# KM Infrastructure and Electronic Services with Innovation Diffusion Characteristics for Community Economic Development

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**Abstract:** Building knowledge management (KM) infrastructure involves reuse and refocus of several existing infrastructure components, and awareness around future visions and conditions of infrastructure. We present a community perspective using a staircase metaphor for conceptualizing government supported KM infrastructure and services. Additionally we illustrate a model for government's role in providing and leveraging infrastructure components from all tiers of government. With examples, we build a case for adding diffusion of innovation characteristics, and features from innovation networks analysis in KM infrastructure. Observability and trialability are important to knowledge acquisition, while compatibility are central to knowledge application, packaging, and creation. Ease of use, and perceived usefulness affects knowledge use in all its forms.

**Keywords**: KM infrastructure model, SME, small business, economic development, e-Government, knowledge services, diffusion characteristics, community

## 1. Introduction

More sophisticated services than are currently available are required to serve the noble goals of many web sites set up to make information and knowledge available to all. As a sector example, sites such as www.canlli.org, www.austlii.org, and www.law.cornell.edu all share a similar mandate to make legal information available and freely accessible to ordinary citizens. However, a current search on, say, privacy law on these sites is not useful or easily decipherable to most of us. Needed are real technological advances in methods for natural language processing, context-sensitive text mining, and image and voice processing to realize full technology-enabled KM. In recent years, Web sites, Intranets, and search engines such as google and kartoo have become markers on the course to the future of KM.

The cycle of technology research, invention, adoption, and use is only one facet of KM. Keep It Simple Stupid (KISS) is a guiding principle to knowledge diffusion. Such principles are rooted in the diffusion of innovation literature which identifies characteristics such as ease of use, perceived usefulness, observability, trialability, and compatibility as critical success factors. Nonaka and Takeuchi's (1995) famous model for knowledge creation in companies identifies the two key forms of knowledge, tacit and explicit, which characterize various conveyance means for knowledge and thus motivate the combination of vehicles through which we acquire knowledge and skills. Additionally, the field of research on innovation networks analyzes topological issues such as the relation between the strength of the linkages in the networks through which we transfer knowledge, and network homogeneity that can degrade innovation capability.

It is our thesis that knowledge management infrastructure and related services should be built from the ground up with learnings from various fields. In this paper, we particularly focus on KM infrastructure that governments build with the intent for small and medium sized enterprises (SMEs) in communities to leverage for economic development. We illustrate our thesis using as an example the government of Canada's work in this area.

Motivated to increase the country's productivity, the Canadian government issued a 10-year innovation strategy agenda in January 2001. Canada's innovation strategy identifies goals, targets, and government priorities in four key areas: knowledge performance, skills, innovation environment, and community clusters. In this paper, we describe knowledge management (KM) infrastructure to support Canada's four key strategic areas from the perspective of three tiers of government: federal, provincial, and

municipal. Within the tiers, we illustrate the KM infrastructure in terms of innovation network theory (Allee 2000, Ahuja, 2000; Baum and Ingram, 2000; Benassi and Gargiulo, 2000, Burt 1992) and innovation diffusion theory (Mahajan and Muller, (1979); Davis, 1989; Mahajan, Muller and Bass, 1990; Mathieson, 1991; Moore and Benbasat, 1991; Rogers 1995; Hu et al, 1999; Agarwal and Prasad, (1998); Durrington *et al*., 2000) with respect to knowledge management. Both fields of study facilitate the knowledge and innovation creation and diffusion process. Furthermore, we map many of the findings in these two fields to Nonaka and Takeuchi's (1995) knowledge creation framework thereby showing why findings in these two fields are important to knowledge management.

We organize the paper as follows. Section 2 presents communities' clustering from a KM infrastructure view. Section 3 reviews a model for federal and provincial government to use as a guide for building KM infrastructure, as well as provide illustration of the model with best practices in Canadian KM infrastructure. In section 4, we make a recommendation for a provincial KM infrastructure piece that is still missing from the Canadian governments efforts. Section 5 targets how communities build their own KM infrastructure and use it. Finally, section 6 provides a summary and conclusion.

## 2. The community cluster perspective for knowledge infrastructure and service

We present a conceptual community view of a country's knowledge management infrastructure in this section. This perspective helps us to visualize community clusters. Community clusters are not limited to spatial proximity in our view. Figure 1 illustrates our community cluster perspective, shown from the view of someone standing at the top of a wide staircase and looking down. The top stairs represent the communities in a country. Some citizens view the entire staircase as one community. Some citizens only see one tile in one stair at the spot where the citizen is standing. It is important when managing knowledge for governments to take a wide-angle view from the top of the staircase – the community focus. The top staircase level in Figure 1 represents KM infrastructure for all the communities in a country. The level beneath represents that for all the municipalities and counties; the one just below represents the provincial KM infrastructure. The bottommost rung and the KM infrastructure common to all is the federal KM infrastructure. We propose not to duplicate the common infrastructure provided at bottom steps at higher levels. Rather, federal infrastructure should be leveraged and efforts at the top of the staircase should be targeted to knowledge not easily available at the bottom of the staircase.

