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KNOWLEDGE CONTINUITY: HOW TO ENSURE KNOWLEDGE IS TRANSFERRED AND PRESERVED IN THE GOVERNMENT SECTOR

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Abstract: Knowledge management serves to systematically process explicit (tangible) and tacit (know-how typically in people's heads) in such a way as to make the best possible content available to everyone in the organization today and tomorrow. An integral component of continuous improvement in the efficiency, effectiveness and innovation in any organization consists in the systematic identification, explanation and dissemination of best practices for emulation and lessons learned so as to avoid repeating the same old mistakes. This paper focuses on "knowledge continuity" – i.e., the process whereby knowledge is transferred to or disseminated among future employees. The particular case of non-profit government organizations is addressed, as these organizations face unique challenges in preserving and transferring knowledge. A case study conducted at Transport Canada is used to present a step-by-step methodology designed to ensure knowledge continuity.

Knowledge management (KM) is the discipline that helps organizations systematically, explicitly and deliberately build, renew and apply knowledge to maximize an enterprise's effectiveness, competitiveness and innovativeness (Wiig, 1993). Effective KM initiatives help organizations capture knowledge of significant value and usefulness and ensure its use and reuse to avoid reinventing the wheel. The benefits of KM can be seen in improved performance on the individual, group and organizational levels, cost savings, advanced competitive standing and effective organizational learning (Lesser and Prusak, 2004).

Knowledge is sometimes defined as information plus people (or human experience) as it incorporates many intangibles such as experiential learning, judgment and intuition, to create extra value for an organization by informing decisions and improving actions. Knowledge is continually created by employees in their work. Some of this knowledge can be communicated, captured, stored and accessed for later use ("explicit knowledge resource"). Much of the knowledge, however, is in tacit knowledge form and is never communicated until the need to reuse it occurs (e.g. Nonaka and Takeuchi, 1995). Explicit knowledge is the output of activities and tasks that can be recorded as reports, user manuals, procedures, emails, etc. It is relatively easy to capture, store and communicate explicit knowledge. Explicit content tends to exist in digital form and be stored in containers such as databases, wikis, blogs, and knowledge repositories such as intranets. Tacit knowledge is the knowledge that is inside the heads of individuals and is difficult to capture or to communicate (unlike explicit knowledge).

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Here, knowledge is defined as information combined with experience, context, interpretation, and reflection. The knowledge source may be explicit or tacit depending on where it is located (for example, policy document versus individual expert). Knowledge processing, then, is the systematic approach to translating between the explicit and tacit forms of this knowledge in a given context. While we recognize that the act of "knowing" is a socially constructed sense-making endeavor that requires ongoing dialogue, coordination, and collaboration, this research is based on the assumption that it is possible to described knowing processes by tracking knowledge resources as units of analysis, and describing the transformation, change, and processing affecting these resources. For example, if an individual relocates a knowledge resource, changes its content, or modifies its metadata, these changes will inform us about knowledge use, and the processes associated with the act of knowing. Choo's (2006) theory on the use and reuse of knowledge, and organizational knowing is a good fit with the social constructivist perspective on knowing. For Choo (2006), organizational knowing is mediated (with rules, roles and technology), situated (located in time and space), provisional (often tentative), pragmatic (oriented toward goals) and contested (sometimes affected by conflicts). More importantly, organizational knowing involves various processes of sense-making, knowledge creation and decision making, which all work as a cycle and which, by definition, affect knowledge use and reuse.

A valuable type of knowledge resource could be the description of a best practice, a lesson learned, a summary document or an anecdotal story, that exists in a tangible container and is transmitted by digital means (may also have a paper-based equivalent). It is essential to process these valuable knowledge resources– to disseminate it for widespread use and reuse – so that the organization can benefit from best practices (e.g. become more efficient, more innovative) and lessons learned (to avoid repeating past mistakes). However, little is known about the use and reuse of these valuable types of knowledge content and the various containers they are found in, and little research has been done on how they are processed and accessed. To date, KM studies have emphasized the identification of KM practices without real long-term assessment of the value and usefulness of captured knowledge. A better understanding of the nature of these types of knowledge resources and how they are processed in organizations, would inform us on how knowledge can best be learned, transferred and retained, both in terms of content and containers to mitigate the cost of lost, forgotten or un-transferred and unused knowledge.

Knowledge continuity is a term adapted from business continuity: the latter refers to ensuring that a business can continue to operate in the event of a catastrophic event (such as 911) and relies on having good backups for all critical business operations. Knowledge continuity is an analogous but longer term endeavour to ensure that critical knowledge and know-how is not lost when employees leave an organization, typically due to retirement, extended leave (e.g. disability, maternity) or turnover (for another job within the organization or for another employer). Beazley et al (2003) note that knowledge continuity can be viewed as a form of productivity continuity – measured in the length of time required to attain the same level of productivity after someone leaves the organization. A related term is that of the learning curve, or the length of time it will take a new employee to get up to speed on a given job after being hired. Typically, knowledge continuity is an issue of intergenerational knowledge transfer as those leaving tend to be more senior and experienced employees while their successors tend to represent the younger generations.

The key element is that knowledge moves with people – whether it leaves with people who leave the organization or it moves with them as they change jobs within the same organization. In the year 2011, the first baby boomers will turn 65 and more than 61 million are expected to retire by 2031 (APQC, 2002). In the US government, 71% of permanent employees will became eligible for regular or early retirement in 2010 and of those, 40% are expected to retire. In Canada, nearly one-third of Canada's population are baby boomers, born between 1946 and 1964 and they are now aged between 39 and 58. Many in the health, education and public service fields have already begun retiring, with many more in all fields expected to begin retiring in 2005, peak in 2011 and slow down by 2020 (Barron, 2003). In the Canadian federal government, boomers in the public service tend to retire younger (in their late fifties) after having banked more years of pensionable service than those in the private sector. In fiscal year 2006/2007, the average age at retirement of the public servants studied was 58.4 and they retired on average with 29.2 years of pensionable service (Fox, 2008.)

