwise be lost when an employee retires [USDA 2001]. From years of experience retirees are more knowledgeable, and know what methods tend to work and what don't. These informal gatherings can also get retirees involved with employee recruitment, planning for the future of the company, and development of long term plans [Filip 2003]. Employees are benefited by involvement in advisory teams as well, allowing them to remain active in the company, knowing that they are still of value and are appreciated [Gale 2003].

3.3.3 Employee Retention

Society's views on employment have shifted over the years from a time when remaining with one company for a lifetime was quite common to a time when a change in employers every few years is the norm. Employers are beginning to realise the vast costs associated with separation, replacement, and training when an employee leaves an organisation prematurely. Solomon (1988) suggests that these costs can be in the range of 1.5 to 2.5 times the yearly salary of the person who leaves for knowledge workers while Harkins (1998) believes it can reach as high as four times the departing person's salary.

Employee satisfaction is the key to employee retention. Employees who are dissatisfied, especially outstanding employees, have a higher probability of leaving an organisation in search of a job they feel better satisfies their wants and needs [Sigler 1999]. Demands for higher wages, non-compliant with organisational practices and managers' directions, and poor interactions with

co-workers are indicators and employee is dissatisfied. From recent studies of issues influencing employees' decisions to stay with or leave an organisation, four basic factors were prominent: "effective management, career development opportunities, life-work balance benefits and programs, and compensation and recognition" [Berry 1998].

Effective management is very much dependent upon well established and utilised communication lines between employees and management. Management must not distance themselves from employees, instead build relationships, establishing confidence and loyalty, and being aware of employee performance levels [Berry 1998]. When management is more aware of poor performers, implementation of protocol for disciplining poor performers is simplified. By doing so, the negative work atmosphere and poor morale created by poor performers is drastically reduced [FWHA 2000]. A strong relationship between management and employees also enables management to more accurately reward talented employees and assign them to projects that take advantage of their expertise.

Career development opportunities are of great benefit to the employee and employers. Training courses that keep employee knowledge current and help them learn new skills are tightly linked to career development. Training opportunities are very rewarding to employees, giving them the opportunity for advancement within the company [Sigler 1999]. When an employee feels an opportunity for advancement exists, they are less likely to seek employment outside the company where the opportunity for advancement exists [Berry 1998]. Employee training also improves the company's profitability. Studies have also shown that corporations who invest above average amounts in training outperform their competitors who invest less [Bassi & McMurrer 2002].

Life-work balance benefits and programs, areas once almost unheard of are taking centre stage when it comes to employee satisfaction. Gone is the Monday to Friday nine to five work schedule or sixty to seventy hour work weeks, replaced by flexible working hours, the opportunity to work from home, and more family time [FWHA 2000]. Employers are recognising that employees have lives outside the office. In addition, some companies are starting to offer household chores assistance, such as laundry services and handy person services, child assistance, fitness centres, and sabbatical programs, all to provide employees with more balance and flexibility to encourage employee satisfaction [Berry 1998].

Compensation and recognition is most likely the most traditional and widely implemented employee retention strategy. Like customers, when employees' compensation and recognition expectations are meet or exceeded by the organisation, the employee's intentions to stay with the organisation are much higher, which decreases employee turnover [Rust et al. 1996]. As society becomes more and more expectant of reward, the reward must become more "meaningful, highly, visible and show an individual has made a significant contribution to the organisation" [Berry 1998]. It must also "occur in a timely and equitable manner". Traditional compensations such as cash bonuses, stock ownership, and salary increases are complemented by recognition in the form of certificates at department meetings, meals, and a verbal thank-you. More meaningful recognition can include tickets to sporting games, the theatre, or a special event.

4. Common Misconceptions and Mistakes

A common misconception companies have about knowledge management systems is the belief that they will build organizational culture. On the contrary, knowledge management systems require organizational culture to exist before they are implemented in order to obtain success. Employees must be open to the introduction of a knowledge management system and be willing to freely share and transfer knowledge within the organizational structure [Dunne & Horgan 2001].