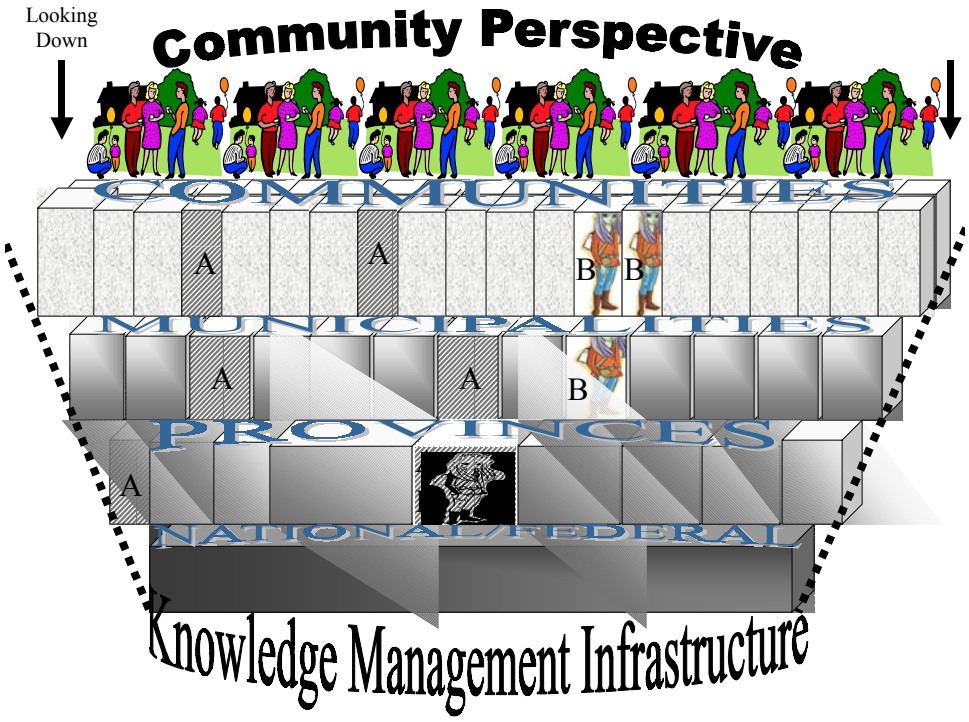


**Figure 1:** A Staircase Metaphor for Knowledge Management Infrastructure

 

Knowledge management infrastructure for community clusters form from slicing and dicing the stairs, according to themes, or industry sector, or other common criteria. For example, a community cluster (see A in Figure 1) could consist of the historical rural shipbuilding communities of River John in Pictou County, and Shelburne in Yarmouth county, both in the province of Nova Scotia, plus the past shipbuilding city of Saint John in the province of New Brunswick. Another example of a community cluster (see B, in Figure 1) may be all the communities belonging to one county where geography and political leadership are the common ingredients.

Although we place emphasis on knowledge management infrastructure for economic development in urban and rural communities, our model clearly shows that local KM infrastructure does not exist in a vacuum. Indeed, local infrastructure is greatly impacted and often path dependent on higher tier government KM infrastructure. The KM infrastructure at the national/federal level is pervasive in a bottom-up fashion and is accessible by all tiers of government.

Integrated service delivery is a frequently-used term in government that refers to the integration of services across layers of government departments, agencies, communities, and jurisdictions. Using the staircase metaphor, we can effortlessly conceptualize horizontal-only vertical-only, and then combinations of horizontal and vertical usage of infrastructure. Horizontal-only integration is more apt to occur at the bottom rungs of the staircase, at the federal level for instance. In contrast, innovative community services may require higher degrees of both vertical and horizontal integration of infrastructure services.

## 3. Federal and Provincial KM infrastructure model

The Canadian federal government summarizes the challenges of creating and maintaining a knowledge economy in the four key areas of priorities as follows (GoC, 2001):

> *"Knowledge performance: Finding better ways to create knowledge and for firms to bring these ideas to the market.*
>
> *Skills: Ensuring that in years to come that Canada has enough highly qualified people with the skills for a vibrant, knowledge-based economy.*
>
> *The Innovation Environment: Modernizing business and regulatory policies to support and recognize investment and innovation excellence.*
>
> *Community clusters: Supporting innovation at the local level so that our communities continue to be magnets for investment and opportunity."*

We capture these federal government priorities in the following model (Jutla et al 2002, Jutla 2003), illustrated in Figure 2, which guides governments in building infrastructure for a knowledge-based society. Keeping in mind that a major government role is the building and maintaining of many types of infrastructure, we will show that each of the six components in our model require knowledge assets, and hence a layer of knowledge management runs through them.

We present a working definition of the term infrastructure before we introduce the different areas of infrastructure to support services that are essential to knowledge-based societies. We adopted Slootweg and Verhoef's (1999) definition of infrastructure, and modified it to include assets such as workforce, and skills; in electronic society, physical facilities include physical network backbones, databases, and hardware/software.

> *"An infrastructure is a large-scale technological system, consisting of physical facilities and knowledge assets, and delivering (an) essential public or private service(s) through the storage, conversion and/or transportation of certain commodities/services. The infrastructure includes those parts and subsystems necessary for fulfilling the primary storage, transportation and/or conversion function(s) as well as those supporting a proper execution of the primary function(s)."*

The model in Figure 2 suggests that a knowledge and innovation based economy is the desired outcome of effectively building the following six components' infrastructures and processes. Each component has associated process inputs and outputs, as infrastructure is set up to support a particular flow (e.g. content, regulation, e-government service, communication, skill).

 