Finally, in Québec, in the secondary sector, 50% of public service workers were 45 years of age and over in 2003. The anticipated decline in Quebec's population beginning in 2026, added to the decline in the population of the 15 to 64 year-olds by 2011 and the fact that half the population now retires before the age of 60 – this percentage was 14% in 1976 – means a labor shortage is feared. This is an accepted fact (Emploi Québec, 2006.)

The major objectives of knowledge continuity, in sequential or chronological order, are:

- To identify key corporate knowledge found in specific occupations, people and communities of practice that must be transferred to successors – knowledge mapping.
- To capture or render knowledge tangible and concrete from those about to depart – knowledge modeling.
- To facilitate a smooth transition between those leaving the organization and those who will succeed them in the same position – knowledge transfer
- To retain this knowledge within the organization as well – knowledge retention (Dalkir, 2002).

KM continuity initiatives must therefore act on proficiency: *who* needs what *knowledge* to perform what *task* or take what decision. At the level of the individual, we need to know what they should pass on to their successor. A simple framework using interviews is usually enough to address this level. For groups where work is done collaboratively with colleagues, a workshop approach is recommended in order to identify what to transfer and retain – and how. These two levels are usually done in collaboration with the human resources department. Finally, for the organizational level, an organizational memory has to be designed, implemented and maintained. This is usually accomplished by a combination of interviews and workshops and is usually conducted in collaboration with the information management/information technology department (Dalkir, 2002).

It is important to identify the critical knowledge *(savoirs)* independent of their containers – that is to say, the know-how needed to perform a task as opposed to a manual that outlines the procedures. In this way, we can be more certain of having addressed all of the content that needs to be transferred to new employees. Once knowledge has been identified or mapped, the next step is to model this knowledge and then to select the best means of transferring to others. Last but not least, it is also crucial to transfer this content to some form of organization memory – typically an intranet or shared space on the organizational network (with other media backups such as cd or paper versions). In summary, knowledge continuity should be done in parallel to business continuity – both require a proactive plan and well-thought out and tested procedures.

It is important to note that the succession process is not always one-to-one: that is, the departure of a given employee can impact more than the specific position they occupied. The impact may extend to the wider community, group or network that the departing employee was associated with.

The methodology developed for the Canadian federal government sector is outlined in this paper and a case study of its initial application in Transport Canada is described to illustrate how to implement the proposed knowledge continuity process. The original experimentation took place in 2001and the methodology has subsequently become incorporated into the Canadian Treasury Board guidelines to both employees and managers (Conseil du Trésor du Canada, 2002).

■ TWO KEY CHALLENGES: KNOWLEDGE TRANSFER AND KNOWLEDGE PRESERVATION

The first challenge is to determine, locate, and then share critical knowledge. The second challenge is to then ensure that this valuable knowledge is preserved in organizational memory. Turnover is a major catalyst for potential loss in the collective knowledge of an organization. Such turnover can be due to retirement but

also to high internal mobility. The latter is particularly true of government as lateral movement is often the only way of obtaining promotions and more interesting work challenges. There is an urgent need for knowledge retention guidance and a "preemptive, strategically aligned knowledge capture and transfer system that can counterbalance both inevitable and unforeseen challenges" (APQC, 2003, p. 5).

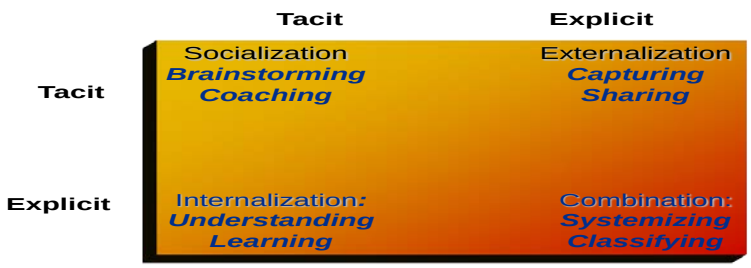
Beazley et al (2002) note that there is not only a risk of both acute knowledge loss (due to retirement, turnover, etc.) but also a risk of slower knowledge depletion or "chronic" knowledge loss. It is important to note that knowledge continuity responses tend, on the whole, to be reactive – in response to the announcement that someone will be leaving (sometimes, with a minimal notice of only two weeks). While this is the most visible and most distressing scenario, knowledge loss can also occur in a less obvious way. Each time valuable knowledge is created and not transferred nor preserved, there can be equally devastating effects on the organization. Amongst the best known cases is the case of NASA. The knowledge associated with the first Moon landing has largely been lost but no one realized this until quite recently, when there was talk of either repeating the Moon landing or perhaps sending a manned craft to Mars. It took over 40 years to realize that the valuable knowledge on how to build the Saturn booster rocket, an essential component for manned flight, had not been captured, transferred nor preserved within the organizational confines of NASA (DeLong, 2004). To make matters even worse, it appears that the original tape of the first Moon landing has been "misplaced" – no one who knew where it was still works for NASA! "NASA admitted in 2006 that no one could find the original video recordings of the July 20, 1969, landing" and it appears that they were subsequently erased and written over. (Fox, 2009)

The two major forms of knowledge, tacit and explicit, must both be transferred and preserved. It is slightly easier to transfer and preserve knowledge that is explicit, that is, already rendered in some tangible concrete form such as a book, report, diagram, case study or workflow model. However, while the containers are definitely explicit, it is rare that this one incarnation of knowledge alone will be sufficient to enable another person to carry out a task or a job responsibility effectively, efficiently and with an acceptable degree of proficiency. Most explicit knowledge requires extensive tacit knowledge in addition. An example would be giving a newly minted driver a manual and then asking them to drive through downtown Montreal!