The main mistake made by companies when implementing knowledge management is being afraid to jump in with both feet. Companies with a clear vision of what they want to achieve and a well laid out approach of how to achieve the desired outcome typically experience success. Those who choose to join the knowledge management bandwagon in an effort to reap some quick benefits, but focus only on the explicit knowledge side and don't implement a long-term strategy typically experience failure. All three components of knowledge management, explicit knowledge, implicit knowledge, and tacit knowledge, are crucial. Each component serves its own purpose, but relies on the other components for support. If a knowledge management system does not prevent reinvention of the wheel by leveraging knowledge assets already in existence it is not doing its job [Arora 2002].

Attempting to place only a dollar value on knowledge capital is another common mistake. Not only will much difficulty be encountered in doing so, but results will be unrepresentative of the true value of knowledge, especially in the early stages following the implementation of a knowledge management system. This is due in part to the fact that an organization does not own its human capital like it does with other assets [Bassi et al. 2000].

5. Recruiting and Retaining Individuals in Transportation Agencies

The National Cooperative Highway Research Program (NCHRP) prepared a survey for state and provincial transportation agencies regarding how they recruit and retain professionals. This survey was completed by 24 states and three provinces [NCHRP 2003]. The Ministry of Transportation of Ontario (MTO) also performed a similar survey [MTO 2004]. The results obtained from MTO and NCHRP are compared within this report.

Some things never change over time and one is that people value monetary rewards. A consensus from the survey of 27 transportation agencies was that the most common reason engineers, technicians and IT professionals go to a job, stay with a job or leave a job is because of the salary. MTO also listed that salary was the greatest incentive for professionals to work with them. No data was available from MTO as to the reason people left their organization. When recruiting engineers, an equal number of transportation agencies listed salaries as a key factor as listed school involvement. A variety of activities fall under the school involvement category, including: co-op or internships with students, job fairs and visiting high schools to promote engineering. Many transportation agencies stated that providing further training or reimbursement for Master's studies aided in acquiring and retaining employees. Training is listed as the second most successful method at MTO for encouraging new employees and retaining others. MTO provides two training programs; Engineering Development Program (EDP) and Transportation Technician Initiative (TTI). EDP allows engineers to rotate through different

positions throughout the province. Rotational jobs as a recruitment and retention incentive is done by a few of the transportation agencies as well. TTI and EDP allow MTO to strengthen their employee group so that they will not have a shortage of staff in the future. The third incentive for employees from the perspective of MTO is succession planning. A fifth of the transportation agencies surveyed noted that acknowledging a career path or ladder for their employees worked well for recruitment and retaining. The career ladders all came back to one point though, salary increases after a given amount of time or significant achievement. A few states had unique ways of recruiting their employees. The state of Delaware flies a banner plane over their beaches and those of Maryland. South Carolina states that "The 'team' approach allows engineers already on board with us to share their knowledge and assist with the recruitment of engineers". The 'team' approach was never further explained but referenced several times. Newfoundland stated several times that they had never had trouble recruiting using normal methods of recruitment, which were also never explained. The three main recruitment incentives listed by MTO are similar to that of the NCHRP survey although MTO does not mention any contact with universities, colleges or high schools. Other agencies feel that their internship and co-op programs, job fairs and pre graduation job offers are very useful in their recruiting [NCHRP 2003, MTO 2004].

A variety of responses came from the survey regarding the impact of different recruitment strategies. Half of the responses stated that with their strategies they were able to fulfill their need for engineers. A few agencies commented on how they enjoyed being able to "try" an individual through a co-op or intern position and if they felt they were suitable then offer them a full time position. MTO noted that they received almost three times as many applications in 2004 than in 2001 for ten positions in their Engineering Development Program (EDP). The qualifications for the applicant pool at MTO are subsequently increasing every year [NCHRP 2003, MTO 2004].

