A Study Investigating the Design and Development of Components of a Comprehensive Tool Incorporating Characteristics of Continuity Management, Knowledge Harvesting, and Knowledge Management

Mary Ellen Pierson

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Curriculum and Instruction
(Instructional Design and Technology)

Kenneth R. Potter
Barbara B. Lockee
D. Michael Moore
Jamie O. Little

February 10, 2011
Blacksburg, Virginia

Keywords: continuity, knowledge harvesting, knowledge management, continuity management, prompting questions

A Study Investigating the Design and Development of Components of a Comprehensive Tool Incorporating Characteristics of Continuity Management, Knowledge Harvesting, and Knowledge Management

Mary Ellen Pierson

ABSTRACT

This study explored the design and development of the knowledge harvesting and knowledge management components of a comprehensive tool which incorporates characteristics of continuity management, knowledge harvesting, and knowledge management. While tools exist to support restoring continuity in the aftermath of a disastrous event, little is done to address maintaining continuity through the non-disastrous events. Employee separation is one such non-disastrous event, and one that all organizations face. Knowledge harvesting is suggested as a means to address collecting the knowledge of employees within an organization so that it can be reused by new employees or temporary replacements. The combination of the attributes of continuity management, knowledge harvesting, and knowledge management resulted in five characteristics of a comprehensive tool. These characteristics were operationalized in the design of a comprehensive tool and provided contextual information for the design and development of the knowledge harvesting and knowledge management components. Findings of the evaluations of the components indicated that the developed components complied with the design-based specifications. Lessons learned from the implementation and evaluations of the knowledge harvesting component suggest that the right questions for the knowledge harvesting process should be determined by the organization based on the need for the information and the nature of the information needed; that the tool should incorporate terminology, prompting questions, and a structure that are right for the organization and that the users will understand; that users may benefit from time to respond and having options to submit responses in various formats; and that users may benefit from encouragement and support throughout the knowledge harvesting process. Lessons learned from the implementation and evaluations of the knowledge management components suggest that the ability to provide a prompt follow-up to a user's response could improve the effectiveness of the tool; that the structure and development of the database requires precision; and that while the database must be precise, it must also be flexible and accurately accommodate changes to the content.

Acknowledgements

I am most grateful for the support and encouragement extended to me by many as I worked through this process. I would like to thank the members of my committee. To my advisor, Dr. Potter, for coming through when everything seemed lost and for the many hours you put into reading, editing, and simply listening. To Drs. Lockee, Moore, and Little, for the advice and support each of you extended to me as this project took shape.

I would also like to extend thanks to Dr. Jane Falls for unending support and friendship through those days when clarity was elusive; to Dr. Kathy Cennamo for providing me with an opportunity to start on the trail to achieving a personal milestone; to Dr. Patricia Broderick for helping me come to understand the stressors in my life and their influence on this process; and to the many graduate students with whom I have had the pleasure to work and from whom I have learned much.

Most importantly, I am especially grateful to my family. To my husband, Bill, whose love and support carried me through countless hours of reading and writing. To my daughters, Rachael and Sarah, whose willingness to listen and professional observations were most helpful. To those who joined our family during this process, my sons-in-law Justin and Kyle. You are men that make a mother's heart glad. To those that left the family during this process, the aunts and uncles and friends, but most especially to my mother. And, finally, to the little one that will be joining the family in a few months.

Table of Contents

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

Statement of the Problem

While all organizations are susceptible to events that threaten their continuity (Cerullo & Cerullo, 2004), employee separation is one event that threatens both the continued operations as well as the day-to-day productivity of an organization (Beazley, Boenisch, & Harden, 2002; DeLong, 2004). A potential problem resulting from employee separation is the loss of knowledge of the organization built by employees while on the job. The loss of this knowledge, recognized as an organizational resource (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003), threatens to impact organizational continuity unless it is harvested.

Recovering from the Disastrous Event

Disastrous events impact organizational continuity (Cerullo & Cerullo, 2004). These events often occur with little or no warning, disrupt all operations, and result in damage such that an organization is unable to continue operations for a period of time ("Disaster Recovery Journal Glossary," 2007). Most noted are natural disasters and power outages, followed by information technology outages, terrorism, failures experienced by service providers, labor strikes, biological diseases, and civil unrest (Witty, 2005).

Developing plans to restore operations appears to be a high priority in the business community. Forrester Research and the Disaster Recovery Journal ("The State of DR Preparedness," 2008) reports that 77% of the businesses surveyed had continuity management plans with another 18% expecting to have them completed in the 12 months following the survey. As positive as these numbers appear, there is a downside to them as they do not

necessarily represent advanced planning by the organization. Almost half of businesses developed continuity management plans only after having faced an unexpected interruption (Yoshida & Deyle, 2005) Studies suggest the lack of preparedness is due to the cost of the planning process, the complexity of the process, the amount of time needed to conduct the process (Webb, Tierney, & Dahlhamer, 2000; Yoshida & Deyle, 2005), and the perception that a plan is not needed (*Expecting the unexpected: Disaster preparedness strategies for small businesses*, 2007).

Within higher education, the picture of continuity management planning is not as clear as it is for businesses. While awareness for continuity management planning was high (61%), increasing due to the disastrous hurricanes Katrina in 2004 and Rita in 2005, efforts to make continuity management planning part of the day-to-day operations of the university were low (Pirani & Yanosky, 2007). Continuity management was one of the top ten strategic issues for institutional success in 2006 and 2007 and was expected to remain an issue for 2008 and 2009, and yet lacked human or financial resources from the institution (Allison & DeBlois, 2008; Camp & DeBlois, 2007; Dewey & DeBlois, 2006; Maltz & DeBlois, 2005). Although continuity management planning is often the responsibility of institutional Chief Information Officers (Allison & DeBlois, 2008), it "[has] been more fully integrated into the [information technology] organization" (p. 18) at many colleges and universities.

Several issues arise from the university-based surveys. First, although information technology is widespread across many university campuses, expectations that continuity management efforts will be campus-wide because of its integration with these units may be mistaken. Second, placing leadership for continuity management planning within the information technology group has the potential to over emphasize the role of information technology in each

unit's plan, while neglecting other perspectives of continuity and additional factors that should be involved in continuity management planning.

A Non-disastrous Event: Employee-Job Separation

Non-disastrous events often impact the day-to-day operations in ways that are unremarkable and yet, because organizations are systems, an interruption to a critical subsystem of an organization could ripple through an organization.

Employee separation can be considered a non-disastrous event. When temporarily separated, the employee is still part of an organization, however temporarily not present to perform his or her duties. Voluntary absences may be due to personal illness or injury, child care issues, family or personal obligations, military duty, and family leave (Bureau of Labor Statistics, 2009). Involuntary absences, on the other hand, appear less frequently in the literature, and could be caused by a mandatory leave of absence for disciplinary reasons. When permanently separated, the employee is no longer part of the organization, and also may be for voluntary or involuntary reasons. Voluntary turnovers are the choice of the employee and may occur because of resignations, retirement, transfers, or personal issues such as the type of work, interaction with supervisors and co-workers, compensation, and family relocation (Beazley, et al., 2002; DeLong, 2004). Involuntary turnover may be due to termination, disciplinary actions, and layoffs (Baldwin, Wilkinson, & Barkley, 2000; Tracey, 2003).

Within higher education, additional causes for absence and turnover are possible. Voluntary turnover may be due to students' graduation. Involuntary turnover may be due to lack of tenure, the end of a research project, insufficient progress during a probationary period, or a

reduction in the work force, and in the case of student employees, the end of a semester, or when performance issues cannot be resolved through other means (Baldwin, et al., 2000).

Cost of Employee-Job Separation

Regardless of the cause for employee-job separation, separation exacts a cost on an organization. Employee turnover impacts "morale, recruitment, and hiring and training costs" (Tracey, 2003, p. 686). Employee absence results in lost productivity, lost punctuality, and lost profit (Campbell, 2002). When new hires or temporary replacements do not have the same knowledge as those they are replacing, they may average 2.5 hours per day searching for job-related information rather than performing their job (Feldman & Sherman, 2001).

Need for the Study

There is a need to harvest employee knowledge to mitigate the impact of the interruption caused by employee separation and lost knowledge. This need exists because (a) interruptions occur regularly to day-to-day operations within organizations; (b) interruptions from employee separation, whether from turnover or absence, are inevitable; and (c) when employees separate, they take their knowledge of the organization with them. Knowledge harvesting is recommended as a part of organizational continuity management efforts to address the interruption from lost knowledge (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003).

Research Purpose

The purpose for this exploratory study was to design and develop a knowledge harvesting and knowledge management component for a comprehensive tool. The comprehensive tool is one that harvests, stores, and delivers employee knowledge of the day-to-day work performed within an organization and incorporates characteristics of continuity management, knowledge harvesting, and knowledge management.

Research Questions

The following research questions guided this study:

1. What literature-based characteristics could contribute to the design and development of a comprehensive tool for knowledge harvesting, knowledge management, and continuity management?
2. How could the design-based specifications be operationalized to create a knowledge harvesting component and a knowledge management component?
3. What lessons could be learned from the operationalization and subsequent evaluation of design-based specifications for a knowledge harvesting component and a knowledge management component?

Limitations

Initially, two factors were identified to limit the scope of the comprehensive tool. First, while knowledge harvesting and knowledge management tools may support a variety of management issues in an organization, the focus of the tool was specifically to support the continuity management of an organization. Other management applications for this tool were

outside the scope of this study. Second, continuity management can address the resources and procedures needed to facilitate a response when disastrous as well as non-disastrous events impact an organization. While this knowledge harvesting and management tool could be used to support continuity management in response to disastrous events, in this study the focus was on its use as a tool to mitigate interruptions to the day-to-day operations of an organization from non-disastrous events, such as employee separation.

Definition of Terms

The following definitions are provided for terms as used in this study.

Continuity. Within an organization, continuity is defined as a state wherein the organization has the ability to restore operations when events impact the organization or any of its parts or maintain operations when events threaten to impact the organization or any of its parts (FFIEC, 2003; Pirani & Yanosky, 2007).

Continuity Management. Continuity management refers to a process that addresses the resources and procedures needed by an organization to restore or maintain continuity (Charters, 2007; Cornish, 1999; Hiles, 1999; NFPA, 2007). Managing the continuity of an organization includes the ability to plan, organize, coordinate, and supervise tools that address the resources and procedures needed by an organization to facilitate a response when events impact an organization.

Knowledge Harvesting. Knowledge harvesting is a process that involves the elicitation of knowledge, as well as the encoding, collection, and storage of this information for the purpose of making it available for reuse at a time in the future (Beazley, Boenisch, & Harden, 2003;

Eisenhart, 2001; Pugh & Dixon, 2008). It does not prescribe methods for the collection and storage of information, but recognizes that it should be collected and stored to support its reuse.

Knowledge Management. At its most basic level, knowledge management is a process that supports the collection, storage, and use of knowledge (Alavi & Leidner, 2001). Knowledge management systems are products that facilitate the reuse of information through the application of knowledge management functionalities.

Operationalization. To operationalize something is to make it operate. Trochim (2001) defines it as "your translation of an idea or construct into something real and concrete" (p. 64). In this study, operationalization was a two-step process. The design phase served to operationalize the characteristics into specifications and the development phase served to operationalize the specifications into physical form.

CHAPTER 2: LITERATURE REVIEW

Organizations are systems that face events that threaten to impact the continuity of day-to-day operations on a regular basis. Managing continuity within organizations includes the ability to plan, organize, coordinate, and supervise efforts that support continuity. Organization-related knowledge is an important factor in managing continuity. This literature review begins with a discussion of organizations as systems, continuity, and continuity management in organizations. It continues with a discussion of organizational knowledge, knowledge harvesting, knowledge management, and tools for collecting organizational knowledge for continuity management. The literature review ends with a synthesis of the issues indicated from the literature review.

Organizations and Continuity

This section of the literature review briefly discusses the structure and function of organizations, presents two perspectives of continuity for this study (maintenance and restoration), and discusses continuity management, including characteristics of continuity management and factors related to continuity management.

Organizations as Systems

The view of an organization as a system is well recognized in studies of organizations (Burke, 1994; Cummings & Worley, 1997; Lundgren, 1974; Nadler, Shaw, Walton, & Associates, 1995; Scott, 2003). Systems theory describes a system as more than simply the "sum of its parts" (Bertalanffy, 1950, p. 142), but as a "complex of interacting elements" (p. 143).

Systems theory provides a framework within which to view the structure and functionality of an organization (Bertalanffy, 1972; Johnson, Kast, & Rosenzweig, 1964) as well as the relationships between organizations.

Structurally, a system is not a random mix of individual elements but the purposeful combination of elements that benefit the system (Bertalanffy, 1950). Each element brings a different role and responsibility to the system. Subsystems exist within systems, share many of the characteristics of a system, and are comprised of unique sets of elements. Likewise, organizations incorporate multiple subsystems which are comprised of unique sets of elements.

Functionally, a system acts and interacts (Bertalanffy, 1950). The actions of a system are represented in the input-process-output model (Kast & Rosenzweig, 1972). In its most basic form the model states that needed inputs (or resources) are received, transformed by the processes (or operations) of the system, and outputs are created. In an organization, some resources are transformed into the final product, while some are used to support operations (Stogdill, 1967). Operations are a "set of activities…organized in a logical sequence" (Gibb, Buchanan, & Shah, 2006, p. 45) that are influenced by the rules of an organization, and can be standardized to ensure consistent, reproducible outputs. Outputs can take the form of goods, services, or information and may be sent out of an organization or remain within an organization to become resources for other subsystems (Kast & Rosenzweig, 1972; Stogdill, 1966, 1967). The interactions of a system can take place inside the system as well as outside the system. For an organization, these interactions provide the means to receive resources and supply outputs (Bertalanffy, 1950, 1972; Burke, 1994; Lundgren, 1974; Marion, 2005; Millman, 1964).

Survival is a fundamental goal of an organization (Palmer, Dunford, & Akin, 2006; Stogdill, 1966) and although it is rarely stated openly, it is a goal agreed upon by most involved

within an organization (Palmer, et al., 2006). To survive, an organization must continue to create outputs; it must continue to operate, as outputs can suffer in quality or quantity when operations break down; and, it must "maintain a flow of resources" (Scott, 2003, p. 168), as operations require resources. However, there exists a mutual dependency between resources and operations (Bertalanffy, 1950). The introduction of different resources could require different operations in order to produce the same outputs. Likewise, the introduction of different operations could require different resources to produce the same outputs. Without these adjustments, outputs could change or cease to be produced. Just as important to the survival of an organization are its interactions. Internal interactions build a collective effort that works toward organizational goals (Bertalanffy, 1972; Cummings & Worley, 1997; Johnson, et al., 1964; Kast & Rosenzweig, 1972; Lundgren, 1974; Stogdill, 1966, 1967). External interactions support the sharing of information that may assist in identifying events that have the potential to disrupt the availability of resources or continuity of operations.

Perspectives of Continuity

In an organization, continuity is described as operations that continue (Hiles & Barnes, 1999). However, events may have the potential to harm an organization and thereby pose a threat to an organization's ability to continue operations. Actualized threats may cause interruptions and these interruptions break continuity. When interruptions break continuity, an organization may *restore* (Pirani & Yanosky, 2007) or recover (FFIEC, 2003) continuity. Interruptions may initially impact one or more subsystems. However, if the interruption impacts a critical subsystem and it is not addressed, the break in continuity in the subsystem can spread to impact the entire organization. Tools, such as government support programs, orientation or training

programs, and user guides and equipment manuals, may assist in restoring continuity when threats do occur (Hiles & Barnes, 1999; Scott, 2003).

