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Understanding Knowledge Services at Natural Resources Canada

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Understanding Knowledge Services at Natural Resources Canada

Natural Resources Canada

Office of the Chief Scientist

Knowledge Services Task Group

Final Report

June 2006

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EXECUTIVE SUMMARY

Information and knowledge represent a significant part of the Government of Canada's vision for the next generation of public services. Yet there are no generally accepted definitions of public-sector information and knowledge services. To address this gap, Natural Resources Canada established the Knowledge Services Task Group to examine and describe knowledge services from the perspective of science departments.

The task group's work was positioned as the first step of a three-step process: describe, measure and manage knowledge services. Its analysis emphasized complex knowledge, where the challenge was to discover patterns and understand processes, using experience and tacit knowledge. A systems approach enabled analysis of the behaviour of this complex system in response to component interactions, feedback and delays. The model has a number of attributes, including organizational focus, scalability, two drivers (organizational mandate and user needs) and two levels of resolution (performance measurement and classifying activities).

Four types of knowledge services are defined: content (i.e. objects, data, information, knowledge and wisdom); products (e.g. databases, scientific publications, maps); services (e.g. advice, teaching, facilitation); and solutions (e.g. direction, coordination, results). A value-chain approach describes the flow of knowledge services through a sequence of stages, in which value is embedded, advanced or extracted at multiple points along the chain. A knowledge market is a group of related knowledge services value chains that interact and function collectively. The value chains form a closed loop, in which value is embedded, advanced or extracted by many agents in a continuous knowledge cycle that forms the basis of a knowledge economy.

The knowledge services system has nine stages: generate, transform, manage, use internally, transfer, add value, use professionally, use personally and evaluate. The first five stages are internal to the organization; the remaining four stages are external. A component framework of *who* is *working* on *what* and *why* is used for every stage. In six cases, the components have two or more elements. The 34 components are grouped into five sub-systems for discussion and illustration: production, management, sharing, sector and society. The system also has nine parameters that are component-scale elements found in multiple stages.

Initial measurement recommendations focused on elements of the knowledge services system that are key to shifting from a supply- to a demand-driven market process. These elements are the use of outputs (content, products, services and solutions), the flow of outputs to users and the promotion of the use of outputs. The task group also recommended that potential barriers be evaluated in the managing stage.

The major conclusions are as follows: (1) The knowledge services model provides an adequate framework to support measurement and subsequent management of knowledge services as a system. (2) Knowledge markets are richer and more complex than they are described by other provider/user models. (3) Knowledge markets have neither beginning nor end. Agents embed, advance or extract value in a continuous cycle of intellectual property transactions. (4) Knowledge service value chains have nine stages – generate, transform, manage, use internally, transfer, add value, use professionally, use personally and evaluate. (5) Evaluating both post-production system performance and pre-production market needs is necessary for both supply and demand approaches to knowledge markets.

1. INTRODUCTION

"One of the saddest features of the real world is that goods do not spontaneously present themselves for distribution."

– The Economist (November 5, 1994)

Science provides a wellspring of discovery and innovation that supports industry competitiveness in a global economy. It can enhance the well-being and living standards of a nation's citizens as well as those of the global village. It also enables improved resource stewardship and reduces environmental degradation. Nonaka (1998) argues that in an economy where the only certainty is uncertainty, the only sustainable competitive advantage is an ability to create and use knowledge. Similarly, Holmes (2001) argues that to remain relevant, governments must be able to create and use knowledge in social domains, such as health care, education and national security.

1.1. KNOWLEDGE ECONOMY. The importance of the knowledge economy is well documented in the private sector. For example, Machlup (1962) first described the economic dimensions of the knowledge industry in the United States. Drucker (1973) was the first to describe knowledge work and knowledge workers. More recently, Tapscott (1996) discussed the impacts of the emerging digital economy and networks on business, industry and society. Stewart (1997) discussed the distinctive attributes of knowledge from a market perspective. Davenport (1998) used a knowledge marketplace analogy to describe the exchange of knowledge among individuals and groups.

The importance that the Government of Canada attaches to the knowledge economy has been reflected in four recent speeches from the throne (Privy Council Office 1997, 1999, 2001, 2002). Further, the amount of science conducted by the Government of Canada is substantial. In 2003–2004, the Government of Canada spent $4.6 billion on its science and technology (S&T) activities (Statistics Canada 2003). From an economic perspective, this sum represents the cost of generating knowledge. Realizing a return on this considerable investment requires that the knowledge be used to benefit the government, society or its citizens.

1.2. KNOWLEDGE CYCLE. Canada's scientific community has recognized that creating knowledge is not enough. A national workshop on priorities for S&T integration described a "knowledge cycle" framework for integrated S&T (Environment Canada 2005). The cycle comprised research, value, receptors and benefits, which illustrates the key concept that science must look beyond the search for knowledge to how that knowledge benefits Canada and Canadians. The Canadian Institutes of Health Research developed a knowledge cycle comprising research, knowledge synthesis, distribution and application, and evaluation of uptake. This strategy focuses on interactions among researchers and users. The model used by Natural Resources Canada's (NRCan's) Knowledge Services Task Group disaggregates these high-level concepts to a level of detail that allows for application in both a holistic and bureaucratic government environment.

1.3. PUBLIC SERVICE VISION. S&T departments are increasingly mandated to create and disseminate knowledge within the context of Government of Canada priorities. These priorities are reflected in the Next Generation Public Services Vision, which outlines the need to transform government

services from a provider to a user perspective (Treasury Board Secretariat, 2005). The Service Vision lists five types of services:

- **Information** – Information about a service or program (e.g. information about Employment Insurance eligibility) and information generated by the government (e.g. weather, statistics).

- **Knowledge** – Transfer and application of knowledge to enable better decisions and actions by better-informed citizens (e.g. Go Smokefree! campaign, fuel-efficient driving).

- **Transaction** – Binding exchange between the government and Canadians (e.g. submitting tax returns, applying for Employment Insurance).

- **Interaction** – Dialogue between the government and Canadians (e.g. community partnerships with non-governmental organizations helping the homeless).

- **Intervention** – Government intervention for public good and safety (e.g. environmental protection, emergency preparedness, national defence).

These definitions provide a starting point for determining what should be included in NRCan's study. However, at the highest level, it could be argued that most of what government does begins as knowledge work: someone, somewhere, knows that something should be done and how to do it. Without knowledge as a starting point, nothing follows. It could be equally argued that most of what government does is intended as a social intervention: something needs to be changed for the public good. Thus, even before we begin, the five categories are not as distinct as they first appear. Classification models must, therefore, be based on overall appearance and function – it looks and works more like this than that.

For now (the rationale is discussed in section 4.1), the task group simply indicates that transaction, interaction and intervention services are excluded from its analysis unless they are minor elements of the linkage between science and Canadians. Further, what begins as a knowledge service may branch out of the task group's knowledge services model to become transactions, interactions or interventions. For example, scientific publications and their eventual outcomes (e.g. improved forest management, less energy use) are included, but information about a science program (or any other program) is excluded. Similarly, scientific content that provides background to regulatory activities is included, but development and enforcement of regulations are excluded.

That two of five types of service relate to information and knowledge attests to the recognition of their relative importance. However, the Vision also states that there are "no generally accepted definitions or descriptions of public sector information and knowledge services … To identify and act on opportunities … the government must first establish a shared understanding of the attributes of public sector information and knowledge services." As these services are key resources of the 21st-century information/knowledge economy, we must understand the nature of such services in a government context if we are to maximize their effectiveness. The purpose of this report is to provide a mechanism and structure for describing public sector information and knowledge services.

2. KNOWLEDGE SERVICES TASK GROUP

"To convert tacit knowledge into explicit knowledge means finding a way to express the inexpressible."

– Ikujiro Nonaka (1998)

This section describes the establishment and mandate of the Knowledge Services Task Group, its role in an organizational context, the nature of the work to be done and the steps followed in accomplishing the task group's objective.

2.1. MANDATE. Federal government science departments have struggled to provide a coherent and rigorous explanation of the purpose and nature of science in the context of public policy and federal government initiatives for implementing these policies. Consequently, it has been difficult to influence the direction of initiatives, such as Government On-Line, Infrastructure and Service Transformation, so they could more efficiently and effectively use the contributions of science-based departments, and these departments could identify how best to meaningfully participate in such initiatives.

To better understand how S&T knowledge can contribute to federal government undertakings, such as the Service Transformation Initiative, Natural Resources Canada (NRCan) established the Knowledge Services Task Group with the following mandate:

> "Examine the nature of the work of science and science-related programs in Natural Resources Canada, describe appropriate elements in the context of Government of Canada Service Transformation and submit a report of its analysis."

2.2. ROLE. In establishing the task group, it was implicitly assumed that knowledge services could be described and defined well enough and measured with enough accuracy and resolution to enable senior management to manage organizational aspects of the process. From a business perspective, Kaplan and Norton (2004) provide a mathematical reference for managing an organization's strategy:
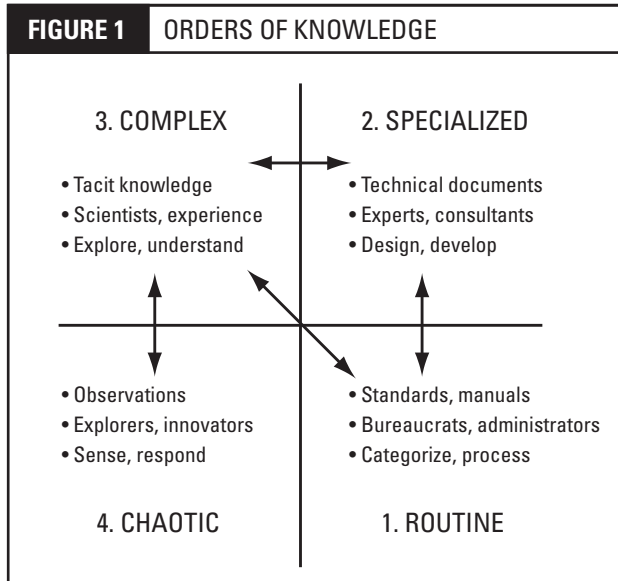
> "Effective strategy = Describe strategy + Measure strategy + Manage strategy"

In essence, to manage a strategy, it must first be measured, and to measure it, it must first be described. It should be apparent that the same relationship could be applied to managing any aspect of an organization. The work of the task group was recognized as the first step of the sequence.

The task group's purpose was to explore and analyse ways in which appropriate NRCan data-, information- and knowledge-related activities might be modelled within the Government of Canada service context. The task group was instructed to undertake the following:

• Consider a broad range of NRCan science-based activities and government services.

• Use the nature of scientific and technological work as a key organizing principle.

• Describe the outputs of S&T activities in a service delivery context.

2.3. PROCESS. Kurtz and Snowden (2003) developed a framework comprising four orders of knowledge that position the work to be done by the task group (see Figure 1). The lower right-hand quadrant represents routine knowledge. This is the world of bureaucrats and administrators, where the primary task is to classify work and then use rules and standards to process the work. The upper right-hand quadrant represents the specialized professional knowledge of experts and consultants. Here, the objective is to design and develop systems and processes, using existing technical specifications and explicit knowledge.

FIGURE 1 ORDERS OF KNOWLEDGE

3. COMPLEX

- Tacit knowledge
- Scientists, experience
- Explore, understand

2. SPECIALIZED

- Technical documents
- Experts, consultants
- Design, develop

- Observations
- Explorers, innovators
- Sense, respond

- Standards, manuals
- Bureaucrats, administrators
- Categorize, process

4. CHAOTIC

1. ROUTINE

The upper left-hand quadrant represents complex knowledge, where the challenge is to discover patterns and understand processes, using experience and tacit knowledge. Finally, the lower left-hand quadrant represents chaos, where there are no discernable patterns. Here, we are limited to exploration, experimentation and adaptation, based on observed responses. As indicated by the arrows, it is possible to move between adjacent quadrants, except between Chaotic and Routine. The task group worked in quadrants 3 (understanding) and 1 (classification).

Task group members combined decades of experience in S&T, an ability and willingness to "think outside the box" and a capacity to adapt to a complex, unknown and constantly evolving structure. Members did not "represent" constituencies within the department; rather, they represented themselves. This was essential to enable the task group to conceptualize, describe and understand what, to our knowledge, no one had documented before.

The objective was not only to achieve consensus, but also to understand by eliciting tacit knowledge from task group members. Thus, when a "sense of discomfort" was expressed with a term, definition or structure, the dialogue continued, even though the individual could not explain the problem. Ideas built on one another, taking twists and turns and exploring new approaches. Sometimes a solution revealed itself during the discussion, and sometimes it was left as an open question, with a solution surfacing days or even weeks later. In many cases, unexplainable problems resulted from incorrect or incomplete descriptions or definitions.

2.4. STEPS. A sequence of tasks was outlined for the task group to follow to accomplish its objective. In the beginning, the sequence was suitable for initial exploration of *terra incognita* – proceed from the general to the particular. As the dialogue progressed, patterns began to emerge, and the need for increasingly specific tasks became apparent. At roughly the halfway point, a list of steps emerged. These steps for developing a descriptive model of knowledge services, with their completion dates, are as follows:

1. Establish the task group *(terms of reference, governance, processes, work sequence)*; completed January 2005.

2. Describe the strategy *(task group purpose, approach, scope, priorities)*; completed March 2005.

3. Outline and define the system framework *(focus, hierarchy, sub-systems, drivers)*; completed April 2005.

4. List and define system functions *(types of components, stages)*; completed May 2005.

5. Report on progress and seek endorsement of direction *(presentation, draft documents)*; completed June 2005.

6. List components and parameters; completed July 2005.

7. Define components and parameters; completed September 2005.

8. List sub-components and sub-parameters; completed September 2005.

9. Draft departmental report; first draft completed September 2005.

10. Classify case studies; completed October 2005.

11. Draft knowledge management article; completed October 2005.

12. Define sub-components and sub-parameters; completed May 2006.

13. Submit report, present results and recommend actions; completed June 2006.

Activity at any point tended to focus on particular steps in this sequence, although the task group continuously considered subsequent steps and refined previous results.

3. APPROACH

"Two roads diverged in a wood, and I –
I took the one less traveled by,
and that has made all the difference."

– Robert L. Frost (1916)

This section describes the context for task group outputs, methods used to describe and increase understanding of knowledge services, the approach used to develop a model of the knowledge services system and desirable attributes of the model.

3.1. OUTPUT CONTEXT. Early in the dialogue, the task group considered four questions that identified the target audience, the intended intermediate and final outcomes, and the outputs that would be necessary to cause those outcomes.

• **Who is the audience for our results?** The Treasury Board of Canada Secretariat, senior Natural Resources Canada (NRCan) decision-makers and science-based departments.

• **What do we want them to do?** Adapt programs to reflect the nature of S&T knowledge services to help achieve the government objectives of better serving Canadians.

• **What will we do that causes this response?** Increase awareness of the issue and understanding of the process, leading to recommended changes to the way NRCan provides knowledge services.

• **How will we do this?** Develop a descriptive model and classification framework for S&T knowledge services, report our findings and present our results to appropriate audiences.

The bureaucratic outcome – programmatic changes – is the purview of government and departmental decision-makers. The mandate of the task group is limited to recommending such changes, based on increased understanding of knowledge services. Increased understanding and model development are discussed in the next two sections.

3.2. INCREASED UNDERSTANDING. The task group began by establishing the nature of the output that would represent increased understanding. In keeping with its role of describing, but not quantifying, knowledge services, it focused on developing a model with rigorous semantics. By defining knowledge services and their constituent elements in text form, the task group could claim to understand all of them. Thus part of the task group's explicit output would be an internally consistent set of definitions that explained knowledge services and all their parts. Two definitions formed the cornerstone of the task group's work:

• **Description –** "Statement intended to provide a mental image of something based on its salient features; what something looks like."

• **Definition –** "Statement that expresses the essential nature or meaning of a word, phrase or concept; what something is."

The task group's intent was to explain knowledge services (see Figure 1, quadrant 3) but not quantify how the system works (see Figure 1, quadrant 2). As will be discussed later, the task group also defined elements to a level of detail that permits classifying all organizational activities (see Figure 1, quadrant 1) without mathematically quantifying the model. Quantification must be undertaken before the model can be used to measure cause and effect. But as noted previously, we must first describe (understand) something before we can measure its effects.

3.3. MODEL DEVELOPMENT. A variety of approaches can be used to integrate complex structures and processes, such as systems analysis, logic models or production-control charts. The task group chose a systems approach, as it not only includes the other approaches but also enables analysis of the behaviour of complex systems in response to component interactions, feedback and delays. And as will be seen, knowledge services are complex, notwithstanding the task group's efforts to model them as simply as possible.

A system is "a set of interrelated components that function collectively to transform inputs into outputs to achieve a common goal" (Simard 2000). Therefore, a systems approach describes multiple related components that interact with each other. A key element is that they function as a whole to achieve a common goal. The purpose of the interactions is to bring inputs to the system, do work that transforms them into outputs and send the outputs to the system's environment. Multiple interactions can result in dynamic system "behaviour."

There are several types of systems. Simple flow-through systems (e.g. logic models, production-control charts) do not exhibit system behaviour (they either work or not). Feedback systems (e.g. publishing) adjust their functions in response to information from the environment (number of publications). More sophisticated systems (e.g. an organization) can learn and adapt the way they do work by observing environmental reaction to their outputs (e.g. change outputs). Finally, complex systems (e.g. knowledge services) can change their goals to enhance long-term sustainability (e.g. from supply- to demand-driven).

3.4. MODEL ATTRIBUTES. A number of desirable attributes of the knowledge services model were identified:

- **Independence –** The model would be independent of content, issues or organization. It would provide a framework that could be applied to any subset of knowledge services in the Government of Canada.

- **Organization level –** The prototype model would be based on NRCan. Interactions among multiple departments were considered too complex for the initial model.

- **Scalability –** The model would be scalable upwards to apply to multiple departments and, ultimately, the Government of Canada as well as downwards to a sector level. Given that NRCan comprises four semi-autonomous sectors with different but related mandates, the prototype model is expected to be robust enough to be scalable in both directions.

- **Primary system driver –** The basic system driver would be a department's legal mandate. The mandate must be the primary driver because if the organization does not have defined authority and the resources to produce outputs, nothing else follows.

- **Secondary system driver –** The model should also respond to the wants and needs of users of organizational outputs (the knowledge marketplace). User needs is a secondary driver to reflect the desire of the government and NRCan to shift from a supply- to a demand-driven approach to government services.

- **Process –** The model should be based on use rather than delivery of knowledge services. Use leads actively to outcomes and benefits, while delivery leads passively to the receipt of outputs.

- **Two-way flow –** The model should have a capacity to reflect user wants and needs that demand or pull outputs from the organization as well as organizational processes that supply or push outputs to the users.

- **Resolution –** There should be two levels of resolution: one for performance measurement and a more detailed level for classifying organizational activities.

4. KNOWLEDGE MARKETS

"In the network economy, both physical and intellectual property are likely to be accessed by businesses rather than exchanged. Ownership of physical capital becomes increasingly marginal to the economic process."

– Jeremy Rifkin (2005)

This section discusses three aspects of knowledge markets. It begins by describing the knowledge services that are supplied and demanded in knowledge markets. It then explains the knowledge services value chain, in which content flows from creation through nine stages to yield results for Canadians. Finally, it outlines a new concept of information and knowledge markets that provides a deeper understanding than the traditional provider and user interface model (see section 4.3).

4.1. KNOWLEDGE SERVICES. The term "knowledge services" is used to collectively describe four groups of organizational outputs: content, products, services and solutions. The following are definitions of each group, along with a list of the types of output in each group and one example of each type:

- **Content –** "Embedded value, in the form of the message or signal contained within all elements of the content value chain [see section 4.2 and Annex 1] that are held or owned and intended to be transformed, used or transferred by an organization." There are five types of content: objects (e.g. rock collection), data (e.g. weather), information (e.g. state of forest), knowledge (e.g. climate change impacts) and wisdom (e.g. management experience).

- **Product –** "Tangible and storable commodity or merchandise, wholly or partly derived from and dependent on or in support of content, with embedded value, intended to be used or transferred by an organization." There are 11 types of products: database (e.g. elevation database), scientific article (e.g. journal publication), technical report (e.g. departmental publication), promotional material (e.g. press release), geospatial products (e.g. map), statistical products (e.g. natural resources statistics), standards (e.g. geospatial data infrastructure), policies (e.g. access to knowledge), regulations (e.g. explosives), systems (e.g. forest-fire information) and devices (e.g. earthquake measurement).

- **Service –** "Intangible and non-storable work, function or process, wholly or partly derived from, dependent on or in support of content, with embedded value and intended to be used or transferred by an organization." There are six types of services: answers (e.g. "ask an expert"), advice (e.g. consultation), teaching (e.g. presentation), facilitation (e.g. secretariat), support (e.g. provincial resources ministers) and laboratory (e.g. experiments).

- **Solution** – "Successful result of using content, products or services to embed or extract value by accomplishing organizational objectives." There are six types of solutions: direction (e.g. strategy), operations (e.g. conduct research), plans (e.g. work plan), positions (e.g. on various issues), integration (e.g. national forest inventory) and results (e.g. submitting this report).

Annex 4 provides definitions of and descriptions for all content, products, services and solutions.