Incentives for recruitment and retention tend to be similar for transportation agencies. The retention strategies have had a good impact for most agencies. One agency stated that they were losing employees because they could not provide a salary competitive to that of the private sector. Two other agencies however, noted that they had employees staying with them that could have been receiving a larger salary in the private sector. Reduced turnover rates of 2 to 5% were noticed at a few agencies, while others noted they had less vacant positions. Generally agencies were stating that with their retention strategies their organizations were looking very stable and there was a good impact. MTO did not provide information as to how their retention strategies were working [NCHRP 2003, MTO 2004].

MTO has been doing voluntary exit questionnaires since 2002 to gather information about people who leave the organization. Very few of these questionnaires have been completed at MTO and a third that have are by retiring staff. A couple of transportation agencies also perform exit surveys. Some also do entrance and random inquiry surveys which are administered by their Office of Quality [NCHRP 2003, MTO 2004].

6. Role of Succession Planning in Knowledge Management

Employee recruitment and retention in transportation agencies, as previously discussed, should be a vital element of their overall management strategy. Recruitment and retention can also be a part of succession planning, but it does not cover the full scope of succession planning. In turn, proper succession planning can and should be a key part of knowledge management.

First, however, it is appropriate to define succession planning. According to work carried out within TAC [Tighe and Haas 2003], it is:

> "A process for ensuring the orderly planning for renewal, upgrading and continuity of an organization's resources including people, technology and information/data"

It should be noted that succession planning in this definition comprises three main elements: (a) people and their experience and expertise, (b) technology in terms of methods and procedures, codes of practice, software, hardware, facilities, etc., and (c) information and data, particularly in terms of the time dimension. While all three elements are related and important, it is the first element of people succession that is given attention in the following discussion.

It may also be noted that in knowledge definition terms, the following applies:

a) People: implicit and tacit knowledge
b) Technology: explicit knowledge
c) Information and data: explicit knowledge

Lack of proper succession planning has been labelled "institutional Alzheimer's" - the corporate memory loss that occurs when key employees leave an organization [Globe and Mail 2002]. The article noted points out that such companies as Clarica Life Insurance, EDS Canada and multinational Proctor and Gamble have a goal to "leverage our substantial investment ... to make the most of the knowledge contained within the firm".

Unfortunately, this has not been the norm. For example, the Ministry of Transportation Ontario "surplussed" (to use their terminology) in 1996 all their engineers with less than 5 years seniority and their technologists/technicians with less than 15 years. The loss of investment and the impact for the future of losing a large number of (mostly young) people has to be substantial. Fortunately, however, about 5 years later, the Ministry adapted a new policy of "Hiring for the Future" which states [MTO "Road Talk" 2002]:

> "A strategic approach to ... guarantee long term vitality ... pool of personnel to draw upon for succession planning ... attracting and retaining permanent employment...".

These are good reasons for succession/planning/knowledge management and they include the following [Tighe & Haas 2003]:

1. It is cost-effective
2. It contributes to organizational stability
3. It is good public relations
4. It reassures the "marketplace" (both internal and external).
5. It preserves a substantial investment
6. It is just good business

Proper succession planning is critical to the future vitality of the transportation sector. Several key components are involved in succession planning and they include the following:

- Recognising the need and obtaining top level commitment
- Developing a plan which involves timing of replacements, including sufficient training and overlap, provides for contingencies (e.g., sudden resignations) and contains mentoring responsibilities
- Making the necessary investments
- Keeping the plan dynamic by periodic updating and periodic assessment of its effectiveness
- Documenting the plan and procedures, its ongoing activities and accomplishments and the lessons learned.