While tools may be used to restore continuity, tools may also be used to *maintain* continuity (FFIEC, 2003; Pirani & Yanosky, 2007). In discussing systems theory, Bertalanffy (1972) claims that appropriate tools counteract the interruption that breaks continuity. When viewed from this perspective, tools may mitigate the impact of the interruption on the operations of the organization, prevent a break in continuity, and as a result maintain continuity.

The occurrence of a threat may be impossible to predict. Some threats may cause interruptions suddenly (Beazley, et al., 2002). The abrupt loss of a course instructor or the sudden interruption of financial support is an example. Each of these events could be recognized as a threat to an organization and could occur at any time. On the other hand, threats may cause interruptions slowly (Witty, 2005). The expected separation of an instructor or a gradual decrease in student enrollments is an example. In these instances, the interruption resulting from actualized threats may take time to occur. Because of this delay, an organization may have time to prepare for or prevent the interruption by developing tools and incorporating these tools into the organization, resulting in continuity that is either restored or maintained.

In summary, two perspectives of continuity are presented – restoration and maintenance. In restoration continuity, the threat occurs and causes an interruption, which breaks continuity. Continuity is restored by means of tools. In maintenance continuity, the threat may occur but tools in place before the threat occurs mitigate the impact of the interruption and continuity is not broken.

Continuity Management

An organization's need to survive is accompanied by a need to ensure continuity. Ensuring continuity is supported by managing it, and the management of continuity is supported by tools. While the ideal situation is one in which tools are in place to maintain continuity when events threaten to impact an organization, a common situation is one in which continuity is restored after an interruption occurs. Much of the continuity literature approaches continuity management and associated tools from the restoration perspective. This section discusses continuity management, while the tools that support the management of continuity are discussed in a later section.

Continuity management for restoration provides an organization with the ability to "recover … processes" (FFIEC, 2003, p. 1) and "ensure that recovery of a process or service is achievable" (Gibb & Buchanan, 2006, p. 129). Continuity management is found in the restoration continuity management literature as part of crisis management (Elliott, Swartz, & Herbane, 2002), disaster management (Barnes, 2001; Hiles, 1999), or risk management (McCrackan, 2005). Within these areas, continuity management is noted as operational risk management (Edmiston, 2007), contingency planning (Isaacs, 1999; Swanson, et al., 2002), business continuity planning (FFIEC, 2003; Pirani & Yanosky, 2007), business continuity management (Gibb, et al., 2006), pre-disaster mitigation program (Carr, 2007), disaster recovery (Gibb, et al., 2006; Pirani & Yanosky, 2007), preparedness (Webb, et al., 2000), and hazard mitigation (Yoshida & Deyle, 2005).

Despite the focus on continuity management for restoration, Cornish (1999) claims continuity management can be employed "regardless of any events or incidents that occur" (p. 93). Continuity management can "ensure the stability of essential functions" (Cline, 2007, p. iii)

and “provide confidence that processes and services can be delivered in the face of risks” (Gibb & Buchanan, 2006, p. 129).

A Brief History of Modern Continuity Management

Modern continuity management’s emphasis on computer-based technologies is evident in its history as summarized by Elliott, Swartz, and Herbane (2002). In the 1970s, modern continuity management focused on restoring the availability of computer technologies. Organizations were beginning to rely on computer hardware for data management. Natural disasters, such as floods or fires, were considered the primary threats, and computer hardware was considered the point most vulnerable to interruptions from these threats. Strategies that addressed the backup of mainframe computer systems were considered the primary means to ensure continuity. In the 1980s the focus was still on computer technology, but grew to include the whole organization as computer systems moved from mainframes to desktop systems. Because of the widespread infusion of computers across an organization, this period saw continuity management address two components – one to reduce the impact from a disaster and a second to recover from the disaster. However, natural events were still identified as the primary causes of the disasters. In the 1990s, continuity management moved toward addressing the needs of the whole organization rather than focusing solely on computer technology. Prevention as well as recovery efforts were retained from the previous decade but the needs of employees and stakeholders were given new attention. Man-made events were added to the list of threats to operations, but the focus was still on the disastrous event. In the first decade of the 21st century, attempts are being made to encourage including continuity management into overall business strategies (Foster & Dye, 2005; Walsh, 2008).

Characteristics of Continuity Management

Continuity management is developing into a process that is holistic, preservative, and continuous. Continuity management that is holistic reviews all resources and operations of an organization as well as interactions with the environment (McCrackan, 2005; Vancoppenolle, 1999). Specific holistic recommendations include identifying and documenting the threats to an organization, the interruptions that have occurred, the scope of the impact, and the manner in which the organization dealt with past interruptions, as well as the part of stakeholders in organizational operations and an organization's interactions with other organizations (Elliott, et al., 2002). Continuity management that is preservative protects an organization's ability to meet its goals and purpose, support customers, and maintain a profit (Hiles & Barnes, 1999, p. xiii). It accomplishes this by preserving resources that support the operations of an organization. For continuity management to be continuous it must be integrated as a vital part of an organization. It is not a one-time effort in which a group of individuals develops a tool which is put aside until an interruption occurs, but it is the integration of that tool into the administration of an organization (McCrackan, 2005). Because of its incorporation into administrative efforts, continuous continuity management is able to respond to changes in the organization by realigning with the new structure or function, or both.

Modern continuity management is a relatively new strategy. Consequently, the holistic, preservative, and continuous nature of continuity management are characteristics that are currently emerging. These three characteristics present continuity management as a strategy that is increasing in the scope of its coverage, the depth of investigation into threats and past interruptions, the ability to change as an organization changes, as well as the ability to maintain the continuity of resources and operations needed for continued production.

Factors in Continuity Management

Because organizations differ, the factors that are important to the continuity of one organization may be different from those for another organization. To determine the full range of factors suggested for continuity management, literature for continuity management, survival, and sustainability was reviewed. A master list of factors was compiled from more than 40 documents from private industry, federal government, military, and professional associations for continuity management, as well as documents written specifically for finance, health care, fire prevention, voluntary organizations, state and local governments, family owned businesses, information technology groups, and higher education (see Appendix A). More than 250 factors were identified as factors for continuity management. Once collected, the factors were put into one of three classifications identified by Barney (1991) - physical, human, or organizational. Physical factors refer to resources used by the organization that are available from the environment, human factors are those resources related to employees, and organizational factors are those resources that refer to the structure and functionality of an organization. During the classification process, similar factors were grouped together under a single term (see Appendix B). The frequency of the factors indicates that within the first twenty factors all eight physical factors are included, ten of the 27 organizational factors are included, and two of the nine human factors are included (see Appendix C).

Employees were noted as an important factor in continuity management. Also noted were the employee's knowledge, skills, and abilities. However, should an employee be separated from the organization through absence or turnover, his or her knowledge of the organization is not available to the organization. Because of the value of an employee's knowledge of the

organization to the continuity of the organization, the next section discusses organizational knowledge and a means to collect it.

Organizational Knowledge

Employees and their knowledge, skills, and abilities are important factors in restoring or maintaining continuity in an organization. This section discusses classifications of knowledge, organizational-related knowledge and information, and knowledge harvesting as a part of continuity management.

Data, Information, and Knowledge

Data, information, and knowledge are related but distinct concepts (Davenport & Prusak, 1998). Data are numbers, images, words, or sounds (Hislop, 2005) that are without meaning or value (Lilley, Lightfoot, & Amaral, 2004). Data are often the result of observations, calculations, and experiments (Bergeron, 2003). For example, the number “three” is data. Information is data that is interpreted (Beazley, et al., 2002), given meaning and value (Davenport & Prusak, 1998), and organized into patterns within a context (Hislop, 2005) that is relevant to the individual (Wilson, 2002). Information informs the one who receives it. For example, “three correct responses” is information. The data has meaning – there are three of something. This information can provide value to the instructor of the course, add to a pattern of correct and incorrect responses, and suggest a context wherein a test was administered. As with data, information exists outside the mind of the individual and, because of this, can be managed. Knowledge, however, is in the mind, it is what one knows, it is personal (Wilson, 2002). Wilson states:

> ‘Knowledge’ is defined as what we know: knowledge involves the mental processes of comprehension, understanding and learning that go on in the mind and only in the mind, however much they involve interaction with the world outside the mind, and interaction with others. Whenever we wish to express what we know, we can only do so by uttering messages of one kind or another – oral, written, graphic, gestural or even through ‘body language’. Such messages do not carry ‘knowledge’, they constitute ‘information’” (¶ ‘Knowledge’ and ‘information’).

Knowledge results from the processing of information and data by the individual. Processing information occurs through application, analysis (Hislop, 2005), organization, synthesis, summary (Bergeron, 2003), and reasoning (Lilley, et al., 2004). Managing the processing of information and data and the knowledge that result from the processing can only be done by the knower and is therefore unique for each individual (Wilson, 2002). In the example above, three correct responses becomes knowledge to the instructor of the course when she is able to add them to her list of student test scores, compare results, determine trends in student test scores, and develop the changes that may be needed in her instruction prior to the next test.

Organizational knowledge is a term frequently found in the literature. Davenport and Prusak (1998) claim that knowledge exists in individuals, as well as in groups of individuals in an organization and in the “routines, processes, practices, and norms” (p. 5) of an organization. They add that it can be transferred “through structured media such as books and documents, and person-to-person contacts ranging from conversations to apprenticeships” (p. 6). However, given the approaches discussed earlier in this section, the notion of organizational knowledge being present in a group of individuals in an organization or in documentation or processes is contrary to the notion of it being in the mind of the individual. To clarify this difference for the purposes

of this discussion, organizational knowledge is the knowledge of the organization that exists in the minds of individuals and is referred to as organizational-related knowledge in this document. If it exists outside the individual it is information and is referred to as organizational-related information in this document.

Tacit, Explicit, and Implicit Knowledge

Knowledge may be classified as tacit, explicit, or implicit. Tacit knowledge is personal, but hidden from the individual and as a result it is impossible to articulate or encode (Hislop, 2005; Kidwell, Vander Linde, & Johnson, 2000; Kutler, et al., 2005; Lam, 2000; Nonaka, 1994; Tschannen-Moran & Nestor-Baker, 2004; Wilson, 2002) and not expressed. Some tacit knowledge is built while performing work on the job, making it specific to the employment context in which it was built (Eisenhart, 2001; Freeze & Kulkarni, 2007; Hammer, Leonard, & Davenport, 2004; Heath, 2003; Kidwell, et al., 2000; Lam, 2000; Nonaka, 1994; Wasonga & Murphy, 2006). It has also been identified as judgment (Mulder & Whiteley, 2007) or intuition (DeLong, 2004).

As with tacit knowledge, explicit knowledge is in the mind of the knower but, unlike tacit knowledge, it was expressed through the use of language, numbers, and symbols (DeLong, 2004; Heath, 2003; Kidwell, et al., 2000; Lam, 2000; Nonaka, 1994; Polanyi, 1966; Wilson, 2002; Wong & Radcliffe, 2000). The act of expression converts what is expressed to information (Wilson, 2002). Once it is expressed, the information may be encoded (DeLong, 2004; Freeze & Kulkarni, 2007; Heath, 2003; Kidwell, et al., 2000; Lam, 2000; Nonaka, 1994), which involves a change of form (Ormrod, 1999) and may result in information written or drawn by

hand or in digital formats (Alavi & Leidner, 2001; Heath, 2003; Kidwell, et al., 2000; Lam, 2000; Wong & Radcliffe, 2000).

When encoded, the information may be collected (DeLong, 2004; Mooradian, 2005), stored (DeLong, 2004; Lam, 2000; Nonaka, 1994), packaged (Kidwell, et al., 2000; Kutler, et al., 2005; Wong & Radcliffe, 2000), and shared multiple times (Kutler, et al., 2005) without requiring the knower's participation (DeLong, 2004; Lam, 2000).

Unlike tacit knowledge that cannot be expressed and explicit knowledge that has been expressed, implicit knowledge is that which can be expressed but has not been (DeLong, 2004; Freeze & Kulkarni, 2007). In contrast to tacit knowledge, implicit knowledge can be expressed, although it may be difficult to do so. In contrast to explicit knowledge, implicit knowledge has not been expressed, although it has the potential to be expressed. Once it is expressed, it takes on the characteristics of information. The characteristics of tacit, implicit, and explicit knowledge, and information are summarized in Table 1.

Organizational-related knowledge exists in all three classifications. As tacit knowledge, organizational-related knowledge cannot be expressed and is therefore not included in the remainder of this document. As implicit knowledge, organizational-related knowledge has not been expressed but can be expressed. As explicit knowledge, organizational-related knowledge has been expressed at one time and converted into information. Sharing organizational-related knowledge within the organization requires that it be expressed. Repeated sharing benefits from having this expressed organizational-related knowledge encoded and collected. If encoded and collected, then it is a resource the organization can use in its continuity management efforts.

Table 1

Characteristics of Tacit, Implicit, and Explicit Knowledge, and Information

Tacit knowledge	Implicit knowledge	Explicit knowledge	Information
Personal	Personal	Personal	Public
In the mind	In the mind	In the mind	Outside the mind
Context-specific	Context-specific	Context-specific	Context-specific
Built from processing actions and interaction	Built from processing actions and interactions	Built from processing actions and interactions	Built from expressed knowledge
Cannot be expressed	Can be expressed, but has not been	Has been expressed and converted to information	
Cannot be shared			Can be shared
Cannot be encoded			Can be encoded, collected, and stored. Once encoded, collected, and stored, can be shared repeatedly without the knower's participation

Harvesting Organizational-Related Knowledge

Based on the definitions presented here, organizational-related knowledge can only be used by an organization after it has been expressed. For this reason, a means is needed that encourages the expression of organizational-related knowledge. Knowledge harvesting is

recommended to meet this need as part of an organization's continuity management efforts (Beazley, et al., 2002; DeLong, 2004).

The knowledge harvesting process encourages the expression of organizational-related knowledge built by the individual while performing his or her job (Eisenhart, 2001; Mulder & Whiteley, 2007), as well as knowledge that was built from resources outside the organization and adapted to the requirements of his or her job within the organization. The elicitation phase of the process is iterative and interactive, using questions that allow the organizational-related knowledge to emerge (Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005). The questions use vocabulary and a language that is familiar to both the knower and the collector. Rosenberg (2006) makes the point that the right sources are needed. It seems obvious to choose individuals that have the organizational-related knowledge that is wanted however Sternberg and Wagner (1986) suggest looking to those who are considered experts. Attention to these details ensures that the elicitation process results in information that contains "enough clarity that someone else guided by it could repeat the steps of the process and achieve the same result" (Eisenhart, 2001, p. 51).

Several contexts are suggested for the interaction and iterative questioning required in the elicitation phase. These contexts include apprenticeships, interviews, debriefing sessions, communities of practice (Keyes, 2006), focus groups (Rosenberg, 2006), conversations with experts (Wasonga & Murphy, 2006), training sessions, mentoring (DeLong, 2004), observations (DeLong, 2004; Freeze & Kulkarni, 2007; Wilson, 2002), and participating with the knower (Heath, 2003; Lam, 2000). In these contexts, organizational-related knowledge is expressed through the spoken words and actions of the knower (Mulder & Whiteley, 2007). What is expressed includes descriptions of the events that prompt a certain response as well as the rules

used by the individual in the decision-making process when responding to such events (Seidman & McCauley, 2005), and may be found in the stories, descriptions, metaphors, and other narratives of the knower (Wasonga & Murphy, 2006).

To be used at a time in the future, the spoken words and actions of the knower that are expressed in the elicitation phase must be put into a format that is usable by the eventual users (Davenport & Prusak, 1998; Eisenhart, 2001). As discussed previously, encoding converts the expressed organizational-related knowledge in ways that provide for its collection, storage, and future use. Encoding allows for the production of electronic and hard copy documentation, video and audio recordings, email, chat transcripts, databases (Markus, 2001), and presentations (Kutler, et al., 2005). It is evident that tools are needed to facilitate not only the encoding of expressed organizational-related knowledge but the collection and storage as well. For example, audio and video recorders can encode, collect, and store whatever is expressed and save it in a format that allows it to be used at a time in the future (Markus, 2001). However, the sharing and future use must be facilitated by a tool other than the one that harvested the words and actions or the harvested organizational-related knowledge will be restricted in its use to the capabilities of the tool that harvested it.