There is a sequential relation among the services. Table 1 (below) shows four types of content (objects, data, information and knowledge) being transformed into products and services and used internally to produce solutions. Thus an organization may use or transfer content directly; it may transform content into products and services that are, in turn, used internally or transferred; or it may transfer solutions that have been developed for organizational use.

Only those products and services that are wholly or partially derived from content generated by the organization are considered to be knowledge services, as is appropriate for S&T organizations. Services that are not based on content generated by the organization are considered here to be programmatic, rather than knowledge services. These include transaction, intervention and interaction services, as well as information about programs (including S&T). Programmatic services are not part of the knowledge services system. However, knowledge services are often used to support programmatic services.

The definitions indicate that all outputs contain embedded value. The definitions also address intellectual property issues, in that content must be owned or held by the organization. Ad hoc content is eliminated by specifying organizational intent to transform, use or transfer the content.

| TABLE 1	EXAMPLES OF SEQUENTIAL FLOW OF KNOWLEDGE SERVICES		
Content	**Product**	**Service**	**Solution**
Forest insect collection	Report on outbreak potential	Identify alien invasive species	Outbreak eradication program
Mining activity data	National mining statistics	Analyse resource supply	Sustainable development policy
Spatial climate change information	Map of climate change impacts	Respond to queries about climate change	Mitigation and adaptation strategy
Energy technology knowledge	Decision support system	Analyse cost-effectiveness	Go/no-go decision on commercialization

Having based its work on a market model, it was important for the task group to consider the differences between knowledge and traditional goods and services. Stewart (1997) lists seven distinctive attributes of knowledge from a market perspective:

- Knowledge is non-exclusive in that it can be in more than one place at one time and can be used by more than one person at the same time.

- Knowledge ranges from permanently to temporarily useful (e.g. Newton's laws of motion and current weather, respectively).

- Knowledge is normally used without being consumed. Thus it is infinitely reusable.

- Selling knowledge does not reduce the existing supply, nor does it preclude selling it again.

- Buyers purchase knowledge only once.

- Knowledge quality is difficult to determine in advance of purchase.

- Once disseminated, knowledge cannot be recalled, although its use may be restricted.

To date, these attributes have made it difficult to develop viable and sustainable business models based on knowledge markets.

4.2. VALUE CHAINS. The concept of value chains is often used in the private sector for describing production or distribution channels. Value chains describe a sequence of steps in which inputs are transformed into increasingly refined and higher-value outputs and eventually sold to consumers. For example, a tree is cut into logs that are transported to a mill where they are sawn into rough lumber. This lumber is milled into finished lumber that is transported first to a distributor and then to a retailer where it is sold to a consumer. Each step in the chain adds value through production or distribution; some of the added value can be extracted as profit.

Business strategies often focus on moving up the value chain to be closer to consumers. For example, a manufacturer may bypass wholesalers or retailers by selling products directly to consumers. For the government, a value chain represents a series of steps in which knowledge-based goods and services are provided and used, resulting in a sequence of intermediate changes that ultimately yield results for Canadians. The Government-On-Line initiative is a clear example of moving up a value chain.
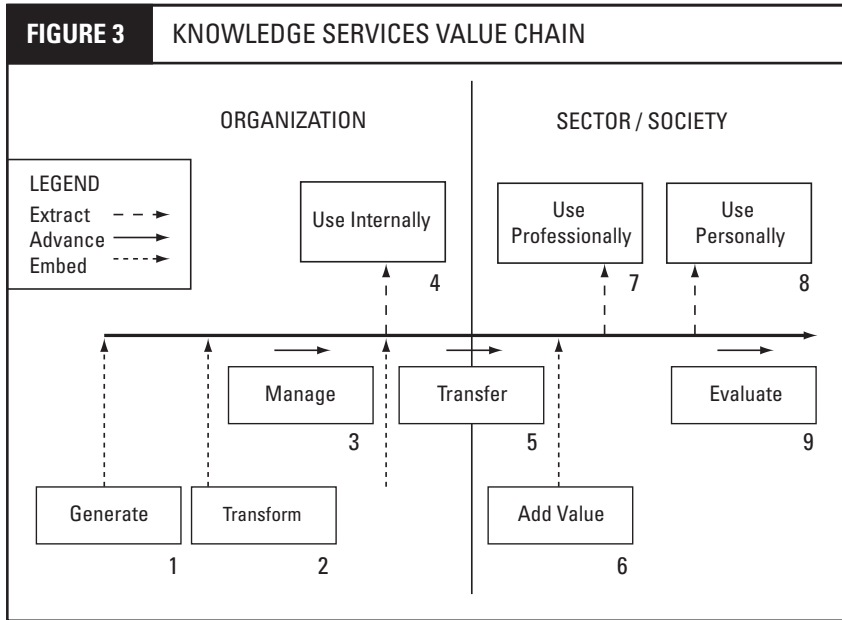
FIGURE 2	CONTENT VALUE CHAIN

Objects → Data → Information → Knowledge → Wisdom
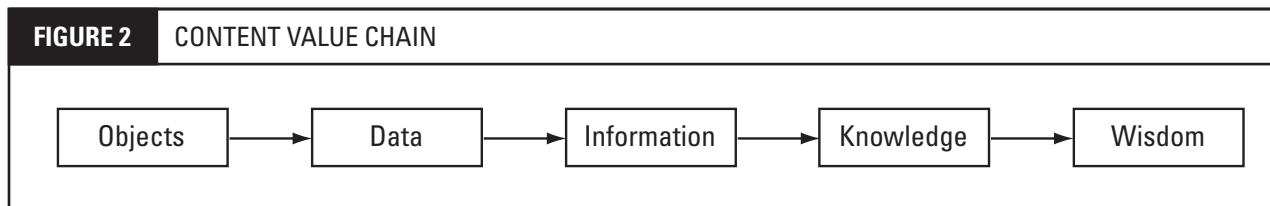
From a knowledge perspective, the task group defined a **content value chain** (see Figure 2) as the "flow of content through a sequence of stages in which its form is changed and its value or utility to users are notably increased at each stage . . .". In the content value chain, objects are measured to yield data, the meaning of data is interpreted (information), information is synthesized to yield understanding (knowledge), and finally, experience and judgement (wisdom) enable the correct application of knowledge. Note that value and utility must be viewed in the context of use. For example, a manager wants to obtain knowledge by talking to an expert, not by collecting data to conduct an experiment. In contrast, information has less value to a scientist because it cannot be disaggregated into the original data that are needed to create new knowledge.

In general, as content moves "downstream" along the value chain, its value and utility increase. For example, it is more efficient to ask an expert for advice about a problem than to collect data and study the problem. Moving downstream involves knowledge work and associated costs, which should reflect the increased value of the form of content produced at each stage. Thus the further "upstream" one has to move to solve a problem, the greater the cost.

Science is a partial exception to the linear flow portrayed in Figure 2, in that scientific knowledge arises from analysing data, and the knowledge is then transformed into published information.

As well as the content value chain, the task group defined a **knowledge services value chain** (see Figure 3). It is the "flow of knowledge services through the knowledge services system in which value is embedded, advanced or extracted by the organization, sectors and society." The knowledge services value chain has nine stages, starting with the generation of content and ending with a final evaluation of the process. (Individual stages will be discussed later in this report.)

As with the content value chain, downstream services generally have higher embedded value than upstream services.


FIGURE 3 — KNOWLEDGE SERVICES VALUE CHAIN

ORGANIZATION | SECTOR / SOCIETY

LEGEND
Extract – – ▸
Advance ——▸
Embed ······▸

Use Internally — 4
Use Professionally — 7
Use Personally — 8
Manage — 3
Transfer — 5
Evaluate — 9
Generate — 1
Transform — 2
Add Value — 6

A value-chain approach to knowledge services demonstrates the following key principles:

• Knowledge services involve more than the simple transfer of knowledge.

• The value chain comprises nine stages: generate, transform, manage, use internally, transfer, add value, use professionally, use personally and evaluate.

• The value chain comprises three processes – embedding, advancing and extracting value – that occur at multiple stages.

4.3. PROVIDER/USER MARKET.

Davenport (1998) used a marketplace model to describe the exchange of information or knowledge. He considered the processes and pathologies of such a structure, focusing on knowledge workers within an organization.

Simard used an information marketplace approach (see Figure 4) for the Global Forest Information Service (2002) and the Global Disaster Information Network (2005). The purpose of such marketplaces is "to enable, support and facilitate the exchange of … data, information and knowledge between providers and users." He also described the benefits, opportunities and challenges of developing and implementing such a marketplace. This model also describes the Government

FIGURE 4 — TRADITIONAL INFORMATION MARKETPLACE

SUPPLY (Providers)

Providers and users connect through an information market

DEMAND (Users)

of Canada's Government On-Line initiative. Its primary purpose is to develop an infrastructure that makes government information available to and accessible by all Canadians.
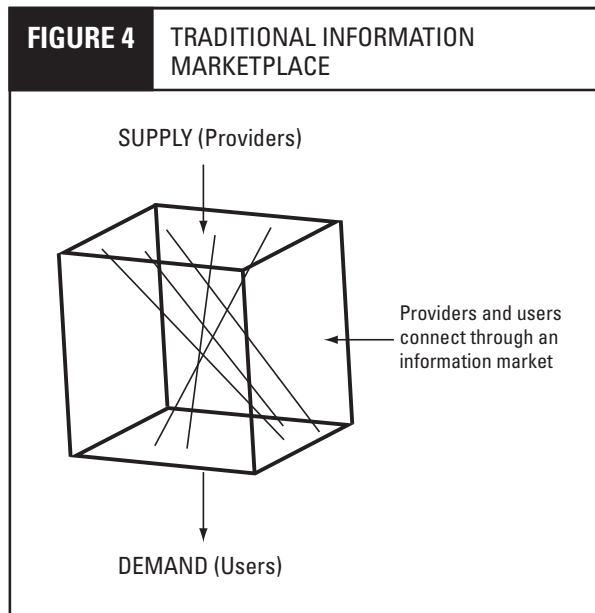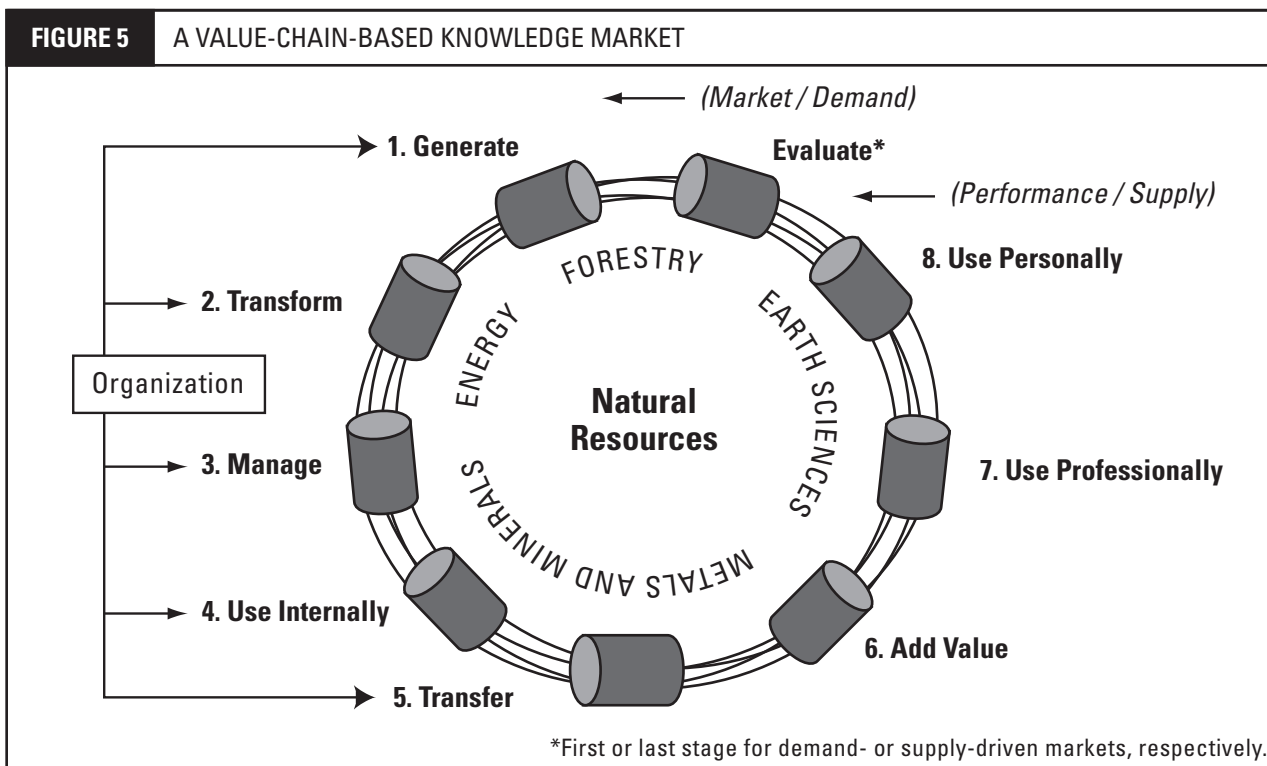
The traditional marketplace model incorporates an important concept for the task group's work—the idea of autonomous (independent) providers and users. At an international level, autonomous providers and users are self-evident. In contrast, many view the government as an enterprise in which all departments participate equally and similarly in all federal programs. A key principle of knowledge management is that "knowledge cannot be conscripted; it must be volunteered" (Snowden 2003). That is, if someone chooses not to share his or her knowledge, relatively little can be done to force him or her to do so. There are any number of ways in which a person conceal what he or she knows without revealing that concealment. This applies equally to departments and individuals. Consequently, a

government-wide knowledge market functions as an association of "semi-autonomous" providers and users with distinct and separate mandates within a context of government policy.

4.4. KNOWLEDGE MARKET. The traditional marketplace model oversimplifies the nature of an information or knowledge market. Providers and users are not simply facing each other with infrastructure between them. Rather, providers, users and enablers are located at multiple points along a knowledge value chain within specific domains, such as energy or forestry. Rather than having "providers supply" and "users demand," the task group proposes three basic market processes: embedding value into knowledge-based services, advancing that value along a value chain and extracting the embedded value to eventually yield results for Canadians.

The task group further proposes that a knowledge services market is circular in nature. There is neither a beginning nor an end, but rather a continuous cycle, with knowledge services being produced and used at multiple points.

To create a cyclic model, we begin by bending Figure 3 so that it closes upon itself as a circular value chain. Then we add some related value chains in the form of a "bundle," similar to twisted wires. Related value chains interact with each other in parallel, as partners to jointly embed, advance or extract value at particular stages. These chains may also interact sequentially, in that one organization's output becomes another's input. For the prototype model, the task group used sectors of Natural Resources Canada. The result is shown in Figure 5. From this, the task group defines a knowledge market as "a group of related knowledge-based value chains that function collectively to embed, advance and extract value along a knowledge services value chain to yield benefits."

FIGURE 5 | A VALUE-CHAIN-BASED KNOWLEDGE MARKET

*First or last stage for demand- or supply-driven markets, respectively.

The first observation is that this cyclic model has no beginning or end. Rather, hundreds of "agents" are embedding, advancing or extracting value in a continuous cycle of knowledge, as happens in the real world. Each extraction of value through the transfer and use of organizational outputs represents a transaction in a traditional market sense. Note that acquiring knowledge but not using it does not extract any value. The transformation from a linear view of value chains with a beginning and an end to a cyclic view of continuously flowing knowledge markets can be described as a form of large-scale feedback process.

A cyclic model can also be partially related to program-planning cycles in that the end of one cycle is the beginning of the next. However, in knowledge markets, different organizations are on different planning cycles. Further, within organizations, different branches, programs and projects are on different points of the knowledge market cycle. Thus, although all parts of an organization might use the same planning cycle, they begin and end their plans at different points along the knowledge market cycle. Finally, organizations have partners or clients who, in turn, also have partners or clients. Put differently, one organization's information output (stage 5, transfer) might be the next organization's information input (stage 1, generate). As with the position of electrons circling the nucleus of an atom, a program's place in the knowledge market cycle is relative and difficult to determine precisely.

The second observation is that the evaluation stage in the cyclic model is deliberately unnumbered, as befits a chicken-and-egg situation. In a supply-driven market, evaluating performance is the last stage of the value chain. Governments tend to emphasize this form of evaluation. Further, most government programs have been around for decades, so much can be evaluated, beginning with past performance. In a demand-driven market, however, market analysis is the first stage of the value chain. Businesses must identify and understand their markets to know what to produce in order to survive. Therefore, the nature of the evaluation reflects the nature of a knowledge market. Ideally, market evaluation should involve post-production performance measurement and pre-production market analysis.

The third observation is that this is not a "free" market. Although the market is influenced by user wants and needs, production and distribution are controlled by the organization. The organization's mandate determines what is produced, while the budget and organizational capacity limit how much is produced, as well as its quality, service standards, etc. Shifting from a supply- to a demand-driven perspective will not change the limits, although it will influence the outputs.

The final observation is that the market model can be scaled down to an individual sector. For example, in forestry we can consider forest ecosystems, forest fire, forest inventory, etc. At this level, the market is approaching the scale and scope of a community of practice, which may be the lower practical limit of the model. Looking upwards, the model should be scalable to natural resources departments, S&T departments and, ultimately, the Government of Canada.
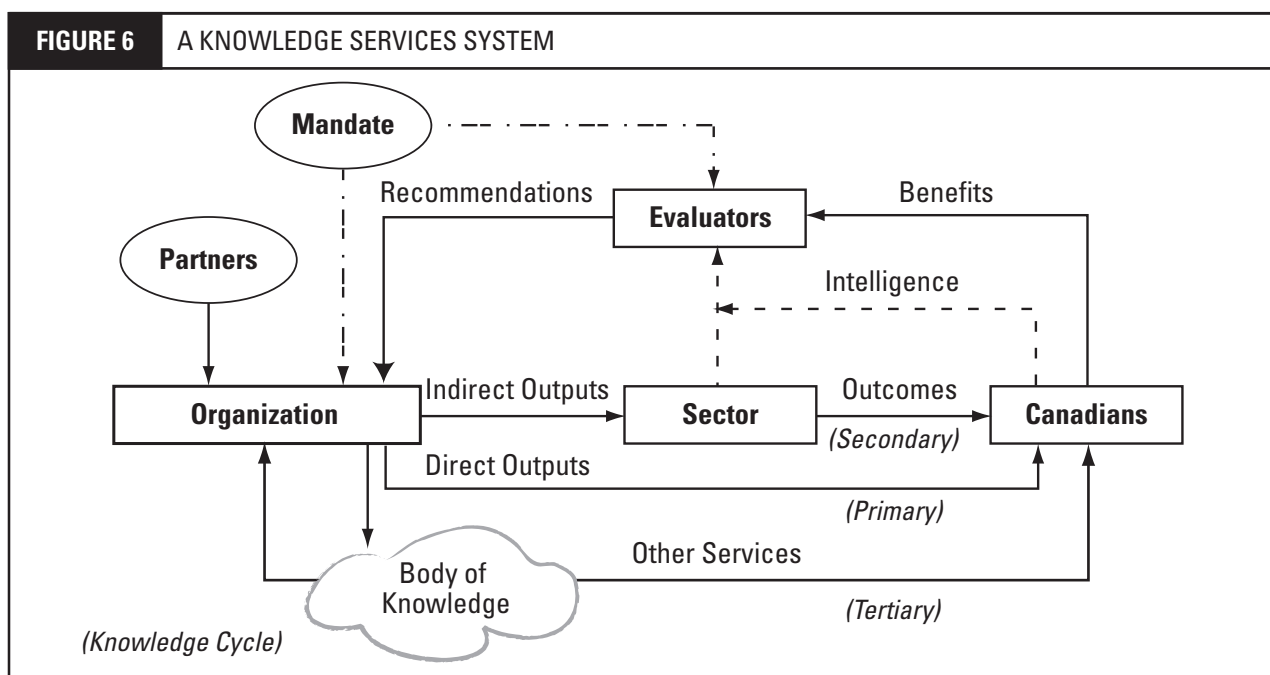
5. KNOWLEDGE SERVICES SYSTEM

> *"There exist models, principles and laws that apply to generalized systems or their sub-classes irrespective of their particular kind, the nature of their component elements and the relations or 'forces' between them."*
>
> – Ludwig von Bertalanffy (1968)

This section discusses a hierarchy of three aspects of a knowledge services system: the system, system stages and system components.

5.1. SYSTEM. A knowledge services system provides the underlying infrastructure and processes that enable a knowledge market to function. Yet this system does not exist as a tangible entity in the real world. It is an artificial construct that combines many components and flows across organizations, sectors and the societies it serves. Although driven by organizational mandates, it has no place in the organization chart and no line item in the budget. That it does not exist as an identifiable entity, in large measure, explains why no one has understood what it does. However, if we are to understand knowledge services, we must bring together in one place all of the processes that collectively transform the outputs of science into results for Canadians. We have to be able to "heat water at one end and see steam coming out at the other."

A knowledge services system is "a group of interrelated sub-systems and infrastructure that functions collectively, subject to organizational mandates, to embed value into knowledge services, enable the flow of that value along a value chain and extract the value to yield benefits." When parsed into elements, this definition tells us much about the knowledge services system. The system consists of many parts, founded on S&T programs and knowledge organizations. These parts are related and connected to each other, and they work together. Moreover, the system is based on the flow of knowledge services through a value chain, in which value is embedded and extracted. A knowledge services system is shown as a whole in Figure 6.