■ KNOWLEDGE CONTINUITY MODEL AND METHODOLOGY

Knowledge is a complex area and therefore a model is helpful in knowing how to manage it. The knowledge transfer and retention model that was selected was that of the knowledge spiral by Nonaka and Takeuchi (1995), as shown in Figure 1 below. In this model, the social interactions between tacit and explicit knowledge are conceptualized in the form of a knowledge spiral, that follows the journey knowledge undertakes from individual to organization – and back to the individual.

FIGURE 1: MODEL OF KNOWLEDGE TRANSFER (NONAKA AND TAKEUCHI, 1995)



According to Nonaka and Takeuchi, human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge. In the first quadrant, socialization, people build a field of interaction for knowledge sharing. In the second, externalization, there is some knowledge transfer and conversion to a more tangible form of knowledge. In the third quadrant, combination, explicit knowledge is connected, organized and classified for easier access. In the fourth quadrant, individuals learn and acquire collective knowledge from organizational memory, typically through experiential learning (learning by doing). Socialization produces "Sympathized Knowledge". Externalization produces "Conceptual Knowledge". Combination produces "Systemic Knowledge". Internalization produces "Operational Knowledge". Understanding the role of tacit knowledge raises the importance of seeing knowledge management as relationship management as much as information management.

This model provides a conceptual framework in which to conduct knowledge continuity strategies and operations. APQC (2003) outlines a good approach to the identification of valuable knowledge in an organization, namely, "to interview employees, subject matter experts, senior managers and other relevant stakeholders. Some specific criteria used to determine what knowledge needs to be transferred and retained include

- Relevance of knowledge to business strategy;
- Risk if knowledge is lost;
- Estimated useful lifespan of knowledge ("shelf life" of knowledge);
- Difficulty of replacement;
- Time-dependency of knowledge."

Once the valuable knowledge has been identified, it is then represented as a map to show the connections between knowledge, people, and organizational units as well as to develop high-level classifications of the knowledge (a knowledge taxonomy). The knowledge map serves to identify not only who creates valuable knowledge, but who else uses this knowledge. Maps also serve to document the context for each valuable type of knowledge identified and identify any knowledge gaps in the organization (valuable knowledge that should be there but isn't). At this stage, then, a knowledge inventory (list) and knowledge map (model) of valuable knowledge is produced.

Liebowitz (2009, p. 3) outlines two approaches to the identification of valuable knowledge within an organization. The first is linked to a Human Resources strategy and is used by IBM. The following questions are asked:

- Who will be retiring?
- What is their business value, and what will be the impact of losing them?
- When is this going to happen?
- How to respond for the greatest business benefit?

The second approach is situated at the individual employee level and would consist of the following questions:

- What specific areas of knowledge do you possess?
- Is there a backup expert in this area? (If so, who)?
- On a scale of 1 (low) to 10 (high), how important is this knowledge area in terms of the organization's strategic vision looking 5 to 8 years down the road?

He also notes four major potential barriers to knowledge retention:

- People may not want to share their knowledge;
- People will be biased in identifying what is valuable knowledge (biased by that which is more recent, perceived causality where none exists, faulty memory etc),

- People may not be motivated (disgruntled employees, feel they should be paid more etc.) and
- People may be skeptical that 30-40 years of experiential expertise can be captured in a few interviews.

As a result, it is very important to introduce knowledge continuity projects well. Take the time to present why the organization is doing this, what the benefits are for all involved and what it will involved from each person. If the terrain is not properly prepared, there is a risk of a great deal of wasted time and effort.

Tacit knowledge is of course more labour intensive to capture, transfer and preserve because we may not even be aware that it exists. The best way of knowledge mapping is to talk to people who have internalized (quadrant four of Nonaka and Takeuchi, as shown in Figure 1) valuable knowledge and know-how. Interviews, videotaping, and focus group meetings are some of the tried and true ways of identifying tacit knowledge that should be included in a knowledge continuity plan. Finally, both explicit and tacit knowledge must be captured "in situ" – with their context intact. Otherwise, transfer and preservation will be extremely costly to carry out.

Table 1 lists a number of tools that can be used to capture, transfer and preserve knowledge (APQC, 2003; Dalkir, 2007; Liebowitz, 2009)

TABLE 1: LIST OF KNOWLEDGE TRANSFER AND PRESERVATION METHODS

EXPLICIT KNOWLEDGE	TACIT KNOWLEDGE
Collaborative tools such as joint authoring, meetings to tackle exceptional problems	Networks (internal networks, social networks, communities of practice)
Content management systems	Documentation of workflow, process diagrams
Document management systems	Training
Databases (e.g. of lessons learned)	Mentoring, apprenticeship
Shared folders, shared drives	Videotaping
Issues or problem capture systems	Storytelling
Intranets, portals, shared networks	Knowledge modeling and mapping of subject matter expertise
Expertise locator systems	After action reviews, project post-mortem sessions
Email analysis	Interviews, focus group interviews
Discussion forum content analysis (also wikis, blogs, social networking sites etc)	Exit interviews
Post-its or cheat sheets (Liebowitz, 2009, p. 21)	Phased retirement programs
Manuals, how-to guides	Emeritus or alumni programs (whereby retirees are still kept "connected" to the organization)
FAQs	Knowledge sharing forums
Formal training program content	Job sharing

No single approach can serve to identify all the valuable knowledge in a given organization (APQC, 2003). The best approach is to select a combination of approaches that will work best for each type of identified valuable knowledge resource.

■ THE INSTITUTIONALIZATION OF A PUBLIC SECTOR KNOWLEDGE CONTINUITY STRATEGY: THE CASE OF TRANSPORT CANADA

Transport Canada represents a good case study to illustrate how various knowledge transfer and retention methods were tried out, validated, refined and eventually formed the basis of government policy for succession planning. A knowledge continuity project was carried with the Transport Canada Regulatory and Inspection Secretariat. The mandate of this unit was to provide:

- Succession Planning for retirees;
- Knowledge Transfer for Critical Positions;
- A repeatable process for other government organizations;
- Implement a pilot project because of the Deputy Minister's commitment to file on a knowledge continuity capability.