Limitations of the Knowledge Harvesting Process

One of the most important features of the knowledge harvesting process is that it allows for the harvested organizational-related knowledge to be used at a time in the future (Pugh & Dixon, 2008). However, the process has limitations that may jeopardize the value of the organizational-related knowledge harvested and consequently, its future use. First, the right questions must be asked during the elicitation phase to encourage the expression of organizational-related knowledge. In a study of knowledge loss in organizations, DeLong (2004)

found that some organizational-related knowledge could have been expressed but was not because the collector did not ask the right questions. Second, during the elicitation phase, the knower must have enough time to respond to the questions. In the same study, DeLong found that some organizational-related knowledge was not expressed because the knower did not have enough time. Having enough time may allow for repeated questioning, it may allow the collector to approach a point in the elicitation phase when the right questions are asked, and it may provide the time to harvest the sufficient detail and clarity suggested by Eisenhart (2001). Third, the contexts suggested for the elicitation phase discussed in the previous section do not support the entire knowledge harvesting process. There is nothing inherent in any of the contexts mentioned that facilitates the encoding, collection, and storage of the words or actions that are expressed during the elicitation phase.

The issue of appropriate questions is noted by other researchers. Based on their work, Rosenberg (2006) as well as Wong and Radcliffe (2000) provide questions to enhance the harvesting of organizational-related knowledge related to the duties of a position. Rosenberg's questions focus on "capturing the right content that will provide the most value to those who use it" (p. 123), and are listed in Table 2. The questions suggested by Wong and Radcliffe refer to the tasks completed as the employee is performing his or her duties, and as such may be used to enhance the organizational-related knowledge elicited via Rosenberg's questions. Although developed for a case study to harvest design-specific knowledge of subject matter experts in a small engineering company, these authors suggest that their questions may be used to encourage the expression of unexpressed organizational-related knowledge related to the work performed by an employee. Their questions are listed in Table 3. It must be noted that neither set of questions is an exhaustive list for eliciting organizational-related knowledge.

Table 2

Questions Suggested by Rosenberg for the Knowledge Harvesting Process

- What precisely is it that you do?
- How often do you do it?
- How important is it?
- How did you learn to do what you do?
- Can you demonstrate what you do?
- What tools and resources do you use to do what you do?
- Can you or have you ever taught others to do what you do?
- If you had the time and the proper support, could you document what you do so that others could do it as well?
- What have you learned by doing what you do (recommendations, advice to others, lessons learned)?

Note. Adapted from "*Beyond e-learning: Approaches and technologies to enhance organizational knowledge, learning, and performance*," by M. J. Rosenberg, 2006, p. 124.

Table 3

Questions Suggested by Wong and Radcliffe for the Knowledge Harvesting Process

- What information/knowledge/technique is required in the current situation?
- What additional factors need to be considered?
- What equipment/document is required?
- What effect the design task has on the organization, systems, and so on?
- Where should the information/knowledge/technique be applied?
- Where can the information/knowledge/skills be acquired?
- Where is the design task to be carried out?
- When is the design task to be carried out?
- When shall we use particular information/knowledge/technique?
- Why do we need to carry out the design task?
- Why is particular knowledge/theory/technique used/applicable in this case?
- Who will be the most appropriate person for conducting the task?
- Whom should be contacted for information/knowledge/ technique required?
- Who will use the results/products of the task?
- Which route should be chosen?
- Which knowledge/theory/technique should be used?
- Which equipment/document is required for conducting the task?
- Which format is used for presenting the results of the task?
- How to conduct the design task?
- How can the knowledge/theory/technique be applied?
- How do we analyze the data obtained and present the results?

Note. Adapted from "The Tacit Nature of Design Knowledge," by W. L. P. Wong and D. F. Radcliffe, 2000, *Technology Analysis & Strategic Management*, 12(4), p. 505. Copyright 2000 by Taylor & Francis, Ltd.

Regarding the issue of time, it appears that a significant amount of time may be required of the knower as well as the eventual end users of the harvested organizational-related knowledge. In recounting the implementation of a proprietary knowledge harvesting process at Georgia-Pacific, Eisenhart (2001) indicates that the questioning occurred in a series of one-on-one interviews. After each set of interviews, the information was taken to the eventual users to determine what was missing from what was harvested. This process provided questions for the

next interviews. Despite the multiple iterations of interviews, Eisenhart states “cycling between the experts and the eventual users is essential to avoid wasting time and exhausting their patience” (p. 50). However, the total time involved in this knowledge harvesting process was not documented, the number of iterations was not indicated, and the number of iterations that may be sufficient to harvest the detail of information wanted was not suggested.

Ultimately, knowledge harvesting is an intentional process. It is not the random collection of expressed organizational-related knowledge and organizational-related information, but serves to support organizational goals (Davenport & Prusak, 1998; Eisenhart, 2001). An employee’s organizational-related knowledge was noted as an important resource for an organization’s continuity management efforts. It becomes a critical factor when it remains unexpressed and leaves with the employee when he or she separates from an organization.

Based on the literature review to this point, two important observations emerge. First, a tool that harvests an employee’s organizational-related knowledge and converts it to organizational-related information is needed to support the management of the continuity efforts of an organization. Second, a tool that gathers organizational-related information already existing within an organization is also needed to support organizational continuity. The next section discusses knowledge management as a technology that may provide the capabilities for a continuity management tool incorporating the knowledge harvesting process.

Knowledge Management

In the previous section knowledge harvesting was recommended to support continuity management in an organization because of its focus on eliciting, encoding, collecting, and storing organizational-related knowledge for future use. However, to support the future use of

organizational-related information it must be managed. This section discusses the characteristics of knowledge management for managing organizational-related information.

It should be noted that the term *knowledge management*, as used in most of the literature, is a misnomer according to the distinction between knowledge and information discussed earlier in this review. However, it will be used in this discussion due to it prevalence in the literature with the understanding that it actually refers to the management of information.

There are various perspectives of knowledge management (KM) in the literature. It is viewed as the "identification and analysis of available and required knowledge, and the subsequent planning and control of actions to develop knowledge assets so as to fulfill organizational objectives" (Macintosh, 1999, "Definition"). Bergeron (2003) views knowledge management as "a deliberate, systematic business optimization strategy that selects, distills, organizes, packages, and communicates information essential to the business of a company in a manner that improves employee performance and corporate competitiveness" (p. 8). Jennex (2007) views it as "the practice of selectively applying knowledge from previous experiences of decision making to current and future decision making activities with the express purpose of improving the organization's effectiveness" (p. 4).

Characteristics of Knowledge Management

In general, KM is a tool that is both a process and a product. Whether as a process or a product, knowledge management should exhibit certain characteristics. Knowledge management should collect, store and manage the reuse of its content. When operationalized, collection can be an active process in which the system is actively collecting information as the individual carries out the task. Collection can also be a passive process in which the system collects only that

which is put into the system. In this instance, the knowledge management system (KMS) serves as a repository for the content (Rossett, 2000). The KMS stores the content that was collected, and storage supports the system's ability to repeatedly provide content to the user.

Content must be managed to support its reuse. Knowledge management should classify, provide access to, and distribute content (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Jennex, 2007; Keyes, 2006). Classification involves identifying the pieces of organizational-related information according to criteria relevant for the context and grouping the pieces according to these criteria. Access to the content may be standardized, and, as in the case of a computer-based KMS, should be able to be restricted to those users with the appropriate permission. KM should allow for information to be selected from the stored content. A computer-based KMS should have the capability to filter out content that is not relevant to the request submitted to the system (Cowley-Durst, 1999). Once the appropriate content is selected, it should be distributed to the user or users, in a format that is appropriate to meet the needs of the user. Without the ability to distribute, the content is locked in the system.

Knowledge management should be able to deliver "the right knowledge to the right person at the right time" (Beazley, et al., 2003, p. 66). Given the importance of the future use of harvested organizational-related knowledge as a part of managing organizational continuity, knowledge management offers the possibility of providing organizational-related information to whomever needs it, wherever they are located, and at whatever time it is needed.

Knowledge Management Tools for Continuity Management

It was noted previously that continuity management includes the ability to plan, organize, coordinate, and supervise tools that address the resources and procedures needed by an organization to facilitate a response when events impact an organization. It was also noted that some tools support the knowledge harvesting process, and that some tools are knowledge management systems.

Proponents of continuity management advocate the development and implementation of a continuity management plan. This plan is a tool that details the resources and procedures needed to facilitate a response when events break continuity (Charters, 2007; NFPA, 2007). It is seen as a practical solution providing confidence that operations can be restored (Cerullo & Cerullo, 2004; Gibb & Buchanan, 2006). A survey of best practices published jointly by *Disaster Recovery Journal* and DRI International (2007) indicates that a continuity management plan should specify "mission critical operations" (p. 113), and the steps to restore operations specifically to technology, the work area, human resources, and the supply chain. The National Fire Prevention Association (NFPA, 2007) standards indicate that a continuity management plan should focus on those events that pose the greatest threat to an organization, identified from a risk analysis, impact analysis, and a cost-benefit analysis. Because of the recommended limited scope for these continuity management plans, they have the potential to omit the resources and procedures needed to facilitate a response to maintain continuity.

In the Continuity Management Best Practices survey (Disaster Recovery Journal & DRI International, 2007) and the continuity standards established by the National Fire Prevention Association (2007) restoring the continuity of an organization focuses on restoring the operations of the organization by restoring the availability of resources. Although employees and their

knowledge are indicated as resources, there are no means in the survey or the standards that address restoring the availability of organizational-related knowledge held by an employee should the employee be separated from an organization because of a disastrous event.

The literature cited here focuses on a reactive approach to continuity management by restoring continuity after an event has broken continuity. However, based on the statement by Cornish (1999), tools used to reactively restore continuity may also be used to proactively maintain continuity.

Synthesis

This section synthesizes the recommendations from the literature for a comprehensive and widely available tool for continuity management, knowledge harvesting, and knowledge management; reviews current knowledge management tools for continuity management; and discusses the gaps between these recommendations and the current state of continuity management tools.

Recommended Characteristics of a Comprehensive Tool

This synthesis of the literature reveals several characteristics a comprehensive tool should possess to support continuity management, knowledge harvesting, and knowledge management. The features of these characteristics are discussed in the following section and summarized in Table 4.

First, a tool should be contextually holistic, both in structure and function. Structurally, an organization, or "organizational unit", is a system that is comprised of subsystems, or "subunits" (Bertalanffy, 1950), each of which interacts with other subunits within the

organization as well as with other organizational units or their subunits in the environment (Bertalanffy, 1950, 1972; Elliott, et al., 2002; Scott, 2003). Functionally, organizations use resources during their operations to create outputs (Bertalanffy, 1950, 1972; Burke, 1994; Lundgren, 1974; Marion, 2005; Millman, 1964). All current threats and potential interruptions to the operations of the organization from the actualization of any of these threats should be identified, along with the procedures and resources needed to restore or maintain continuity (Charters, 2007; McCrackan, 2005; NFPA, 2007; Vancoppenolle, 1999). To fully support the continuity of an organization, a tool should be an integral part of the entire organization (McCrackan, 2005). To be contextually holistic, a tool should incorporate all of the structure and functions of an organization, all current threats and potential interruptions to the functions and interactions, and the procedures and resources needed to restore or maintain continuity.

Second, a tool should be temporally holistic. Continuity assumes continuation through time. Continuity management planning efforts partially prepare the organization for future threats and interruptions by documenting the current state of the organization (FFIEC, 2003; Gibb & Buchanan, 2006). However, historic information related to the context of the organization should be considered as well. An organization should document past interruptions to the organization or any of its subunits, the impact of these interruptions, and steps taken to restore continuity (Elliott, et al., 2002). A temporally holistic tool should address past, present, and future organizational-related information.

Third, a tool should be responsive. A tool should respond to organizational changes in structure or functions (Hiles & Barnes, 1999; McCrackan, 2005; Swanson, et al., 2002). It should respond to the needs of the users for access to the tool, any of its content, at any time, and from any location (Charters, 2007; NFPA, 2007). A tool should respond to the user's need for

information by collecting, storing, classifying, filtering it in response to requests, and distributing it (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006).

Fourth, a tool should be opportunistic. Employee separation from an organization may occur without notice. A tool incorporated into the organization should provide the opportunity to acquire as much employee organizational-related knowledge as possible while an employee is with the organization (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986), whenever the time is available, and wherever an employee is located (Macintosh, 1999). Knowledge harvesting is recommended to meet these needs (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003). A tool should take advantage of the knowledge harvesting process (elicitation, encoding, collection, and storage) to ensure the future use of this knowledge (Beazley, et al., 2002; Davenport & Prusak, 1998; Eisenhart, 2001; Pugh & Dixon, 2008). Furthermore, a tool should incorporate the features of the elicitation phase as it harvests knowledge. These include asking the right questions, using vocabulary and language that is familiar to the employee, and providing enough time for the employee to respond in an environment that is interactive and iterative (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005).

Finally, a tool should be usable. Knowers as well as those that need to know should be able to use the tool. Current employees should be able to use the tool as a means to contribute and manage their day-to-day organizational-related knowledge (Beazley, et al., 2002; Cornish, 1999; DeLong, 2004; Eisenhart, 2001; Field, 2003). New hires or temporary replacements may not be familiar with the structure or functions of the organization. These employees should be able to obtain information from the tool that is related to the day-to-day operations of the subunit

in which they work (Beazley, et al., 2002; Cornish, 1999; DeLong, 2004; Eisenhart, 2001; Field, 2003). A usable tool should facilitate the employee's contribution of organizational-related knowledge as well as the retrieval of contributed organizational-related knowledge.

Table 4

Recommended Characteristics of a Comprehensive Tool

Characteristic	Indicators
Contextually holistic	Includes all organizational units Includes all subunits Includes all interactions inside the organization Includes all interactions outside the organization Includes all resources Includes all operations Includes all outputs Includes all current threats to the organization Includes potential interruptions from the actualization of any identified threat Includes all procedures to maintain operations Includes all procedures to restore operations Is integrated into the organization
Temporally holistic	Includes past information Includes present information Includes information for the future
Responsive	Includes changes to organizational structure Includes changes to organizational functions Provides access any time Provides access from any location Provides access to tool Provides access to content Encodes, collects, and stores input Classifies content contextually and temporally Filters content in response to requests Distributes content Preserves original content through edits Provides navigation of content

Opportunistic	Harvests knowledge while an employee is employed Harvests organizational-related knowledge at any time Harvests organizational-related knowledge from any location Harvests as much organizational-related knowledge as possible Harvests organizational-related knowledge of day-to-day operations Provides an interactive environment Provides an iterative environment Asks the right questions Provides enough time for responses Uses appropriate vocabulary and language
Usable	Facilitates current employees' contribution and management of organizational-related knowledge Facilitates a new hire's or temporary replacement's location and retrieval of organizational-related knowledge

Current Knowledge Management Tools for Continuity Management

A comprehensive tool for continuity management that incorporates knowledge harvesting and knowledge management should be able to elicit, encode, collect, store, retrieve, and display information. However, the limited scope and lack of attention to employees and their organizational-related knowledge as resources in continuity management plans raised the question as to the state of publicly-available continuity management software tools to address these functionalities as well as these limitations. While there are various types of knowledge management systems that may support the many needs of an organization, the reviews in this section are limited to a discussion of knowledge management systems that serve as tools to support continuity management and facilitate a response when a threat occurs.