FIGURE 6 A KNOWLEDGE SERVICES SYSTEM

A knowledge services system is driven by organizational mandates that are external to the system; from our perspective, they are a given. The system is based on a department-scale organization, although it should be scalable up to the Government of Canada or down to a sector. As mentioned previously, the market will operate in a context of semi-autonomous providers and users because the mandates that drive the process and essential resources are legally funnelled through departments. Finally, we can manage and adapt what we do within a department; although we hope to influence a sector and society, we cannot manage them. The primary external interaction that enables upward scalability is through partners, i.e. "persons, groups or organizations with legal, contractual or informal mutual agreement to cooperate in achieving common objectives as principles in a business, program or project with joint rights and responsibilities."

Based on its mandate, an organization produces outputs that can take one of three routes to Canadians:

• As their name implies, direct outputs (primary flow) go directly from the organization to benefit Canadians.

• Indirect outputs (secondary flow) go through the natural resources sector, where they are used to yield outcomes that benefit Canadians. "The sector" involves the professional use of outputs by clients, while "Canadians" involves the personal use of outputs by individuals.

• Finally, some outputs (tertiary flow) go from the organization to the body of knowledge where, through other services (transactions, interaction, intervention), the outputs ultimately benefit Canadians. For example, a book or map (knowledge product) is sold and distributed (transaction). A white paper (information) is used as a basis for regulation (intervention). The body of knowledge is also part of a knowledge cycle, in which the organization and others use existing knowledge to create new knowledge.

The knowledge services system includes two feedback loops. First, the use of organizational outputs or sector outcomes yields individual or societal benefits. Various groups evaluate these benefits, reacting and, in some cases, responding with recommendations that organizations consider. This supports a supply-driven market: This is what we have; can you use it? It is done after the fact, like driving by looking in a rearview mirror. Second, there is an intelligence process, in which the organization consciously seeks information about the wants and needs of the sector and Canadians and adapts its programs to produce an appropriate mix of products and services. Intelligence supports a demand-driven market: What are your wants and needs, we will try to satisfy them. It is done before the fact, like driving by looking through the windshield. Although government tends to emphasize evaluation and business tends to emphasize intelligence, both are necessary for a properly functioning knowledge services system.

The task group established the scope and boundaries of the knowledge services system by identifying external processes that would not be modelled as part of the system:

• Determinants of organizational mandates or programs *(drivers)*.

• Determinants or methods of content generation *(supply)*.

• Determinants of external user wants or needs *(demand)*.

• The use of knowledge to create new knowledge *(knowledge cycle)*.

• Services not derived from organizational content *(other services)*.

The knowledge services system model comprises a five-level hierarchy, ranging from the whole to a level of detail that enables organizations to classify all activities related to the knowledge services system:

1. **Knowledge services system –** The complete system (see Figure 6).

2. **Sub-systems (five) –** Identifiable groups of stages for discussion purposes.

3. **Stages (nine) –** Distinct phases of the knowledge-based products and services value chain.

4. **Components (34) and parameters (nine) –** Distinct part of one or multiple stages, respectively; this level supports the measurement of system performance.

5. **Sub-components (245) and sub-parameters (44)** – Identifiable category of a component or parameter; this level supports the classification of organizational activities.

FIGURE 7   STAGES OF THE KNOWLEDGE SERVICES SYSTEM
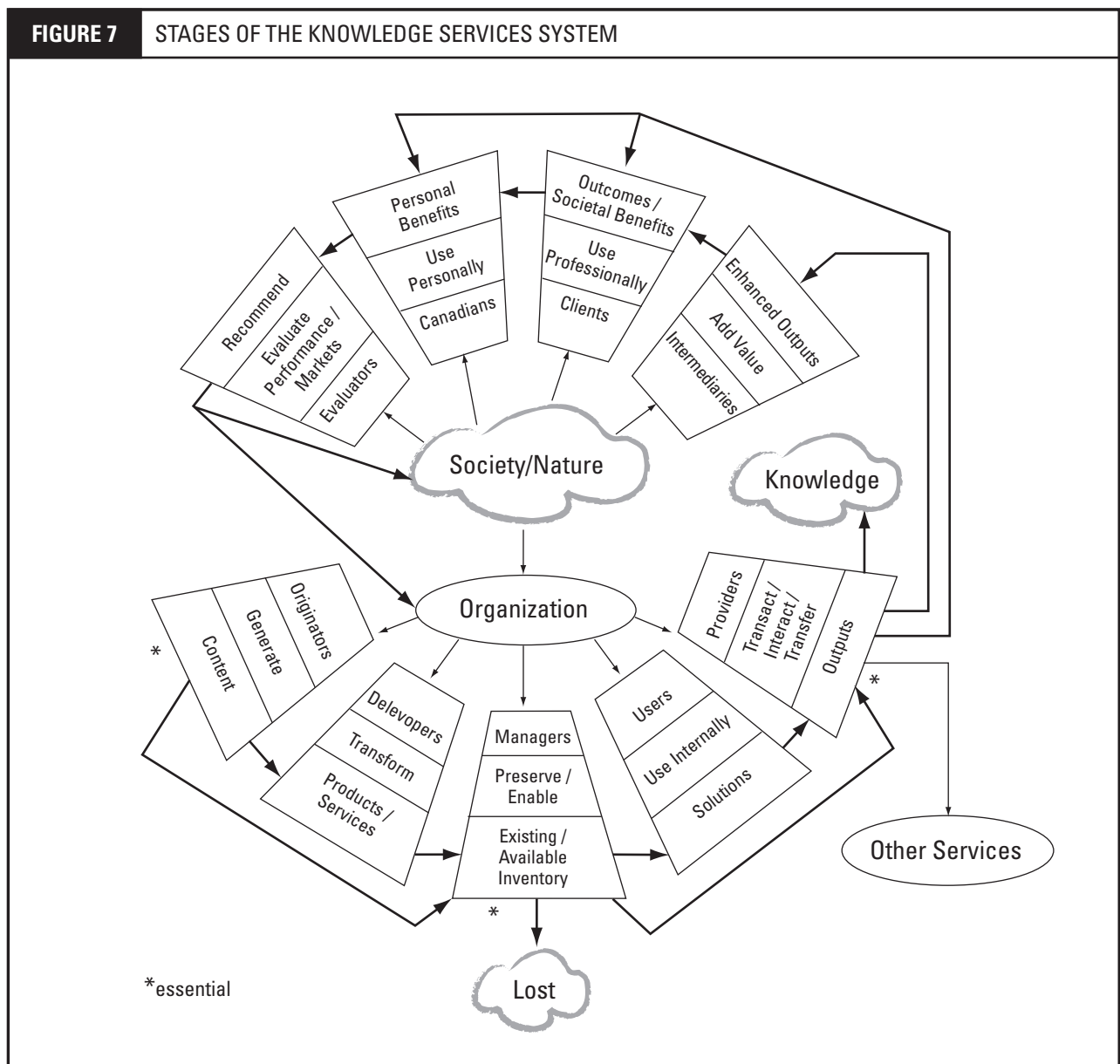
5.2. STAGES. Figure 7 shows the nine stages of the knowledge services system as a cyclic flow, following the knowledge market model. The cycle begins with an organizational mandate to generate content, and it ends with recommendations to the organization resulting from performance and market evaluation. The first five stages are internal to the organization, while the four remaining stages are external. Stages marked with an asterisk (*) are necessary for the system to function because everything must flow through them. One or more (but not all) of the other stages may be bypassed without stopping the system. In any case, each stage performs one of three functions: embedding, advancing or extracting value.

The following statements explain the purpose of each stage of the knowledge services system:

1. **Generate*** – Content with intrinsic value and potential utility must be generated as the first stage of the knowledge services value chain.

2. **Transform** – Content is transformed into products and services to increase its utility or value to users.

3. **Manage*** – The flow of knowledge services must be enabled to permit their use or transfer to clients or other Canadians.

4. **Use internally** – Knowledge services are used internally to accomplish organizational objectives.

5. **Transfer*** – Knowledge services must be transferred to clients and other Canadians to enable external use.

6. **Add value** – Intermediaries work to increase the availability, utility or value of knowledge services.

7. **Use professionally** – Clients with sector-related knowledge use knowledge services to benefit an identifiable sector.

8. **Use personally** – Canadians use knowledge services to realize personal benefits.

9. **Evaluate** – The system is evaluated to improve its performance in supplying or fulfilling the demands of knowledge markets.

* = essential

5.3. COMPONENTS. The knowledge services system is organized around a two-dimensional structure (see Table 2). The vertical dimension represents components in each stage of the knowledge services value chain. The horizontal dimension represents the flow of products and services through nine stages of the value chain. In six cases (shown with an oblique [/]), a component has more than one element. For convenience, the stages are grouped into identifiable sub-systems: production, management, sharing, sector and society. Note that in the knowledge services system, the major thrust of the Government On-Line (GOL) initiative (providing electronic access) is accounted for by one sub-component of transfer via one channel. This explains why it was impossible to fit the work of science-based departments into the GOL framework.

Each stage has three types of components and a purpose: *who* is *working* on *what*, and *why*. These represent a subset of the Framework for Information Systems Architecture developed by Zachman (1987). A conscious effort was made to consistently use nouns for *who* and *what* and verbs for *work*. The component types are defined below (and in Annex 1):

• **Who** – "Persons, groups or organizations who do knowledge work."

• **Work** – "Processes, activities or actions that embed value into, advance value or extract value from knowledge services."

TABLE 2	COMPONENTS OF THE KNOWLEDGE SERVICES SYSTEM			
Organization				
	Production		**Management**	**Sharing**
Stage	**1** **GENERATE**	**2** **TRANSFORM**	**3** **MANAGE**	**4** **USE INTERNALLY**	**5** **TRANSFER**
Who	Originators	Developers	Managers	Users	Providers
Work	Generate	Transform	Preserve / Enable	Use Internally	Transact /Interact / Transfer
What	Content	Products / Services	Existing Inventory / Accessible Inventory	Solutions	Outputs
Why	Embed Value	Add Value (internally)	Enable Flow	Extract and Embed Value	Enable External Extraction

	Sector		**Society**	
Stage	**6** **ADD VALUE**	**7** **USE PROFESSIONALLY**	**8** **USE PERSONALLY**	**9** **EVALUATE**
Who	Intermediaries	Clients	Personal Interests	Evaluators
Work	Enhance	Use Professionally	Use Personally	Evaluate Performance / Evaluate Markets
What	Enhanced Outputs	Outcomes	Personal Benefits / Societal Benefits	Recommendations
Why	Add Value (externally)	Extract Value (sector)	Extract Value (individuals)	Enable System Improvements

- **What –** "Inputs to and outputs from each stage of the knowledge services value chain."

- **Why –** "The purpose, reason for existence and importance of the knowledge services system and its sub-systems and stages."

In selecting component names, the task group started by describing the process or function and then choosing the most appropriate name. Although considerable effort went into selecting terms that relate to the nature of the component, the terms are secondary to the definitions. The task group avoided using the same term for two concepts. To the maximum extent possible, each term has one and only one meaning. Selections may not be the most popular (and usually ambiguous) term or the first term that springs to mind, but every selection was carefully integrated with other terms and processes in the knowledge services system.

Definitions began with a core, extracted from dictionaries, that reflected the essence of the task group's intended meaning. The task group augmented core definitions to link to related terms and to ensure consistency among related terms. The definitions are not generic or all-encompassing; they include only what is essential for the knowledge services system. Components are defined in Annex 2; sub-components are listed in Annex 3 and defined in Annex 4.

In addition to *who*, *work* and *what* components, the knowledge services system includes several parameters and sub-parameters. A parameter is an "attribute that is affected by multiple stages of the knowledge services value chain and that significantly and measurably affects the knowledge services

system." From a systems perspective, parameters can be thought of as processes that lie in a layer above the system and that interact with it at many points. Only those parameters that have a significant interaction with the system are included here. They are important enough to be worth the additional effort of monitoring.

The knowledge services system includes nine parameters: channel, quality, utility, scale, intellectual property, ownership, source, criteria and indicators. For example, ownership affects property rights with respect to products and services. Another example is that the scale of a service must match that of the intended use. Parameters are defined in Annex 2; sub-parameters are listed in Annex 3 and defined in Annex 4.

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6. SUB-SYSTEMS

> *"A particle can be understood only in terms of its activity – of its interaction with the surrounding environment – and that the particle, therefore, cannot be seen as an isolated entity, but has to be understood as an integrated part of the whole."*

> – Fritjof Capra (1975)

A sub-system is a "distinct, identifiable part of the knowledge services system that performs related work to achieve objectives that support the goals of the parent group." Although shown as the second level in the system hierarchy, sub-systems are used primarily for discussion and illustration, to group identifiable and closely related stages. (The work of the model is done at the component and sub-component levels.) There are five sub-systems: production, management, sharing, sector and society. Each is described in this section.

FIGURE 8 THE PRODUCTION SUB-SYSTEM
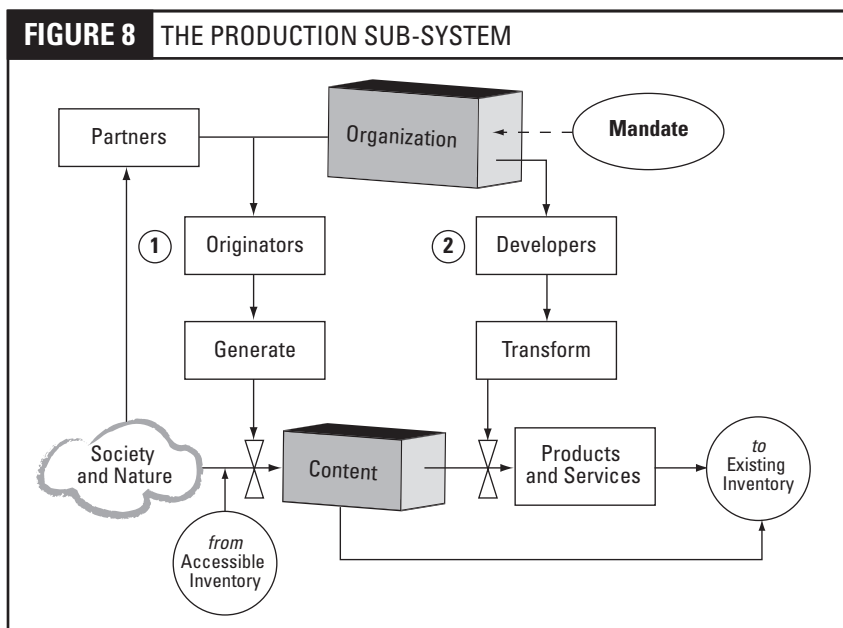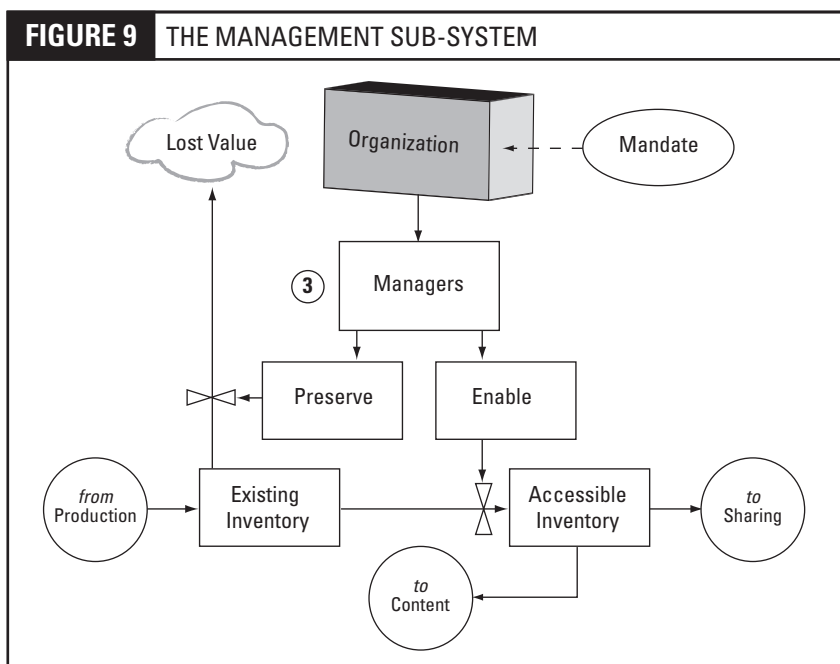
6.1. PRODUCTION SUB-SYSTEM. Production is "a sub-system comprising processes, activities or actions that embed value into content by generating it or transforming it into products or services intended to be used or transferred by an organization." As shown in Figure 8, production involves stages 1 (generate) and 2 (transform) of the knowledge services system.

In stage 1, originators embed value by generating content. The "valves" (⋈) in Figure 8 symbolize increasing or decreasing flows from inputs into outputs. Nature and society provide an infinite source of input material. As well, the accessible inventory provides an internal source of input material. Originators work within an organizational context. Partners may also participate through links to the organization. The three-dimensional boxes in Figure 8 indicate lower-level sub-systems that are of interest, but not

essential, to the knowledge services system. For organizations, the sub-system transforms mandates into programs. For content, the knowledge value chain transforms lower value content (e.g. data) into higher value content (e.g. knowledge).

In stage 2, developers increase embedded value by transforming content into products and services that flow into the existing inventory. Note that content may flow directly to the existing inventory without being transformed into products or services. Stages 1 and 2 involve embedding and increasing value, respectively.


FIGURE 9 THE MANAGEMENT SUB-SYSTEM

6.2. MANAGEMENT SUB-SYSTEM. Management is "a sub-system that preserves content, products or services with embedded value or enables the extraction of that value through use or transfer." As shown in Figure 9, management (stage 3) consists of two kinds of work—preserve and enable. All production outputs flow into the existing inventory, which can be thought of as a "parking lot." Alternatively, content in the existing inventory can be thought of as having "potential value," i.e. value that could be extracted if it were available and accessible. Existing inventory may be on a personal computer or in someone's file cabinet, on his/her desk or even in his/her head. All content, products and services remain in the existing inventory until managers cause it to flow to subsequent stages by making it accessible, or it is lost.

Managers do two kinds of work. First, they preserve the potential value embedded in content, products or services in the existing inventory to minimize the rate of loss. Without active preservation (i.e. capturing, organizing, storing), the existing inventory is continually degraded. The rate of loss is controlled by the extent of preservation activities.

The second kind of work is more important. Managers enable the flow of value from the existing inventory into the accessible inventory. This changes potential value into exploitable value that can be extracted due to availability and accessibility. Managers enable this flow by providing authority and resources to establish and run programs and projects that manage and provide, promote and facilitate access to content, products and services. This is a critical point. Although the management stage does not increase embedded value, unless the flow to subsequent stages is enabled, the knowledge services value chain ends here, and the value that has been embedded is not extracted.

FIGURE 10 THE SHARING SUB-SYSTEM
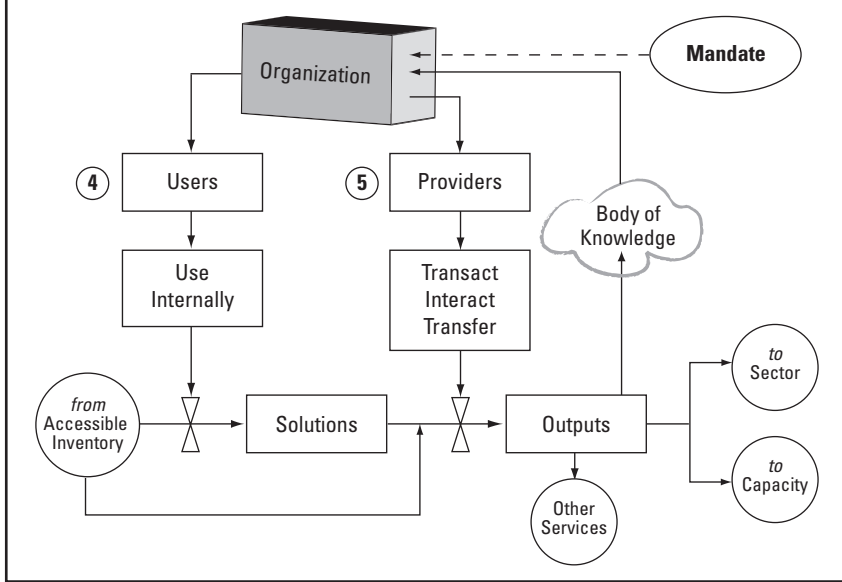
6.3. SHARING SUB-SYSTEM. Sharing is "a sub-system that uses knowledge services internally or transfers them to enable their external use by intermediaries, clients or other Canadians." As shown in Figure 10, sharing involves stage 4 (use internally) and stage 5 (transfer).

In stage 4, internal users use content, products or services to solve organizational problems or analyse issues. This is the first stage in which embedded value is extracted; it is also the only stage where value is also embedded. In addition to helping achieve the organization's mandate, solutions may become organizational outputs if they are adaptable to external client needs or support other services. Regardless of whether content, products or services are used internally, they are available for transfer to external clients or other Canadians.

In stage 5, providers transfer outputs to external clients and other Canadians through transactions and interactions. A transaction is the transfer of intellectual property rights to users; an interaction involves enhancing users' ability, readiness or willingness to apply outputs; and transfer is the delivery, distribution or dissemination of outputs. As with stage 3, stage 5 is an enabling stage in that without transfer, the value chain stops here; there can be no use by external clients or other Canadians.