A pilot project approach, together with an action research model, was used with Transport Canada.

> In action science we seek knowledge that will serve action. The action scientist is an interventionist who seeks both to promote learning in the client system and to contribute to general knowledge. This is done by creating conditions for valid inquiry in the context of practical deliberation by members of client systems. This is what we mean when we speak of enacting communities of inquiry in communities of social practice. (Argyris, Putnam & McLain Smith, 1985, p.36)

Action research is known by many other names, including participatory research, collaborative inquiry, emancipating research, action learning, and contextual action research, but all are variations on a theme. Put simply, action research is "learning by doing" - a group of people identify a problem, do something to resolve it, see how successful their efforts were, and if not satisfied, try again. While this is the essence of the approach, there are other key attributes of action research that differentiate it from common problem-solving activities that we all engage in every day. What separates this type of research from general professional practices, consulting, or daily problem-solving is the emphasis on scientific study, which is to say the researcher studies the problem systematically and ensures the intervention is informed by theoretical considerations. Much of the researcher's time is spent on refining the methodological tools to suit the exigencies of the situation, and on collecting, analyzing, and presenting data on an ongoing, cyclical basis.

Several attributes separate action research from other types of research. Primary is its focus on turning the people involved into researchers too - people learn best, and more willingly apply what they have learned, when they do it themselves. It also has a social dimension - the research takes place in real-world situations, and aims to solve real problems. Finally, the initiating researcher, unlike in other disciplines, makes no attempt to remain objective, but openly acknowledges their bias to the other participants. Greenwood (1993) identifies four key processes in action research: plan, act, observe and reflect. Gerald Susman (1983) gives a somewhat more elaborate listing. He distinguishes five phases to be conducted within each research cycle. Initially, a problem is identified and data is collected for a more detailed diagnosis. This is followed by a collective postulation of several possible solutions, from which a single plan of action emerges and is implemented. Data on the results of the intervention are collected and analyzed, and the findings are interpreted in light of how successful the action has been. At this point, the problem is re-assessed and the process begins another cycle. This process continues until the problem is resolved.

For the Transport Canada project, the Susman model of action research was used. Key stakeholders participated in all project meetings and concrete problems were addressed by three pilot projects. A different pilot project was implemented for each one of the three major units in the Transport Canada Secretariat: Rail

Safety, Marine Safety and Civil Aviation Safety. This paper focuses on the civil aviation pilot. A number of criteria were agreed upon for the selection of a pilot project. These criteria were that the pilot be:

- Business need driven – addresses real business stakeholders, real business needs and cannot be IT – driven only (requires support and active participation of senior managers, human resources and information technology departments).
- Real benefits result – the pilot should not pick easy-to-solve problems, there should be a significant benefit to the stakeholders involved and the benefits should be measurable.
- The focus should be to keep the pilot simple, easy to use and easy to understand.
- There should be a strong fit with overall organizational culture and the specific micro-culture of the civil aviation safety group.

The knowledge continuity goals for the pilot project were to focus on people-to-people transfer first and then later to introduce containers for the knowledge transferred. A number of transfer methods, techniques and tools were used and validated for different positions and different types of knowledge. Documenting the processes of capturing valuable knowledge and making it explicit helped develop an approach that supported & facilitated the transfer of knowledge from experts to successors, not only for Transport Canada but for the government as a whole. Finally, recommendations were made in order to ensure the sustainability of the knowledge continuity method. In other words, knowledge transfer and preservation should be viewed as dynamic processes that will take place more than once. The knowledge continuity methodology therefore had to include recommendations on how to select the best suited approach for a given person, a given position and for the different types of knowledge to be addressed. These recommendations should also form part of the human resource and knowledge management strategic plans of the department.

Fourteen (14) professionals participated in the study. They were all full-time (permanent) employees who were near retirement eligibility who worked in Civil Aviation Safety. Each participant was interviewed both on an individual basis and as part of a focus group. Individual interviews were conducted with two interviewers and spanned an average of 90 minutes. Each interview was then transcribed and the two interviewers met to discuss and resolve any significant differences in the data capture. The transcripts were then sent back to the interviewee for validation, correction and any other editing required. Next, the transcripts were analysed using the method of qualitative research with a thematic analysis of the content. From this analysis, the list of critical knowledge to be transferred and preserved was elicited. The critical knowledge elements were then represented in a graphical form, with the mapping between each one used to represent the type of relationship they had to one another (e.g. a pre-requisite type of know-how, a particular deliverable that results from applying this knowledge and so on).

Prior to the interview, an information gathering phase was conducted in order to learn as much as possible about the civil aviation domain, to put together a preliminary glossary of key terms (and acronyms). This information in turn helped to formulate the interview questions. Following each interview, the transcript was sent back to the participant for any correction and editing required. The MindManager software tool was used to graphically depict the valuable knowledge for each key area as well as for each participant. This software was also used to map their social interactions and identify their extended community of practice. A process model was used to diagram key tasks performed by the participants (flowchart diagrams using Visio software).

A two-day workshop was then held in a room with computers that were used to allow immediate hands-on experience with these tools for the participants. The tools that were used included a repository (online structured knowledge base), a task support system (procedural contextual help for each step of a task) and the MindManager tool to visualize the people they interact with in order to do their job (which can serve as an interface to an expertise locator system for the new employees). Typical questions asked during the workshop included:

- Who needs this knowledge? Who has this knowledge?
- How do they transfer this knowledge?
- To what extent is this knowledge already documented?
- Where does this knowledge currently reside?
- How much is available and in what form?

Process-specific questions included:

- How many tasks do you usually do?
- Which ones are more frequent? Why?
- Which tasks are particularly difficult? Why?
- How can knowledge best be entered, maintained and retired for each of these tasks?