To begin the process of answering this question, continuity management software tools that assist with the development of a continuity management plan were identified from internet searches, product reviews, and the annual software survey published by a continuity management

trade journal. In general, two criteria determined selection for this review. First, the software tool had to provide the ability to collect, store, and manage content. Second, the software tool had to be available to the general public rather than one that is designed by an organization for use solely within that organization. This search excluded software tools for data management, such as those that record total sales or manage documents, as well as a dashboard, which presents real time information about the operations of an organization, and a mashup, which incorporates web-based services from one or more entities into a single webpage.

Several software tools were identified that addressed continuity management for an organization. Information about each of the selected software tools was obtained from publicly available sources, such as websites, product reviews, demos, and tutorials. Of the nine software tools identified, six were databases, two were text editing templates, and one offered both formats (see Appendix D).

During the search for organizational knowledge management tools for continuity management a tool was found that supports the continuity of a position. Although this unique group of KMSs was identified primarily within the military, they were significant because their primary purpose was the continuity of the tasks assigned to a position. Often referred to as continuity books, Nascimento (n. d.) defines them as “reference document[s] produced by an individual to share relevant information concerning a duty or position on which he/she has knowledge” (¶ Definition). The goal of a continuity book is to include all of the information needed to successfully complete the tasks required of the position, therefore, any piece of information the incumbent thinks is needed to perform the job is included. The continuity book is handed down to replacements, ideally creating an unbroken chain of operations performed by an individual within a unit.

Nineteen continuity books were found. Continuity books were found to be documents, either electronic or non-electronic, used support a single individual in a single position, multiple users in the same position, or individuals in a number of different positions (see Appendix E). The types of information recommended by the military for its continuity books include personal skills and goals, job description, procedures, tools and equipment, calendars and deadlines, contacts, forms, records and logs, and organizational infrastructure (Andrews Air Force Base, 1996; Inland Empire Group 3 Civil Air Patrol, n. d.; Korea Region BOSS Forum, 2006; Nascimento, n. d.).

Gaps Between a Comprehensive Tool and Current Tools for Continuity Management

Current continuity management tools were compared to the recommended characteristics of a comprehensive tool incorporating continuity management, knowledge harvesting, and knowledge management identified previously. The current state of these tools is discussed in the following section and summarized in Table 5.

First, no continuity management tool reviewed addresses the whole organization in both structure and function. Some tools are structurally holistic but not functionally holistic. They address all subunits within the organization, and focus on the potential threats to the subunits, interruptions should the threat occur, and procedures and resources needed to restore critical operations. These tools do not address the resources and procedures needed to maintain day-to-day operations. On the other hand, some tools are functionally holistic but not structurally holistic. Continuity books address the individual's organizational-related knowledge of the resources and procedures needed to maintain the day-to-day operations of the position. However, these tools are not used for every subunit in the organization or every position within a

subunit. A sporadic implementation of continuity books could impact the holistic nature of continuity management. In addition, information regarding the threats and interruptions to an individual position are not addressed.

Second, current continuity management tools for an organization typically capture a snapshot of the organization at the time the continuity management plan is developed. They do not address the past structure or functions of the organization. With the exception of the moments captured by the snapshots, none of the tools include as an integral part the means to harvest knowledge of past events, including past threats and interruptions to subunits of the organization. For example, the questions suggested by Rosenberg (2006) as well as Wong and Radcliffe (2000) harvest an employee's knowledge of the work they currently perform. They do not elicit employee knowledge of past events nor the day-to-day work performed in the past.

Third, most of the tools appear to be responsive, however some to a greater degree than others. The tools that employ database technologies to manage the content, specifically those for an organization, are more responsive to changes in organizational structure or functions and are able to provide access any time and from any location. Tools that employ print-based technologies are less responsive. Documents, such as continuity books, produced by the print-based tools can be changed as the structure and functions of the organization change. However, maintaining the contents is often the responsibility of the individual who built the book (Nascimento, n. d.). Omitting or forgetting important information can potentially jeopardize the preservative nature of a tool to maintain continuity. Also, access to a printed document can be limited across an organization, in the time of day it is accessible, and the location from which access is needed.

Fourth, opportunities to harvest an employee's day-to-day organizational-related knowledge are mixed. Continuity books address organizational-related knowledge of day-to-day operations; tools for an organization generally focus on resources and procedures needed to restore operations and therefore omit the harvesting of day-to-day organizational-related knowledge. All of the tools harvest organizational-related knowledge while the employee is with the organization. Most are able to harvest this knowledge at any time, but only some can harvest it from any location. Tools for an organization include the ability to provide an interactive and iterative environment that incorporates familiar terms; tools for a position do not. Questioning an employee to elicit their organizational-related knowledge is not incorporated into any of the tools reviewed. This feature is important as it allows the organizational-related knowledge to emerge (Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005) with clarity in the detail so that another employee can perform the task and achieve the same results (Eisenhart, 2001). Because of this, it is of no value to discuss whether the right questions are asked to elicit organizational-related knowledge, or whether the knower has enough time to respond to the questions.

Finally, most continuity management tools appear to be usable by the intended users. However, since no tool incorporates questioning as part of the elicitation phase of knowledge harvesting, the ability of a tool to facilitate the contribution of organizational-related knowledge from current employees through the use of questions is untested. Likewise, the ability of a new hire or temporary replacement to locate and retrieve information from a tool that elicits organizational-related knowledge using questions and delivers this harvested knowledge is unknown.

Table 5

Gaps Between Characteristics of a Comprehensive Tool and Current State of Tools for Continuity Management

Characteristic	Current State
Contextually holistic	Some address all subunits, but not all day-to-day operations Some address all day-to-day operations, but not all subunits Some address threats, potential interruptions, and resources and procedures to restore day-to-day operations. Some address resources and procedures to maintain day-to-day operations
Temporally holistic	No tool addresses past structure, functions, threats, or interruptions Questions to elicit organizational-related knowledge do not ask for knowledge of past events or day-to-day operations
Responsive	Some are more responsive to changes in an organization than others Some provide access to the content at any time and from any location
Opportunistic	Some can harvest organizational-related knowledge from any location Some harvest organizational-related knowledge of day-to-day operations Some incorporate interaction, iteration, or familiar terms No tool incorporates questions to elicit organizational-knowledge during the knowledge harvesting process
Usable	Ability to be used as a knowledge harvesting and knowledge management tool is untested Ability of the user to locate and retrieve harvested knowledge is unknown

Summary

Characteristics of a comprehensive tool were identified through the analysis of the literature, addressing the first research question. This tool should be contextually holistic,

temporally holistic, responsive, opportunistic, and usable. It was also noted that a comprehensive tool for continuity management that incorporates knowledge harvesting and knowledge management should be able to elicit, encode, collect, store, retrieve, and display information. Gaps between the characteristics of a comprehensive tool and the state of tools for continuity management currently available indicate that there is no one tool currently available that (a) includes all of the characteristics of continuity management, (b) employs the knowledge harvesting process, and (c) supports the continuity of the day-to-day work performed by an employee when the employee is separated from the organization. To address these gaps, the next chapter discusses the design of a comprehensive tool and details the methodology for the design and development of a knowledge harvesting component and a knowledge management component for a comprehensive tool.

CHAPTER 3: METHODOLOGY

The previous chapter identified the need for, and characteristics of, a comprehensive and widely available tool that harvests and manages knowledge, specifically the organizational-related knowledge of day-to-day operations held by employees that may support the continuity of an organization. Continuity management is a strategic planning and management issue for an organization (Cline, 2007) and knowledge harvesting (KH) and knowledge management (KM) are key components of continuity management. The issues associated with, and the tools used in, knowledge harvesting and management fall within the management domain of instructional technology.

This chapter begins with a discussion of the research design, the model used to guide the study, and the features to be incorporated into the comprehensive tool. This is followed by a discussion of the methodology for designing, developing, and evaluating the knowledge harvesting and knowledge management components of the comprehensive tool.

Research Design

The study followed the methodology of developmental research (Richey & Klein, 2007). Developmental research "[establishes] an empirical basis for the creation of instructional and non-instructional products and tools" (p. xv). Developmental research studies are based in real world problems that occur in specific contexts. They are often exploratory, focusing on areas where there is little prior research. Continuity management is a real world problem for which there is little research. In addition, developmental research can emphasize one phase of the process (Richey & Klein, 2007), with one of the outcomes involving the lessons learned from

having designed, developed, and evaluated a product within a specific context (Richey, Klein, & Nelson, 2003).

This study began with a focus on the design of a comprehensive tool that included the characteristics and indicators of the characteristics identified in the synthesis of the continuity management, knowledge harvesting, and knowledge management literature. The characteristics of a comprehensive tool were operationalized and capabilities deserving special attention were noted. This project milestone (Shackelford, 2002) was a "logical stopping point" (Langer, 1989, p. 200) from which to redirect attention from the comprehensive tool to the specific components of the comprehensive tool. These components address knowledge harvesting and knowledge management. The operationalization of the characteristics of the comprehensive tool is included in this chapter as it was necessary for the design and development of the components of the tool.

The ADDIE Model

The ADDIE model was used to guide this developmental study. The full model is comprised of analysis, design, development, implementation, and evaluation phases however the use of the implementation phase in this study was limited. The ADDIE model is systematic, organized (Seels & Richey, 1994), and, when evaluation informs the other phases of the model, iterative (Gustafson & Branch, 2002; Molenda, 2003). Evaluation allows ADDIE to serve as a system of checks and balances during the design and development process (Seels & Richey, 1994).

However versatile the ADDIE model appears, there are things it is not. The ADDIE model is not a prescriptive model. It does not provide specific guidelines regarding the techniques to use to reach specific goals or impact variables involved in the process (Edmonds,

Branch, & Mukherjee, 1994; Reigeluth, 1999). ADDIE is not restricted to the design and development of instructional materials, but is just as likely to be used for non-instructional materials (Hayes, Tyler-Ball, Cohen, Eckes-Roper, & Puente, 2002; Lee & Krayer, 2003; Nguyen & Woll, 2006).

The Comprehensive Tool

The analysis of the literature identified the need for a comprehensive tool that addresses continuity management, knowledge harvesting, and knowledge management. It analyzed the need and issues associated with the need, determined the current means for addressing the need, and identified the differences between current and recommended solutions to the need. The literature review demonstrated that knowledge management may be a component of continuity management and, when associated with continuity management, knowledge harvesting and knowledge management should support (a) eliciting organizational-related knowledge, (b) encoding, collecting, and storing the harvested knowledge, and (c) retrieving and delivering the organizational-related information for its eventual use.

Although the literature review did not identify an existing knowledge management tool that was both comprehensive and available to a wide range of users, the review and subsequent synthesis of the literature did provide a list of the characteristics such a tool should possess (see Table 4). A comprehensive tool should be contextually holistic, involving the structure and functions of an organization as well as potential threats to and their impact on the organization. The tool should be temporally holistic, covering the present and past state of the organization as well as information that may be needed in the future. The tool should be responsive to changes in the structure or functions of the organization as well as to the needs of the users for access to

the tool and the knowledge that was harvested. The tool should be opportunistic by taking advantage of the opportunity to include characteristics of knowledge harvesting. Finally, the tool should be usable by the organization and its employees by facilitating the users' interactions with the tool.

Operationalizing the Characteristics of the Comprehensive Tool

The five major characteristics for a comprehensive tool, identified in the synthesis of the literature, were operationalized before the project focus was redirected toward the components of the tool. This process also illustrated the contribution of each component toward the design and development of the comprehensive tool.

Operationalization involved combining relevant human-computer interaction capabilities, based on established user interface principles (Galitz, 2002), data processing capabilities (Copeland, 2000), and prompting questions, with the five characteristics and 39 indicators of a comprehensive tool identified in the synthesis of the literature. Human-computer interaction capabilities support the design of interfaces and user interaction with the tool through the interfaces. These capabilities include designated areas for inputting organizational-related knowledge and editing knowledge that was harvested; multiple forms, such as menus and drop-down boxes, with which to display related items; non-editable text; and controls with which to initiate actions, such as submitting the knowledge that is harvested or edited, selecting options, and navigating the knowledge that was harvested. Other design principles support a consistent look for the interfaces throughout the tool, an efficient use of the tool, and make the interfaces easy to understand and use. Data processing capabilities support the harvesting of organizational-related knowledge and the management of the knowledge that was harvested. These capabilities allow the tool to accept input, such as text, requests, and commands. They

allow for the encoding, organization, collection, retrieval, and filtering of input. They allow for the storage of knowledge that was harvested or edited. Finally, they allow for the output of the knowledge that was harvested and other information in the tool.

Contextually holistic. In this study, the context for the comprehensive tool is an organization. As discussed previously, an organization involves structure and function (Bertalanffy, 1950). Structure involves the units, subunits, and elements of the organization; function involves the resources, operations, and outputs of the organization (Kast & Rosenzweig, 1972), as well as the interactions that take place to support the organization and threats and interruptions to these interactions (Bertalanffy, 1950, 1972; Charters, 2007; Elliott, et al., 2002; McCrackan, 2005; NFPA, 2007; Scott, 2003; Vancoppenolle, 1999). A contextually holistic tool harvests all organizational-related knowledge of the entire structure and all functions of the organizational unit (Disaster Recovery Journal & DRI International, 2007; NFPA, 2007). Realistically, the amount of organizational-related knowledge actually harvested and the number of organizational units or subunits included will depend, in large part, on how the users of the tool choose to implement the tool within the organization. It is the users' application of the tool that determines the quantity of organizational-related knowledge harvested. As a result, the comprehensive tool was designed to be capable of being implemented in any unit or subunit of the organization and is adaptable to harvest organizational-related knowledge associated with the unit or subunit in which it is implemented.

Recognizing that there may be limitations on the harvested knowledge as a result of the implementation of this tool, this tool was designed to be *integrated into the organization*, and to include the *subunits* within the organizational unit and the *operations* of each subunit. The tool was designed to include the *resources* used by the employee, the *interactions inside the*

organization, the *interactions outside the organization*, the *procedures to maintain operation*, and the *outputs* that are a result of the performance of a task. Additionally, as they relate to a task, the tool was designed to provide the means to include the *current threats to the organization* and *potential interruptions from the actualization of any identified threat.* Because the focus of this tool is on the harvesting and management of knowledge and intentionally excludes procedures to restore operations, including the *procedures to restore operations* was not a part of this tool.

Appendix F presents the human-computer interaction capabilities and data processing capabilities required to operationalize each indicator of a contextually holistic comprehensive tool. The indicators of this characteristic address the structural and functional aspects of an organization for which organizational-related knowledge is harvested. For example, as the authorized user inputs organizational-related knowledge regarding resources used in the performance of a task into the designated area, the tool encodes, collects, stores, and organizes the knowledge that is harvested so that it can be retrieved and displayed when requested.

Temporally holistic. Within the context of an organization, a temporally holistic comprehensive tool involves information that spans the lifetime of the organization (Elliott, et al., 2002; FFIEC, 2003; Gibb & Buchanan, 2006). It *includes past information*, *present information*, and *information for the future*. The tool was designed to be temporally holistic by providing the means to input, store, and display harvested knowledge regarding the past, present, and future state of the structure and functions of the organization as well as impacts to the organization.

Appendix G presents the human-computer interaction capabilities and data processing capabilities required to operationalize each indicator of a temporally holistic comprehensive tool.

The indicators of this characteristic address the structural and functional aspects of an organization from the perspective of time. For example, in order to work with past, present, and future information, the authorized user navigates to the needed knowledge that was harvested and select it. The tool retrieves the selected knowledge that was harvested and displays it in an area designated to allow editing. After the edits are submitted, the tool encodes, collects, stores, and organizes the submission.