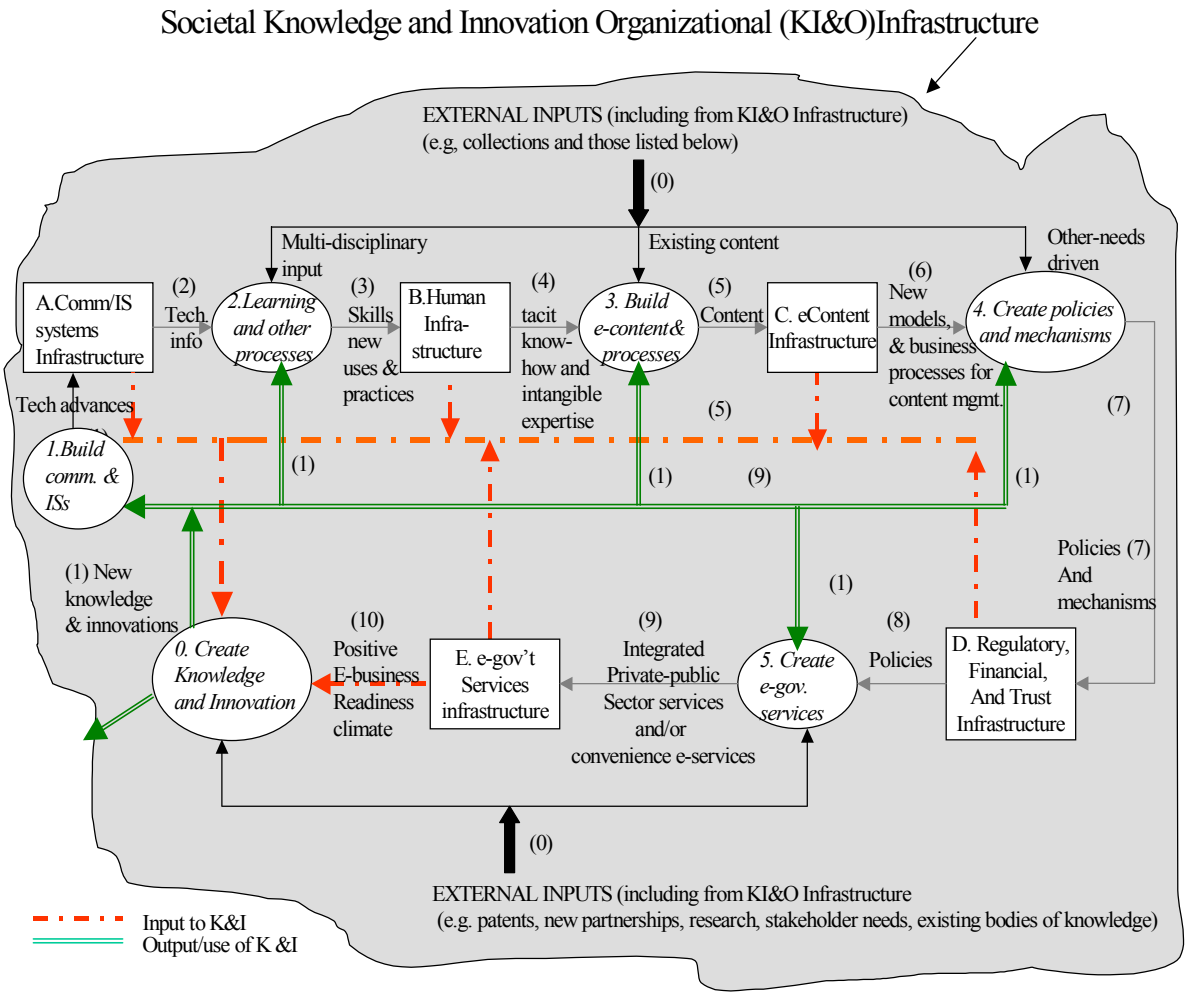


**Figure 2:** KM Infrastructure [adapted from Jutla 2003].

We conceptualize dependencies in the model at a high-level in Figure 2, and refer the reader to Jutla et al (2002) for details on the conceptual literature surrounding this model. We provide visibility in Canada's work in building each major infrastructure component, shown in the model in Figure 2, in the subsequent sections of this paper. Knowledge management relies on the following six infrastructure components.

1. Communications and information systems infrastructure (A)
2. Human infrastructure (B)
3. Content infrastructure (C )
4. Regulatory, trust, and financial infrastructure (D)
5. e-Government infrastructure (E)
6. Organizational infrastructure for knowledge and innovation (F)

Some notes for reading the model shown in Figure 2 are given:

a) All infrastructure components (A, B, C, D, E, F) output (see broken lines) to the "create knowledge and innovation" process (complex aggregate of many processes) which then provide inputs (see double lines) to all other processes used to build the six infrastructure components.
b) Each infrastructure component has many complex processes inputting to it and accepting output from it. For simplicity, we show only one aggregate process per infrastructure component as input.
c) The KI&O organizational infrastructure (shown as the cloud) connects and "oils" the rest of the infrastructure components.
d) Information flows are labeled with numbers (0), (1), (2)…(10) in brackets.
e) Processes are also numbered (0, 1, …5) without brackets..

Although there appears to be a linear sequence among components in our proposed model, it is possible, to have different orders and priorities of building infrastructure components; and it is recommended, to build

 

components in parallel whenever possible. The order we present in our model was the naturally occurring and logical ordering found in most government facilitation to date. Indeed, organizational infrastructure often appeared quite late in many countries' e-government efforts, grafted on when change management in the workplace was identified as critical to success.

Indeed, in many countries, first-generation knowledge infrastructure at a national/federal level involves getting citizens' access to government information and codified knowledge on government Web pages. Thus, information and communications technologies (ICT) infrastructure is among the first KM infrastructure components we build. It is a good case for priority since ICT infrastructure serves more than KM purposes.

Provinces, municipal, and urban and rural communities are being encouraged by the central government to (1) partner and collaborate, (2) serve sophisticated and global markets with demanding customers, and create unique products/services, and (3) meet global standards in order to promote and sustain economic development. Thus, steps are being made to address the fact that many communities often lack both the absolute and comparative competitive advantage to participate in the world market place (Sieber, 2003). e-Government strategies are pioneering a second generation of knowledge management infrastructure to support the communities' economic goals. Second-generation knowledge infrastructure includes creating innovation networks by connecting existing networks, digitized content, and knowledge repositories.

This rest of this section illustrates how the Canadian government is satisfying theoretical characteristics of diffusion of innovation and creating core features of social networks found in literature in the practical setting of providing KM infrastructure. We organize the KM infrastructure according to six components in the model for building knowledge and innovation infrastructure illustrated in Figure 2.

### 3.1 Organizational infrastructure and services

Organizational and social science factors are often afterthoughts in technology diffusion processes. However, organizational infrastructure to support e-business diffusion needs to be built and woven into the fabric of society and business from the very beginning and governments can play an important role here. Organizational infrastructure, consisting of innovation networks and governance structures for coordination, aggregation, funding decisions, and bridging innovation networks, is a key factor in knowledge performance.

Innovation networks are vehicles for diffusion of information, knowledge and innovation across many different individuals and groups in organizations, governments, and among countries. Researchers define diffusion of innovation as the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995). Innovation diffusion theories split commonly into two groups, with researchers focusing on either innovation characteristics' analysis or social network analysis (Higa et al, 1997). Diffusion theories have many parallels in KM. The most popular innovation characteristics are relative advantage, compatibility, observability, trialability, and complexity (Rogers, 1995). Observability is the extent to which the results of an innovation are observable to others. We can immediately map the observability construct to Nonaka and Takeuchi's (1995) model of knowledge creation. For example, a primary vehicle for the flow of tacit knowledge occurs through socialization (Nonaka and Takeuchi, 1995) or behavior/innovation observation, and beliefs copying. Trialability is the extent to which an innovation can be experimented with before adoption We map trialability to knowledge internalization in Nonaka and Takeuchi's (1995) flow of explicit to tacit knowledge quadrant.