Many organizational outputs flow into the "body of knowledge" that the organization and external users use to create new knowledge or applications. This "knowledge cycle" encompasses members of the science community with an interest in organizational science outputs. Collectively, this community discovers new knowledge that raises the overall quality of life for the society that supports it. As important as science is to society, however, it is external to the knowledge services system because it is impossible to trace benefits derived through the knowledge cycle to their source. Although it is not yet clear whether it is possible to trace a source of knowledge to benefits for Canadians, the knowledge services system provides a conceptual framework for attempting to do so.

FIGURE 11 THE SECTOR SUB-SYSTEM
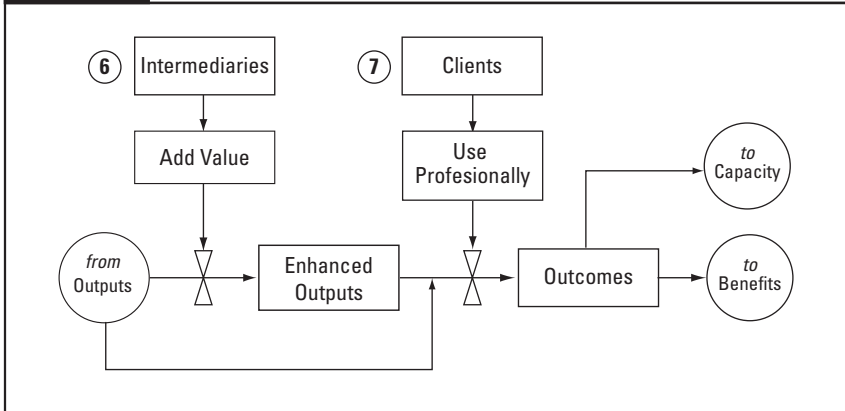
6.4. SECTOR SUB-SYSTEM. A sector is "a sub-system that includes intermediaries or clients, external to the organization, who use organizational outputs professionally to achieve sector outcomes." As shown in Figure 11, the sector comprises stage 6 (add value) and stage 7 (use professionally).

A sector includes all professional use of outputs outside of the organization that produced them. Thus the use of outputs by the Government of Canada other than the originating department is considered sectoral use. A sector is important for science departments because their mandates do not lend themselves well to serving citizens directly. Rather, they support sectors that, in turn, produce and deliver products and services that generate outcomes that enhance the quality of life for Canadians.

In stage 6, intermediaries (e.g. provinces, businesses, the media) may add value to organizational outputs, resulting in enhanced outputs. This is the last stage where value is embedded or increased. Outputs may flow directly to users without being enhanced. When intermediaries add value, visibility of the originating organization and attribution of the output's source are often reduced or eliminated.

In stage 7, clients make professional use of outputs to achieve sector outcomes. This is the second stage where value is extracted from outputs. This stage is the overarching reason that organizational outputs were produced in the first place. Government departments do not exist to serve government needs. Instead, they exist to serve the needs of the sectors they support and, ultimately, the citizens they serve. Outcomes flow into two components – capacity for action and societal benefits.

6.5. SOCIETY SUB-SYSTEM. From the perspective of the knowledge services system, society is "a sub-system comprising external communities, interest groups, organizations or sectors whose purposes, processes or functions realize or evaluate benefits of the knowledge services system or impact the mandates of knowledge organizations." Thus the task group limited its interest to elements of society that interact with the knowledge services system. As shown in Figure 12, society includes stage 8 (use personally) and stage 9 (evaluate).

In stage 8, organizational outputs and sector outcomes flow into "capacity for action." As with existing inventory, this is a "parking lot" for material that is available for Canadians' use. Canadians personally use this capacity to take actions that realize individual benefits in areas that interest them. This is the last stage of the knowledge services value chain – the final extraction of value. From here, benefits flow into the "infinite sink" of society and nature, to complete the cycle that began in the same infinite sources.

FIGURE 12 THE SOCIETY SUB-SYSTEM

Sector outcomes often benefit Canadian society incrementally and over the long term, rather than individual Canadians over the short term. Societal benefits, such as reduced carbon emissions or energy consumption, may be realized at the expense of individual wants and needs. Science-based departments often produce outputs that are intended to provide long-term societal benefits, rather than short-term individual benefits.

In stage 9, evaluation provides feedback to the organization, from supply or demand perspectives. On one hand, system performance is evaluated by determining the efficiency, effectiveness, utility or value of outputs, outcomes or benefits. This *post-production* feedback uses this approach: This is what
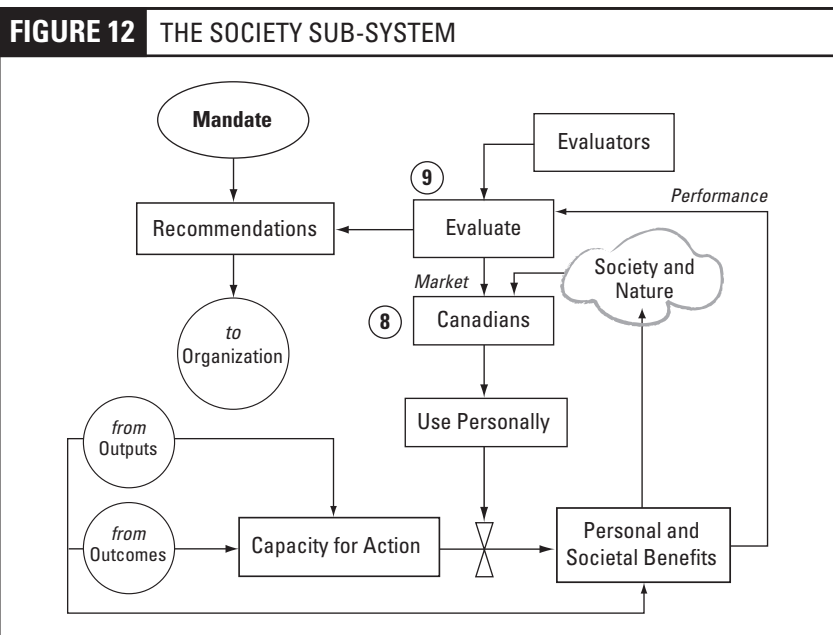
we produced; was it useful? On the other hand, intelligence on current and future wants and needs of knowledge markets allows the organization to adapt or evolve its outputs to satisfy demand cost-effectively. This *pre-production* feedback uses this approach: What do you want us to produce?

Evaluation results in recommendations to maintain the status quo or make adjustments within the mandate. The organization uses the recommendations to improve system performance or change its mix of outputs based on user wants and needs. Stage 9 completes the knowledge services system cycle that began with the organization generating content.

7. MEASUREMENT PRIORITIES

> *"When you can measure what you are speaking about, and express it in numbers, you know something about it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely . . . advanced to the stage of science."*
>
> – William T. Kelvin (1892)

As noted earlier, the work that led to this report represents the first phase of a describe/measure/manage approach to knowledge services. Knowing what the system looks like leads us to phase two, measuring system performance.

To begin, the task group identified high-priority interactions or branch points in the knowledge services system that would most likely yield the greatest amount of information from initial measurement (see Annex 6). Interactions are shown as the " valves" and arrows that link the components in Figures 8 to 12. These interactions and branch points were grouped into five categories – external, capacity, services, branches and parameters – to determine if there were any notable patterns among types of interactions. Individual interactions were then prioritized from two perspectives – relative importance for initial evaluation and potential system barriers.

7.1. RELATIVE IMPORTANCE FOR INITIAL EVALUATION. The total number of interactions for each of the nine stages of the knowledge services system were tabulated to identify high-priority evaluations at the stage level. Stages with more than one component were split to distinguish between the components. The consistency of the results was also determined in order to help refine the final priorities.

There was a factor-of-two range (from 13 to 24 points) between the highest and lowest scores, yielding sufficient discrimination for setting priorities at the end points of the distribution. Individual results were not sufficiently consistent to draw detailed conclusions about the relative importance of individual interactions. Differences among the five groups of interactions were marginal; although tentative patterns were observed, they were not sufficient to support conclusions.

Stages 6 (add value) and 7 (use professionally) were ranked highest in priority for initial evaluation at the stage level. These stages focus on intermediaries and clients, suggesting that marketing analyses should have the highest initial payback in understanding the knowledge services system. Meanwhile, stages 1 (generate) and 3 (enable) – both essential for system functioning – had a low priority for initial study. This reflects a consensus that, despite their importance to the system, stages 1 and 3 are understood enough to leave evaluation for future discussion.

The following ordered list indicates the seven highest priority interactions for initial study. Multiple entries at the same rank indicate no discernable difference in priority:

1. Add value / enhanced outputs

2. Use professionally / societal benefits

3. Users / use internally; Outputs (a branch point); Engagement (a parameter)

4. Transform / services; Partners / organization

7.2. POTENTIAL SYSTEM BARRIERS. The task group also considered potential barriers to knowledge system functioning. However, it could not identify "real" barriers without measuring the entire system. Thus the task group ranked the three highest priority "potential" barriers – i.e. interactions that are most likely to be barriers – based on a consensus of their experience. Evaluating potential barriers yielded different priorities than those for importance. The former emphasize management actions that are necessary to enable or facilitate the production of organizational outputs. Six interactions were selected by more than one member of the task group. The top three interactions that are potential barriers are as follows:

1. Enable / Accessible inventory

2. Use internally / Solutions

3. Preserve / Existing inventory

7.3. BENEFITS. Measuring criteria and indicators for a knowledge services system would enable the following organizational management decisions and actions:

• Better respond to natural resources knowledge markets.

• Evaluate and improve system performance.

• Diagnose and fix system problems.

• Establish priorities for system outputs and outcomes.

• Identify the risks of and opportunities for system development options.

• Allocate resources to adapt programs to better serve clients and other Canadians.

8. CONCLUSIONS

> *"What here constitutes our subject-matter is not the nature of things, which is inexhaustible, but the understanding which passes judgement on the nature of things."*
>
> – Immanuel Kant (1781)

This report describes a model of knowledge services produced and provided by science and technology (S&T) departments of the Government of Canada to achieve results for Canadians. Its purpose is to increase the level of understanding about the nature of knowledge services, which should, in turn, facilitate the participation of S&T departments in the Next Generation Public Services: Government

of Canada 2005 Service Vision. The model should also facilitate the adaptation of elements of that vision to knowledge services. Natural Resources Canada's (NRCan's) Knowledge Services Task Group developed the model. Although it is based on S&T programs in NRCan, it is believed to be applicable to most S&T departments and to knowledge services provided by most other departments.

The knowledge services model includes several properties that significantly affect the management of organizational knowledge-based outputs, as well as the outputs' effectiveness in achieving sector outcomes and their capacity to meet the needs of Canadians:

• A knowledge market operates in a context of semi-autonomous providers and users.

• A knowledge market approach describes knowledge services enough to permit measurement and management.

• There are four types of knowledge services (groups of organizational outputs) – content, products, services and solutions.

• A knowledge market consists of a group of related knowledge-based value chains.

• A knowledge-based value chain models the flow of knowledge services through a sequence of nine stages, in which value is embedded, advanced or extracted.

• Identifying internal and external use along a value chain resolves the confusion arising from providers also being users.

• Focusing on the use of outputs actively leads to outcomes and benefits, whereas emphasizing audiences passively leads to the receipt of outputs.

• A knowledge services system consists of nine stages: generate, transform, manage, use internally, transfer, add value, use professionally, use personally and evaluate.

• Three stages are essential to system functioning: generate, manage and transfer. One or more, but not all of the other six stages may be bypassed without a disruption of the value chain.

• Each stage includes three types of components and a purpose: who, work, what and why.

• There are three flows or channels from the organization to Canadians: primary, secondary and tertiary. Outputs may flow through more than one channel.

• For the value chain to function, management must enable the flow of knowledge services from the existing inventory to the available inventory.

• When intermediaries add value to knowledge services, the originating organization's visibility may be reduced.

• Results for individual Canadians include short-term benefits in their areas of interest and long-term societal benefits that may be realized at the expense of their individual interests.

• Evaluating system performance and market needs is necessary to provide supply and demand perspectives of knowledge markets.

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Understanding Knowledge Services

Annexes

Understanding Knowledge Services
Annexes

"The first task of any theory is to clarify terms and concepts that are confused . . . . Only after agreement has been reached regarding terms and concepts can we hope to consider the issues easily and clearly and expect to share the same viewpoint."

– Carl von Clausewitz (1780–1831)

ANNEX 1. KNOWLEDGE SERVICES SYSTEM AND FRAMEWORK DEFINITIONS

This annex defines system-level terms and phrases with respect to their specific meaning and use within the context of the knowledge services system. They are not generic, all-encompassing definitions of the terms and phrases; rather, the definitions are only what is necessary for consistency and completeness within the knowledge services system. Each definition also lists related terms: hierarchical (directly above or below), sequential (immediately before or after) or parallel (comparable level or function). Related terms are listed alphabetically. Component definitions are listed in Annex 2, and sub-component definitions are listed in Annex 4. For more information, the reader may refer to Annex 8 to find a translation of all the following defined terms.

Attribute: Intrinsic characteristic, quality, feature or property that describes one aspect of a system or component. (*See* Parameter)

Benefit: Positive result of using organizational outputs to promote, enhance, help or sustain a society, a sector or an individual interest. (*See* Knowledge Services System; Outcome; Output; User)

Body of Knowledge: The sum of facts, information, principles and understanding acquired and known by society. (*See* Knowledge Cycle; Output)

Capacity for Action: Ability of individuals and groups to make informed decisions or take appropriate actions resulting from availability of and access to organizational outputs or sector outcomes. (see outputs, outcomes, benefits, society)

Component: Distinct, identifiable part of one stage of the knowledge services system. (*See* Component Type; Stage; Sub-Component; What; Who; Why; Work)

Component Type: Category or class of components based on their inherent nature. (*See* Component; What; Who; Work)

Content: Embedded value, in the form of the message or signal contained within all elements of the content value chain that are held or owned and intended to be transformed, used or transferred by an organization. (*See* Content Value Chain; Output; Product; Service; Solution)

Content Value Chain: Flow of content through a sequence of stages in which its form is changed and its value or utility to users are notably increased at each stage: objects, data, information, knowledge and wisdom. (*See* Content; Knowledge Services Value Chain; Value Chain)

Definition: Statement that expresses the essential nature or meaning of a word, phrase or concept; what something is. (*See* Description)

Description: Statement intended to provide a mental image of something based on its salient features; what something looks like. (*See* Definition)

Element: Specific, identifiable subset of a group that more precisely classifies it. (*See* Sub-Component; Sub-Parameter; Sub-System)

Explicit Knowledge: Knowledge that is expressed and codified in a form that is suitable for transfer. (*See* Tacit Knowledge)

Framework: Structural outline of the components of an organization, system or processes and the relationships among them. (*See* Management; Organization; System)

Intelligence: Data, information and knowledge that have been extracted, processed, interpreted or synthesized to reveal underlying patterns about the wants or needs of the sector or society in the context of the outcomes or benefits of using organizational outputs. (*See* Benefit; Outcome; Output; Recommendation)

Knowledge Cycle: An iterative process in which knowledge is used to generate additional knowledge, thereby increasing but not extracting embedded value. (*See* Body of Knowledge; Knowledge Services Value Chain; Output)

Knowledge Market: A group of related knowledge-based value chains that function collectively to embed, advance and extract value along a knowledge services value chain to yield benefits. (*See* Knowledge Services System; Knowledge Services Value Chain)

Knowledge Organization: An organization in which people use systems and processes to generate, manage, share, use and transfer knowledge to support organizational goals, learning and adaptation. (*See* Mandate; Organization)

Knowledge Services: Programs that produce or provide content-based organizational outputs with embedded value, intended to be used or transferred to meet external user wants or needs. (*See* Knowledge Services System; Knowledge Services Value Chain; Output; Product; Program; Service)

Knowledge Services System: A group of interrelated sub-systems and infrastructure that functions collectively, subject to organizational mandates, to embed value into knowledge services, enable the flow of that value along a value chain and extract the value to yield benefits. (*See* Benefit; Knowledge Market; Knowledge Services; Knowledge Services Value Chain; Management; Organization; Production; Sector; Sharing; Society; Sub-System; System)

Knowledge Services Value Chain: Flow of knowledge services through the knowledge services system in which value is embedded, advanced or extracted by the organization, sectors and society. (*See* Content Value Chain; Knowledge Services; Knowledge Services System)

Management: A sub-system that preserves content, products or services with embedded value or enables the extraction of that value through use or transfer. (*See* Framework; Knowledge Services System; Knowledge Services Value Chain; Organization; Production; Sharing; Sub-System)

Mandate: Formal order, command or statement, given by a higher authority, that provides the basis for the existence of an organization or program and its authority, responsibility, accountability and resources. (*See* Knowledge Organization; Organization; Society)

Organization: Legally constituted, administrative and functional structure that fulfills its mandate by transforming authority, responsibility and resources into programs. (*See* Framework; Knowledge Organization; Knowledge Services System; Management; Mandate; Partner; Production; Program; Sector; Sharing; Society; Sub-System)

Outcome: Medium- or long-term result or impact of using outputs to solve a problem or analyse an issue within a sector. (*See* Benefit; Intelligence; Output; User)

Output: Collective term for content, products, services or solutions, with embedded value, that have been transferred from the organization to intermediaries, clients or other Canadians. (*See* Benefit; Body of Knowledge; Content; Intelligence; Knowledge Cycle; Knowledge Services; Knowledge Services Value Chain; Outcome; Product; Program; Recommendation; Service; Solution; User)

Parameter: Attribute that is affected by multiple stages of the knowledge services value chain and that significantly and measurably affects the knowledge services system. (*See* Attribute; Sub-Parameter)

Partners: Persons, groups or organizations with legal, contractual or informal mutual agreement to cooperate in achieving common objectives as principles in a business, program or project with joint rights and responsibilities. (*See* Organization)

Potential Value: Value that has been embedded into content, products or services that has not been extracted through use. (*See* Value)

Primary Knowledge Services: Knowledge services provided directly to clients or other Canadians without any intermediate processing between the provider and the recipient. (*See* Secondary Knowledge Services; Tertiary Knowledge Services)

Product: Tangible and storable commodity or merchandise, wholly or partly derived from and dependent on or in support of content, with embedded value, intended to be used or transferred by an organization. (*See* Content; Knowledge Services; Output; Service; Solution)

Production: A sub-system comprising processes, activities or actions that embed value into content by generating it or transforming it into products or services intended to be used or transferred by an organization. (*See* Knowledge Services System; Knowledge Services Value Chain; Management; Organization; Sharing; Sub-System)

Program: Accountable organizational mandate to use resources and produce outputs that achieve specified outcomes that address recognized needs of eligible users. (*See* Knowledge Services; Organization; Output)

Recommendation: Advice, consultation or report that presents, proposes or endorses the establishment, continuation, change or termination of organizational outputs. (*See* Benefit; Intelligence; Output)

Secondary Knowledge Services: Knowledge services provided indirectly to clients or other Canadians through intermediate processing between the provider and the recipient. (*See* Primary Knowledge Services; Tertiary Knowledge Services)

Sector: A sub-system that includes intermediaries or clients, external to the organization, who use organizational outputs professionally to achieve sector outcomes. (*See* Knowledge Services System; Knowledge Services Value Chain; Organization; Society; Sub-System)

Service: Intangible and non-storable work, function or process, wholly or partly derived from, dependent on or in support of content, with embedded value and intended to be used or transferred by an organization. (*See* Content; Knowledge Services; Output; Product; Solution)

Sharing: A sub-system that uses knowledge services internally or transfers them to enable their external use by intermediaries, clients or other Canadians. (*See* Knowledge Services System; Knowledge Services Value Chain; Management; Organization; Production; Sub-System)

Society: A sub-system comprising external communities, interest groups, organizations or sectors whose purposes, processes or functions realize benefits of or evaluate wants or needs for the knowledge services system or that impact or influence organizational mandates or programs. (*See* Knowledge Services System; Knowledge Services Value Chain; Mandate; Organization; Sector; Sub-System)

Solution: Successful use of content, products or services to embed or extract value by accomplishing organizational objectives. (*See* Content; Output; Product; Service)

Stage: Distinct, identifiable phase or step of the knowledge services value chain, comprising *who*, *work*, *what* and *why* components that collectively embed value into products and services, advance it or enable its extraction. (*See* Component; Knowledge Services Value Chain; Sub-System)

Sub-Component: Specific, identifiable subset of a component that more precisely classifies who, work or what. (*See* Component; Element; Sub-Parameter)

Sub-Parameter: Specific, identifiable subset of a parameter that more precisely classifies an attribute. (*See* Element; Parameter; Sub-Component)

Sub-System: Distinct, identifiable part of the knowledge services system that performs related work to achieve objectives that support the goals of the parent group. (*See* Component; Element; Knowledge Services System; Management; Organization; Production; Sector; Sharing; Society; Stage)

System: A set of interrelated components that function collectively to transform inputs into outputs to achieve a common goal. (*See* Framework; Knowledge Services System)

Tacit Knowledge: Personal mental knowledge or skill gained through experience, learning or practice that is not in a form suitable for transfer. (*See* Explicit Knowledge)

Tertiary Knowledge Services: Knowledge services that benefit Canadians, society or nature through future outcomes or increased scientific knowledge. (*See* Primary Knowledge Services; Secondary Knowledge Services)

User: Person, group or organization who extracts value by using outputs to accomplish organizational objectives, achieve sector-related outcomes, or take or cause action to derive a personal benefit. (*See* Benefit; Knowledge Services Value Chain; Outcome; Output)

Value: Monetary, market, relative or intrinsic worth, utility, importance, degree of excellence, or desirability of something. (*See* Potential Value; Value Chain)

Value Chain: Flow of an entity through a sequence of processes that change its form and increase its value or utility at each stage of the sequence. (*See* Content Value Chain; Knowledge Services Value Chain; Value)

What: Inputs to and outputs from each stage of the knowledge services value chain. (*See* Component; Component Type; Who; Work; Why)

Who: Persons, groups or organizations who do knowledge work. (*See* Component; Component Type; What; Why; Work)

Why: The purpose, reason for existence and importance of the knowledge services system and its sub-systems and stages. (*See* Component; What; Who; Work)

Work: Processes, activities or actions that embed value into, advance value or extract value from knowledge services. (*See* Component; Component Type; What; Who; Why)

ANNEX 2. KNOWLEDGE SERVICES COMPONENT AND PARAMETER DEFINITIONS

TABLE 2.1	Components and Their Definitions
Component	**Definition**
Stage 1. Generate	
Originators	Persons or groups who embed value by generating new, enhanced or additional content intended to be transformed, used or transferred by an organization.
Generate	Embed value into content by bringing it into existence, deepening or broadening its meaning or increasing the amount held or owned and intended to be transformed, used or transferred by an organization.
Content	Embedded value, in the form of the message or signal contained within all elements of the content value chain that are held or owned and intended to be transformed, used or transferred by an organization.
Stage 2. Transform	
Developers	Persons or groups who increase the embedded value of existing content by transforming it into content-based products or services that are intended to be used or transferred by an organization.
Transform	Increase the embedded value of existing content by making it clearer or more apparent, elaborating details, or making it usable as products or services.
Product	Tangible and storable commodity or merchandise, wholly or partly derived from and dependent on or in support of content, with embedded value, intended to be used or transferred by an organization.
Service	Intangible and non-storable work, function or process, wholly or partly derived from, dependent on or in support of content, with embedded value, intended to be used or transferred by an organization.
Stage 3. Manage	
Managers	Persons who preserve and enable the extraction of value from content, products or services through access, use or transfer.
Preserve	Prevent the irretrievable loss of content, products, services or solutions throughout their life cycle by managing them in permanent physical or electronic media.
Enable	Provide authority, responsibility or resources; supply the means, opportunity or capacity; or facilitate access to content, products or services to permit the extraction of value through use or transfer.
Existing Inventory	Content, products or services with embedded value that have been generated or developed by the organization and are intended to be used or transferred.
Accessible Inventory	Content, products or services with embedded value that have been made available and are capable of being used or transferred by the organization.
Stage 4. Use Internally	
Internal Users	Persons or groups who extract value by using content, products or services to yield solutions that accomplish organizational objectives.
Use Internally	Extract value by carrying out actions that adapt content, apply products or employ services to yield solutions that accomplish organizational objectives.
Solutions	Successful result of using content, products or services to extract and embed value by accomplishing organizational objectives.