Responsive. A responsive comprehensive tool is able to respond to changes in the organization as well as the needs and commands of users. The tool was designed to provide the means to add new or edit current information as it *includes changes to organizational structure* (Hiles & Barnes, 1999; McCrackan, 2005; Swanson, et al., 2002). It was designed to provide the means to add new or edit knowledge that was harvested as it *includes changes to organizational functions* (Hiles & Barnes, 1999; McCrackan, 2005; Swanson, et al., 2002). In response to the needs of those employees using the tool, the tool was designed to *provide access to tool, access to content* (the knowledge that was harvested) as well as a means to *navigate content* (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006). To support the user's need to access and navigate the knowledge that was harvested, the tool was designed to *encode, collect, and store input; classify content contextually and temporally; filter content in response to requests; distribute content; and preserve original content through edits* (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006). The tool was designed to be web-based to *provide access at any time* and *from any location* (Alavi & Leidner, 2001; Beazley, et al., 2003; Beckman, 1999; Bergeron, 2003; Charters, 2007; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006; NFPA, 2007). Computer hardware, such as monitors and input devices, was not considered in this study.

Appendix H presents the human-computer interaction capabilities and data processing capabilities required to operationalize each indicator of a responsive comprehensive tool. For example, access to the knowledge that was harvested was operationalized through the input of a username and password assigned to authorized users, the organization of stored information, the processing of a request that was submitted via a control, and the display of output retrieved because of a request for content.

Opportunistic. As used in this study, an opportunistic comprehensive tool takes advantage of the opportunity to *harvest as much organizational-related knowledge of the day-to-day operations of the organization as is possible while the employee is employed* by the organization (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986). This tool was designed to take advantage of this opportunity by providing an environment that is accessible at *any time* and from *any location* with internet access (Macintosh, 1999), that is *iterative* and *interactive* (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005), and that *provides enough time* for the knower to respond (DeLong, 2004). Additionally, this tool was designed to take advantage of this opportunity by incorporating aspects of the knowledge harvesting process that involve presenting the *right questions* (DeLong, 2004) to the knower and *using vocabulary and language that is appropriate* for the organization where it is implemented (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005).

Appendix I presents the human-computer interaction capabilities and data processing capabilities required to operationalize each indicator of an opportunistic comprehensive tool. For example, the ability of the tool to provide an interactive knowledge harvesting environment requires that it allows authorized users to contribute organizational-related knowledge to the tool

and extract knowledge that was harvested from the tool. Areas for the input of organizational-related knowledge and controls to initiate the submission of input allow authorized users to contribute; multiple methods for displaying related items of knowledge that were harvested allow authorized users to extract harvested knowledge from the tool.

Usable. A usable tool is able to be used by the intended users. A comprehensive and widely available comprehensive tool that is usable is one that *facilitates the harvesting of organizational-related knowledge and the management of organizational-related knowledge and information* by current employees, and it is one that *facilitates the location and retrieval of organizational-related knowledge and information* by the new hire or temporary replacement (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003). However, users must be able to interact with the features of the tool. Relevant guidelines for usability (Nielsen, 2005) that support the user's interactions with the tool were incorporated into the design of this tool. These guidelines involve making options visible and recognizable to the user, using conventions consistently, using terms that are familiar to the users, including help and other documentation, and incorporating a minimalist design.

Appendix J presents the human-computer interaction capabilities and data processing capabilities required to operationalize the indicators of a usable comprehensive tool. For example, the tool provides access to the knowledge that was harvested to those users that are authorized. However, only those users authorized to contribute to the tool have the ability to input organizational-related knowledge and edit knowledge that was harvested by the tool.

Capabilities of the Tool Deserving Special Attention

Some capabilities of a comprehensive tool did not fit into Appendices F through J and deserved special attention, partially because of their influence on the design and development of

the components of the tool. First, knowledge harvesting can be a lengthy process for the knower. The comprehensive tool was designed to provide controls that allow the knower to step out of and return to the knowledge harvesting process at any time in an effort to prevent the knower from becoming overwhelmed by the number of prompting questions or amount of organizational-related knowledge he or she is expected to recall. Second, an employee can hold more than one position within a subunit of an organization, and is likely to perform more than one job as part of any one position. As a result, the comprehensive tool was designed to provide the means to identify the tasks performed by an employee as part of a job, the jobs performed by the employee as part of his or her position, and the positions held by the employee within a subunit. Finally, as is the case with many software tools, administrative actions must be performed to ensure a smooth installation of the tool into the organization and operation of the tool by the intended users. The comprehensive tool was designed to include an administrative interface through which to integrate the tool into the organization and support its use.

The Knowledge Harvesting Component

The elicitation of organizational-related knowledge by means of the knowledge harvesting component involved the knowledge harvesting process and the prompting questions used in the process. This section discusses the methodology for the knowledge harvesting component.

Analysis

Additional analysis was needed to determine the characteristics of the prompting questions and the knowledge harvesting process. A knowledge harvesting process should

proceed in a general-to-specific sequence (Jonassen, Tessmer, & Hannum, 1999), include questions (Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005), be iterative (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005), and be interactive. An iterative knowledge harvesting process is one that occurs repeatedly (Mulder & Whiteley, 2007). An interactive knowledge harvesting process is one that "allow[s] or require[s] some level of physical activity from the user" (Smaldino, Russell, Heinich, & Molenda, 2005, p. 386) and, when appropriate technologies are involved, allows for manipulating information presented in an interface for communication (Gunawardena, 1999).

Characteristics were identified for the prompting questions used in a knowledge harvesting process. Prompting questions should prompt for the recall of knowledge (Driscoll, 2000), allow organizational-related knowledge to emerge (Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005), allow for elaboration, and use vocabulary and language appropriate for the context (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005).

Design

Typically in the design phase, strategies are used to produce a set of specifications that inform the development phase. In this study, the strategies involved (a) operationalizing the elements of the knowledge harvesting component and (b) organizing the content.

Operationalizing the Knowledge Harvesting Component

Prompts assist in the recall of knowledge (Driscoll, 2000) and, because of this, are important in the elicitation of organizational-related knowledge (Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005). The knowledge harvesting component of the

comprehensive tool was populated initially with prompting questions from Wong and Radcliffe (2000) and Rosenberg (2006).

Prompts that allow the knower to elaborate also assist in the recall of knowledge (Ormrod, 1999). A general-to-specific sequence for eliciting knowledge is recommended by the task description method of task analysis (Jonassen, et al., 1999) and was used to sequence the prompting questions. The task description method involves six steps: (a) identifying the job, (b) identifying the tasks performed in the job, (c) developing a general description of each task, (d) developing a detailed description of each task, (e) identifying the requirements of the task, and (f) determining the structure for the performance of each task. The job and task were part of information identified prior to the prompting questions. The remaining steps, c through f, became the steps for the knowledge harvesting process. Each step included several prompting questions with the relevant prompting questions modified to fit the task description method.

Although the questions suggested by Wong and Radcliffe (2000) as well as Rosenberg (2006) provide a useful starting point for eliciting knowledge, there are weaknesses associated with these questions. Specifically, they are not comprehensive, the vocabulary or language used may not be appropriate for use in all organizations, and they are not ordered in any specific sequence. In order for this tool to be comprehensive and widely available to a range of users, these deficiencies were addressed by providing a means to manage a collection of prompting questions by adding new questions as well as editing, moving, and removing current questions. These means are discussed as functionalities of the knowledge management component.

Organizing the Content

Organizing the content provided a bridge between the knowledge harvesting component and the knowledge management component. The knowledge harvesting component has the

potential to harvest much information. As a tool to support continuity in an organization, the information must be accessible, and to be accessible, the information must be identified and organized (Choksy, 2006). Information that is organized increases an employee's ability to find and use information. In general, organizing information that exists within an organization requires identifying categories that are appropriate for the organization.

The context for the operationalized knowledge harvesting component, the operationalized knowledge harvesting component, and the users of a knowledge harvesting process were examined to identify categories of information collected through the component. The categories were organized into a taxonomy, defined as a "unifying framework to promote communication, interoperability, and enable systems of engineering" (Choksy, 2006, p. 185).

Development

In the design phase, a set of specifications for developing the knowledge harvesting component were created. The purpose of the development phase was to convert the specifications for the component into a knowledge harvesting prototype.

The development of the prototype was conducted in two steps. In the first step, storyboards were developed. Storyboarding is described as a "visual planning technique" (Smaldino, et al., 2005, p. 331). It allows a product to be envisioned according to the actions taken by a user as he or she interacts with the product (Holtzblatt, 2003). The storyboards developed for this component illustrated the incorporation of the operationalized prompting questions in the prototype and identified user interaction with the prototype.

In the second step, working versions of the interfaces were developed. This set of interfaces, referred to as a module, allows the knower to interact with the knowledge harvesting

prompting questions. The module was developed using a web-authoring tool according to the information assembled in the storyboards.

Implementation

The implementation phase of the knowledge harvesting component involved identifying the primary user of this component when it is part of the comprehensive tool and a limited implementation of the component prototype. The user with the most interaction with the knowledge harvesting component is referred to as the "contributor". As this user interacts with the component prototype, he or she must be able to find and retrieve information. Interacting with the knowledge harvesting process involves functionality that allows this user to input tasks and task details, respond to the prompting questions, exit the process prior to completing all of the steps, retrieve current information to continue the process, and edit current information.

The implementation of the component prototype was not a full scale implementation but limited to trial users serving as contributors. The context for the implementation was an actual subunit of a distance education program located within a major U.S. research university. Employees of the subunit were asked to participate in the implementation. Each had knowledge of the tasks required to perform at least one job within the subunit. Some information from the subunit was pre-loaded into the prototype and provided to the implementers as examples.

Evaluation

An initial formative evaluation (Dick & Carey, 1996) was conducted to determine compliance and functionality of the knowledge harvesting component. The component was evaluated for compliance with design-based specifications, which were manifested in the

operationalization of the prompting questions and the knowledge harvesting process. The component was evaluated for functionality manifested in the ability of the component to elicit organizational-related knowledge, to stimulate identification of additional prompting questions, and to identify problems with existing prompting questions.

The compliance evaluation was conducted through a review of materials (Dick & Carey, 1996). These authors suggest that a review of materials should take place prior to one-to-one, small group, or field trial formative evaluations. It allows the designer/developer to see the product through the eyes of outside experts, and collect recommended changes to the product prior to initiating timely and costly development efforts.

Three types of external experts are suggested by Dick and Carey (1996) for a review of materials. Content area experts are able to comment on the accuracy of the content and provide suggested improvements, outcome experts are able to comment on ability of the product to achieve stated goals, and a target population expert is able to view the product through the eyes of the eventual users. Due to the nature of the specifications involved in the compliance evaluation, evaluators were both content area experts and outcome experts.

The evaluation for functionality was conducted through a try-out of the prototype (Richey & Klein, 2007) during the implementation. These authors suggest that a try-out of the product generates information that can "explain the success or failure of the product" (p. 106), can relate to the methods used in the design and development, and can inform further development. Intended users should be involved in this type of evaluation.

Evaluation Process

Evaluation of the knowledge harvesting prototype was performed by three expert reviewers and three contributors. The three expert reviewers determined compliance of the

component prototype with knowledge harvesting literature-based design specifications. Three contributors evaluated the component prototype for functionality.

A two-part online survey was used in the compliance evaluation. In exploratory research, online surveys provide participants with freedom to express thoughts and feelings regarding the focus of the survey, save time and cost in development and delivery, and provide flexibility for the designer of the survey and the participants (Anderson & Kanuka, 2003). The first part of the survey collected general information, including email address, location where the implementation took place, the type of computer used for the evaluation, and the web browser used. This information helped describe the environment in which the prototype was evaluated. The second part collected information regarding compliance with the specifications. A mixed methods approach was used for data collection. Multiple choice questions were used to determine the reviewer's agreement, disagreement, or uncertainty that the prototype complies with the specifications. Open-ended questions were used to collect information regarding responses indicating disagreement or uncertainty, as well as collect any other comments about the prototype.

Documents were used to collect data from the evaluation for functionality. This method of data collection allows the participant to document their thoughts and allows the researcher to obtain information in the words of the participant (Creswell, 2003). Responses to the prompting questions and email communication provided documentation of the contributors' try-out of the component prototype. All evaluators were encouraged to take notes during the implementation, and email the researcher with any issues they experienced as they responded to the prompting questions or with the prototype in general.

All evaluators and contributors were asked to report any issues they experienced during their evaluation. All communication, responses to the prompting questions, and evaluation documents sent to and received from expert evaluators and contributors were electronic. Information sent to the compliance evaluators and contributors included the IRB Information Sheet, a brief introduction to the prototype, instructions for the evaluation process, definitions of key terms used in the prototype, and the end date for the evaluation (see Appendices R, S, and T). The email address advertised in the instructions was an alias of the personal email address of the researcher.

Data Analysis

The data analysis involved several procedures. General information regarding the location and equipment used in the compliance evaluation was summarized. Responses to the multiple choice questions were totaled for each design-based specification included in the survey. Comments regarding a response of uncertainty or disagreement were summarized. Information provided in the open-ended questions as well as the documents produced in the try-out evaluation were analyzed for issues that could impact the effectiveness or the functionality of the prototype.

The Knowledge Management Component

Once the knowledge harvesting component has harvested knowledge, the knowledge management component must be able to encode, collect, store, retrieve, and deliver content. This section discusses the methodology for the knowledge management component.

Analysis

The analysis of the literature identified six characteristics for a knowledge management component. Specifically, a knowledge management tool should collect, store, classify, provide access to, filter, and distribute (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Charters, 2007; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006; NFPA, 2007) information.

Although each of the six characteristics was described briefly in the literature review, some elaboration was needed to facilitate the design and development of the component. First, "collecting" was defined as the ability to collect multiple forms of information, including text and commands by users, to support the user's interaction with the tool. Second, "storing" was defined as the placement of information in a specific location to facilitate the management of the saved information. This information included all content that is encoded, which is information entered using letters, numbers, and other characters into the elements for collection or correction, and may include information that is retrieved to be used as input for other actions. Third, the term "classify" was changed to "relate", as it was a better representation of the knowledge management functionality. "Relating" was defined as the ability to establish relationships among pieces of information facilitating the filtering of information. Fourth, "providing access" was defined as the ability to grant permission to enter the tool and to features and information in the tool. Granting permission involved comparison and possible validation of collected information with stored information. Fifth, "filtering" was defined as the ability to retrieve information that has been stored and classified in the tool in response to user- or system-generated requests. Sixth, "distributing" was defined as the ability to retrieve filtered information and store or display the retrieved information.

Design

The design of the knowledge management component involved identifying the functionalities required by users of the component and operationalizing the characteristics of the component. Identification of the functionalities was described previously. Operationalizing each of the characteristics is described in this section.

Operationalization of the Knowledge Management Characteristics

Operationalizing the knowledge management characteristics involved combining data processing and human computer interaction capabilities with the characteristics of a knowledge management component. Operationalizing the characteristics supports the additional content management functionalities identified.

Content Management Functionality

The comprehensive tool is one that is integrated into the organization. An effective design for the knowledge management component of such a tool requires knowing the information the users need from the tool and the interactions needed to obtain this information Churcher (2007). Functionalities required by the primary users of the knowledge management component that support the users' and organization's need for information were identified as part of the design of the component.

Development

The development phase for the knowledge management component involved storyboards, web-based interfaces, and the database. The development of storyboards for the knowledge management component demonstrated the incorporation of the design-based specifications and identified user interaction with the prototype. The development of web-based interfaces for the

knowledge management component involved converting the storyboards into interfaces using a web-authoring tool.

A database was developed to align with the knowledge harvested in the prototype and store all knowledge harvested. A database is a collection of tables containing data related to a specific task (Churcher, 2007). The development of the database as part of the knowledge management component involved creating tables to hold information for each category of information in the taxonomy, known as content tables, and creating tables to hold information that associated categories of content, known as relationship or association tables. Queries were developed as a means to extract information from the database. A query filters, retrieves, and displays a subset of the information in the database based on information in the query that is sent to the database. This information may include the fields of information to display, a value for a field of information, or conditions for a field of information. The results of querying a database may be presented in a number of formats, including tables, forms, and reports. Finally, documents that indicated the source or destination of information from the database used in the display of the interfaces were developed. These documents were referred to as mapping tables.