Complementary research into social network analysis explores the strength of the relationships in the network, and the network topologies. Social capital in the relationships among network participants assists in coordinating and integrating knowledge from many diverse fields. Often the knowledge that is transferred among individuals, groups, teams, and others is tacit and can only be learned through communication, articulation, or personal interaction – combining the externalization and socialization quadrants in Nonaka and Takeuchi's (1995) knowledge creation framework. Networks ease the knowledge transfer and absorption process within and among stakeholder organizations (Allee, 2000), thus also assisting internalization (Nonaka and Takeuchi, 1995). Additionally, innovation networks enable a stakeholder to draw on knowledge from external sources that

 

the stakeholder would not have been able to access otherwise (Gargiulo and Benassi, 2000, Ryecroft & Kash, 2000). These networks create flexible systems enabling communities of practice or "informal and semi-formal networks of internal employees and external individuals based on shared concerns and interests" (Malhotra, 2000). Networks can also facilitate lobbying, representing, marketing, promotion, sector alliances, and international alliances, all activities important to economic development.

Governance structures to support various communities of practice form another part of organizational infrastructure. At the federal level, the Canadian government created an Organizational Readiness Office (ORO), under the Chief Information Officer Branch of the Treasury Board of Canada Secretariat, to provide such governance. The ORO develops community work plans, and research and demographic-analysis capacity for knowledge sharing networks or communities of practice. Currently, the ORO supports three communities in the public service of Canada: information management, information technology, and service management communities of professionals. According to the ORO's web site (www.cio-dpi.gc.ca/oro-bgc/index_e.asp), "..the ORO is also being recognized as a center of excellence in nurturing informal workplace learning and knowledge sharing networks..."

The ORO networks establish a normative environment that allows community members to expect a certain code of conduct from other network members. ORO community members bond through the increased perception of the similarity among community members' goals and values. Rogers' (1995) innovation diffusion characteristic of *compatibility* or the extent to which an innovation is perceived to be compatible with current values, needs, and past experiences of potential adopters is present in the ORO's efforts. As evidence, the ORO site publishes the results of community exercises to identify and relate the similarities among the group and individual's goals and values for each supported community.

Federal-level Industry Canada plays an active role in creating partnerships between public research sector and private sector, often sponsoring workshops and conferences for facilitation. Behind the scenes, the Canadian government has enabled a network of government departments and agencies that service industry to co-ordinate and exchange research projects, experiences, and programs as an initiative under its "e-Business Growth Strategy." To complement the public sector activities, a Canadian e-Business Opportunities Roundtable (eTeam, 2002) comprising of mainly private sector representatives was formed in mid-1999 to "accelerate Canada's leadership in the digital economy." In 2002, the Roundtable morphed into the Canadian e-Business Initiative ( www.cebi.ca).

A good example of the contribution to innovation networks and governance, at the provincial level, is the knowledge infrastructure that the Integrated Services Delivery Division (ISDD) of the Ministry of Consumer and Business Services maintains to support the Ontario Public Service. Several publications (Socitm 2002, ICCS-ISAC 2003) identify that turf tension, organization culture clashes, resistance to change, and tunnel vision are some of the key organizational barriers around providing better e-service delivery to provinces, municipalities and citizens. In 2003, the ISDD addressed the barrier by Web publishing an excellent, and pragmatic, Partnership Workbook that contains the "concepts, knowledge, and experience garnered from research, workshop, and consultations" (ISDD 2003) on the topic of partnerships. This 77 page workbook resource and others, such as a template for a funding agreement between the federal government and a provincial business services society targeted for community economic development, can be found through the Institute for Citizen-Centred service Web site. See figure 3 for a web of other knowledge resources relating to using electronic means for service delivery as well as community economic development.

Other provinces in Canada, such as Nova Scotia and New Brunswick, centralized service delivery by creating a Department solely responsible for this function. Nova Scotia created the Department of Service Nova Scotia and Municipal Relations (SNSMR) incorporating the former Business and Consumer Services portfolio. Unique to Nova Scotia's centralized model is the elevation and recognition of the importance of municipal relations as demonstrated in the Department's name. The department actively supports innovative service deliveries from a wide variety of federal agencies, municipal and intra-provincial partners. More recently, the Nova Scotia Justice department, Halifax Regional Municipality (HRM), and the Registry of Motor Vehicles function of SNSMR

 

partnered to allow citizens to pay parking fines through a single service access point hosted by Service Nova Scotia as opposed to going to 3 separate access points including Justice and HRM. Building on e-government service delivery, SNSMR actively participate in knowledge creation, transfer, use and delivery by sharing their expertise in facilitation, integrated processes, best practices, and knowledge around Web sites portals with municipal partners such as the e-government award winning Cape Breton Regional Municipality, and communities such as Pictou County's River John (www.riverjohn.com). The province enhances knowledge transfer through an informal "loan " of a skilled person resource for a few days in whatever IT capacity the partnering community requires.

### 3.2 Access to communications and information systems infrastructure and services

The first generation of *access* to a first-generation online knowledge infrastructure was driven from the federal tier of government from the mid-nineties onwards. Since then, Canada has made many advances in increasing access of its citizens to a communications infrastructure for knowledge diffusion. For example, through the community access program (CAP), Canada connects 10,000 communities. The VOLNet initiative connects a further 10,000 voluntary organizations. In terms of communications infrastructure, Canada has the world's longest purely optical network at 6000 km. It has the capacity to exceed 40Gbps. According to the OECD (2001), the country is also second in the OECD in terms of broadband penetration. Com Score Metrix Canada and Nielsen Ratings report that approximately two-thirds of Internet home users in Canada are currently subscribing to broadband services in 2003. The Canadian figure is almost twice the broadband penetration of US households. Current deployment of broadband infrastructure can support access from 80% of the population. In the world connectedness index, Canada ranks second with respect to availability, third in price, and first in reach and use (Conference Board of Canada, 2002).

To further support community economic development, Canada has the second largest number of community "freenets" behind the US (see http://www.lights.com/freenet). The freenets intend to provide free email and Web space to individual users. Many freenets are charging a small fee now but it is still possible to find some free service providers for dial-up and DSL services, and to connect mobile personal device assistants (PDAs) to the Internet. The freenets are a low cost solution for hosting the Web sites of small businesses in distressed yet connected communities.