Component	Definition
Stage 5. Transfer	
Providers	Persons or groups who enable the extraction of value through transactions and interactions that transfer outputs to intermediaries, clients or other Canadians.
Transact	Conduct or carry out business to enable the transfer of rights and limits to use, re-use or redistribute outputs from the organization to intermediaries, clients or other Canadians.
Interact	Enhance the ability, readiness or willingness of intermediaries, clients or other Canadians to understand and apply outputs to solve their problems.
Transfer	Deliver, distribute or disseminate outputs to intermediaries, clients or other Canadians.
Output	Content, products, services or solutions with embedded value that have been transferred from an organization to intermediaries, clients or other Canadians.
Stage 6. Add Value	
Intermediaries	External persons, groups or organizations with professional sector-related knowledge who increase the availability, utility or value of outputs to facilitate use by clients or other Canadians.
Add Value	Perform work or provide a service that increases the availability, utility or value of outputs for use by clients or other Canadians.
Enhanced Outputs	Outputs with increased availability, utility or value resulting from the value added by intermediaries prior to their use by clients or other Canadians.
Stage 7. Use Professionally	
Clients	External persons, groups or organizations with professional sector-related knowledge who use outputs to achieve sector-related outcomes.
Use Professionally	Carry out actions that extract value by applying or employing outputs as a means to achieve client objectives and realize sector-related outcomes.
Outcomes	Sector-related results that follow as a consequence of the professional use of outputs by clients.
Stage 8. Use Personally	
Personal Interests	Rights, responsibilities, roles, wants or needs for sector-related outputs or outcomes that draw or attract the attention of individuals who want to take or cause action in order to derive a personal benefit.
Use Personally	Use capacity for action to make a decision or take action so as to derive a personal benefit in an area of personal interest.
Personal Benefits	Results that promote, enhance or help social, economic or environmental interests of individual Canadians.
Societal Benefits	Aggregation of personal benefits or sector outcomes that promotes, enhances or helps the state and sustainability of society, the economy, the environment or institutions.

Component	Definition
Stage 9. Evaluate	
Evaluators	Persons, groups or organizations who evaluate the performance of the knowledge services system or assess markets for knowledge services.
Evaluate Performance	Acquire, analyse and interpret information about outputs, outcomes or benefits to recommend changes that increase their productivity in supplying knowledge markets.
Assess Markets	Acquire, analyse and interpret intelligence about the current and future wants and needs of users in order to recommend adapting or evolving organizational outputs to better fulfill market demand.
Recommendations	Advice, consultation or report that presents, proposes or endorses the establishment, continuation, change or termination of organizational outputs.

TABLE 2.2	**Parameters and Their Definitions**
Parameter	**Definition**
Channel	Means, path or route along, by or through which knowledge services are provided, sent, downloaded or transmitted through the knowledge services system.
Quality	Property, character or attribute that distinguishes relative excellence among knowledge services.
Utility	Fitness for a designated purpose or worth for a specified end.
Scale	Magnitude, duration or level of spatial, temporal, process or organizational outputs relative to their intended use.
Intellectual Property	Organizational outputs produced primarily through intellectual or creative work, effort or study and for which property rights are or can be established.
Ownership	Legally having or possessing knowledge services as intellectual property.
Source	The organizational context within which knowledge services are generated, managed, transferred or used.
Criterion	Characteristics, attributes or standards that provide a basis for evaluation, judgement or decision-making with respect to outputs, outcomes or benefits.
Indicator	Quantitative measurements, indices or values; qualitative observation or description of one characteristic or attribute of a criteria.

ANNEX 3. NUMBER AND LIST OF SUB-COMPONENTS AND SUB-PARAMETERS IN THE KNOWLEDGE SERVICES SYSTEM

TABLE 3.1	Number of Sub-Components in the Knowledge Services System			
Stage	**Who**	**Work**	**What**	**Total**
1. Generate	9	7	5	**21**
2. Transform	9	8	11 + 6*	**34**
3. Manage	8	7 + 9*	3 + 3*	**30**
4. Use Internally	6	6	6	**18**
5. Transfer	8	5 + 6 + 6*	4	**29**
6. Add Value	8	10	7	**25**
7. Use Professionally	7	10	15	**32**
8. Use Personally	12	11	7 + 7*	**37**
9. Evaluate	6	5 + 4*	4	**19**
Total	**73**	**94**	**78**	**245**

*There are multiple parts to these components.

TABLE 3.2	Number of Sub-Parameters in the Knowledge Services System
Parameter	**Sub-Parameters**
Channel	8
Quality	4
Utility	4
Scale	7
Intellectual Property	6
Ownership	5
Source	4
Criterion	3
Indicator	3
Total	**44**

TABLE 3.3	List of Sub-Components	
Originators	**Generate**	**Content**
Scientist Creator Technician Technologist Knowledge analyst Synthesizer Agent Collector Learner	Discover Create Analyse concepts Synthesize Acquire Collect Learn	Objects Data Information Knowledge Wisdom
Developers	**Transform**	**Products / Services**

Engineer
Data architect
Systems analyst
Information analyst
Programmer
Specialist
Author
Compiler
Editor
	Develop
	Codify
	Embed
	Adapt
	Analyse content
	Write
	Assemble
	Produce
		Products
		  Database
		  Scientific article
		  Technical report
		  Promotional material
		  Geospatial products
		  Statistical products
		  Standards
		  Policies
		  Regulations
		  Systems
		  Devices
		Services
		  Answers
		  Advice
		  Teaching
		  Facilitation
		  Support
		  Laboratory

Managers	**Preserve / Enable**	**Existing Inventory / Accessible Inventory**

Senior manager
Manager
IT manager
Champion
Curator
Data manager
Information manager
Knowledge manager
	Preserve
	  Inventory
	  Prioritize
	  Capture
	  Record
	  Organize
	  Store
	  Maintain
	Enable
	  Establish programs
	  Implement programs
	  Persevere
	  Manage IT infrastructure
	  Manage collections
	  Manage data
	  Manage information
	  Manage knowledge
	  Convert
		Existing Inventory
		  Existing content
		  Existing products
		  Existing services
		Accessible Inventory
		  Accessible content
		  Accessible products
		  Accessible services

Internal Users	Use Internally	Solutions
Leader Program manager Planner Advisor Coordinator Knowledge worker	Lead Manage program Prepare plans Advise Coordinate Work	Direction Operations Plans Position Integration Result
Providers	**Transact / Interact / Transfer**	**Outputs**

Publisher
Communicator
Distributor
Webmaster
Librarian
Curator
Expert
Facilitator
	Transact
	  Give
	  Lend
	  License
	  Exchange
	  Sell
	Interact
	  Provide
	  Advertise
	  Explain
	  Promote
	  Support
	  Intervene
	Transfer
	  Publish
	  Proclaim
	  Disseminate
	  Hand out
	  Send
	  Serve
		Transferred content
		Transferred products
		Transferred services
		Transferred solutions

Intermediaries	**Enhance**	**Enhanced Outputs**
Governments Business Practitioners Trainers Researchers Media NGOs International bodies	Generalize Customize Improve Innovate Simplify Translate Train Analyse Endorse Disseminate	Generalized outputs Customized outputs Improved outputs Innovations Clearer outputs Approved outputs Available outputs
Clients	**Use Professionally**	**Outcomes**
Governments Businesses Practitioners Educators Researchers NGOs International bodies	Govern Commercialize Manage Study Report Interact Educate Advocate Negotiate Intervene	Stewardship Competitiveness Preservation Conservation Development Policies Strategies Management Consensus Position Awareness Risk Supply Infrastructure Productivity

Personal Interests	Use Personally	Personal Benefits / Societal Benefits

Social interests
Community interests
Well-being
Safety
Employment
Education
Consumerism
Property ownership
Environment
Age
Recreation
Travelling
	Interact
	Thrive
	Be safe
	Work
	Learn
	Purchase
	Own
	Monitor
	Participate
	Recreate
	Travel
		Personal Benefits
		  Individual benefits
		  Community benefits
		  Social benefits
		  Balance sheet
		  Net worth
		  Environmental conditions
		  Environmental trends
		Societal Benefits
		  State of society
		  Social sustainability
		  State of the economy
		  Economic sustainability
		  State of the environment
		  Environmental sustainability
		  Institutional infrastructure

Evaluators	**Evaluate Performance / Assess Markets**	**Recommendations**

Auditor General
Auditors
Internal users
Market analysts
Clients
Canadians
	Evaluate Performance
	  Evaluate productivity
	  Evaluate outputs
	  Evaluate outcomes
	  Evaluate benefits
	  Evaluate uncertainty
	Assess Markets
	  Validate mandate
	  Determine capacity
	  Solicit advice
	  Solicit opinions
		Proposed content
		Proposed products
		Proposed services
		Proposed solutions

TABLE 3.4	List of Sub-Parameters
Parameter	**Sub-Parameter**
Channel	On-site, off-site, kiosk, mail, on-line, e-mail, telephony, fax
Quality	Authoritativeness, completeness, accuracy, reliability
Utility	Relevance, accessibility, usability, timeliness
Scale	Space, time, complexity, magnitude, hierarchy, governance, compatibility
Intellectual Property	Property rights, inventory, intent, protect, license, enforce
Ownership	Sole, shared, licensed, held, borrowed
Source	Authority, trust, science outputs, program outputs
Criteria	Output criteria, outcome criteria, benefit criteria
Indicators	Output indicators, outcome indicators, benefit indicators

ANNEX 4. SUB-COMPONENT AND SUB-PARAMETER DEFINITIONS

This annex defines all the 245 sub-components and sub-parameters of the knowledge services system. In most cases, it includes descriptions and examples to help clarify the definition. This level of detail is appropriate for classifying and managing knowledge service activities within government departments. Underlining indicates that a word or term is defined later in the stage or in a subsequent stage. Component and parameter definitions (from Annex 2) are also included here for completeness.

The definitions are in order by stage. Stages are in order by who, work and what components. For example, in Stage 1, (Generate), originators (who) generate (work) content (what). Sub-components may be ordered hierarchically, sequentially, in groups of related terms, or randomly (when there is no pattern).

A4.1. STAGE 1 – GENERATE CONTENT IN AN ORGANIZATION

Purpose: Content with embedded value and potential utility must be generated as the first stage of the knowledge services value chain.

TABLE 4.1	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 1 of the Knowledge Services System – Generate Content in an Organization	
Component / Sub-Component	**Definition**	**Description**
1. Originators	Persons or groups who embed value by generating new, enhanced or additional content intended to be transformed, used or transferred by an organization.	Provide metadata, submit to repositories, partnerships.
Scientist	Person or group who uses scientific methods to discover new knowledge.	Privileged use, credit for discovery, scientific publications.
Creator	Person or group who uses inherent and learned talent and skill to create original intellectual work.	Authors, artists, photographers; books, articles, paper, artwork, photographs, recordings, film.
Technician	Person or group who uses technology or technical processes to support the discovery of new knowledge.	Support staff, specialists, research assistants.
Technologist	Person or group who analyses technology to describe or understand how it functions in relation to domains of interest.	Reverse engineering, data for model development.
Knowledge analyst	Person or group who analyses concepts to yield deeper or more precise meaning or understanding.	Splitters, technologists, specialists, internal advice and recommendations.
Synthesizer	Person or group who integrates and interprets content to synthesize broader or higher-level meaning or understanding.	Lumpers, systems analysts, generalists, policy analysts.
Agent	Person or group who acts as a representative, emissary or official of an organization to acquire content from external sources.	Single party, negotiation, contracts, cost, buy, sell, trade.
Collector	Person or group who acts, under the authority and on behalf of an organization, to collect content from external sources.	Multiple parties, agreements, responsibilities, networks, systems, surveys.
Learner	Person or group who learns in order to increase their awareness, knowledge, skill or ability to accomplish tasks.	Anyone who undertakes continuous learning, lifelong learning.
2. Generate	Embed value into content by bringing it into existence, deepening or broadening its meaning or increasing the amount held or owned and intended to be transformed, used or transferred by an organization.	
Discover	Use hypothesis, experiment, analysis, reasoning and insight to find, reveal and prove new cause-and-effect relationships that explain and predict natural or social phenomena.	Scientific method.

Component / Sub-Component	Definition	Description
Create	Use imagination, inspiration, intuition and inherent creative talent or learned skill to bring original intellectual work into existence.	Write, draw, design, paint, play music.
Analyse concepts	Use deductive and inductive reasoning to differentiate, study and interpret concepts to yield deeper, broader or more precise meaning or understanding.	Problems, internal advice and recommendations, positions, take apart.
Synthesize	Using content and inductive reasoning, integrate, study and interpret the functioning of many parts as a whole to yield broader or higher-level meaning or understanding.	Issues, internal advice and recommendations, positions, put together.
Acquire	Use systems and processes to find, access, purchase, license, employ or transfer content from external sources into an organization.	Purchase, license, intellectual property, contracts; usually individual items.
Collect	Use systems and processes to monitor, gather, organize, store and retrieve objects, data or information from external sources.	Surveys, experiments, weather, sector activity; usually large numbers of items.
Learn	Increase awareness, knowledge or skill through being informed, study, instruction, experience or practice.	Gaining experience, training, formal education; acquiring judgement.
3. Content	Embedded value, in the form of the message or signal contained within all elements of the content value chain that are held or owned and intended to be transformed, used or transferred by an organization.	Quality, originality, accuracy, relevance, completeness, timeliness, classification.
Objects	Physical entities and collections used to facilitate and support the generation of content.	Collections: rocks, minerals, fossils, wood, insects, plant materials, diseased material.
Data	Recorded, ordered symbols or signals that carry information and patterns.	Data elements, records, files, databases.
Information	Meaning and context arising from processing, interpreting or translating data to extract an underlying message or pattern.	Documents, maps, images, recordings.
Knowledge	Understanding arising from integration, analysis or synthesis of data or information to reveal cause-and-effect relationships that facilitate the explanation and prediction of natural or social phenomena.	Equations, models, experience.
Wisdom	Experience and judgement that enable the proper and correct application of information and knowledge to make decisions within an organizational, sectoral or societal context.	Tacit knowledge; knowledge that is codified in laws, policies, regulations, rules or guidelines.

A4.2. STAGE 2 – TRANSFORM CONTENT INTO KNOWLEDGE SERVICES

Purpose: Content is transformed into knowledge services to increase its utility or value to users.

TABLE 4.2	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 2 of the Knowledge Services System – Transform Content Into Knowledge Services	
Component / Sub-Component	**Definition**	**Description**
1. Developers	Persons or groups who increase the embedded value of existing content by transforming it into content-based products or services that are intended to be used or transferred by an organization.	May be partnerships.
Engineer	Person or group who embeds content into the design, functionality or operation of devices.	Designers, machinists, engineers, technicians.
Data architect	Person or group who develops database structures, data analysis methods or processes to input data into systems.	Data modelling, taxonomy, infrastructure, metadata.
Systems analyst	Person or group who develops content-based standards, systems or processes.	Software developers, programmers, process developers.
Information analyst	Person or group who analyses content to produce products or services.	Policy analysts, regulators, standards developers.
Programmer	Person or group who codifies content-based processes or algorithms into programs to enable computers to execute the processes.	
Specialist	Person or group who adapts content to support outreach activities.	Subject-matter experts, teachers, trainers.
Author	Person or group who writes content-based documents or other textual media.	Reports, papers, articles.
Compiler	Person or group who gives, conveys or communicates meaning by assembling content into a product or service.	Economists, statisticians, analysts, geographers, data entry clerks.
Editor	Person or group who produces textual material intended for publication.	Editors, designers, producers, printers; meaning is not changed.
2. Transform	Increase the embedded value of existing content by making it clearer or more apparent, elaborating details, or making it usable as products or services.	
Develop	Design, put together and test content-based products or services that are intended to be used or transferred by an organization.	
Codify	Reduce, systematize or classify content into standardized programs, rules or processes that enable, support or are embedded in products or services.	
Embed	Incorporate content into the materials, construction or functionality of devices.	Laboratory instruments, measuring devices, new materials.

Component / Sub-Component	Definition	Description
Adapt	Modify, customize or simplify content, without changing its meaning, to increase its suitability for specific users and uses.	Training, teaching, outreach, communication, presentation, advice.
Analyse content	Use deductive and inductive reasoning to differentiate, study and interpret content to embed its meaning into products or services.	Develop: standards, policies, regulations.
Write	Interpret, describe, explain or summarize the meaning of content in documents or other text-based media.	
Assemble	Compile, combine, collate or integrate content into documents or other products.	
Produce	Illustrate, translate, edit, format or print documents, Web pages or other text-based products intended for external audiences.	
3. Product	Tangible and storable commodity or merchandise, wholly or partly derived from and dependent on or in support of content, with embedded value, intended to be used or transferred by an organization.	
Database	Related records, files or data sets that are independent of applications, involve complex relationships and can be manipulated, analysed and used to support development of other knowledge products.	Scientific, resource inventories, sector activities, socioeconomic, state of the environment, subsets may be extracted.
Scientific articles	Conceptual documents or other media that explain experiments and newly discovered knowledge.	Scientific audience, journal articles, theories, describe experiments, models.
Technical reports	Technical documents or other text-based media that contain meaning within a context of professional methods.	Professional audience, information reports, educational materials, how-to methods, issue analyses.
Promotional material	Outreach documents or other media that communicate, promote, advertise or market organizational activities.	General audience, awareness; flyers, brochures, logos, pamphlets, posters.
Geospatial products	Maps or geospatial images that are based on spatial coordinates and provide static or dynamic displays of spatial relationships.	Maps, map products, remote sensing images, atlases, place-name catalogues.
Statistical products	Recurring numeric tabulations, compilations or summaries within a context, intended to monitor and describe the state and trends of a significant aspect of the organization or sector.	Statistics are more than data but less than information; not one-of-a-kind science experiments; data in context.
Standards	Intellectual infrastructure that supports, facilitates and promotes the use of content, products or services.	Standards, glossaries, catalogues, taxonomies, regulations, policies, rules.
Policies	High-level overall direction, method of action or acceptable processes that guide decisions within the context of general goals.	Governance, paradigms, models, enforceable rules, procedures.