Establishing communication between the interfaces and the database was beyond the scope of this study.

Implementation

The implementation phase of the knowledge management component involved identifying the primary users of this component when it is part of the comprehensive tool and a limited implementation of the component prototype. The user with the most knowledge management responsibilities is referred to as the “administrator”. As this user interacts with the

tool, he or she requires functionality that provides for the management of all information that supports the tool's integration into the organization, knowledge harvesting prompting questions to enhance the effectiveness of the process, jobs and tasks identified by contributors as employees change positions and responsibilities, and employee information that gives permission to access the tool. In addition, this user needs to have the ability to view, query, and edit all information in the tool, and may have the added capability to interact with the tool as a recipient or contributor.

Another user, referred to as the "recipient", was identified. The recipient interacts with the knowledge management component to find and retrieve information from the tool. He or she requires functionality that allows for accessing the tool and the content, navigating the list of tasks, accessing the details of a task, as well as searching the knowledge that was harvested and stored in the tool. A user in the role of a recipient was not involved in this study.

An additional user of this component is one who oversees the system. The system includes the tool, the interfaces, the database, and the software and hardware required to make the tool operational and available to the other users. This "system administrator" will have the capabilities of the administrator, the contributor, and the recipient.

The implementation of the component prototype was not a full scale implementation but limited to a trial user serving as an administrator. The context for the implementation was the same distance education program discussed for the implementation of the knowledge harvesting component. An employee was asked to participate in the implementation. The employee had sufficient knowledge of the subunit to be able to integrate the comprehensive tool into the organization at a time in the future. Information from the subunit was pre-loaded into the prototype prior to implementation.

Evaluation

Before the component prototype can be incorporated into a comprehensive tool to support continuity of an organization, it must be able to manage the harvested knowledge. An initial formative evaluation was conducted to determine compliance and functionality of the knowledge management component. A component prototype was evaluated for compliance with design-based specifications, which were manifested in the operationalization of the knowledge management characteristics. As with the evaluation of the knowledge harvesting component, the compliance evaluation was conducted through a review of materials.

The database was evaluated for functionality based on its ability to facilitate the management of content and encode, collect, store, retrieve, and deliver content. This evaluation was conducted through a try-out of the prototype.

An additional formative evaluation of the materials developed for the knowledge management component prototype was conducted to determine the ability of the materials to contribute to the development of the comprehensive tool. The database, interfaces, and mapping tables were involved in this evaluation.

Evaluation Process

Evaluation of component prototypes was conducted by four expert reviewers and one administrator. Three expert reviewers determined compliance of the prototype with knowledge management literature-based design specifications. One administrator evaluated the database for functionality. One programming/database expert evaluated the database, interfaces, and mapping tables for their ability to contribute to the development of the comprehensive tool.

A two-part online survey was used in the compliance evaluation. The first part collected general information, including email address, location where the implementation took place, the

type of computer used for the evaluation, and the web browser used. This information helped to describe the environment in which the prototypes were evaluated. The second part collected information regarding compliance with the specifications. A mixed methods approach was used for data collection. Multiple choice questions were used to determine the reviewer's agreement, disagreement, or uncertainty that the prototype complied with the specifications. Open-ended questions were used to collect information regarding responses indicating disagreement or uncertainty, as well as collect any other comments about the prototype.

Documents, including email with the administrator and notes taken during the evaluation by the administrator, were used to collect data regarding the functionality of the database. In addition, the report from the expert review of materials conducted by the database administrator provided information regarding the ability of the materials to contribute to the development of a comprehensive tool. This evaluation involved a review of these materials for alignment with basic database principles and a determination of the ability of the materials to support the functionalities required of the comprehensive tool.

All evaluators were asked to report any issues they experienced during their evaluation. All communication and evaluation documents sent to and received from expert evaluators and the administrator were electronic. Information sent to the compliance evaluators included the IRB Information Sheet, a brief introduction to the prototype, instructions for the evaluation process, definitions of key terms used in the prototype, and the end date for the evaluation. The email address advertised in the instructions was an alias of the personal email address of the researcher.

Data Analysis

The data analysis involved several procedures. General information regarding the location and equipment used in the compliance evaluation was summarized. Responses to the multiple choice questions were totaled for each of the elements of the design-based specifications included in the survey. Information submitted in the open-ended questions was analyzed for issues that could impact the effectiveness of the prototype. Documents produced in the evaluation for functionality and the review of database materials were analyzed for issues that could impact the functionality of the component prototypes.

CHAPTER 4: RESULTS

The previous chapter detailed the methodology for the design and development of the knowledge harvesting and knowledge management components of a comprehensive tool. This chapter presents a summary of the findings related to the first two research questions, then presents a more detailed description of the results of the steps taken to operationalize the methodology for each component. The third research question is addressed in the following chapter.

Research Question One

The first research question was: What literature-based characteristics could contribute to the design and development of a comprehensive tool for knowledge harvesting, knowledge management, and continuity management?

Five characteristics of a comprehensive tool emerged from the synthesis of the literature. These characteristics are contextually holistic, temporally holistic, responsive, opportunistic, and usable. Each characteristic included multiple indicators.

A comprehensive tool should be contextually holistic, involving the structure and functions of an organization as well as potential threats to and their impact on the organization. Twelve indicators were noted for this characteristic. A contextually holistic comprehensive tool should be integrated into an organization (McCrackan, 2005), include all organizational units (Disaster Recovery Journal & DRI International, 2007; NFPA, 2007) and subunits (McCrackan, 2005; Vancoppenolle, 1999) within the organization, representing the structure of the organization. It should include all resources, operations, and outputs of the organization, as well

as all interactions that take place inside the organization and with entities outside the organization (McCrackan, 2005; Vancoppenolle, 1999), representing the function of the organization. It should include all current threats to the organization and potential interruptions from the actualization of any identified threat (Charters, 2007; McCrackan, 2005; NFPA, 2007; Vancoppenolle, 1999), representing the influences that can impact the continuity of an organization. Finally it should include the procedures to maintain operations and restore operations (Charters, 2007; McCrackan, 2005; NFPA, 2007; Vancoppenolle, 1999) in an effort to support the continuity of the structural and functional aspects of an organization.

A comprehensive tool should be temporally holistic, involving information that spans the lifetime of the organization. Three indicators were noted for this characteristic. A temporally holistic tool comprehensive tool should include past information (Elliott, et al., 2002) supporting a history of the organization. It should include present information (FFIEC, 2003; Gibb & Buchanan, 2006), supporting the organization's ability to restore or maintain continuity after or through a break in operations by documenting the current state of the organization. It should include future information (FFIEC, 2003; Gibb & Buchanan, 2006), to take advantage of the opportunity to document ideas to be implemented at a time in the future. These three indicators, when taken together, support the organization's ability to document the history of the organization and support its continuation.

A comprehensive tool should be responsive to changes in the structure or functions of the organization as well as to the needs of users for access to the tool and the knowledge that is to be harvested. Twelve indicators were noted for this characteristic. A responsive comprehensive tool should include the ability to change information as the organization changes elements of its structure, such as units or subunits (Hiles & Barnes, 1999; McCrackan, 2005; Swanson, et al.,

2002). It should include the ability to change information as the organization changes elements of its functions, such as to resources, operations, outputs, interactions that take place within the organization as well as interactions with entities outside the organization (Hiles & Barnes, 1999; McCrackan, 2005; Swanson, et al., 2002). A responsive comprehensive tool should include the ability to provide access at any time and from any location (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006). . It should include the ability to provide access to the tool and to its content. In representing the knowledge management characteristics, the tool should include the ability to encode, collect, and store information; classify information according to the organizational context and time input; filter information in response to requests for information; and distribute information that is requested and filtered. It should include the ability to preserve information prior to it being edited and after it is edited. Finally, it should provide a means for the user to navigate the content within the tool.

A comprehensive tool should be opportunistic by taking advantage of the opportunity to include characteristics of knowledge harvesting. Ten indicators were noted for this characteristic. A comprehensive opportunistic tool should harvest organizational-related knowledge of the day-to-day operations (Cornish, 1999) from current employees (Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986). It should have the ability to harvest organizational-related knowledge at any time and from any location (Macintosh, 1999). . It should be able to harvest as much organizational-related knowledge as possible (Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986).. It should provide a knowledge harvesting environment that is interactive and iterative (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005), that poses the right questions for the context where it is used (DeLong, 2004), that provides enough

time for the contributor to respond, and that uses vocabulary and language that is appropriate for the implementation context (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005).

Finally, a comprehensive tool should be usable by the organization and its employees. Two indicators were noted for this characteristic. A usable comprehensive tool should facilitate the contribution and management of current employees' organizational–related knowledge (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003). It should facilitate the retrieval of harvested knowledge by the new employee or the temporary replacement.

Research Question Two

The second research question was: How could the design-based specifications be operationalized to create a knowledge harvesting component and a knowledge management component? This section summarizes the process of operationalizing each component.

Operationalizing the Knowledge Harvesting Component

The operationalization of the knowledge harvesting component took place within the design and development phases of ADDIE (Gustafson & Branch, 2002; Seels & Richey, 1994; Molenda, 2003). The analysis phase contributed information regarding the characteristics of the component. As a result of the analysis, characteristics for knowledge harvesting prompting questions and a knowledge harvesting process emerged. In the design phase, operationalizing the knowledge harvesting component involved modifying the literature-based prompting questions (Rosenberg, 2006; Wong & Radcliffe, 2000) and sequencing (Jonassen, Tessmer, & Hannum, 1999) the modified questions. This resulted in 47 prompting questions sequenced into six steps of a knowledge harvesting process. Realizing that a knowledge harvesting process has

the potential to collect much information, a taxonomy (Choksy, 2006) for the content was determined. This process involved examining three sources of information: the context for knowledge harvesting, the operationalized knowledge harvesting component, and the users of the knowledge harvesting process. The resulting taxonomy included employee, unit, subunit, position, job, task, step, question, and response. This process and the resulting taxonomy served to bridge the operationalization of the knowledge harvesting questions and process and the operationalization of the knowledge management component. In the development phase, the design-based specifications were incorporated into storyboards (Holtzblatt, 2003; Smaldino, Russell, Heinich, & Molenda, 2005), which contributed to the development of web-based interfaces for a prototype of the component represented in a contributor's module. User interface design principles (Galitz, 2002) were incorporated into the development of the interfaces.

Operationalizing the Knowledge Management Component

As with the knowledge harvesting component, the operationalization of the knowledge management component took place within the design and development phases of ADDIE (Gustafson & Branch, 2002; Seels & Richey, 1994; Molenda, 2003). Six characteristics of knowledge management (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Charters, 2007; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006; NFPA, 2007) were discussed in the literature review however some elaboration was needed prior to the operationalization of the component. In the design phase, the characteristics were combined with data processing (Copeland, 2000) and human computer interaction (Galitz, 2002) capabilities. Also, additional content management functionalities were identified to support an administrator's management of the content in the tool. In addition to view, select, add, edit, and remove content, the administrator needs the ability to assign or reassign jobs or tasks, move employees, manage

access to information, group jobs or tasks, mark content, and order prompting questions. In the development phase, the design-based specifications were incorporated into storyboards (Holtzblatt, 2003; Smaldino, et al., 2005), contributing to the development of web-based interfaces for a prototype represented in an administrator's module. User interface design principles (Galitz, 2002) were incorporated into the development of the interfaces. To complete the operationalization of the knowledge management component, a database (Churcher, 2007) was developed. The database was developed to include multiple tables for content and the associations between content. In addition, mapping tables were developed to document the source and destination for each piece of information that was displayed on every interface of the contributor's module. So that the database could be tested, the content and association tables were pre-loaded with information from a distance education program located within a major U.S. research university. Queries were developed to assist with the input of information to and the retrieval of information from the database.

The Knowledge Harvesting Component

The knowledge harvesting component focused on the elicitation of organizational-related knowledge and involved the prompting questions and the knowledge harvesting process. This section discusses the results of operationalizing the methods for the knowledge harvesting component.

Design

The design of the knowledge harvesting component involved operationalizing the characteristics of the knowledge harvesting prompting questions and the characteristics of the

knowledge harvesting process. The strategies used to operationalize the characteristics of each of these elements are discussed in this section.

Operationalization of the Knowledge Harvesting Prompting Question Characteristics

The knowledge harvesting component was designed to be populated with an initial group of prompting questions. Two sets of knowledge harvesting prompting questions, one from Rosenberg (2006) and one from Wong and Radcliffe (2000), were operationalized for use as an initial set of prompting questions for the knowledge harvesting component.

Operationalizing the prompting questions was based on three criteria. First, since no details arose from the literature that indicated an optimum number of prompting questions to harvest a sufficient amount of organizational-related knowledge and still experience the benefits of the process (Eisenhart, 2001), every original question would be represented in the final list of questions, as every question has the potential to elicit some knowledge. Second, the Wong and Radcliffe (2000) questions that include multiple subjects, for example "information/knowledge/technique", would be divided into a separate question for each subject to reduce confusion. Third, at this stage in the process, modified questions that were redundant were kept. This last criterion refers primarily to prompting questions suggested by Wong and Radcliffe and is supported by these authors. They acknowledge the fact that a piece of information may fit into more than one of their categories, which include what, where, when, why, who, which, and how, suggesting that some of their questions may ask for the same information.

The modified Rosenberg (2006) prompting questions are presented in Appendix K and the modified Wong and Radcliffe (2000) prompting questions are presented in Appendix L.

Operationalization of the Knowledge Harvesting Process Characteristics

Operationalizing the knowledge harvesting process characteristics involved sequencing the modified prompting questions and incorporating the questions in an iterative and interactive environment.

As noted in the previous chapter, the prompting questions were derived from the literature without guidelines for the order in which to present the questions as part of the process of harvesting knowledge. The task description method of task analysis (Jonassen, et al., 1999), was used as a guide for sequencing as it already employed a general-to-specific sequence. Jonassen, Tessmer, and Hannum provide a description for each step of the task description method, but do not suggest questions to ask at any step in the process. Therefore, the step descriptions provided by these authors were adapted to clarify the purpose of the questions in the step and assist in aligning the modified prompting questions with the step. The original and adapted descriptions are listed in Appendix M.

During the alignment, modified prompting questions that were redundant were examined and one version was kept, assuring that no organizational-related knowledge would be lost by eliminating questions. For example, of these two modified prompting questions, “What equipment is needed to perform this task” and “Which equipment is needed to perform this task”, only one was used in sequencing the prompting questions.

Appendix N lists the 47 modified prompting questions aligned with the steps of the task description method. It should be noted that because the comprehensive tool is intended to support the continuity of the organization, two prompting questions were developed and added to address continuity management.

The final design step involved operationalizing iteration and interaction. Operationalizing an iterative knowledge harvesting process (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005) involved displaying the same sequenced and modified prompting questions for each task input. In addition, the prompting questions associated with a step in the knowledge harvesting process are presented each time the user interacts with that step of the knowledge harvesting process. Operationalizing an interactive knowledge harvesting process (DeLong, 2004; Gunawardena, 1999; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005; Smaldino, et al., 2005) was accomplished by allowing the user to manipulate the interface by selecting options from drop-down menus, input text, edit text, clicking buttons to initiate actions, and selecting linked text within navigation areas.

Organizing the Content

Organizing the content involved identifying the categories and organizing the identified categories. The categories identified for this study included unit, subunit, job, task, step, question, response, employee, and position. Given these categories, the following organizational hierarchy was employed in this study: employee, unit, subunit, position, job, task, step, question, and response.