Table 2 lists the questions asked of participants during the two-day knowledge transfer workshop.

TABLE 2: KNOWLEDGE TRANSFER WORKSHOP QUESTIONS

PRE-WORKSHOP QUESTIONS (ASKED OF EACH PARTICIPANT VERBALLY)	WORKSHOP QUESTIONS (FOUR FACILITATORS ASKED THESE QUESTIONS THROUGHOUT THE HANDS-ON ACTIVITIES)
What's important to you about the Aviation Safety knowledge transfer workshop?	What are the one or two most important tasks associated with your job?
How will you know it has been successful?	Choose one task. What are the key steps associated with accomplishing this task?
What are the two or three key business outcomes that are essential to consider in doing your work?	What are the key steps associated with accomplishing this task?
	Provide a purpose & brief description of each step
	What is the key knowledge/information associated with each step? If it's explicit knowledge, where can it be found? If it is tacit knowledge, how do you learn it and how do you find experts to help you out?
	Who else is involved in the successful completion of this task?

The results of this workshop produced a number of products such as:

- References available and their location;
- Glossary;
- Interview templates;
- Interview transcripts;
- Knowledge maps of subject matter expert knowledge;
- Process maps of subject matter expert task know-how;
- Community of Practice map of key social interactions;

- Dynamic Process Model for the selected task: draft regulation process;
- Task Support prototype for the above process.

Upon completion of the workshop, not only was knowledge captured and documented, but it was made operational in a prototype task support system for the selected task of drafting a regulation. The workshop knowledge gathering approach is referred to as a thematic seminar to gather tacit knowledge from experts (Faust, 2006).

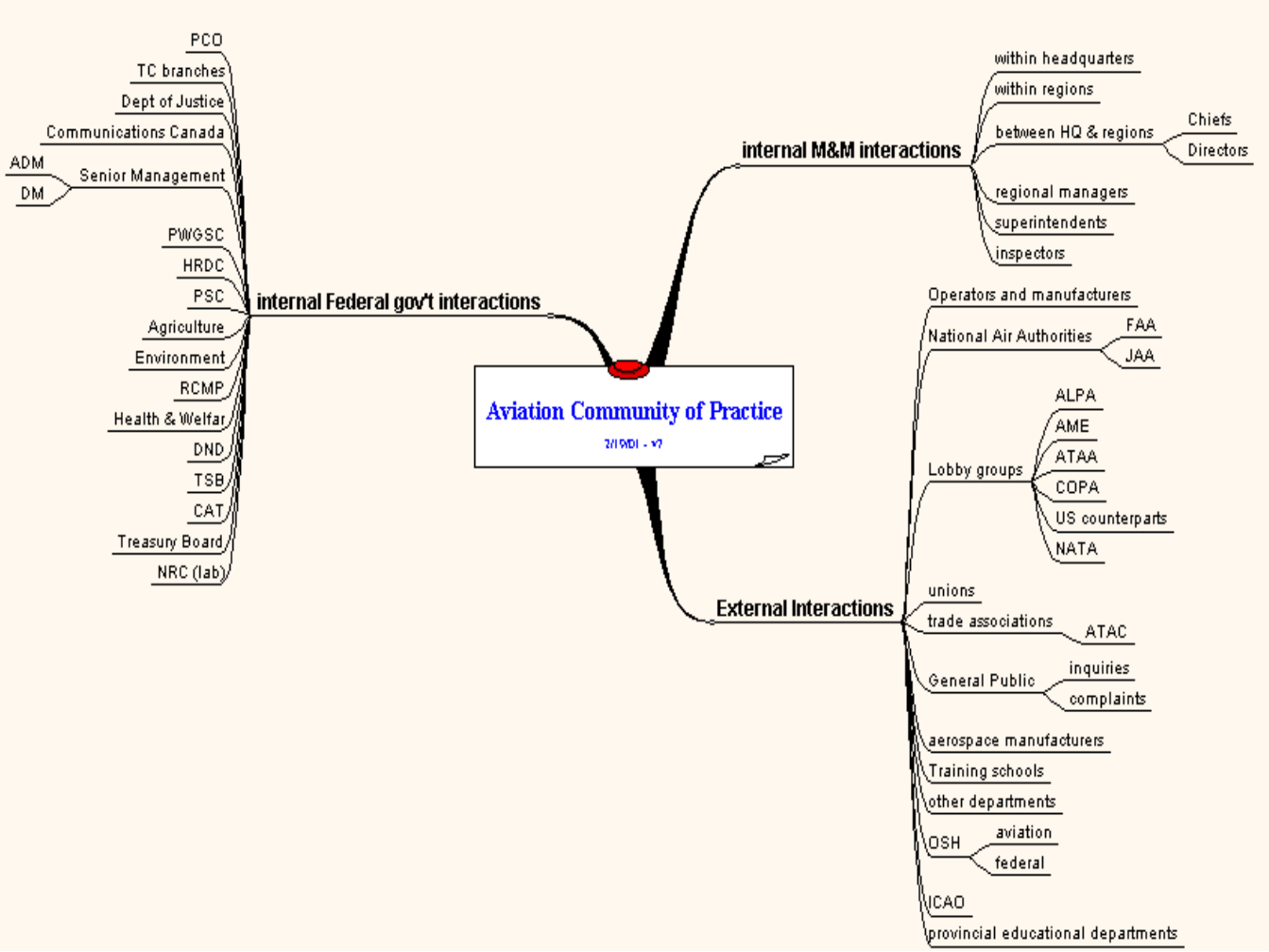
During the interviews and workshops, participants were asked who they interacted with, both within their group, within Transport Canada and with others. They were asked how often each interaction occurred and what the major outcomes were (i.e. were some tangible knowledge products shared as a result of the interaction. Table 3 shows the data for one group, the Civil Aviation group.