Component / Sub-Component	Definition	Description
Regulations	Authoritative and enforceable mandatory procedural rule issued by executive authority of a government.	
Systems	Digital applications that support the <u>use</u> of content, products or services.	Programs, software, decision support systems, Geographic Information Systems, expert systems, diagnostic and analysis tools, algorithms.
Devices	Physical objects, tools or machines that perform mechanical, analog or digital functions or operations.	Materials, hardware, instruments, equipment.
4. Service	Intangible and non-storable work, function or process, wholly or partly derived from, dependent on or in support of content, with embedded value, intended to be <u>used</u> or <u>transferred</u> by an organization.	Provide, perform or supply help, utility or benefit to recipients.
Answers	Respond to requests or queries, by providing facts or information to individuals or groups.	Frequently asked questions, questions and answers; no analysis; someone who knows tells someone who doesn't know.
Advice	Use one-to-one approaches to make case-specific knowledge or wisdom explicit and transfer it.	Recommendations; briefing notes, reviews and comments; between: equals, subordinate/superior, expert/manager, experienced person / novice.
Teaching	Use one-to-many approaches to make general knowledge or wisdom explicit and transfer it.	Presentations, posters, workshops, training, instruction, tours, field trips, demonstrations, teacher/student.
Facilitation	Provide logistical, administrative and advisory support to a group that is serving the content-based needs of the organization, sector or Canadians.	Coordination, negotiation, associations, secretariats, advisory and stakeholder groups, communities of practice, networks.
Support	Provide funding, management, staff and resources to programs, projects or activities that serve the content-based needs of the organization, sector or Canadians.	Incentive programs.
Laboratory	Leasing or sharing facilities or equipment for complementary use or providing laboratory testing, analysis or experimentation for partners or clients.	Leveraging capacity.

A4.3. STAGE 3 – MANAGE KNOWLEDGE SERVICES

Purpose: The flow of knowledge services must be enabled to permit their transfer to clients or other Canadians.

TABLE 4.3	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 3 of the Knowledge Services System – Manage Knowledge Services	
Component / Sub-Component	**Definition**	**Description**
1. Managers	Persons who preserve and enable the extraction of value from content, products or services through <u>access</u>, <u>use</u> or <u>transfer</u>.	
Senior manager	Person who <u>establishes</u> strategic direction, programs or projects that enable <u>access</u>, <u>use</u> or <u>transfer</u> of content, products or services.	Executives, program managers.
Manager	Person who <u>implements</u> programs, projects or tasks that enable <u>access</u>, <u>use</u> or <u>transfer</u> of content, products or services.	Directors, project leaders, team leaders, section chiefs.
Information technology (IT) manager	Person who <u>implements</u> a <u>digital infrastructure</u> to support <u>access</u>, <u>use</u> or <u>transfer</u> of content, products or services.	IT specialists, programmers, applications experts, Web developers.
Champion	Person who leads, is proactive and <u>perseveres</u> in <u>enabling access</u>, <u>use</u> or <u>transfer</u> of content, products or services.	"Pushing the envelope," creative management.
Curator	Person who <u>preserves</u> and manages <u>access</u> to objects, artifacts or collections of physical material to enable their <u>use</u> or <u>transfer</u>.	Supervisors, officers, managers, specialists.
Data manager	Person who <u>preserves</u> and manages <u>access</u> to data and data-based products or services to enable their <u>use</u> or <u>transfer</u>.	Supervisors, officers, managers, specialists.
Information manager	Person who <u>preserves</u> and manages <u>access</u> to information and information-based products or services to enable their <u>use</u> or <u>transfer</u>.	Librarians, records officers, supervisors, managers, specialists; emphasis on documents.
Knowledge manager	Person who <u>preserves</u> and manages <u>access</u> to knowledge and knowledge-based products or services to enable their <u>use</u> or <u>transfer</u>.	Supervisors, officers, managers, specialists.
2. Preserve	Prevent the irretrievable loss of content, products, services or <u>solutions</u> throughout their life cycle by managing them in permanent physical or electronic media.	Repositories, search engines; maintain integrity, manage from acquisition to disposal, migrate to evolving technology.
Inventory	Find, gather, list and classify existing content, products and services.	Collect, metadata.
Prioritize	Estimate the current and future utility and value of content, products and services, rank their importance and determine their life cycles.	Collections, archives, repositories; life cycle: from acquisition to disposition or permanent retention.

Component / Sub-Component	Definition	Description
Capture	Represent, explain or describe tacit knowledge in an explicit form through speaking, tabulating, writing or visualization.	Dialogue, interviews, presentations, reports, documents, letters, records, memoranda, pictures, drawings, schematics, blueprints.
Record	Permanently register content, products or services on reproducible physical, mechanical, analog or digital media.	Objects, paper, paper tape, punched cards, film, microfilm, magnetic tapes, computer disks, CD-ROMs.
Organize	Establish, arrange or classify content, products or services in a coherent, integrated structure to facilitate storage and subsequent retrieval and use.	Metadata, catalogues, indexes, formats; link to physical assets, context and attributes.
Store	Place or leave content, products or services in permanent repositories to support subsequent retrieval and use.	Warehouses, libraries, storerooms, computer media, museums, records offices.
Maintain	Protect, care for and recondition content, products or services and adapt media to evolving technologies.	Conserve, copy, restore; minimizing risks of accidental or deliberate loss; redundancy, mirror sites, backup.
3. Enable	Provide authority, responsibility or resources; supply the means, opportunity or capacity; or facilitate access to content, products or services to permit the extraction of value through use or transfer.	Enabling functions are precursors to use or transfer.
Establish programs	Authorize, assign responsibility and support a program, project or activity that enables access, internal use or transfer of content, products or services.	
Implement programs	Allocate resources and direct and supervise a program, project or activity that enables access, internal use or transfer of content, products or services.	
Persevere	Overcome barriers, obstacles and resistance to change to enable access, internal use or transfer of content, products or services.	
Manage information technology infrastructure	Develop, implement and operate hardware, software and communication networks that support access, use or transfer of content, products or services.	Internet, intranet, Web sites, portals, Common Office Environments, servers, personal computers, repositories, data warehouses.
Manage collections	Develop, implement and direct processes to acquire, organize, preserve and provide access to objects, artifacts or collections to enable their use or transfer.	
Manage data	Develop, implement and direct processes to organize, preserve and provide access to data or data-based products or services to enable their use or transfer.	

Component / Sub-Component	Definition	Description
Manage information	Develop, implement and direct processes to organize, preserve and provide access to information or information-based products or services to enable their use or transfer.	
Manage knowledge	Develop, implement and direct processes to organize, preserve and provide access to knowledge or knowledge-based products or services to enable their use or transfer.	
Convert	Change physical or digital content, products or services from one form to another.	
4. Existing inventory	Content, products or services with embedded value that have been generated or developed by the organization and are intended to be used or transferred.	"Parking lot" for all embedded value; everything sits here until it is made available by management or lost.
Existing content	Content with embedded value that has been generated and is intended to be used or transferred.	
Existing products	Products with embedded value that have been developed and are intended to be used or transferred.	
Existing services	Services with embedded value that have been developed and are intended to be used or transferred.	
5. Accessible inventory	Content, products or services with embedded value that have been made available and are capable of being used or transferred by the organization.	Non-consumptive use does not preclude re-use or leveraging.
Accessible content	Content with embedded value that has been made available and capable of being used or transferred.	
Accessible products	Products with embedded value that have been made available and are capable of being used or transferred.	
Accessible services	Services with embedded value that have been made available and are capable of being used or transferred.	

A4.4. STAGE 4 – USE INTERNALLY TO YIELD SOLUTIONS

Purpose: Knowledge services are used internally to accomplish organizational objectives.

TABLE 4.4	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 4 of the Knowledge Services System – Use Internally to Yield Solutions	
Component / Sub-Component	**Definition**	**Description**
1. Internal users	Persons or groups who extract value by <u>using</u> content, products or services to yield <u>solutions</u> that accomplish organizational objectives.	
Leader	Person with organizational position, practical experience or conceptual knowledge who <u>leads</u> a group or organization to determine appropriate <u>solutions</u>.	Foresight, vision, setting goals.
Program manager	Person with organizational responsibility, authority and resources who <u>manages</u> a group or organization to yield efficient and effective <u>solutions</u>.	Achieving goals, operations; projects, programs, branches, sectors, running programs.
Planner	Person or group who prepares and recommends <u>plans</u> that specify methods and procedures for realizing <u>solutions</u>.	Managers implement.
Advisor	Person with extensive domain or organizational knowledge, expertise or experience who <u>recommends</u> approaches and desired <u>solutions</u>.	
Coordinator	Person with extensive domain or organizational knowledge, expertise or experience who <u>coordinates</u> organizational activities leading to integrated <u>solutions</u>.	Facilitate.
Knowledge worker	Person with specific subject or process knowledge, expertise or experience who uses content, products or services to do <u>work</u> that yields <u>solutions</u> to assigned tasks.	
2. Use internally	Extract value by carrying out actions that adapt content, apply products or employ services to yield <u>solutions</u> that accomplish organizational objectives.	
Lead	Inspire, provide an example or set a precedent to guide a group or organization towards appropriate <u>solutions</u>.	Does the right thing; strategic direction.
Manage program	Direct, authorize, assign responsibility and allocate resources to produce efficient and effective <u>solutions</u>.	Does things right; decision-making, running the organization, judgement.
Prepare plans	Design, develop and recommend <u>plans</u> that specify methods and procedures for realizing <u>solutions</u>.	

Component / Sub-Component	Definition	Description
Advise	Determine, analyse and compare expected impacts, consequences or results of alternative approaches in order to recommend proposed solutions.	Internal advice, consultation.
Coordinate	Organize, combine or structure diverse activities, work or processes to facilitate integrated solutions.	Internal, programs, strategies.
Work	Complete tasks, activities or processes that produce or accomplish results.	
3. Solutions	Successful result of using content, products or services to extract and embed value by accomplishing organizational objectives.	
Direction	A vision, approach or strategy that establishes a way or direction towards appropriate organizational goals.	Laws and policies, environmental scans, strategic plans, business cases.
Operations	Directed, organized and integrated human resources, technological infrastructure and work flow that, taken together, achieve organizational goals and objectives.	Vertically integrated inputs; problems solved; tends towards objectivity.
Plans	Documents, charts or illustrations that specify methods and procedures for realizing solutions.	Work plan, schedule, blueprints, flowchart.
Position	A document or statement that formally establishes, describes and defends an organizational stance, opinion or approach on an issue.	Horizontally integrated inputs; issues analysed; tends towards subjectivity; policies.
Integration	Coordinated activities, work or processes that achieve a unified, shared organizational objective.	
Result	Output, product or consequence of work that achieves or accomplishes organizational objectives.	Reports: status, progress, annual; work: plans, guidelines, methods, business cases, strategies, surveys.

A4.5. STAGE 5 – TRANSFER OUTPUTS EXTERNALLY

Purpose: Knowledge services must be transferred to intermediaries, clients and other Canadians to enable external use.

TABLE 4.5	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 5 of the Knowledge Services System – Transfer Outputs Externally	
Component / Sub-Component	**Definition**	**Description**
1. Providers	Persons or groups who enable the extraction of value through transactions and interactions that transfer outputs to intermediaries, clients or other Canadians.	
Publisher	Person or group who allows publication of scientific or technical outputs intended for professional use.	Approval to publish.
Communicator	Person or group who disseminates simplified outputs intended for general audiences.	Target audiences, market segments.
Distributor	Person or group who disseminates tangible outputs.	Distribution lists.
Webmaster	Person or group who enables organized and structured on-line access to digital outputs through an Internet site or portal.	Post to Web site; manage: content, repositories, search engines.
Librarian	Person or group who provides or facilitates organized and structured access to tangible outputs.	Library loans, view reference material, library collections, circulation.
Curator	Person or group who provides organized and structured on-site access to and interpretation of objects or collections.	Rocks, minerals, insects, plant materials, disease tissue.
Expert	Person or group who advises or counsels intermediaries, clients or other Canadians on using outputs to achieve outcomes or benefits.	Recommendation, guidance, explanation.
Facilitator	Person or group who assists, supports or helps intermediaries, clients or other Canadians in using outputs to achieve outcomes or benefits.	National, international, agreements, associations, secretariats.
2. Transact	Conduct or carry out business to enable the transfer of rights and limits to use, re-use or redistribute outputs from the organization to intermediaries, clients or other Canadians.	Buy and sell, provide and access, trade, license, negotiate; contract or other legal basis.
Give	Supply, deliver or make outputs available to intermediaries, clients or other Canadians without fees, cost or limitations on use, re-use or redistribution.	Free, unrestricted use; if we build it, it will be used; a sense that there should be a use.

Component / Sub-Component	Definition	Description
Lend	Supply, deliver or make <u>outputs</u> available to <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u> for temporary use, on condition that they or their equivalent be returned.	Libraries, collections.
License	Supply, deliver or make <u>outputs</u> available to <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u> with limitations on use, re-use or redistribution, with or without fees.	Strings are attached, residual organizational property rights.
Exchange	Barter, trade or substitute <u>outputs</u> in return for other valued outputs received from <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u>.	Two-way or multi-party agreements, partnerships, reciprocal, give and receive.
Sell	Transfer rights, obligations and limitations associated with <u>outputs</u> to <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u> in exchange for money or other financial consideration.	Price, cost; no residual organizational rights to physical property but may retain intellectual property rights (e.g. a book).
3. Interact	Enhance the ability, readiness or willingness of <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u> to understand and apply <u>outputs</u> to solve their problems.	Organizational activities, part of transfer process, engage users, marketing; not legally binding; deploy, technology transfer.
Provide	Make <u>outputs</u> externally available and accessible with or without consideration of external <u>use</u>.	Passive.
Advertise	Increase the external visibility of <u>outputs</u> by publicly announcing, making known or calling attention to their availability.	Supply-driven; here is what we have, can you use it?
Explain	Describe and/or demonstrate what <u>outputs</u> do and how they work to increase user know-how and understanding.	User relates outputs to needs; use is more likely if users know more about them.
Promote	Encourage, market or advocate the external <u>use</u> of <u>outputs</u> by demonstrating their utility or value.	Best practices; user would benefit from use; utility and value exceed cost and effort.
Support	Supply resources, funds, expertise, systems or assistance to facilitate the external use of <u>outputs</u>.	Help the user by doing some of the work, templates, user guides.
Intervene (organization)	Solve problems, remove barriers or establish interoperability to enable the external use of <u>outputs</u>.	Standards, guidelines, rules, policies, regulations, processes; not legally binding.
4. Transfer	Deliver, distribute or disseminate <u>outputs</u> to <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u>.	Media, packaging, routes, one or more flows.
Publish	Formally make public, release or issue <u>outputs</u> to <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u>.	Outward flow to groups; publications may be in any media; science, technology, positions.
Proclaim	Publicly declare or promulgate and put into action or force regulations that must be used by <u>intermediaries</u>, <u>clients</u> or other <u>Canadians</u>.	Outward flow to groups; responsible for implementation.

Component / Sub-Component	Definition	Description
Disseminate	Spread, disperse or distribute outputs to intermediate, client or other Canadian audiences.	Outward flow to groups or the public; sell, market, advertise, promote.
Hand out	Respond to in-person requests for outputs by directly handing, giving or providing tangible outputs to them.	Requests/receipts.
Send	Respond to requests for products from individuals or groups by transferring electronically, mailing or shipping products to them.	Requests/receipts; via carriers or networks; any media.
Serve	Respond to requests for services from individuals or groups by providing services for them.	Requests/receipts.
5. Outputs	Content, products, services or solutions with embedded value that have been transferred from the organization to intermediaries, clients or other Canadians.	
Transferred content	Content that has been transferred from the organization to intermediaries, clients or other Canadians.	
Transferred products	Products that have been transferred from the organization to intermediaries, clients or other Canadians.	
Transferred services	Services that have been transferred from the organization to intermediaries, clients or other Canadians.	
Transferred solutions	Solutions that have been transferred from the organization to intermediaries, clients or other Canadians.	

A4.6. STAGE 6 – ADD VALUE TO OUTPUTS

Purpose: Work is done by intermediaries to increase the availability, utility or value of knowledge services for identified purposes.

TABLE 4.6	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 6 of the Knowledge Services System – Add Value to Outputs	
Component / Sub-Component	Definition	Description
1. Intermediaries	External persons, groups or organizations with professional sector-related knowledge who increase the availability, utility or value of outputs to facilitate their <u>use</u> by <u>clients</u> or other <u>Canadians</u>.	
Governments	Sovereign authority, legal jurisdiction, departments or agencies that increase the availability, utility or value of outputs through governance.	Federal, provincial, territorial, local or aboriginal; laws, policies, regulations.
Businesses	Industries, companies or enterprises that increase the availability, utility or value of outputs through innovation, brokerage or profit-based enhancement services.	Investors, economists, financial analysts, market analysts, regional developers, small proprietorships, entrepreneurs.
Practitioners	Persons, groups or organizations who increase the availability, utility or value of outputs through professional activities.	Managers, planners, specialists, professional workers, professional associations.
Trainers	Persons, groups or organizations who increase the availability, utility or value of outputs by training students in their use.	Teachers, trainers, instructors, schools, students.
Researchers	Persons, groups or organizations who increase the availability, utility or value of outputs through study, research, analysis or interpretation.	Scientists, professors, economists, analysts, academic associations, research institutes, universities, colleges.
Media	Organizations or networks that increase the availability, utility or value of outputs by communicating with target audiences.	Newspapers, radio, television, magazines, advertising, Internet, Web.
Non-governmental organizations	Groups that increase the availability, utility or value of outputs through work, facilitation or advocacy.	Stakeholders, activists, lobbyists, environmental groups, industry associations.
International bodies	Groups or organizations that increase the availability, utility or value of outputs through joint multinational activities.	International agreements, memorandums of understanding, partners, conventions, treaties.
2. Add value	Perform work or provide a service that increases the availability, utility or value of outputs for <u>use</u> by <u>clients</u> or other <u>Canadians</u>.	
Generalize	Make outputs more general by increasing their applicability, breadth or depth to enable a broader range of <u>use</u>.	

Component / Sub-Component	Definition	Description
Customize	Make outputs more particular by modifying, adapting, refining or repackaging them to enable a different or more specific use.	
Improve	Make outputs incrementally better by increasing functionality, efficiency or quality to enhance their utility or the value of their use.	Evolution, cost-effectiveness, ease of use, timeliness, accuracy.
Innovate	Transform outputs into novel products or services or combine them in novel ways to increase their utility or the value of their use.	Revolution, time to market, product cycle, return on investment, market share.
Simplify	Make outputs plain or more understandable; reduce their scope, complexity or elaboration to broaden their use.	
Translate	Change or turn outputs in one language or set of symbols into another to broaden their use.	Between any two languages; from math to language, database formats.
Train	Increase understanding of outputs by instruction, demonstration or explanation to increase their use.	
Analyse	Study and interpret outputs to yield deeper or broader understanding or to add meaning that increases their utility or the value of their use.	Concepts, content.
Endorse	Publicly express formal approval, acceptance, favourable opinion or official sanction of outputs and recommend their use.	
Disseminate	Provide publishing, distribution, marketing or communication services to facilitate access to outputs and enable their use.	Sell, advertise, promote, manage transactions, broker.
3. Enhanced outputs	Outputs with increased availability, utility or value resulting from the value added by intermediaries prior to their use by clients or other Canadians.	
Generalized outputs	Outputs that enable a broader range of use than in their original form.	
Customized outputs	Outputs that enable a different, more specific or particular use than in their original form.	
Improved outputs	Outputs with more utility or value for their intended use than in their original form.	Evolution, somewhat better.
Innovations	Novel outputs or output combinations with new utility, value or uses relative to their original form.	Revolution, different.
Clearer outputs	Outputs that are more intelligible, meaningful or understandable by intended or new users than in their original form.	Simplify, translate, train, analyse.
Approved outputs	Outputs that have been officially endorsed, accepted or recommended by authoritative sources.	Third-party reviews.
Available outputs	Outputs that are more widely or easily accessible than in their original form.	Published, broadcast in mass media, marketed through a broker.

A4.7. STAGE 7 – USE PROFESSIONALLY TO ACHIEVE OUTCOMES

Purpose: Knowledge services are used by professional clients with sector-related knowledge to benefit an identifiable sector.

TABLE 4.7	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 7 of the Knowledge Services System – Use Professionally to Achieve Outcomes	
Component / Sub-Component	**Definition**	**Description**
1. Clients	External persons, groups or organizations with professional sector-related knowledge who <u>use</u> outputs to achieve sector-related <u>outcomes</u>.	
Governments	Sovereign authorities, legal jurisdictions, departments or agencies that use outputs to achieve <u>outcomes</u> through <u>governance</u>.	Federal, provincial, territorial, local, aboriginal.
Businesses	Industries, companies or enterprises that use outputs to achieve <u>outcomes</u> through <u>commercialization</u>.	Private sector, consultants, service industries, investors, financial analysts, developers, manufacturers.
Practitioners	Persons, groups or organizations who use outputs to achieve <u>outcomes</u> through <u>management</u>.	Managers, planners, foresters, engineers, miners, energy workers, health care workers, professional associations, prospectors.
Educators	Persons, groups or organizations who use outputs to influence <u>outcomes</u> through <u>education</u>.	Teachers, graduate students, academic associations, research institutes, universities, colleges, technical schools, libraries.
Researchers	Persons, groups or organizations who use outputs to influence <u>outcomes</u> through <u>study</u>, analysis and new interpretation.	Scientists, professors, economists, analysts, academic associations, research institutes, universities.
Non-governmental organizations	Individuals, groups or organizations who use outputs to influence or achieve <u>outcomes</u> through work, facilitation or <u>advocacy</u>.	Stakeholders, activists, lobbyists, environmental groups, industry associations.
International bodies	Groups or organizations that use outputs to achieve <u>outcomes</u> through joint multinational activities.	International agreements, memoranda of understanding, partners, conventions, treaties.
2. Use professionally	Carry out actions that extract value by applying or employing outputs as a means to achieve client objectives and realize sector-related outcomes.	Solve problems, analyse and understand issues, make decisions.
Govern	Exercise sovereign authority; make and administer laws, regulations or policies; or exert determining, controlling or guiding influence related to sector <u>outcomes</u>.	Canada, provinces, territories, First Nations, municipalities.
Commercialize	Market products or services for profit to yield or support sector <u>outcomes</u>.	Market share, timeliness, competitiveness, customers.
Manage	Direct, authorize, assign responsibility and allocate resources to achieve organizational objectives or sector <u>outcomes</u>.	Managing natural resources.