Identifying categories of information began by examining the context for knowledge harvesting, the operationalized knowledge harvesting component, and the user of the knowledge harvesting process. First, regarding the context where knowledge harvesting takes place, Jonassen, Tessmer and Hannum (1999) suggest that the structure of the organization be known before identifying the jobs and tasks performed. Organizational unit and subunit (Disaster Recovery Journal & DRI International, 2007; McCrackan, 2005; NFPA, 2007; Vancoppenolle,

1999) were noted as elements of the structure of an organization (Bertalanffy, 1950) and each was identified as a category. Second, regarding the operationalized knowledge harvesting component, job and task are identified as the first two steps in the sequence of the operationalized knowledge harvesting process. Each was identified as a category of information to provide the flexibility that allows this information to be identified before harvesting knowledge for any one task (Jonassen, et al., 1999). The iterative nature of the operationalized knowledge harvesting process indicates that the remaining four steps in the knowledge harvesting sequence will be repeated regardless of the task for which knowledge is being harvested, therefore step was identified as a category. In sequencing the modified prompting questions, specific questions were associated with each step in the sequence, therefore question was identified as a category. Since the expectation of a knowledge harvesting process is that the contributor will respond to the prompting questions, response was identified as a category of information. Finally, two issues were noted regarding the user of the knowledge harvesting process. Because knowledge of the work performed on a day-to-day basis is personal to the employee performing the task, the task-related knowledge that is harvested must be identifiable by the employee performing the task. Because organizational-related knowledge is personal to the employee, employee personal information, such as name and username, was identified as a category. Also, it was noted previously that employees may hold multiple positions within a subunit or unit of the organization, therefore position was identified as a category.

Organizing the identified categories produced a taxonomy of information for the component prototype, which included employee, unit, subunit, position, job, task, step, question, and response. The organization was accomplished by examining the hierarchy of the categories identified. Because organizational-related knowledge is personal, the employee was placed first

in the hierarchy, followed by the categories related to organizational structure. The work performed created the next levels in the hierarchy. Finally, the categories from the operationalized knowledge harvesting component were added.

Development

A contributor's module was developed to facilitate the elicitation of employee organizational-related knowledge by allowing the user to contribute knowledge in response to the prompting questions. Development of the knowledge harvesting component was guided by the design-based specifications. As noted in the previous chapter, it is the contributor that is the primary user of the knowledge harvesting component. The contributor is the employee with organizational-related knowledge of day-to-day operations (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986). The development of the knowledge harvesting component is discussed within the context of the contributor's module.

Development of the Storyboards

Storyboards were developed to create a visual plan for the interfaces of a contributor's module (Holtzblatt, 2003; Smaldino, et al., 2005). The storyboards included the knowledge harvesting specifications and the data processing and human computer interaction capabilities needed to support the harvesting of contributor knowledge. Information for each storyboard included a description of the interface, the actions required of the component prototype to display the interface, the intended users for the interface, the actions required by the user in interacting with the interface, the human-computer interaction capabilities incorporated into the interface, the data processing capabilities incorporated into the interface, and the characteristics

and indicators represented in the interface. An image of an interface as it could appear in a web browser was included as well. One of the storyboard pages is included in Appendix O.

Incorporating Usability

Usability principles (Nielsen, 2005) were incorporated into the storyboards for the knowledge harvesting component. First, options should be visible and recognizable to the user. Options were presented to the user in the links of the navigation areas and drop-down menus. The use of text for links simplified the presentation of the information and eliminated any problems users may have downloading images. Second, elements of the interfaces should be consistent and in a logical order. The taxonomy contributed to the development of a template, which helped to maintain consistency throughout the interfaces. The use of drop-down menus to present options, HMTL buttons to submit selections, and input and editing areas for content were used consistently throughout the interfaces. Third, the interfaces should employ terms that are familiar to the users. Familiar vocabulary and language not only supports the usability of the tool, but also is specified for the knowledge harvesting process (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005). The researcher's experience in the intended implementation context was relied upon for modifying the prompting questions, describing terminology in the prototype, and writing informational pieces for each interface. Fourth, the interfaces should provide easily retrievable help and documentation. Every interface included a link to an Information area as well as a link to enable communication with the administrator of the comprehensive tool. Finally, the interfaces should employ a minimalist design. The amount of information presented on each interface was limited to only the information needed for the interaction. Rarely-used information was located in a separate information area.

Development of the Web-based Interfaces

The development of the contributor's module took place after the storyboards were developed. Interfaces in the module were developed to be web-based and to function in a web browser. Although the comprehensive tool is designed so it ultimately will be able to utilize the internet to provide access to the tool and its contents at any time and from any location (Macintosh, 1999), this functionality was not part of this study. Specifications for the interfaces were translated from the storyboards to interfaces using Macromedia Dreamweaver. Guidelines for the design and development of web-based user interfaces (Galitz, 2002) were incorporated into the process to enhance the information assembled in the storyboards. The following sections describe this process.

Organization. The taxonomy established in the design of the knowledge harvesting component was used to organize the content on the interface and direct the flow of the user's interactions.

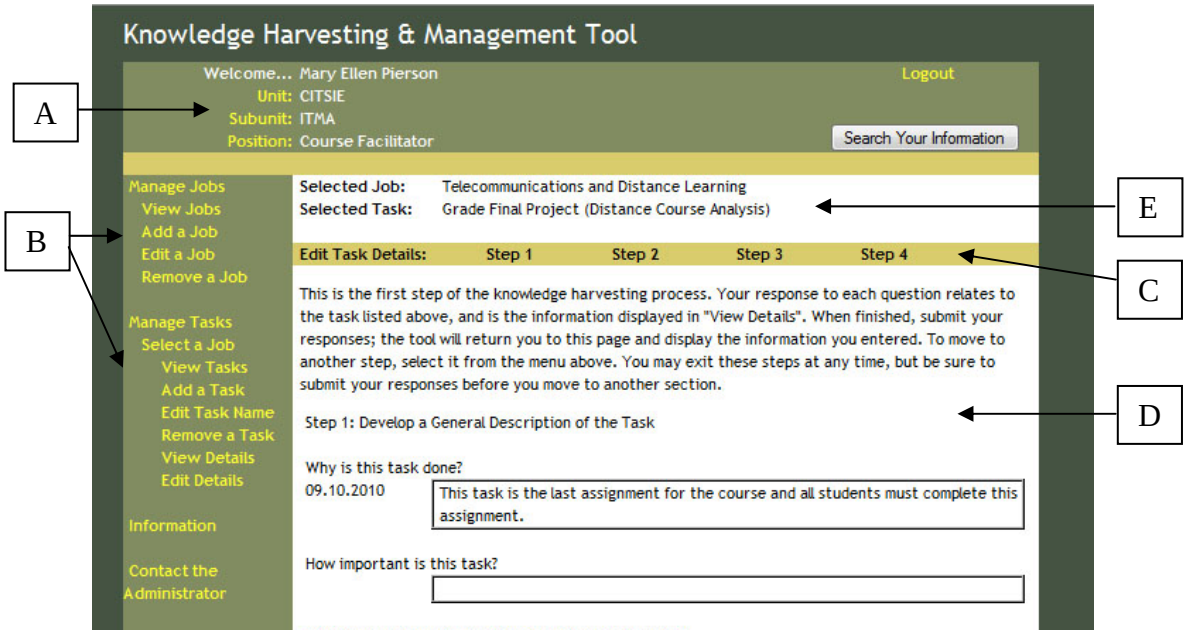
Navigation. Three navigation schemes emerged from an examination of the taxonomy, namely a location, work, and knowledge harvesting navigation scheme. First, employee, unit, subunit, and position, representing the contributor and his or her location within the organization, were grouped and became the *location navigation* (see Figure 1, item A). Second, jobs and tasks, representing the work performed by the employee, were grouped into a *work navigation* (see Figure 1, item B). While it is possible that information about the jobs and tasks performed exists within the organization, it is also possible that there are jobs and tasks performed by employees that are not documented within the organization. In order to harvest as much information as possible that is related to the jobs and tasks, this navigation area includes functionality that allows the employee to modify his or her list of jobs and tasks. Third, the remaining categories

of the taxonomy, which included step, prompting question, and response, were examined and step was used for the *knowledge harvesting navigation* (see Figure 1, item C). This allows the user to leave the process and return to any step in the process, noted as one of the contextual influences of the comprehensive tool.

"Progressive disclosure" (Galitz, 2002, p. 50) provides simplicity to the interfaces and has the potential to create efficient interactions. With each selection of unit, subunit, and position, the selected option is added to the location navigation. After these three are selected, the location navigation remains in the interface and the work navigation is added. After the user selects a job and a task to manage, the location and work navigation areas remain in the interface and the knowledge harvesting navigation is added.

Control Placement. The location navigation area incorporates a top-to-bottom flow. It is a hierarchical navigation in which options are presented based upon previous choices. For example, the subunits displayed are based upon the unit selected and the positions displayed are based upon the subunit selected. The work navigation area also incorporates a top-to-bottom flow, but is a blend of the hierarchical and simultaneous types of navigation. As a hierarchical navigation, it requires the user to add jobs before tasks, and to select a job before adding or editing the tasks associated with the job; as a simultaneous navigation, all of the options for managing jobs or managing tasks are presented at the same time. The knowledge harvesting navigation area incorporates a left-to-right flow and is a simultaneous type of navigation, as all of these steps in the knowledge harvesting process are presented to the user at the same time. The user could select any step in the process, or leave the process and select any step upon return.

Visual Clutter and the Amount of Information. Managing the amount of information on the page reduces clutter, highlights the differences among elements on a page, and supports user interaction with the information on the page (Galitz, 2007). With the navigation areas located on the interface, the remaining area became the primary area for user interaction (see Figure 1, item D). In this area, users make selections from drop-down menus, add content, edit content, and click buttons to initiate actions. The interaction area became the location for the remaining four steps of the knowledge harvesting process. Because of the relationship between jobs, tasks, and the knowledge harvesting process, the user is required to select a job and one of the tasks associated with the job before gaining access to the knowledge harvesting process. The selected job and task are displayed at the top of this area (see Figure 1, item E). Below these selections is the knowledge harvesting navigation. Below the navigation is the information that comprises a step of the knowledge harvesting process, namely, the number and name of the step, a brief description of the step, the prompting questions assigned to the step, areas for responses, and a control to submit the responses.



(A = location navigation, B = work navigation, C = knowledge harvesting navigation, D = interaction area, and E = selected job and task)

Figure 1. Sample interface from the contributor's module.

The amount of information in the interaction area varies based on the interactions that take place on the page. The user is introduced to the interaction by information at the top of the interaction area. Messages are provided at the bottom of the interaction area to help with navigation, for example "Select an area from the navigation on the left to move to that area; to cancel an operation on a page, for example, "To cancel this action or end editing this job name, select an area from the menu on the left; or to repeat an action, for example, "To view tasks for another job, return to 'Select a Job' from the menu". Additional information is displayed in two different areas. First, the Manage Jobs and Manage Tasks pages, indicated by links in Figure 1, explain the concept of jobs and tasks as used in the comprehensive tool, the processes of managing jobs or tasks via links in the work navigation area, and the management of administrator-assigned jobs or tasks. Second, additional assistance is provided in an information

area. Included in this area are an Information page, which presents an overview of terms used in the comprehensive tool; a FAQ (Frequently Asked Questions) page, which presents questions and answers related to problems the user may experience; and a Site map that displays the organization of the interfaces in this module.

Focus, Emphasis, and Aesthetics. A color pallet of greens and yellows was developed using the Adobe color theme generator. This color combination is rated one of the highest in effectiveness by Galitz (2000). A dark green is used to identify the border of the interface. A lighter shade of green used for the location navigation and work navigation. Gold is used as a visual separator between the location navigation and the rest of the interface and as a background color for the knowledge harvesting navigation. A second shade of yellow is used for the text links in the location and work navigation areas. White is used as a background color for the interaction area to draw the user's attention to this area of the interface. White is also used for the text that indicates the user's name, unit, subunit, and position options selected after login and displayed in the location navigation. Black is used for text in contrast to the white background in the interaction area and for text in contrast to the yellow background of the knowledge harvesting navigation.

According to Galitz (2002), "words are more meaningful to users than icons" (p. 23), therefore, no graphics, icons, or images appear as controls in the interfaces. Navigation items are text and the only buttons used are those produced by the HMTL coding, for example, buttons that submit a selection or text. Since this is an initial attempt to design and develop interfaces for a comprehensive tool that meets certain specifications, graphics, icons, and images were not thought to be critical to determine the functionality of the prototype.

Implementation

As discussed in the previous chapter, the implementation of the knowledge harvesting component was limited and involved trial users. Three employees of the implementation context participated. Each was considered a contributor as each had knowledge of the work performed for at least one job within the organization. In order to implement the knowledge harvesting component a prototype was created using word processing software. This prototype was equivalent to the web interface in terms of the prompting questions presented, but unlike the pre-functioning web interfaces, it permitted collection and storage of all responses. This prototype listed all of the steps in the sequence and the modified prompting questions assigned to each step along with a box for the user's response to each question (see Appendix M). The unit, subunit, position, and an example of a job and task consistent with the respondent's role in the organization were pre-loaded into the prototype prior to sending it to the contributor. Implementation of the component prototype took place over an 18-day period. The results of the implementation are presented later in the functionality evaluation section of this chapter.

Evaluation

An initial formative evaluation of the knowledge harvesting component was conducted to determine compliance and functionality (Dick & Carey, 1996; Richey & Klein, 2007). Each part is discussed in this section.

Compliance Evaluation of the Knowledge Harvesting Component

Three external experts served as compliance evaluators. Each has an advanced degree with an emphasis in Instructional Design and Technology and has expert knowledge of concepts incorporated into the prototype, most importantly the concepts of knowledge and information. In

addition, one evaluator had previous experience with task analysis to elicit employee knowledge of work performed. The compliance evaluation was conducted over an eight-day period.

Compliance Evaluation Survey

The compliance evaluation was conducted using an online survey (Anderson & Kanuka, 2003). In the first part, the survey asked for general information. The second part was comprised of four sections. The first section involved the alignment between the original prompting questions and the modified prompting questions. It included a table for each set of prompting questions (Rosenberg, 2006; Wong & Radcliffe, 2000) that listed the original and the modified form of each question and a link to information explaining the process of modifying the literature-based prompting questions. The second section involved the sequence (Jonassen, et al., 1999) of the knowledge harvesting process. It included a table of the steps in the sequence and the modified prompting questions assigned to each step as well as a link to information explaining the process of sequencing the modified prompting questions. The third section involved the design-based specifications for the knowledge harvesting process. Specifically, that it includes questions (Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005), is iterative (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005), and is interactive (Mulder & Whiteley, 2007). Within this section were two links to examples of the specifications. Below the table or examples in these three sections were multiple-choice questions related to the specification for the section and open-ended questions for comments to explain disagreement or uncertainty. The fourth section included open-ended questions asking for suggestions of additional prompting questions and comments regarding the knowledge harvesting process or the prompting questions.

An initial version of the online survey was reviewed for functionality. Three individuals, none of which were connected to the study, were asked to review the survey before it was presented to the evaluators. One reviewer commented that the term "interactive" may need to be defined within the prototype to "set expectations for the tool". This reviewer also commented about the notation used in the table listing the original and modified Wong and Radcliffe (2000) prompting questions. She indicated there was some confusion "because I first interpreted [it] as a bulleted list beneath the question". This notation was removed in a later version of the table. Another reviewer added that this survey is "very clear and concise". Additional follow-up questioning provided information regarding clarity of the questions used in the surveys, consistency in the images that were presented, and typographical errors.

Findings from the Compliance Evaluation

The general information indicated that surveys were completed from a mobile phone, work, and home; on an iPhone, PC, and Mac; and using Safari, Microsoft Internet Explorer, and Firefox browsers. This information was collected in case the evaluators encountered technical problems with the survey. However, no technical problems occurred.