There are also obstacles to succession planning/knowledge management and they can include the following:

1. Rapid turnover of administrators
2. Financial exigencies
3. "We can buy people, technologies and information" philosophy
4. "We can always rely on immigration" for any shortfalls
5. Frequent resignations and/or "poaching" by competitors
6. Lack of commitment and lack of data or resources
7. Lack of documentation (technology, methods, equipment, procedures, etc.)
8. Lack of training programs
9. Lack of balance between outsourced work and "knowledgeable client"
10. Short term political decisions

6.1 Economics of Succession Planning/Knowledge Management

In addition to the transfer of knowledge, succession planning provides tremendous cost savings. As noted earlier, formal mentoring and thus succession planning provide an inexpensive method for passing down corporate knowledge and wisdom by keeping employees satisfied, challenged and most important, loyal. This loyalty translates into employees who are interested in their jobs

and who feel they are part of a team where they count. The senior employees are truly interested in their protégé's success and often try to promote and challenge them. It is also a well-established fact in management that if people feel they are part of a team and "valued" by the organization they are less likely to leave the company or field of work.

Employee turnover rates are an excellent measure of cost savings. A privately held U.S. based software company provides tremendous benefits to its employees including use of extensive recreational facilities, day care and medical facilities, etc. In an industry where annual employee turnover rates are 20%, this company has an average turnover rate of 3% per year. Experts at Stanford University have estimated that this dramatic reduction in employee turnover results in conservative savings of 60 to 80 million U.S. dollars per year [CBS 2003]. These savings are simply associated with the retention of corporate knowledge, stability in the workforce, and reduced stress associated with convenience of amenities.

Although it is difficult to completely quantify the cost savings associated with succession planning, it is evident that if employees at all levels in the organization are part of a team they are less likely to leave. Effective organizations are those that capitalize on their resources and transfer knowledge across the organization. In short, succession planning can be a key area of cost savings for the transportation and pavement sector.

A comprehensive study on the value of training and its relationship to succession planning, a summarized by [Muench 2004], states that:

> "Knowledge is a vital organization asset..... .Today,.....organizations are routinely valued not on their physical but rather their intellectual capital", where intellectual capital is [Edvinsson and Malone 1997] "The possession of the knowledge, applied experience, organizational technology, customer relationships and professional skills that provide an organization with a competitive edge in the market".

The study by [Muench 2004] indicates that a return on investment (ROI) analysis of the value of training ranges widely but even the most conservative estimate would put it at 7%. Another way to look at this is in terms of knowledge creation, and in turn knowledge management. In essence, any management process seeks a positive ROI and certainly training/knowledge creation can and should provide that ROI.

7. Conclusions

This report has addressed the basic elements of knowledge and knowledge management. More specifically, the following conclusions can be drawn from the report:

1. Knowledge is an asset. It has value and thus should be a component of asset management. A generic, overall framework for asset management illustrates that knowledge is explicitly or implicitly embedded in each item or activity at all levels (strategic, network/system wide and project/site specific)
2. Knowledge itself has been defined by various people and organizations but perhaps more important is the categorization:

a) Explicit knowledge, usually in the form of documented information
b) Implicit knowledge, or "know how", can involve both documentation and verbal communication
c) Tacit knowledge, a human embodiment of experience, skills, judgement and other attributes

3. Recruiting and retaining individuals in transportation agencies is a cost-effective endeavour and an asset preservation or enhancement strategy
4. Succession planning, in terms of people, technology, and information, covers explicit, implicit and tacit knowledge. It should be a key part of knowledge management.
5. While knowledge management has been the subject of numerous studies, and while the literature is replete with the subject matter, there is little operational guidance for agencies who wish to incorporate knowledge management within their corporate strategy or business process.

8. Recommendations

The next steps to follow the study reported herein are recommended to be the following:

1. Development of an operational protocol for knowledge management in the area of explicit knowledge, with application/demonstration to a specific item; eg., long life or perpetual pavements. This is a component, which by its very definition, will cover a long period of time, more than one generation of engineers and technicians and thus it is vital that continuity exists to maximize the value of the knowledge involved with design, materials, construction, monitoring, maintenance, life cycle analysis, etc.
2. Development of an operational protocol for knowledge management in the area of implicit knowledge, with application/demonstration to a specific case study; eg., technical competence and succession planning in bituminous materials. With the advent of new technologies, but also the need for realizing the value of past experience and gained expertise, this can be an important contribution to the long term return on investment.

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