Component / Sub-Component	Definition	Description
Study	Generate new sector-related content that influences sector <u>outcomes</u>.	New: data, information, knowledge, facts, meaning or understanding.
Report	Produce or present statistics or documents related to <u>outcomes</u> that describe, explain or discuss the state of the sector or the organization.	"State of" reports; national, provincial or industry statistics, annual reports.
Interact	Network, solicit feedback or develop consensus related to sector <u>outcomes</u>.	
Educate	Teach or impart information, knowledge or skill that enhances a sector's capacity to achieve <u>outcomes</u>.	
Advocate	Communicate, encourage, market or promote actions or activities that result in sector <u>outcomes</u>.	Non-governmental organizations, lobbyists, associations, interest groups.
Negotiate	Arrange or bring about an agreement or consensus about sector <u>outcomes</u> through conference, discussion or compromise among multiple parties.	Federal/provincial/territorial, public/private, multiple parties.
Intervene (sector)	Facilitate, support or require sector activities or actions that support, yield or achieve sector <u>outcomes</u>.	Standards, guidelines, rules, processes; not legally binding.
3. Outcomes	Sector-related results that follow as a consequence of the professional use of outputs by clients.	Sustainable development.
Stewardship	Wise and holistic care of sector resources today so as to maximize options for future generations.	Sustainability, multi-dimensional, horizontal, not wasting, phased transitions.
Competitiveness	Use of sector resources by industry to create national wealth, economic prosperity and employment in a global marketplace.	Development.
Preservation	Prohibiting current use of sector resources and maintaining them in a natural state for future generations.	Parks, wildlife refuges, rare and endangered species, nature conservancies, strategic reserves.
Conservation	Restricting, limiting or sustainably managing current use of sector resources to ensure future availability.	Reduce, re-use, recycle, replenish, sustained yield, harvest growth, certification.
Development	Harvesting, extracting and processing sector resources to create wealth, employment and prosperity, in the context of society's needs.	Industry, private sector, markets, supply and demand, efficiency, costs.
Policies	Overall course, acceptable procedures or method of action, selected from analysed alternatives, concerning sector-related goals.	Analyse outcomes.
Strategies	High-level plans, directions and approaches that support sector-related policies.	Establish approaches, attain goals.
Management	Authorities, responsibilities, accountabilities and resources to deliver programs that implement sector-related strategies.	Deliver programs and accomplish goals; land, water, forestry, mining, energy.

Component / Sub-Component	Definition	Description
Consensus	Agreement among stakeholders on common, joint or integrated sector-related policies, strategies or management.	Federal/provincial/territorial, private/public, academic/management, individual/group.
Position	Document or statement that formally establishes, describes and defends a stance, opinion or approach toward consensus on a sector-related strategic issue.	Relative to other sectors, the country or internationally; stewardship, competitiveness, preservation, laws, regulations.
Awareness	Having or showing realization, perception or knowledge of sector-related issues, states or positions.	Knowing about, being informed, cognizant, conscious of, sensible, knowledgeable.
Risk	Potential loss of sector value from natural, accidental or deliberate events or actions combined with the probability of an event.	Natural, technological and biological hazards; monitoring, warning, response, mitigation, recovery.
Supply	Stock or flow of resources, extraction or harvesting efficiency, or grade of raw material that can be profitably processed.	Tree: regeneration, replanting or growth; pump wells to lower residual, process lower-grade ore, renewable resources, recycling.
Infrastructure	Sector-related transportation, transmission, distribution or storage systems and networks.	Roads, railroads, pipelines, airports, waterways, communications networks, transmission networks, tank farms, strategic reserves.
Productivity	Quantity, amount or value of sector-based products and services produced per unit of resource used.	Output/input ratio, reduced costs, more efficient production, higher value.

A4.8. STAGE 8 – USE PERSONALLY TO REALIZE BENEFITS

Purpose: Knowledge services are used by Canadians to realize personal benefits. Current and future personal benefits are aggregated to yield societal benefits.

TABLE 4.8	Definitions and Descriptions for *Interest, Use* and *Benefit* Components and Sub-Components for Stage 8 of the Knowledge Services System – Use Personally to Realize Benefits	
Component / Sub-Component	**Definition**	**Description**
1. Personal interests	Rights, responsibilities, roles, wants or needs for sector-related outputs or outcomes that draw or attract the attention of individuals who want to take or cause action, in order to derive a <u>personal benefit</u>.	Advantages, benefits, concerns, desires, points of view, opportunities, challenges, ideas, activities.
Social interests	Interactions, relationships, participation or interdependency among society and individuals or groups.	Language, equity, policy making, regulations, policies, laws.
Community interests	Interactions, relationships, participation or interdependency among individuals in identifiable groups with similar culture, interests or place.	Culture, Aboriginal people, visible minorities, people with disabilities, neighbourhoods, communities, traditional knowledge.
Well-being	Contentment with sector-related sustainable development, negligible impact of exposure to health hazards, or satisfactory personal wealth and prosperity.	Existence values, sector identity, perceived or actual risk, workmen's compensation, savings, investments, insurance.
Safety	Awareness of sector-related hazards, events or actions, and mitigation measures to minimize injury, loss or destruction from potential or actual events or actions.	Monitoring, warning, evacuation, response, mitigation, recovery; fires, floods, earthquakes, storms, accidents, explosives, terrorism.
Employment	Work performed or services rendered under a written or oral contract of hire, in exchange for wage or salary, in cash or in kind.	Looking for work, job, pay, wage, salary, occupational safety, type of work, unemployment, unions.
Education	Knowledge, skill or development acquired or learned through teaching, training, instruction, practice or experience.	Students, formal education, self-learning, lifelong learning, books, libraries, how-to guides, on-the-job-training.
Consumerism	Selection, purchase and use of products or services to satisfy wants or needs.	Product safety, price, financing, reliability, operating and energy efficiency, recycling, maintenance.
Property ownership	Possess, have, hold or have power or control over real property.	Real property, homes, land, natural hazards, gardening, neighbourhoods.
Environment	State of physical, chemical and biotic factors and conditions that surround and affect the well-being or interests of individuals.	Air, water, fauna, flora, ecosystems, soil, endangered species, climate, preservation, invasive species.
Age	Stage or time of life when identifiable and common interest, qualification, power or capacity arises or rests.	Youth, seniors, children, adults, teens, legal age, regulations.

Component / Sub-Component	Definition	Description
Recreation	Hobby, diversion, relaxation; means of refreshment or rejuvenation of strength and spirits.	Tourists, eco-tourists, outdoor enthusiasts, picnickers, campers, hunters, fishers, hikers, photographers.
Travelling	Trips, tours or journeys from one place to another; moving over a distance along a direction, path or route.	Driving, commuting, taking public transport, flying, taking a train, boating, cycling, walking.
2. Use personally	Use capacity for action to make a decision or take action so as to derive a personal benefit in an area of personal interest.	Making decisions, taking actions.
Interact	Promote, facilitate, support or enable mutual and reciprocal social or cultural action or influence between individuals, among groups or in society.	Friends, family, associates, communities, neighbourhoods; shared social, cultural or other interests.
Thrive	Achieve contentment or satisfaction, flourish, maintain health and/or gain wealth or possessions.	Existence values, sector identity, perceived risk, workmen's compensation, insurance, finance, savings, investments.
Be safe	Take precautions or preventive action or respond to potential or actual sector-related hazards, events or actions to minimize resulting injury, loss or destruction.	Injury, disability, death, natural hazards, explosives, accidents, terrorist acts, evacuate, protect.
Work	Perform regular and sustained mental or physical activity to earn a livelihood and/or gain wisdom, volunteer for altruistic reasons or accomplish necessary personal tasks.	Trades, vocations, professions, calling, occupations, pursuits, businesses; labour, tasks, duties, activities, support a cause, build or fix something.
Learn	Acquire or increase awareness, skill or knowledge through being informed, discovery, study, instruction, experience or practice.	Students, training, lifelong learning, self-learning, libraries, schools, reference books, how-to guides, on-the-job-training.
Purchase	Obtain or acquire possession, ownership or rights to use property in exchange for money or its equivalent.	Utility, product safety, costs, operating and energy efficiency, recycling, disposal, license, rental.
Own	Possess, have or hold as property or have power and control over the use and disposition of real property.	Homes, land, real property, natural hazards, gardening, neighbourhoods.
Monitor	Watch, observe or track areas of personal interest to adapt responses and decisions to conditions, based on wants, needs or values.	Environment, safety, community, society, well-being, employment, travelling and all other interests.
Participate	Take part in, be a part of or share interests or activities related to a specific interest group or community.	Youth, seniors, children, adults, teens, legal age (permission), communities, groups.
Recreate	Pursue individual or group hobbies, interests, diversions or relaxation.	Tourists, hobbyists, outdoor enthusiasts, picnickers, campers, hunters, fishers, hikers, photographers.
Travel	Take or go on trips, tours or journeys; move from one place to another along a path or route.	Drive, commute, take public transport, fly, take a train, take a boat, cycle, walk, hike.

Component / Sub-Component	Definition	Description
3. Personal benefits	Results that promote, enhance or help social, economic or environmental interests of individual Canadians.	Context of individual values.
Individual benefits	Behavioural, cultural or social relationship, interaction or influence that benefits one person.	Getting a job, taking a trip, buying an appliance, learning a skill, enjoying a vacation.
Community benefits	Mutual and reciprocal social or cultural interaction or influence that benefits members of an identifiable group.	Aboriginal programs, unrestricted access, bilingualism, cultural festivals, zoning by-laws.
Social benefits	Mutual and reciprocal societal or cultural interaction or influence that benefits a majority of Canadians.	Right to vote, national defence, policy development, social insurance, health programs.
Balance sheet	Short-term financial condition, tabulating the difference between income and expenses as of a given date.	Budget, cash flow.
Net worth	Long-term financial condition, tabulating the actual or expected difference between the value of assets and liabilities over a specified period.	Individual wealth, integrating balance sheets over time, bankruptcy, prosperity.
Environmental conditions	Short-term aspects of the state of the environment that currently affect or impact individuals or their activities.	Weather, water, air, contaminated soil; natural hazards: fires, floods, earthquakes, landslides.
Environmental trends	Long-term aspects of the environment that will affect or impact the future quality of life, well-being or personal values.	Endangered species, invasive species, preservation, climate change, pollution, waste.
4. Societal benefits	Aggregation of personal benefits or sector outcomes that promotes, enhances or helps the state and sustainability of society, the economy, the environment or institutions.	Context of social values; increases, aids, makes better, monitors, reports, trends.
State of society	Aggregation of individual, group or societal relationships or interactions that affect or influence the well-being of communities or society.	Individual interests and values: culture, hobbies; mutual interests: health, safety, education, equity.
Social sustainability	Ability to foresee, plan for, adapt to and thrive under changing and evolving national and global social infrastructures.	Governments, cultures, values, treaties, role of religion.
State of the economy	National wealth and global economic competitiveness that affect or influence the financial condition and economic prospects of communities or society.	Global market share, employment levels, balance of payments, natural resources accounts.
Economic sustainability	Ability to foresee, plan for, adapt to and thrive under changing and evolving national and global economies.	Long-term wealth, competitiveness, employment levels, globalization, knowledge economy.
State of the environment	Overall environmental conditions that affect or influence the quality of life of communities or society.	Air, water and soil quality; land stability, ecosystem health.
Environmental sustainability	Ability to foresee, plan for, adapt to and thrive under changing and evolving regional and global environments.	Climate, preservation, invasive species; long-term trends of: air, water and soil quality.
Institutional infrastructure	Societal enablers that support, facilitate or promote the sustainability of society, the economy or the environment.	Defence, health, security, safety, laws, regulations, governance, education, equity, science, technology, international position.

A4.9. STAGE 9 – EVALUATE THE KNOWLEDGE SERVICES SYSTEM

Purpose: Evaluation is needed to measure and improve system performance in supplying or fulfilling the demands of knowledge markets. As the connection between market cycles, this stage has a dual purpose – evaluate what has previously been done and assess what should be done in the future.

TABLE 4.9	Definitions and Descriptions for *Who, Work* and *What* Components and Sub-Components for Stage 9 of the Knowledge Services System – Evaluate the Knowledge Services System	
Component / Sub-Component	**Definition**	**Description**
1. Evaluators	Persons, groups or organizations who <u>evaluate</u> the <u>performance</u> of the knowledge services system or <u>assess markets</u> for knowledge services.	
Office of the Auditor General	Governmental group external to the organization that is mandated and authorized to <u>evaluate</u> the <u>production</u> of outputs or their outcomes or benefits.	Federal, provincial, territorial or local government.
Auditors	Persons or groups internal to the organization who are mandated and authorized to <u>evaluate</u> the <u>production</u> of outputs or their outcomes or benefits.	Departments, agencies, organizations.
Internal users	Persons or groups who evaluate the value and utility of knowledge services for achieving organizational objectives.	Programs, policy development, reporting, other services, communications.
Market analysts	Persons or groups who <u>assess</u> current and future market wants and needs for organizational outputs.	
Clients (evaluators)	Persons, groups or organizations who evaluate the value and utility of outputs for achieving sector-related outcomes or societal benefits.	Businesses, practitioners, educators, researchers, non-governmental organizations, international bodies.
Canadians	Inhabitants of Canada who evaluate the value and utility of outputs or outcomes for realizing personal benefits.	Personal interests.
2. Evaluate performance	Acquire, analyse and interpret information about outputs, outcomes or benefits to recommend changes that increase their productivity in supplying knowledge markets.	Post-production, internal drivers, historical.
Evaluate productivity	Use criteria and indicators of efficiency to measure and report on the production of organizational outputs per unit of input.	Audit, formative evaluation: costs, milestones, targets, management, administration.
Evaluate outputs	Use criteria and indicators of effectiveness to measure and report on the internal use or transfer of organizational outputs.	Summative evaluation: deliverables, relevance, utility, value.

Component / Sub-Component	Definition	Description
Evaluate outcomes	Use criteria and indicators of impact to measure and report on sector outcomes derived from use of outputs by clients.	Government of Canada Service Vision, Council of Science and Technology Advisors, S&T framework, role of S&T in government.
Evaluate benefits	Use criteria and indicators of value to measure and report on benefits derived from use of outputs and outcomes by Canadians.	Government of Canada Service Vision, Council of Science and Technology Advisors, S&T framework, role of S&T in government.
Evaluate uncertainty	Measure the probability of negative or positive consequences resulting from the use of uncertain outputs.	Liability for errors, planning, foresight, risk management; reduce bad outcomes and increase good outcomes.
3. Assess markets	Acquire, analyse and interpret intelligence about the current and future wants and needs of users to recommend adapting or evolving organizational outputs to better fulfill market demand.	Pre-production, external drivers, solicit opinions and feedback, future wants and needs.
Validate mandate	Review and revise the authority, responsibility, accountability and resources that provide the basis for knowledge service programs in terms of evolving priorities.	Government priorities.
Determine capacity	Estimate the organizational capability, facility or authority to allocate resources to produce, perform or transfer desired outputs.	What organizations can do.
Solicit advice	Request direct feedback or input from internal users, intermediaries or clients about their current and future wants and needs for outputs to achieve sector-related outcomes.	Sector strategies, plans, outcomes.
Solicit opinions	Survey Canadians about their current and future wants and needs for outputs and outcomes to realize benefits in sector-related areas of interest.	Users provide input to proposed sector initiatives, programs, projects, outputs.
4. Recommendations	Advice, consultation or report that presents, proposes or endorses the establishment, continuation, change or termination of organizational outputs.	
Proposed content	Content that could be generated to better supply or fulfill the demands of the knowledge market.	
Proposed products	Products that could be developed to better supply or fulfill the demands of the knowledge market.	
Proposed services	Services that could be developed to better supply or fulfill the demands of the knowledge market.	
Proposed solutions	Solutions that could be produced to better supply or fulfill the demands of the knowledge market.	

A4.10. KNOWLEDGE SERVICES PARAMETERS

Purpose: Parameters and sub-parameters affect more than one stage of the knowledge services system. *Channel* supports the entire knowledge services system. *Quality*, *utility* and *scale* relate to external considerations; *intellectual property*, *ownership* and *source* relate to internal management; and *criteria* and *indicators* relate to system performance.

Parameter / Sub-Parameter	Definition	Importance / Description
1. Channel	Means, path or route along, by or through which knowledge services are provided, sent, downloaded or transmitted through the knowledge services system.	
On-site	Provide outputs through the knowledge services system at the organization's location.	Libraries, laboratory analysis, physical collections, demonstrations.
Off-site	Provide outputs through the knowledge services system, using temporary public fora or visiting the user's location.	Symposia, conferences, workshops, presentations, consultations, trade fairs, booths, site visits.
Kiosk	Provide continuing remote access to digital or physical outputs through the knowledge services system, using displays or points of contact.	Store fronts, public places, outside the organization.
Mail	Send tangible outputs through the knowledge services system, using carriers.	Courier service, Canada Post, office mail.
On-line	Enable downloading of digital outputs through the knowledge services system, using digital networks.	Pulling, Internet, intranet, extranet, Web, File Transfer Protocol, digital libraries, data warehouses, Web servers and browsers.
E-mail	Transmit digital outputs or links to them through the knowledge services system, using digital networks.	Pushing, Internet, intranet, extranet, mail servers, mailing lists.
Telephony	Transmit outputs in audio or verbal format through the knowledge services system, using electronic communications networks.	Phone calls, conference calls; conversations, questions and answers, discussions, dialogue, Voice over Internet, voice mail, mobile communications, recorded messages.
Fax	Transmit outputs as graphic images through the knowledge services system, using electronic communications networks.	Data, text, graphics.
2. Quality	Property, character or attribute that distinguishes relative excellence among knowledge services.	Feature, nature.
Authoritativeness	Extent or degree to which outputs are conclusive, are based on knowledge or expertise and are accepted by users.	

Parameter / Sub-Parameter	Definition	Importance / Description
Completeness	Extent or degree to which outputs include or contain all parts, elements or aspects that are wanted by or necessary to users.	
Accuracy	Extent or degree to which outputs are free from error, are exact or precise or conform to a standard or true value.	Individual elements may be right or wrong; groups have distributions or percentages of error.
Reliability	Extent or degree to which outputs are dependably available and consistent across successive instances.	Similar, the same.
3. Utility	Fitness for a designated purpose or worth for a specified end.	
Relevance	Extent or degree to which outputs are material, pertinent or applicable to the wants or needs of users.	Appropriate.
Accessibility	Extent or degree to which outputs can be obtained, delivered to, downloaded or received by users.	
Usability	Extent or degree to which outputs are easy, convenient and practical to use.	
Timeliness	Extent or degree to which outputs are available when they are wanted or needed by users.	Early, just-in-time.
4. Scale	Magnitude, duration or level of spatial, temporal, process or organizational outputs relative to their intended use.	Degree, extent or duration; level: detail, aggregation, granularity or resolution; large to small, long to short, or high to low.
Space	Spatial context of place and extent.	Place: coordinates, place names or relative locations; extent: points, spots, sites, areas, zones, regions, continents, planet.
Time	Temporal context of when, duration and flow.	Clock, dates, events; intervals, relative references, delays; past, present, future; classes: instant, immediate, brief, current, short-term, mid-term, seasonal, long-term.
Complexity	Process context of components, interactions and system behaviour.	Static, dynamic, flow-through, feedback, learning, reasoning, goal-changing.
Magnitude	Process context of span, spectrum or range.	Micro-, mechanical, sensory, meso-, synoptic, strategic, macro, global (e.g. water vapour, rain, thunder storm, front, air mass).
Hierarchy	Organizational and relational context of order, rank or standing.	Society, governments, departments, sectors, branches, programs, tasks.
Governance	Organizational and relational context of executive, managerial or operational decision-making.	Business cases, visions, charters, governance, framework, policies, strategies, plans.