A theme throughout supporting knowledge management in this paper is reuse of existing infrastructure elements. In the physical ICT world, technology advances such as ad hoc networks (Malek, 2003) are reusing existing devices such as personal computers, printers, and even toasters as relay devices for mobile communication packets. Through the vision and eventual realization of the Semantic Web, we expect some refinement of ICT infrastructure with standardization around platforms supporting user agents' communication for useful Web services. Examples of potential Web services include: easily seeking out useful knowledge, automating the integrating of information and knowledge from various stakeholders, automating the visualization of information and knowledge according to a range of user profiles, and managing collaborative stakeholder updates to distributed assets containing domain knowledge.

Provincially, there has been a move towards the standardization of ICT infrastructure. Nova Scotia has over 8000 licenses for SAP financial and human resource applications. When the Cape Breton Regional Municipality (CBRM) had a successful, low-cost implementation of SAP R/3™, providing activity based accounting and customer relationship management, CBRM was well on its way to providing its communities with infrastructure on which to develop community services. CBRM achieved low-cost implementation through knowledge transfer around SAP™ from the Halifax Regional Municipality and Services Nova Scotia and Municipal Relations, thus reaping one of the main benefits of standardization – access to an existing pool of skilled resources and proven procedures. Such standardization links to the compatibility characteristic in the diffusion of innovation literature. Its benefit shows relative advantage. Another government effort emerging from Denmark (DK 2003) to standardize open source software links very closely to compatibility with respect to alignment in country's values.

We have not yet seen the diffusion to communities of the next generation of ICT infrastructure that will provide powerful visualization of complex phenomenon, and

 

integration of voice capabilities. Emerging ICT paradigms such as the Semantic Web and computer grids are expected to provide interoperability and plug and play capability of software applications running on optimal configuration of hardware, and knowing where to access appropriate data. The application of knowledge supported by these powerful systems could revolutionize many fields. Some predict that in the next 50 years, all information about objects including humans, processes, and organizations will be online (Brown and Dugald, 2000). Perhaps all meta-information will also be available so that machine agents will be able to help humans sift through the vast volumes of data, and to reason to produce useful knowledge.

### 3.3 Human infrastructure and services

Human infrastructure consists of a workforce with the skills to effectively and efficiently acquire, apply, create, and transfer knowledge. A preliminary study shows that most employees create knowledge within scope of his/her expertise, and most package existing (versus creating) information and knowledge, whereas all interviewees apply knowledge in their job (Daigle-LeBlanc, 2001).

Knowledge transfer to students, SMEs, and communities is being done on several fronts. Infrastructure comprises skills distribution channels, not only over the Internet, but also through existing channels including the face-to-face channel. Strategists agree that using existing, branded, skills distribution infrastructure is effective and recommend modifying or adding new programs to deliver over them. Adding complementary Internet delivery channels to these delivery systems increases their reach and provides material to support their programs in a cost effective manner.

Governments, associations, and communities transfer knowledge to citizens and members through services such as educational seminars, practice sharing, and job training. One of the more useful mechanisms for transferring knowledge and innovation to the SME sector is through distribution channels such as university business development centres, and government business service centres. These provide pertinent e-business development skills at very low cost to SMEs. Traditional services have included writing business plans, developing new products, and assisting with complex accounting and taxation issues. These centres and/or networks have existing client bases that they can influence directly and hence increase the rate of e-business adoption by SMEs. In 2000 and 2001, agencies of Industry Canada conducted dozens of workshops and seminars on e-commerce for the SMEs across Canada.

Supporting Canada's Innovation Strategy is Industry Canada's Student Connections Program (SCP). Running out of provincial business service centers, community colleges, and university business centers, the SCP (http://www.scp-ebb.com) hires and trains post secondary students and recent graduates from universities and community colleges as small business advisors. Although the Students Connection Program trains on a whole variety of business services, it has been responsive to the government's desire to e-business enable its SMEs, and currently offer face-to-face courses on Internet training, customized Internet training for seniors, electronic commerce implementation, and electronic commerce strategy at beginner and advanced levels. Supplementary, free online course materials are also available.

Generally, government support for the development of e-business knowledge and innovation has focused on setting up research centers, helping e-business ventures in key national industrial sectors, and on facilitating the adoption of e-business by the SME sector. Research institutes have been encouraged to combine expertise from multiple disciplines such as engineering, computer science, business, law, and policy. Other research institutes have set up associated e-business incubators to facilitate the transfer of innovation to the commercial SME sector. Infusing existing infrastructure for research and development with additional funding for strengthening and expanding multidisciplinary research, and for creating additional places for higher education in targeted disciplines, is another way of expanding knowledge assets. According to (FF4, 2003) "the skills gap in Canada is most severe in the core occupational disciplines of computer science, microelectronics design, photonics and wireless design, software design, and systems analysis." Thus, demand for skills is still high in subsets of the computer science (CS), management of information systems (MIS), and electronics and electrical engineering (EE) disciplines. These are among the disciplines that tend to create skill sets to invent new technologies, techniques, and processes.

 

Colleges and universities aid in skills' development and extend the reach of certain skill development services through making them available through online learning and distance education. Online courses are rapidly becoming a commodity accessible to many employees. However, the current workforce generations are not sufficiently familiar with online communication technologies to yet benefit from e-learning programs. FF4 (2003) reports that over "20% of SMEs cannot find the skilled employees they require to implement e-business." Specifically, there are not enough trained personnel with a hybridization of technical and business skills. A recent British survey of health professional students conducted at the University of Sheffield shows that most had never used Internet Relay Chat, message forums, and videoconferencing although they regularly surfed the Web and used email. The conclusion of that study was " most students do not have sufficient experience of on-line learning environments and therefore future use of Continuing Professional Education material in this environment is likely to be limited (Stokes et al, 2003)". Fortunately, current groups of high-school students are skilled in the use of on-line chat rooms and message forums. These technologies have diffused in much the same way as hotmail and yahoo mail accounts did (Judge, 2002), through observing friends and colleagues using the media and then trying it out themselves, thus utilizing two powerful innovation of diffusion characteristics – observability and trialability.

This interdependence of ICT and human infrastructure components is just example of the interdependencies that exist in a knowledge-based economy. We hypothesize that the next generation of university students who are currently growing up with the Internet will be better prepared for training through multimedia and distance. Rich multimedia can facilitate knowledge use in all its forms (acquisition, application, creation, and packaging for transfer). Tacit to tacit, explicit to tacit, and tacit to explicit knowledge transfer is taking place in health training centers around the world where footage of procedures can be played, paused, analyzed, and assimilated before internship or apprenticeship begins.