TABLE 3: STAKEHOLDER INTERACTION ANALYSIS: EXAMPLE OF THE CIVIL AVIATION GROUP

CATEGORY OF STAKEHOLDER	NUMBER OF DIFFERENT INDIVIDUAL STAKEHOLDERS OF EACH CATEGORY	FREQUENCY OF INTERACTIONS
External (not part of the government)	20	5
Internal but not part of Department of Transport	17	8
Internal (Transport Canada)	7	2

An example of the community of practice map with the key social interactions with major stakeholders is shown in Figure 2.

FIGURE 2: COMMUNITY OF PRACTICE MAP FOR CIVIL AVIATION GROUP



The results showed that a great deal of knowledge concerning how to perform the key tasks were best transferred and preserved using a task support system. Gery (1991) defined electronic performance support systems (EPSS) as "an integrated electronic environment that is available to and easily accessible by each employee and is structured to provide immediate, individualized on-line access to the full range of information, software, guidance, advice and assistance, data, images, tools, and assessment and monitoring systems to permit job performance with minimal support and intervention by others" (retrieved from http://www.pcd-innovations.com/infosite/whatepss.htm on November 2, 2009).

In the civil aviation community of practice, the number of relationships is high but the rigor and frequency of interactions appears to be less. There were a greater percentage of formal rather than informal interactions. The type of knowledge to be transferred is much more procedural, policy-oriented and directive in nature which makes a task support approach to knowledge transfer is entirely appropriate. A task support system can easily capture and make available for future reuse a "library" of relevant EPSS objects such as:

- Definitions;
- Process overviews;
- References;

- How-to guides;
- Examples;
- Models;
- Who to ask for more help;
- Guidelines, policy and standards;
- Checklists;
- Instructions and procedures;
- Training and e-learning modules;
- Navigational aids (how to navigate, how does each task and each object relate to a more global map of the knowledge needed to do this task well?

The prototype that resulted from the two-day workshop with participants was not a very sophisticated one. It was a "low-fidelity" mockup with just enough functionality that participants could get a feel for how they would use the system and how they would interact with the content. The prototype can serve as a great starting point for the official organizational memory system as the design has already been developed and validated to a great extent. In addition, the content has been organized – there is a taxonomy or classification scheme for the knowledge that has been deemed important to transfer and to retain. The prototype is thus an evolutionary and incremental way of designing and "feeding" the organizational memory system.

The key thematic findings from the individual interviews and focus group were:

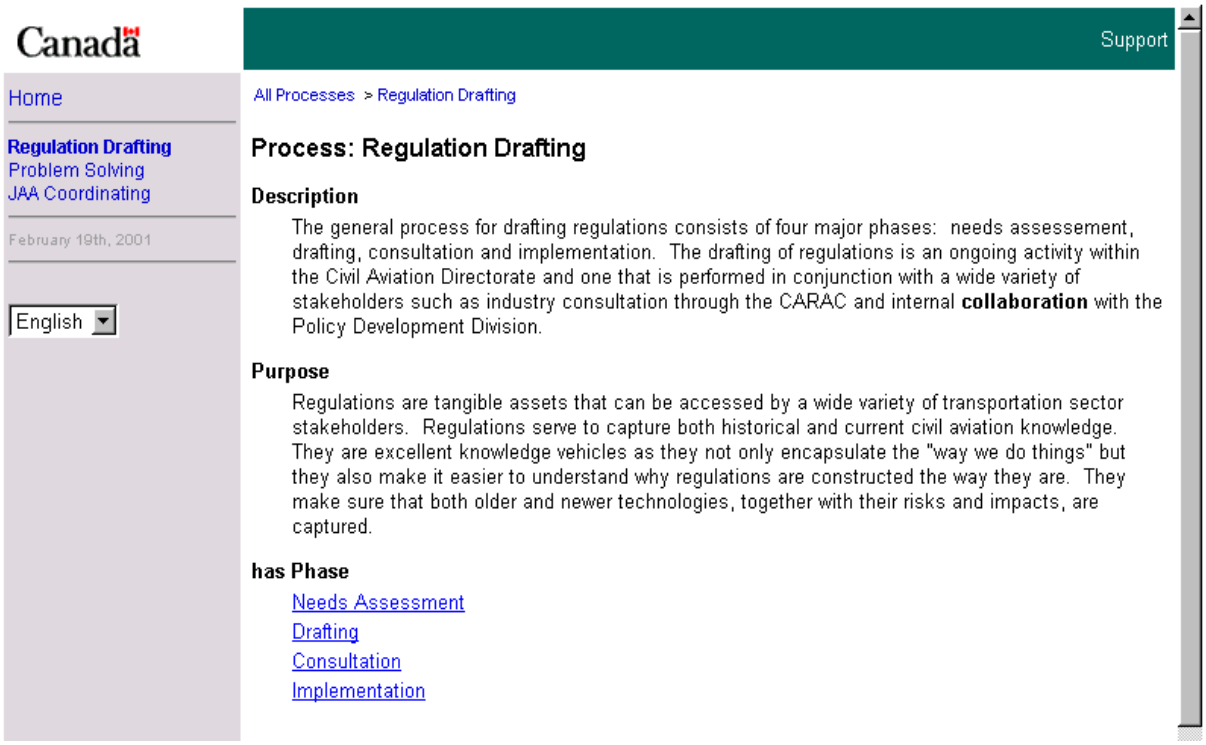
- Focus on the concrete, though as a team they function intuitively. They had limited awareness of the processes involved in their tasks (this is to be expected from individuals who are very experienced and who possess a great deal of expertise).
- Dominance of intuitive data.
- They tended to be Big Picture rather than detail oriented. Focused on individualistic approaches based on personal experience rather than standardized process.
- Discovery was that an intuitive process could be captured in a formal way. They did find the workshop process difficult. Significantly the nature of their work is largely process and detail-oriented.