Parameter / Sub-Parameter	Definition	Importance / Description
Compatibility	Suitability, interoperability or similarity of the scale of outputs relative to their intended use.	Too much detail wastes effort but too little conceals key processes; integration is feasible but differentiation may be impossible.
5. Intellectual property	Organizational outputs produced primarily through intellectual or creative work, effort or study and for which property rights are or can be established.	Knowledge (what we know); assets (what we have); services (what we do); content, products, services, solutions.
Property rights	Power and authority to possess, use, transfer or dispose of intellectual property and to receive fees, royalties or other consideration in exchange for its use.	
Inventory	Compilation of the description, classification, utility and value of intellectual property.	Includes only outputs intended for transfer.
Intent	End purpose, goal or objective that underlies a particular approach or method of managing intellectual property rights.	Why do we want to protect intellectual property?
Protect	Use legal, administrative or security methods to safeguard intellectual property rights.	Copyrights, patents, trade marks, contracts, agreements, confidentiality, encryption, secrecy.
License	Transfer limited rights and responsibilities of holding, using, transferring or disposing of intellectual property.	Transaction: exclusive or non-exclusive; may include royalties, fees or other consideration.
Enforce	Monitor external use of intellectual property, update protection and licences over time and take action against those who infringe on property rights.	Use it or lose it, consequences.
6. Ownership of intellectual property	Legally having or possessing knowledge services as intellectual property.	Knowing the ownership status of organizational outputs is essential to managing them as assets.
Sole ownership	Full and permanent rights to possess, use, transfer and dispose of intellectual property are possessed by a person, group or organization.	No limits to use, transfer or disposal, also protecting integrity.
Shared ownership	Full and permanent rights to possess, use, transfer and dispose of intellectual property are jointly possessed by more than one person, group or organization.	Joint use and protection; partnership, not necessarily equal.
Licensed	Limited rights and responsibilities of holding, using or transferring intellectual property, as specified in an agreement between the owner and the licensee.	May be permanent or temporary, limits of use.
Held	Permanent possession, responsibility and limited use of intellectual property without property rights.	Libraries; buy a book, music or art; may not photocopy, reproduce or resell; must respect and convey intellectual property rights of owners.

Parameter / Sub-Parameter	Definition	Importance / Description
Borrowed	Temporary possession, responsibility and limited use of intellectual property without property rights.	Products must be returned in original condition; may not photocopy, reproduce or resell; must respect intellectual property rights of owners.
7. Source	The organizational context within which knowledge services are generated, managed, transferred or used.	The source of content, products and services affects their nature, how they are managed, their suitability for various users and uses and how they are transferred.
Authority	Official mandate to produce and disseminate outputs.	Laws, regulations, policies, certification, license, incorporation.
Trust	Assurance, confidence or belief that outputs are truthful, unbiased, objective and usable without misgiving.	Branding, seals of approval.
Science outputs	Outputs generated with the specific intent of discovering or creating new knowledge.	Privileged first use; experimental results and conclusions; authored publications.
Program outputs	Outputs generated with the general intent of fulfilling an organization's mandate.	Legislation, policies, positions, regulations, programs, operations; may or may not be published (not authored).
8. Criteria	Characteristics, attributes or standards that provide a basis for evaluation, judgement or decision-making with respect to outputs, outcomes or benefits.	Criteria are needed to evaluate effectiveness and appropriateness of knowledge services.
Output criteria	Evaluation criteria for improving processes and productivity to enhance organizational outputs.	Marginal change easiest to evaluate; performance.
Outcome criteria	Evaluation criteria for modifying organizational programs and priorities to enhance sector outcomes.	Substantial change; more difficult to evaluate than outputs.
Benefit criteria	Evaluation criteria for adapting organizational goals and strategies to enhance benefits to Canadians.	Non-linear change; most difficult to evaluate; throne speeches, results for Canadians, Government of Canada Service Vision, Council of Science and Technology Advisors, role of S&T in government.
9. Indicators	Quantitative measurements, indices or values; qualitative observation or description of one characteristic or attribute of a criterion.	Indicators are needed to measure or describe criteria.
Output indicators	Indicators for measuring or describing a characteristic or attribute of an output criterion.	Numbers, quantities, amounts, measures, indexes, values; easiest to measure, efficiency.
Outcome indicators	Indicators for measuring or describing a characteristic or attribute of an outcome criterion.	More difficult to measure than outputs, effectiveness, impacts.
Benefit indicators	Indicators for measuring or describing a characteristic or attribute of a benefit criterion.	Most difficult to measure, values, impacts.

ANNEX 5. CASE STUDY OUTLINES

A set of case studies was used as the first step in validating the knowledge services model. Five successful national-scale Natural Resources Canada (NRCan) knowledge services were selected and classified using the model framework. These services are: the Canadian Wildland Fire Information System, the Geoscience Data Repository, The Atlas of Canada, the National Forestry Database and the RetScreen® International Clean Energy Decision Support Centre. The concept was simply that if the prototype framework did not adequately describe an existing service, it would be adjusted until it did. Taken together, the case studies resulted in changes to 7 percent of the original framework. That the final framework adequately classifies five diverse services lends credibility to its robustness.

The case studies were independently completed by experts who were familiar with each program. By design, none of the experts had access to each other's case study. This insured that each case study was unbiased by what others had said. Consequently, the original submissions were interpreted to present them in a consistent format. Further, none of the case studies exhaustively classifies everything that is done and that fits within the model framework, because each reviewer noted activities that did not appear in all of the case studies. The primary objective of these case studies was to ensure that the model does not omit anything important.

A5.1. Canadian Wildland Fire Information System

The Canadian Wildland Fire Information System automatically produces and disseminates daily and seasonal national maps of fire weather, fire behaviour and large-fire locations. The system is a key component of the Forest Fire in Canada Web portal, which also includes a weekly national fire situation report, frequently asked questions about fires, a description of the NRCan Fire Research Group, links to NRCan fire publications and links to other fire sites. The case study reported the following:

Stage

1. Scientists discover knowledge; collectors collect data on weather, fuels and topography.

2. Data architects develop databases; systems analysts develop systems; programmers codify knowledge; authors write documents.

3. A champion persevered to enable accessibility; a program manager established the program; information technology (IT) managers manage IT infrastructure; information managers manage information.

4. Advisors recommend positions; coordinators coordinate work; knowledge workers accomplish tasks.

5. A Webmaster provides electronic access; experts demonstrate outputs; a publisher publishes outputs; communicators disseminate outputs.

6. Managers adapt outputs; researchers analyse outputs; the media simplify and disseminate outputs.

7. Municipalities evacuate communities; federal, provincial and territorial governments advocate positions; managers manage fire; businesses innovate; researchers study outputs.

8. Canadians use outputs for ownership, environmental, recreation and travel interests; fire management is more efficient, effective and sustainable than if the outputs had not been used.

9. The Government of Canada audits system development; clients advise on the utility and value of outputs; the media advise on wants and needs.

A5.2. Geoscience Data Repository

The Geoscience Data Repository is a collection of six geoscience databases (e.g. geology, geochemistry, geophysics) that is managed and accessed through a set of integrated information services. The databases are standardized and interoperable, which increases the discovery, access and use of the data that are collected and maintained. The data are accessed at no cost to users through a suite of six Web sites (e.g. map images, fossil fuels, mineral deposits) that facilitate easy integration into new applications. The repository and services are linked to related sites, such as publications and GeoConnections. The case study reported the following:

Stage

1. Scientists and technicians create, collect and acquire data, observations, measurements and samples; they analyse data to produce information; they synthesize new knowledge; they author documents and interpretations.

2. Data architects develop databases; specialists develop systems and models; specialists assemble, codify and adapt standards, terminology and maps; compilers embed content and produce map products; editors edit publications.

3. Data and information managers organize, store and manage data and information; IT specialists provide and support IT infrastructure; information management and IT managers monitor compliance with life-cycle management.

4. Scientists use and re-use data and information; leaders lead, inspire and guide; managers establish and develop objectives, programs and projects; knowledge workers complete tasks that accomplish objectives.

5. Publishers publish and distribute maps and map products; communicators promote, simplify and disseminate information and solutions; curators and Web managers provide access to content.

6. Researchers re-interpret data and information to create new knowledge; specialists translate and enhance content; intermediaries develop enhanced outputs.

7. Federal, provincial, territorial and municipal governments use outputs for decisions, outcomes and awareness of issues; business uses outputs for profit, decisions and investments; international groups use outputs for decisions, options and investment potential.

8. Canadians use outputs to learn and understand about geology and resources, to make investment decisions and for safety and sustainability.

9. Government evaluators analyse and measure programs, projects, benefits and outcomes; managers and politicians use outputs to propose new programs, activities and projects; Canadians use outputs to evaluate government performance.

A5.3. The Atlas of Canada

The Atlas of Canada program compiles authoritative, national-scale geographical data sets organized by a number of themes, such as forestry, water and land management. It also develops national geospatial frameworks to structure the data. It provides open access to the spatial data as well as display techniques. Finally, the Atlas Web site is targeted to Canadians, with emphasis on students. It combines user-centric design concepts for access and display with a Government of Canada viewpoint on issues through discussions prepared by responsible agencies. The case study reported the following:

Stage

1. Partners create, acquire, collect, analyse and synthesize data (databases, geometry, attributes), information (reports) and knowledge.

2. Data architects develop databases and management systems; specialists (geographers) and compilers (cartographers) assemble, codify, adapt and embed the data into geospatial products; specialists produce teaching materials; authors write reports.

3. Data and information managers organize, store, maintain and manage existing data, information and knowledge; they provide access to content, products and services.

4. Knowledge workers (policy analysts) coordinate the integration of content in the Atlas to yield solutions (policies, regulations, communications materials).

5. The publisher (the Government of Canada) provides on-line access to the Atlas.

6. Government agencies, researchers and international bodies adapt Atlas content and services to meet their needs and those of their clients and stakeholders.

7. Government agencies, educators and international bodies educate citizens and stakeholders to promote a knowledgeable citizenry, establish international positions, promote visibility and awareness of issues and achieve organizational objectives.

8. The Atlas reflects a number of Canadian interests so Canadians can better understand and participate in the social, economic, environmental and institutional context in which they live.

9. Governments and Canadians evaluate outcomes and benefits by surveying opinions in order to propose new information content, representations and services.

A5.4. National Forestry Database

The National Forestry Database Program compiles national forestry statistics to describe forest management and its impact on the forest resource, develop a public information program based on the database and provide reliable, timely information to provincial, territorial and federal policy processes. The Program is a partnership between federal, provincial and territorial governments. Direction is provided by a Steering Committee comprising representatives from every forestry agency in Canada and the NRCan Canadian Forest Service (CFS). Most of the data are provided by provincial and federal land management agencies. The CFS is responsible for compiling and disseminating the statistics. The case study reported the following:

Stage

1. Agents acquire data; collectors collect data.

2. Compilers assemble statistics; authors write documents.

3. Program managers manage the program; IT managers manage the IT infrastructure; data managers manage databases.

4. Analysts recommend positions; coordinators coordinate work; knowledge workers accomplish tasks.

5. A Webmaster provides electronic access; the publisher publishes outputs; communicators disseminate outputs.

6. Researchers adapt and analyse outputs for sustainable development; the media simplify and disseminate outputs.

7. Governments negotiate and advocate positions; educators use outputs to teach; governments report on the state of the forest and international commitments.

8. Students use outputs to learn.

9. The Canadian Council of Forest Ministers audits the production of outputs; clients advise on the utility of outputs; Canadians provide opinions on their wants and needs.

A5.5. RETScreen® International Clean Energy Decision Support Centre

RETScreen® builds the capacity of planners, decision-makers and industry to implement energy efficiency projects. It develops decision-making tools that reduce the cost of pre-feasibility studies, disseminates knowledge to help people make better energy decisions and trains people to analyse the technical and financial viability of potential projects. The case study reported the following:

Stage

1. Scientists discover knowledge about energy; technologists analyse technology; collectors collect data on climate.

2. Data architects develop climate databases; systems analysts develop energy efficiency decision-support systems; programmers codify knowledge; authors write manuals.

3. Program managers manage programs; IT managers manage IT infrastructure; data managers manage data.

4. Managers manage programs; advisors recommend positions.

5. Webmasters provide products and services through on-line access and CD-ROMs; experts increase understanding through courses and workshops; facilitators promote clean energy projects; Web developers facilitate learning through public forums.

6. Intermediaries translate products; educators teach courses; international groups endorse products.

7. Professionals use RETScreen® to analyse energy efficiency projects; RETScreen® promotes long-term societal benefits by facilitating migration to energy-efficient technology.

8. No personal use is listed.

9. The global performance and user base of RETScreen® were independently evaluated; RETScreen® received the Public Service Award for Excellence in Service Delivery; user needs are evaluated to adapt and evolve products and services; market demand for energy efficiency analysis is continuously evaluated.

ANNEX 6. MEASUREMENT PRIORITIES

This annex describes the method used to rank the relative importance of interactions and branch points in the knowledge services system. Forty-two interactions and branch points were identified. They were grouped in five categories: external, capacity, services, branches and parameters. The interactions were then ranked according to perceived importance for initial study. A five-point scale was used for individual responses from members of the Knowledge Services Task Group (1 = very low, 2 = low, 3 = medium, 4 = high, 5 = very high). Stipulating an equal number of entries for each category from each member insured a consistent sample.

The raw scores for all interactions are given in the tables in this annex. The scores indicate the perceived importance of the interaction between the immediately preceding component and subsequent components. For example, in Table 6.2, the score for the *mandate-organization* interaction is 13 and that for *organization-generate* is 14. The theoretical range of total scores was 6 to 30 points; actual totals ranged from 13 to 24, about half of the theoretical range (Table 6.1).

TABLE 6.1	Distribution of Importance Classes for Interaction		
Class		Range of scores	Number of interactions and branches
1	Very Low	13	7
2	Low	14–16	7
3	Medium	17–19	12
4	High	20–22	10
5	Very High	23–24	6
Total			42

The approximately two-fold range between the highest and lowest scores demonstrates consensus about the end points of the distribution. However, it indicates little about the middle region. The Knowledge Services Task Group selected the six interactions in the "very high" class (23–24 points) as candidates for initial study. These are marked with an asterisk (*) in the tables below.

The totals were also rated for consistency (highest minus lowest individual score) to assist in refining relative positions. In the tables below, above- or below-average consistency of individual results is noted with a plus sign (+) or a negative sign (–), respectively. Overall, the rankings tend towards inconsistency, reflecting diverse views of participants about an emerging concept. This diversity demonstrates that further study will be needed to permit the drawing of detailed conclusions about the relative importance of various interactions in the knowledge services system.

In Table 6.2, the external group consists of interactions that affect the knowledge services system but are external to it. This group was below the overall average ranking of importance (16.6) and was generally unremarkable. The top-rated interaction was *partners-organization* ("high"). This rating was relatively consistent, however, indicating that *partners-organization* should be upgraded to the "very high" class.

TABLE 6.2	Priority Scores for External Interactions (5)			
Source	Score	Output 1	Score	Output 2
Mandate	13 (–)	Organization	14	Generate
Partners	22 (+)	Organization		
Society and nature	15	Content		
Benefits	19 (–)	Society and nature		

Average   16.6

(+/– = above/below average consistency, respectively)

Table 6.3 includes two groups – capacity (who is doing work) and services (what is being produced). Multiple lines (a, b or c after the stage number) denote stages with more than one type of work or output. Overall, services ranked somewhat higher (19.7) than capacity (17.3), suggesting a tendency towards a demand perspective in which deciding what to produce determines capacity requirements. A supply approach would use existing capacity to determine what to produce. Only one interaction in the capacity group (*users-use internally*) was in the "very high" class.

TABLE 6.3	Priority Scores for Internal Capacity and Services Interactions (25)					
Stage	Who	Capacity Score	Work	Services Score	What	Total
1	Originators	14 (–)	Generate	18 (–)	Content	32
2a	Developers	18	Transform	21	Products	39
2b			Transform	23* (–)	Services	41
3a	Managers	13	Preserve	17 (–)	Existing inventory	30
3b	Managers	13	Enable	20 (–)	Accessible inventory	33
4	Users	23*	Use internally	17 (–)	Solutions	40
5a	Providers	16 (–)	Transact	13 (+)	Outputs	39
5b	Providers	17 (–)	Transfer	20 (–)	Outputs	37
5c			Interact	23*	Outputs	40
6	Intermediaries	21	Add value	24* (+)	Enhanced outputs	45
7a	Clients	21	Use professionally	22	Outcomes	43
7b			Use professionally	24*	Societal benefits	45
8	Canadians	21	Use personally	19	Personal benefits	40
9a	Evaluators	13 (–)	Evaluate	17	Performance	30
9b			Evaluate	18 (–)	Markets	31

Average   **17.3**   **19.7**

(+/– = above/below average consistency, respectively)

The services category is the second highest category in overall ranking (19.7). Four interactions (*transform-services, interact-outputs, add value-enhanced outputs, use professionally-societal benefits*) are in the "very high" class. However, the ranking for *transform-services* is inconsistent, indicating that it should be dropped to the "high" class, whereas *add value-enhanced outputs* is relatively consistent, putting it in first place.

TABLE 6.4	Distribution of Importance Classes for Stages	
Class	Range	Number
Low	30–33	5
Medium	35–37	1
High	39–41	6
Very High	43–45	3

The rankings from the "Total" column (in Table 6.3) were divided into four classes, showing the relative importance of stages (Table 6.4).

Three stages (6, 7a, 7b) are somewhat more important than the remaining twelve. These three stages deal with intermediaries and clients, suggesting that at a stage level, marketing analyses should have the highest initial payback in understanding the knowledge services system. Note that two stages that are essential for system functioning (stages 1 and 3 – Figure 7 on page 15) have a low priority for initial study. This reflects a consensus that despite their importance to the system, they are understood enough to leave evaluation to a later time.

Table 6.5 shows the five branch points that were identified. This group is not only above average in overall ranking (20.0) but also the most consistent, in that all branches are in "medium," "high" or "very high" classes (Table 6.1). One branch (*outputs*) is ranked in the "very high" class for initial evaluation.

TABLE 6.5	Priority Scores for Branches (5)		
Stage	Source (Branch point)	Score	Destinations (Flow)
1	Content	19	Products / Services / Existing inventory
3	Existing inventory	20	Lost value / Accessible inventory
3	Accessible inventory	18	Content / Solutions / Outputs
5	Outputs	23*	Knowledge / Intermediaries / Clients / Other Canadians
7	Outcomes	20	Capacity for action / Societal benefits

Average   20.0

Table 6.6 lists priority scores for parameters. Overall, this group has the lowest priority (14.5). All but one parameter is in a "medium" "low" or "very low" class for initial evaluation.

The Knowledge Services Task Group also ranked barriers to system functioning to determine initial measurement priorities. Because actual barriers cannot be known until the system is fully measured, the group ranked "potential" barriers. As for relative importance, a five-point scale was used. But this time, each member ranked only five interactions.

TABLE 6.6	Priority Scores for Parameters (7)
Parameter	Score
Channel	*
Quality	*
Utility	*
Scale	15
Intellectual property	17
Ownership	13
Source	15
Criteria	13
Indicators	14
Average	**14.5**

*Not ranked. Three parameters were added after priority evaluation was completed.

Seventeen (of 42) interactions were selected as potential barriers by one or more members. Six interactions selected by more than one member are listed below, along with their overall scores. (Note: Interactions in the "very high" class [23–24 points] are already candidates for initial study and are marked with two asterisks.)

TABLE 6.7	Key Potential Barriers
Potential Barrier	Score
Accessible inventory**	12
Use internally–Solutions	10
Preserve–Existing inventory**	8
Transfer–Outputs	6
Outputs–Branch	5
Managers–Enable**	3

Clearly, stage 3 (Management) predominates from a barrier perspective, as it includes 23 (12 + 8 + 3) of 44 identified potential barriers and has three of the six interactions identified as potential barriers (**). There is also a consensus that internal use of content, products and services to produce solutions (stage 4, Use Internally) may not be all that it should be. Of the six interactions, only *outputs-branch* was also identified as important for initial study, thus strengthening the argument for its inclusion. However, the overall disparity of results between importance and barrier justifies the use of both criteria.

ANNEX 7. INDEX OF DEFINITIONS

This alphabetical index lists every term that is defined in this report and the location of the definition. Definitions are found in Annexes 1, 2 and 4. Although some definitions are also included in the body of the text, they are not included in this list. Annex 1 is alphabetical. Annex 2 includes the table and stage number. Annex 4 includes the stage and component number.

ANNEX 8. ENGLISH-FRENCH GLOSSARY

This English-French lexicon gives a translation of only those terms that were defined in Annex 1 of this document.

English	French
Attribute	Attribut
Benefit	Avantage
Body of Knowledge	Corpus du savoir
Capacity for Action	Capacité d'action
Component	Composante
Component Type	Type de composante
Content	Contenu
Content Value Chain	Chaîne de valeur du contenu
Definition	Définition
Description	Description
Element	Élément
Explicit Knowledge	Savoir explicite
Framework	Cadre
Intelligence	Renseignements
Knowledge Cycle	Cycle du savoir
Knowledge Market	Marché du savoir
Knowledge Organization	Organisation du savoir
Knowledge Services	Services du savoir
Knowledge Services System	Système des services du savoir
Knowledge Services Value Chain	Chaîne de valeur des services du savoir
Management	Gestion
Mandate	Mandat
Organization	Organisation
Outcome	Résultat
Output	Extrant
Parameter	Paramètre

English	French
Partners	Partenaires
Potential Value	Valeur potentielle
Primary Knowledge Services	Services du savoir primaires
Product	Produit
Production	Production
Program	Programme
Recommendation	Recommandation
Secondary Knowledge Services	Services du savoir secondaires
Sector	Secteur
Service	Service
Sharing	Partage
Society	Société
Solution	Solution
Stage	Stade
Sub-Component	Sous-composante
Sub-Parameter	Sous-paramètre
Sub-System	Sous-système
System	Système
Tacit Knowledge	Savoir tacite
Tertiary Knowledge Services	Services du savoir tertiaires
User	Utilisateur
Value	Valeur
Value Chain	Chaîne de valeur
What	Quoi
Who	Qui
Why	Pourquoi
Work	Tâche