### 3.4 Content infrastructure and services

According to a study targeted to measuring knowledge use (Daigle-LeBlanc, 2001), "surf the Web" ranked almost equally to the most popular answer "ask someone" as the most common methods of knowledge acquisition by managers and professionals.

The Canadian and other governments have created many Web sites for use as governmental knowledge resources (see a sample in Figure 3) to facilitate the vision of building strong communities that effectively participate in a world knowledge economy.

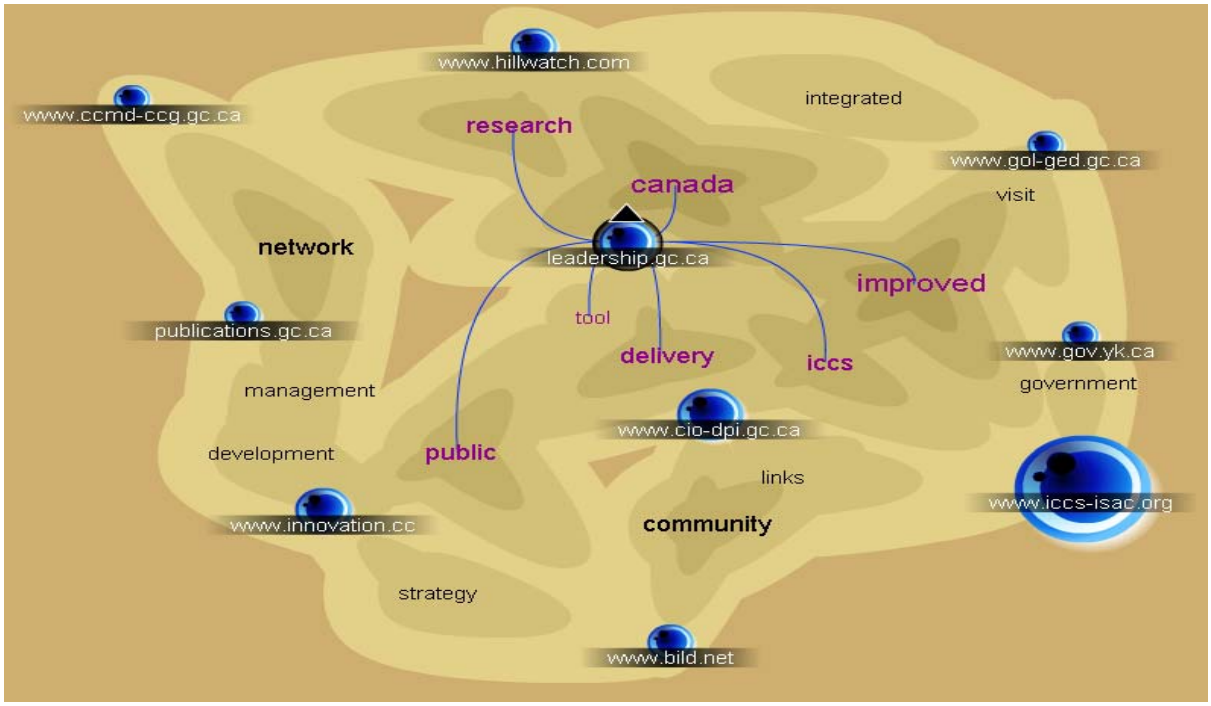


 

**Figure 3:** A Segment of Canadian Web Sites hosting e-Government Knowledge Resources
(source:www.kartoo.com using search keyword: "Institute for Citizen Centred Service")

Knowledge portals facilitate access to content: the repositories and other digital collections that contain domain knowledge. Content management software is necessary to maintain up-to-date and relevant information, intelligence, and knowledge. Currently many communities consider a portal as an access point for members as well as for the external world to learn about them, but a fully functional portal can be a knowledge source. Knowledge portals, as vehicles to knowledge delivery, may support tacit to explicit knowledge transfer (Vitales, 2002).

The knowledge portal is only one piece of the KM infrastructure; the other piece is the actual knowledge repositories and ontologies. In Canada, we find digital collections for organized content focused on culture, science, geography and other areas at http://collections.ic.gc.ca/. Youth Employment programs create many of the collections, as well as SchoolNet initiatives where students aged 15-30 create web sites using content from Canadian museums, and other archives. A digital repository comprising modernized work descriptions and desired and actual skills for and of government employees across Canada is a knowledge asset that would facilitate recruitment and the optimizing of mobility across the largest workforce in most nations – the government employees. Private sector already have such repositories at workopolis.com, http://jobs.gc.ca/it-ti/index_e.htm, http://www.jobsetc.ca/ , http://www.scp-ebb.com/, and www.ecorps.ca.

Canada's efforts at organizing content for SMEs are best found in the strategis (http://strategis.ic.gc.ca) web site – a site that provides databases of information for trade, supply, export, legal research, business financing, patents, and matches on private sector and university-based expertise to name just a few. These databases also power the www.CanadaInternational.ca site. For more sophisticated community economic development, providing hands-on models with incubator style online marketplaces (Jutla et al, 2003) will be the way forward. In June 2001, the then Minister of Industry launched a service called SourceCAN billed as ".. Canada's public and private sector e-marketplace, connecting Canadian businesses and their capabilities for the domestic and global e-marketplace and exposing opportunities through local and international e-business partnerships. " Free access is provided to an up-to-date database of Canadian companies and their capabilities, business opportunities matching, posting, e-catalogues, and virtual trade shows. Five major feeds are input to the e-marketplace. Federal and provincial governments request for bids represent a major feed as the largest proportion of SME economic activity in Canada comes from servicing the government. Business members form another major feed into the e-market. Three major feeds come from the US government. One feed provides general procurement information including sales of US government property, procurement actions, and contract awards. Another US feed is from the Trade Opportunity Program (TOP), a daily feed that lists all procurement opportunities with the US government. The third US feed is from the US department of agriculture listing procurement opportunities in the US agricultural sector.