The recommended knowledge transfer and preservation strategy for this particular group can be traced back to the Nonaka and Takeuchi model (see Figure 1).

There is clearly a dominance of process knowledge within the civil aviation M&M community. Sharing of this knowledge appears to occur in an informal basis and is situated in the first quadrant (socialization). There is a need for innovative ways to capture knowledge which today remains largely intuitive and personal experience-based. Tacit knowledge needs to be 'put down in writing' e.g. document case histories in terms of best practices, lessons learned, etc. This is situated in the second quadrant (externalization). There is a need for single window access to relevant process knowledge such as FAQs, draft regulation process steps, which is in the third quadrant (combination). Task support and other referential tools can be used to ensure internalization of process knowledge (know-how) as well as historical anecdotal knowledge which is in the fourth Nonaka and Takeuchi quadrant (internalization). All the quadrants have been covered which greatly increases the likelihood of *successful* knowledge transfer and preservation.

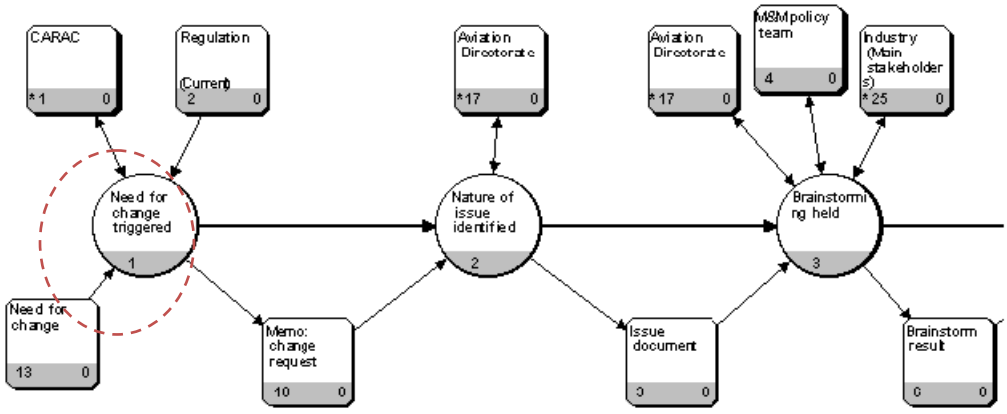
Task support systems are excellent online help systems for procedural knowledge. An example from the civil aviation group is shown in the screenshots in the figures that appear below.

FIGURE 3: PROCESS DESCRIPTION: KNOWLEDGE TO BE TRANSFERRED AND PRESERVED PERTAINING TO THE DRAFTING OF A REGULATION IN CIVIL AVIATION



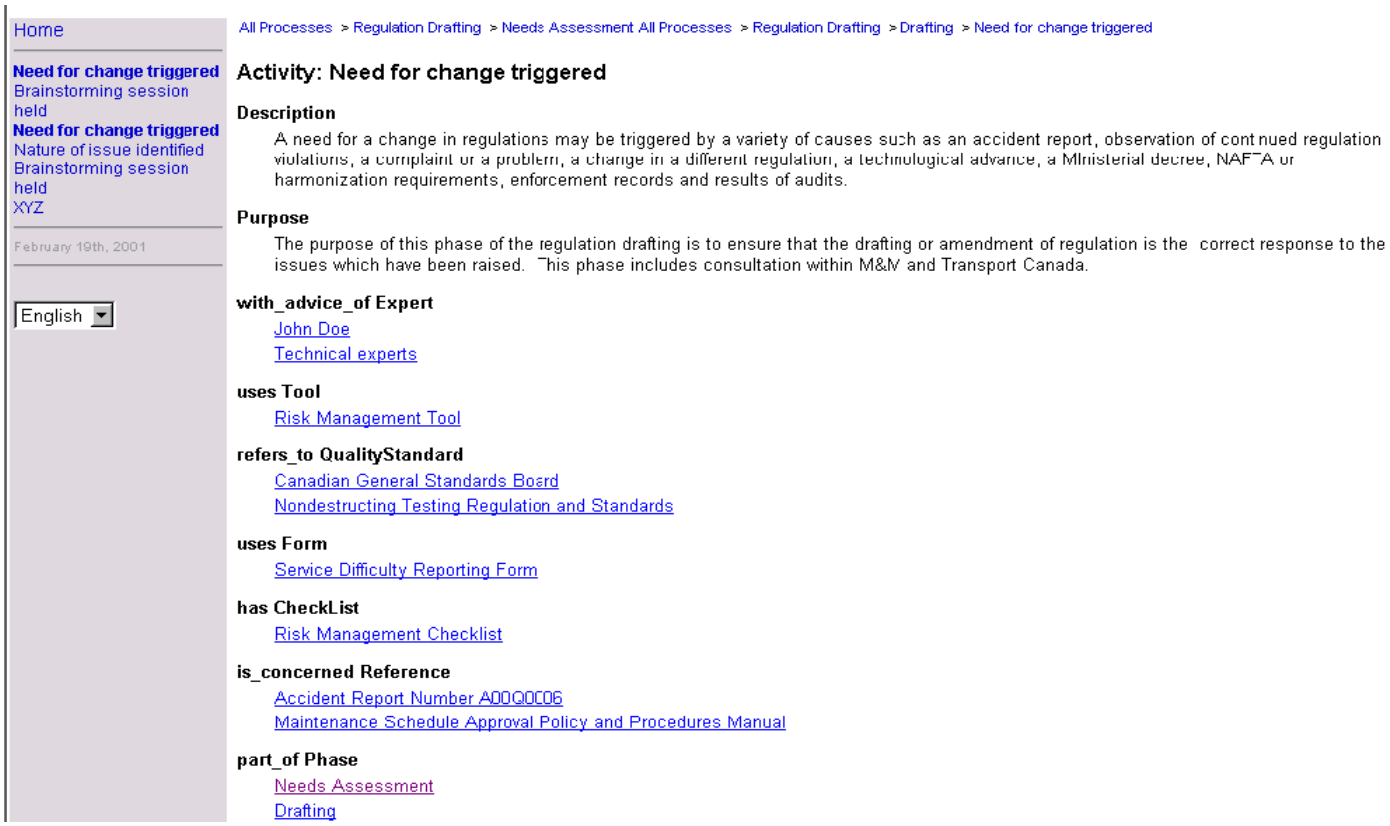
A model of the process "regulation drafting" to describe what it is, its purpose and the major phases that have to be completed in order to draft a regulation: needs assessment, drafting the regulation, consultation with stakeholders and implementing the regulation.

FIGURE 4: THE REGULATION DRAFTING PROCESS KNOWLEDGE MODEL FOR THE PHASE: NEEDS ASSESSMENT



Needs assessment is one of the four subtasks required for regulation drafting. The needs assessment task can be further broken down into activities or steps. Each of the three activities seen in the figure above can then be described and supported using a task support tool. All the new employee has to do is click on the specific subtask. The first one, "need for change triggered" is shown in great detail below.

FIGURE 5: SCREEN SHOT OF THE TASK SUPPORT AVAILABLE FOR THE ACTIVITY: NEED FOR CHANGE TRIGGERED



In the Figure 5 screen shot, we can see a clickable list of resources available to help the new employee carry out the task "how to make a change in a regulation" such as references, a checklist, a risk management tool and documented expert from experts. This prototype thus illustrated how knowledge transfer and retention could be carried out using task support. The prototype provides:

- Interactive online references for employees;
- Can be used as seed set of key words for intranets, portals, repositories etc.
- Inventory of accessible knowledge;
- Inventory of process knowledge used and tangible products generated when key tasks are carried out;
- Explicit how-to guide for selected tasks.

In addition, the task support tool can be used to develop a more comprehensive job description for the roles and responsibilities of the group members, provide a contact list for the extended community of practice, provide structured legacy materials for newcomers and act as a tool to help in employee orientation, training and mentoring. The task support system can be used to accelerate both training (explicit knowledge) and mentoring (tacit knowledge) by providing actual content, case studies, checklists all of which serve to structure and facilitate the knowledge transfer process. Finally, the task support system can be used after

training and mentoring sessions, while the new employee is actually doing their job, as it can provide on-the-job support for the successors.

Finally, a post-mortem was held to assess how well the knowledge mapping, capture, transfer and preservation techniques worked with this particular group. Some of the questions that were posed included: What worked as expected? What were the surprises? How could we improve the next time? Results of the assessment showed that:

- The knowledge continuity process was much more labor intensive than originally anticipated;
- The knowledge you *thought* was in good, explicit shape was not quite that way;
- The process you have in documented form is *not* the process you want to promote:
- You want to capture new thinking (and the project created some!)
- You will most likely want to get rid of old thinking that is no longer valid (or simply cannot be explained to successors);
- Costs of upkeep FAR exceed those of initial set-up;
- Better understood what a pilot project process was – it is really form of organizational learning;
- Now know what to expect for future pilots with respect to planning and risk assessment;
- Better able to translate KM benefits to business benefits for all key stakeholders.

In summary, the Nonaka and Takeuchi model provided a suitable framework for knowledge continuity. The combination of an action research platform with individual and group interviews provided a good means of collecting data. The hands-on pilot project approach helped make the knowledge continuity methodology easier to understand as it was situated on actual content and all of the "work" was done by the actual participants.

■ DISCUSSION AND CONCLUSIONS

The knowledge continuity project at Transport Canada demonstrated that there is a level of skepticism about ability to deliver knowledge transfer and knowledge management processes. This only highlights the importance of focusing on concrete actions and results to ensure that the process becomes institutionalized. The methodology outlined here supports the cognitive apprentice style transfer of knowledge from retiring experts to successors with the benefits of decreasing orientation time, decreasing time-to-effective performance and decreasing the time demanded of experts. The approach is equally appropriate for the transfer and retention of both tacit and explicit knowledge (e.g. technical knowledge and the know-how & know-why that stems from years of experience). Aiman-Smith et al (2006) note that most organizations use phased retirement making effective use of retirees and implementing mentoring programs and are slowing the loss of knowledge and capabilities as a result. Other best practices include:

- Employee rotation programs;
- Sharing case studies of lessons learned;
- Using communities of practice to diffuse the knowledge more widely;
- Storytelling;
- Job shadowing;
- Creating a knowledge manager position or an entire KM department to ensure resources are available to conduct knowledge continuity activities.

The authors note that: "proactive management and planning are key factors to addressing the coming knowledge and capability shortage" (p. 22). A good KM strategy, strongly integrated with the overall organizational strategy, is an excellent means of ensuring that knowledge loss is slowed, if not prevented. Ives et al. (2004) point out that some of the newer tools such as blogs and social networking may serve as effective approaches to knowledge capture, transfer and retention. Such tools would be particularly popular with the

younger successors who could take the "techie" lead in mentoring while more senior experts could focus on the knowledge specific to the job at hand.

Finally, the importance of allocating enough and the right kind of resources cannot be emphasized too much. The getting and the organizing of actual knowledge is extremely labor-intensive and requires a multitude of competencies. The KM resources need the capability to develop content models (taxonomies or classifications of the knowledge to be transferred and preserved), others need to provide editorial standards, yet others will be responsible for the capture and feeding of knowledge into organizational memory, subject matter experts will need to continuously validate the content and weed out what is out of date or no longer valid. KM continuity is an ongoing requirement for all organizations and sustainability needs to be ensured.

Faust (2006) notes that "most KM initiatives have failed due to the lack of specified methods for conserving tacit knowledge". (p.10) The knowledge continuity methodology outlined here has been applied in a wide variety of organizational contexts, both in the public and private sectors, and has proven to be an effective means of identifying, transferring and preserving both tacit and explicit knowledge.

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