Canadian businesses can display their catalogues free of charge in GE's Express Marketplace, a B2B digital marketplace that is currently administered by GE Global exchange Services (GXS). However, SMEs do have to pay service charges to GE for selection, procurement, requirements, and transaction payment/billing (settling) services. According to a press release from GXS (2001), the Web-based GE Global eXchange Services' (GXS) Express Marketplace "supports SourceCAN by making supply chain services - such as reverse auctions, procurement workflow, purchase order status tracking, turning purchase orders into invoices, and tracking invoice payment status - available to SourceCAN member companies on a subscription and/or per-transaction basis." An online demonstration of the Express Marketplace can be found at https://www.gexmp.com/docs/en/demo1.html. Statistics on SME usage of SourceCan are not currently available.

One year after the SourceCAN release, in November 2002, the Canadian province of New Brunswick (NB) launched SourceNB – a syndicated, localized version of SourceCAN focusing on the Atlantic provinces ( http://www.sourcenb.ca/E/press_nov20_02.cfm ). With a higher profile to the local business than its parent, SourceNB lists requests for

 

bids/tender from governments of several dozens of countries, including Australia, the Caribbean, Africa, Europe, Latin America, and Asia.

### 3.5 Regulatory, trust, and financial infrastructure and services

The management of technology literature states that online trust ranks as important as ease of use, and perceived usefulness when considering factors that affect e-commerce adoption (Gefen et al, 2003). The success of knowledge innovation networks for economic development will depend on trusted interactions among partners. Privacy, with respect to knowledge assets, including the nature and density of user actions, is a key piece to build into a trust infrastructure. The federal government has addressed this at a regulatory level with the Personal Information Protection and Electronic Documents Act (PIPEDA) which comes into force in January 1, 2004. It recognizes the equivalence of electronic signatures and documents to their physical counterparts. It also legislates the privacy aspect of security for businesses and their customers. By 2004, all Canadian businesses must comply with PIPEDA or equivalent provincial regulations. Additionally, PIPEDA will govern all inter-provincial or international exchanges of PII in the course of a commercial activity.

Although Alberta and British Columbia have proposed equivalent privacy acts, they are not yet considered equivalent. In the near future, provinces will piggyback on the federally-provided infrastructure. Indeed, there is probably little value added for duplicating privacy regulations at provincial levels. There are times when provinces and municipal business associations can play a part in creating trust services such as assurance seals. Evolving from the TrustInfo seal, the ChamberTrust B2B seal is a premier trust seal in use at the International Chambers of Commerce, the World Chamber of Commerce, the Paris Chamber of Commerce, and the British Columbia Chamber of Commerce in Canada. The seal is endorsed by the OECD, the government of Canada, SME chambers, and other key stakeholders in e-business among SMEs. The idea behind the security of the seal is the four-level check. In order for businesses to obtain the ChamberTrust seal, the business must be a member of a provincial government business registry, local chamber of commerce, a local bank, and must provide a contact person in the SME.

Community portals can keep community members up to date on other regulatory changes that affect economic development outlooks. For many years, in comparison to its southern neighbor, the USA, Canada's tax and regulatory structures were not as favorable for business. Comprehending the business and individual disadvantages to investing and staying in Canada, the government of Canada (GoC) created a five year Tax Reduction Plan in year 2000 which proposed the "largest tax cut in Canadian history". The Canadian federal plan is that, provided the US tax legislation remains as is, by year 2006, Canadian corporate tax rate including capital taxes will by 5% lower than the US, and that the income tax rate will be 7.1 % lower than in the US.

### 3.6 e-Government and Knowledge Services

Accenture has ranked Canada's efforts in e-Government as the best out of leading countries in the last three years mainly because of maturity in service transformation. Canada has the largest percentage of citizen uptake of e-government services in the world, with continuing encouragement from their citizens for more online services. This statistic is very much unlike that in other "first-world" countries such as the UK where citizen uptake is hovering in the single digit figures (Pinder, 2003).

Over and above providing specific e-government services, is the importance of the government's leadership role in showing how to use Internet-based knowledge and information services effectively. Not only can SMEs and communities view examples of best practices, but they can also leap-frog through their own innovative combinations of knowledge services.

SMEs can incorporate e-government services to create new higher value aggregate services – the bouquet concept. A service example would be an SME travel company offering a seamless experience in providing the airline booking service, complete with fast online checks for the traveler's passport expiry dates, online application for new passports, and checks with the department of health for what vaccinations are required to travel to a particular country (Regio, 2002). Furthermore, it is imaginable that the travel company can go online and acquire appropriate licenses (e.g. hunting/fishing licenses), U-pick reservations for strawberry or cherry picking (from Dept. of Agriculture and Fisheries), or book Bob's Harbour Cruise (from Tourism, Nova Scotia)

 

months before its client ever leaves home. Weather forecasts and maritime advisory alerts, or tide and water-level predictions (from Fisheries and Oceans Canada) can be pushed to devices on pleasure craft vessels, or received by email, a few days, or at any specified time(s) before a trip. The SME travel agency could "wrap" these individual services from the government in a neat service bundle for the consumer.

Other imaginative services can be created on top of e-government offerings and other distributed knowledge repositories in communities. According to GOL (2003), the GOL initiative "includes over 130 services from 30 federal departments and agencies by 2005." Many of these services will be integrated. It is up to the innovative SMEs and communities to create aggregate services by incorporating them in their own unique products and services.

## 4. Communities creation and use of km services for economic development

Mosteller's (1981) example of the diffusion of scurvy control through the British naval community classically illustrates why knowledge delivery and knowledge application is important. The system in the British Navy, social and otherwise, did not successfully diffuse medical findings of the positive results of treatment of scurvy with citrus fruits for decades. It was nearly 200 years before the knowledge was used. This often quoted example substantiates that knowledge management infrastructure should build in a heightened degree of "perceived usefulness" – another important diffusion of innovation characteristic.

Perceived usefulness and ease of use are two constructs shown to be necessary for adoption of technological innovation in the widely adopted Technology Acceptance Model (TAM) (Davis, 1989). Both constructs are counterparts to Rogers' (1995) relative advantage and complexity constructs. The province of Nova Scotia has captured these two characteristics in its deployment of the Google search service over its provincial information and knowledge assets. The service, renamed "Ask Joe Howe", is a simple, yet highly effective search service which virtually created a provincial innovation network of easily locatable human contacts, and connected previously unlinked data stores across the province of Nova Scotia. The technological service filled many structural holes in Nova Scotia's previously weakly-linked innovation networks. In addition, the Department of Services Nova Scotia and Municipal Relations (SNSMR), responsible for the Ask Joe Howe service, now possesses and uses the capability to customize government content, keywords, and to train the search engine based on questions that citizens type. Ask Joe Howe is perceived as very easy to use – most citizens use Google search services for daily use and its interface is thus familiar, and consistent.

Following on the heels of the provincial success, the e-Director of SNSMR loaned personnel resources out to a rural municipality for a day to participate in the re-deployment of the proprietary Google search engine service at a local library in a rural community in River John (see riverjohn.com). That deployment supported the creation of a "Business Room" in the local library where local citizens could find many online and offline resources to business questions they may have. In mere hours, search access became feasible over multiple municipal and localized business-related archives, as well as over provincial and federal business resources, such as the http://strategis.ic.gc.ca/ebizenable and www.businessgateway.ca sites. This example speaks to optimizing the mobility of human knowledge assets and hence enabling tacit/explicit knowledge transfer between tiers of government.

Some of the more proactive communities in Nova Scotia are leveraging age-old knowledge source infrastructure such as community and town libraries to create central hubs around which citizens will adopt Internet technologies to support economic development. The library in River John is a source of pride for the community members. Over time, they donated hundreds of thousands of Canadian dollars to build it. According to one community supporter, it takes 30 seconds to drive through this community, which has no bank and one automated teller machine, but most striking is the beautiful, new library. The chief librarian for the Pictou county area is an innovation champion who follows the Keep It Simple Stupid (KISS) principle. He wanted to aggregate community resources for community SMEs, and he set up the partnership with the province to get the community the "Business Room". He aims to make the picture collection of community history widely available through a simple knowledge portal. The e-director of SNSMR is transferring knowledge by

 

encouraging the eventual development of a fully functional knowledge portal.

## 5. Integrating KM infrastructure for better service delivery

Currently, informal, championing stakeholders, such as River John's librarian, are approaching provinces or departments responsible for e-government delivery to partner for innovative service delivery. We propose that more formal and timely KM infrastructure services may be achieved if a body is assigned responsibility for systematic examination of opportunities across communities. There is currently a gap at the provincial governments level with respect to having an entity similar to the federal–level Organizational Readiness Office to create, coordinate and maintain the knowledge infrastructure responsible for:

1. Identifying service opportunities
2. Coordinating and aligning strategies and tactics to transfer innovation across communities
3. Aggregating and optimizing resources, capabilities, and capacities of public and private sector infrastructure, human capital from local and state-level employees, public sector association employees, and private sector employees for optimizing knowledge use
4. Creating new knowledge transfer channels for communication among stakeholders
5. Measuring knowledge infrastructure and service success
6. Stimulating knowledge sharing and deploying knowledge protection mechanisms
7. Connecting municipalities and communities with funding mechanisms for creating innovations
8. Strengthening the ability of communities to absorb new knowledge
9. Strengthening cluster brands

Such an entity could help close the gaps among tiers of infrastructure in government and to allow seamless slicing and dicing of the KM "staircase". However there is debate in the research literature over tightly embedded relationships or strongly linked network ties resulting in network closure, and weakly-linked or open networks. Closed networks promote situational normality, trust, and unfortunately sometimes homogeneity. Some theorists view networks as most efficient when there exist weakly-linked ties and structural holes between network members (Ahuja, 2000; Burt 1992, Baum and Ingram, 2002, Gargiulo and Benassi, 2000). They argue that the knowledge becomes more diverse and non-redundant. Indeed some government practitioners choose to take a hands-off approach citing that in their experience too much governance stifles innovation and sometimes can cause the death of good ideas. Compromise between the closed and very open structures may eventually gain the most safety and flexibility. Research in innovation networks is still at an early stage. It may be promising for virtual community clustering that some research finds no correlation involving spatial or unit proximity and time of adoption of innovation in a social network (e.g. Durrington et al, 2000).

## 6. Summary and conclusions

We present a model that is useful not only as a guide to building federal-level KM infrastructure, but allows other tiers of government to similarly organize, make decisions to rely or not to rely on nationally-provided components, and/or focus on auxiliary and proprietary components at the community level. Organizations and communities can supplement government's infrastructure in providing corresponding mechanisms at each level of KM infrastructure. For example, at the organizational infrastructure level, businesses can set up "affinity groups" which have been shown in the human resources and management literature (e.g. Davenport et al, 1996, Van Aken et al, 1994) to be an effective means of knowledge acquisition, alongside "asking someone" and "surfing the Web" (Daigle- LeBlanc, 2001). Modernizing and simplifying computer-based tools and services, recruiting and hiring skilled personnel, forming effective training policies, managing electronic content, creating governance and other regulatory frameworks for sharing knowledge, and inventing innovative ways to knowledge-mine external feeds are all business examples for complementing the matching types of infrastructure governments provide for knowledge management.

Themes of reuse, keep it simple, and innovation championing are pervasive throughout community efforts at building KM infrastructure for economic development. It makes sense for the higher tiers of government to provide the more complex and costly infrastructure components, build a simple interface to these components, and let the masses build on top of them. In this paper, we have identified what infrastructure and services

 

governments can provide to support KM in communities. Furthermore, we illustrate the role of characteristics of observability, trialability, ease of use, perceived usefulness, and compatibility when building KM infrastructure at several tiers of government. We discuss tradeoffs of strongly linked, trusted networks and weakly linked, but inherently more flexible networks. At this point, governments appear to be balancing the desire to fill gaps and to maintain a hands-off approach.

In Canada, e-government strategies are pioneering a second generation of knowledge management infrastructure to support SMEs economic goals. One example of the emphasis on KM is the Nova Scotian acquisition of a proprietary Google engine service, renamed "Ask Joe Howe", which was first deployed at a provincial level, and then diffused to the community level to leverage community knowledge resources as well as provincial/federal knowledge resources for business. Governments are starting to take advantage of the mobility of an essential infrastructure element, and are temporarily placing skilled government workers in the communities that can most take advantage of their knowledge skills.

Third generation KM infrastructure will emerge in the next decade with new challenges and opportunities. Until then, we expect involvement of multiple communities in creating localized e-content with possibly thematic connections (e.g. vintage trains, shipbuilding, quilt making) will grow as communities climb and add higher steps to the staircase of knowledge.

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