Prompting Questions. Regarding the operationalization of the prompting questions, all evaluators agreed that both sets of modified prompting questions prompt for the recall of organizational-related knowledge, that the modified Rosenberg (2006) prompting questions allowed for elaboration, and that the modified Wong and Radcliffe (2000) prompting questions allowed organizational-related knowledge to emerge and used vocabulary and language appropriate for the intended implementation context (see Table 6).

Evaluators indicated uncertainty with three issues. One evaluator was not sure that the modified Rosenberg (2006) prompting questions allowed organizational-related knowledge to

emerge. He commented that he "would want to see some self-reflection by the user on their perceived skill level at these task[s] and how long they have done it". Another evaluator was not sure that the modified Wong and Radcliffe (2000) prompting questions allowed for elaboration. He commented that "these questions seem more focused than the previous set [Rosenberg] and might lead to short answers". One evaluator was not sure that the modified Rosenberg questions used vocabulary and language appropriate for the intended implementation context. He suggested that he "might modify the first question to more clearly nest tasks within jobs, then ask 'For the tasks within this job...' for the remainder".

Knowledge Harvesting Process. Regarding the operationalization of the knowledge harvesting process, all evaluators agreed that the process was in a general-to-specific sequence, included questions, and was iterative (see Table 6).

Two evaluators were unsure that the process was interactive. One commented "I'm not sure what interaction, other than contacting the administrator, is available within the tool." Another commented "I'm not sure what you mean by 'interaction'. If you mean interaction with other people, then it does not directly provide opportunities for interaction. However, many of the questions indirectly encourage interaction". One evaluator disagreed that the process was interactive. He commented "I am not sure I see the interaction in the samples, ideally, I would like to see them be able to visually organize the sequence of tasks".

Table 6

Compliance of the Knowledge Harvesting Component with Design-based Specifications

Specification	Agree	Disagree	I'm not sure
Prompting questions:			
Prompt for the recall of organizational-related knowledge			
Set #1: Rosenberg	3		
Set #2: Wong & Radcliffe	3		
Also allow organizational-related knowledge to emerge			
Set #1: Rosenberg	2		1
Set #2: Wong & Radcliffe	3		
Allow for elaboration			
Set #1: Rosenberg	3		
Set #2: Wong & Radcliffe	2		1
Use vocabulary and language for the context (ITMA)			
Set #1: Rosenberg	2		1
Set #2: Wong & Radcliffe	3		
Knowledge Harvesting Process:			
Proceeds in general-to-specific sequence	3		
Includes questions	3		
Is iterative	3		
Is interactive		1	2

Additional Comments from the Compliance Evaluation

Evaluators were given the opportunity to enter additional comments on the component prototype. One evaluator provided much information regarding the modified prompting questions and the sequence for the questions. He noted that pairs of questions seemed similar and may cause confusion. These include " What jobs do you perform?" and "What tasks do you perform?", "What events can threaten the performance of this task?" and "What interruptions can impact the performance of this task?", "What equipment is needed to perform this task?" and

"What equipment do you use to perform this task?", and "What documents can assist in performing this task and where are they located?" and "Which document is needed to perform this task?". He found additional questions vague, including "How can the knowledge be applied in the performance of this task?", "How can the theory be applied in the performance of this task?", and "How can the technique be applied in the performance of this task?". He noted that it could be the use of the word "can" in these questions, and added that changing it to "should" may be better. Finally, he suggested rewording one question, from "What do you need to know to perform this task?" to "What knowledge do you need to perform this task?" as it "better ties in with the later question: 'At what point in the process of performing this task is the knowledge needed?' ".

He also noted that the terms "information", "knowledge", "technique", and "theory" may be confusing. He questioned whether it would be helpful to add a description for these terms in the component prototype.

Regarding the sequence for modified prompting questions, this evaluator suggested moving "Who has information that may help you perform this task?", "Who has knowledge of this task that may help you?", and "Who is familiar with the technique needed for this task?" from step 4 (Develop a detailed description of each task) to step 5 (Requirements of the task) to be placed with other "Who"-based questions dealing with knowledge, information, and techniques. Whether or not the questions are moved, he suggested re-sequencing one set so both sets are presented in the same order.

General comments about the component prototype were also submitted by evaluators. One evaluator noted that "The only additional items I would look for are related to the impact of

a task/job on either downstream tasks/jobs, personnel or decision making/decision makers." Another evaluator noted that this was a

> very comprehensive tool that could be aligned with knowledge objects or training performance indicators to further support responses and to scale real skill levels with perceived skill levels. To me, one of the most critical and difficult items to capture is the timing of tasks, knowledge, and information in completing a task. The timing is difficult to teach and to reproduce in new employees, but it could be captured through your system.

Functionality Evaluation of the Knowledge Harvesting Component

The evaluation for functionality was conducted through a try-out of the component prototype by intended users (Richey & Klein, 2007) during the implementation of the prototype. Three current employees of the intended implementation context, all of whom were course facilitators within the distance education program and therefore contributors, participated in this evaluation. Data were collected over an 18-day period.

Contributors were sent a packet of information and the prototype. The contributors were asked to respond to the modified prompting questions for three self-selected tasks. The tasks could be from the same job or different jobs performed within the implementation context. Contributors were asked to copy the form as needed.

Findings from the Functionality Evaluation

The contributors noted prompting questions that appeared to be similar, in addition to those noted by the evaluators. "What factors need to be considered before you perform this task", "What do you need to know to perform this task", and "What steps are involved in performing this task" were indicated. Another implementer thought "How can the technique be

applied in the performance of this task", "Where can the skills needed to perform this task be acquired", and "What documents can assist in performing this task and where are they located" were redundant with others presented earlier in the sequence.

Communication with the contributors revealed confusion in interacting with the prompting questions. One contributor questioned whether the "you" in the prompting questions referred to the employee performing the task, for example, grading an assignment, or to the student completing the assignment. Another contributor questioned the term "performance" as used in the question "What events can threaten the performance of this task". It was asked whether the prompting question referred to the ability of the employee to perform the task or to the employee's skill in performing the task. Another question dealt with the theory-related prompting questions. Specifically, with which theories the user should be familiar, and when and how the theory can be applied to the performance of the task were the issues noted.

Identifying jobs and tasks also generated questions. The contributors were given "Grade Lesson 1" as an example of a task. However, one implementer commented that the grading of a lesson "could contain multiple tasks" and that "completing additional tasks [might not] provide additional [information] if the task continues to focus on the general task of grading".

Summary of the Findings for the Knowledge Harvesting Component

In summary, the compliance evaluation of the knowledge harvesting component indicated that the modified prompting questions prompted for the recall of organizational-related knowledge, allowed organizational-related knowledge to emerge, allowed for elaboration, and used vocabulary and language for the context with three exceptions. One evaluator was uncertain that the Rosenberg (2006) prompting questions allowed organizational-related knowledge to emerge, stating that perceived skill level and length of time performing the task

should be added. One evaluator was uncertain that the Wong and Radcliffe (2000) prompting questions allowed for elaboration, stating that these questions might lead to short answers. One evaluator was uncertain that the Rosenberg prompting questions used vocabulary and language for the context, stating that it may be necessary to emphasize the focus of the prompting questions on the identified task.

All three compliance evaluators indicated that the process proceeded in a general-to-specific sequence, included questions, and was iterative. Two of the three evaluators were uncertain that the process was interactive, indicating that the term was not defined or evident within the information provided. One evaluator disagreed that the process was interactive, stating that it was not visible in the information provided.

Additional comments noted pairs of prompting questions that appeared to be similar, vague, or may be improved by rewording as well as issues regarding terms used in the questions. It was suggested that re-sequencing three prompting questions might be needed.

The evaluation of the functionality of the knowledge harvesting component noted that some questions appeared to be similar, however these questions were different from those noted in the compliance evaluation; confusion during the interaction with the component prototype; and problems identifying jobs and tasks.

The Knowledge Management Component

The knowledge management component addressed the encoding, collection, storage, retrieval, and delivery of the knowledge elicited and harvested through the knowledge harvesting component. This section discusses the operationalization of the methodology for the knowledge management component.

Design

The design of a knowledge management component involved identifying the functionality required in managing the content and operationalizing the knowledge management characteristics. The strategies used in this process are discussed in this section.

Operationalization of the Knowledge Management Characteristics

The six literature-based knowledge management characteristics - collect, store, classify, provide access, filter, and distribute (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006) - were operationalized. First, collecting was operationalized by including content input areas to collect information, content editing areas to collect corrections to previously collected information, drop-down menus from which the user is able to select options, and controls to initiate the collection or correction of information. Second, storing is a function of the database, and as a result, can only be seen after it has occurred. Therefore, storage was considered operationalized when the knowledge that was harvested or the information that was input was able to be managed. Third, relating was operationalized based on the taxonomy (Choksy, 2006). Relationships were established between categories of information. For example, a password was related to a username, units were related to a username, subunits were related to a unit, positions were related to a subunit, jobs were related to a position, tasks were related to a job, steps of the knowledge harvesting process were related to a task, prompting questions were related to a step of the process, and responses to the prompting questions were related to the question. Fourth, providing access was operationalized by making provisions for the use of validation procedures. Validation involves the comparison of information that was input with stored information and allowing entry to the tool and access to features and content in the tool. Once entry is allowed, access to features and content is

controlled according to permissions stored in the tool. Within viewable content, access is provided through the navigation links, and drop-down menus and the controls to submit the option selected. Fifth, filtering was operationalized by requesting information through user- or system-generated requests. System-generated requests, or queries, were developed to produce the options displayed in drop-down menus, the user-based information displayed when viewing jobs or tasks, and information displayed as a result of selecting a navigation link. User-generated requests provide customized filtering of information. Sixth, distributing was operationalized in three ways. Filtered information was stored to be input, or distributed for another action. Filtered information was distributed to the interface for display as editable text, or, it was distributed to the interface for display as non-editable text.

Content Management Functionality

Additional functionalities were built into the KM component to facilitate the management of administrative content. To support the integration of the comprehensive tool into the organization, provisions were made to permit an administrator to perform all contributor functionalities as well as the ability to assign or reassign jobs or tasks, move employees, manage access to information, group jobs or tasks, mark content, and order prompting questions. First, unassigned jobs and tasks can be added by the administrator. The KM component allows the administrator to assign a job or a task to a specific user at a later time. Second, the work performed by an employee within an organization can change. The KM component allows the administrator to reassign jobs and tasks, along with the associated prompting questions and responses, to other employees or reassign current jobs or tasks to a new position from the work performed by multiple employees. Third, organizational structure can change but the work performed by an employee can remain the same. The KM component allows the administrator to

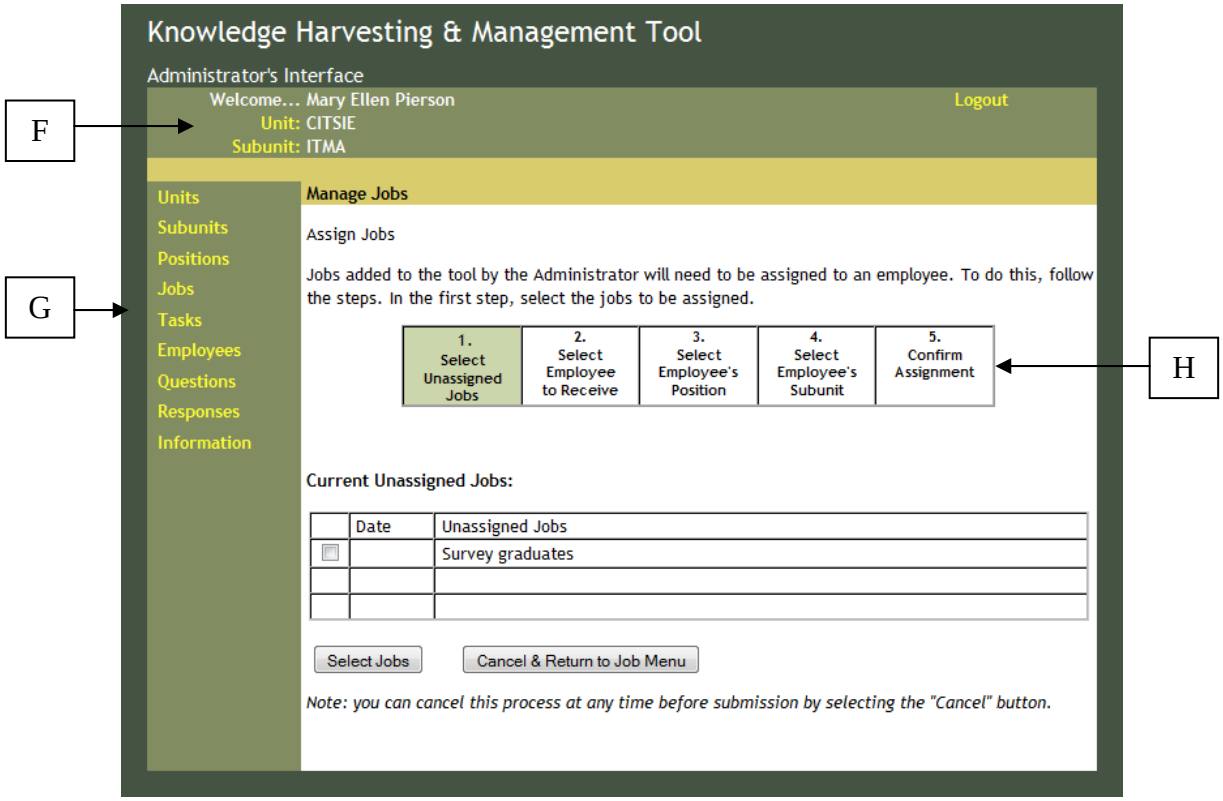
move employees and the jobs and tasks performed by the employee to different locations within the organization. Fourth, associated with these job- or task-related management functions is the management of the user's access to the information related to the job or task. The KM component allows the administrator to manage user access to the information that allows the user to only read information or to read and write information associated with a job or a task. Fifth, managing the work performed within an organization may involve analyzing the jobs and tasks and grouping those that are similar. The KM component allows the administrator to group similar jobs or tasks, identify the group with a unique name, and manage the jobs or tasks within the group. Sixth, instances could occur when certain content needs to be identified. The KM component allows the administrator to mark content, for example when a response to a prompting question illustrates a best response that should be conveyed to other employees within the organization. Marking content also allows the administrator to manage the prompting questions that are displayed in the tool. Finally, the operationalization of the knowledge harvesting component provided a sequence for the initial prompting questions. However, the order used in this study may not be appropriate for all organizations. The KM component allows the administrator to order the prompting questions that will be displayed within a step.

Development

The infrastructure developed for the administrative KM module consisted of two major elements, input forms to permit the entry and editing of information and a database to permit the storage, filtering, retrieval, distribution, and display of the information. As noted in the previous chapter, one of the special considerations for the comprehensive tool was a means to support the management of the comprehensive tool. The administrator's module allows for the integration

of the tool into the organization and supports the use of the tool through the management of all content.

Storyboards (Holtzblatt, 2003; Smaldino, et al., 2005) and web-based interfaces were developed for an administrative KM module using the same processes detailed in the development of the contributor's module for the knowledge harvesting component. Galitz's (2002) guidelines were incorporated into the process, and are summarized in Appendix U. Figure 2 presents a sample web-based interface from the administrator's module and indicates the location navigation (F), the category navigation (G), and a step-based navigation (H). (Although not included as part of this study, an example of a recipient's interface is included in Appendix X to illustrate the functionality provided to this user.) Web-based interfaces are not the only means an administrator might use to manage information harvested through the KH component. For example, information and commands also can be entered directly into a database without going through a web-based interface. The database operationalized for the KM component is discussed in the next section.



(F = location navigation, G = category navigation, and H = step-based navigation)

Figure 2. Sample interface from the administrator's module.

Developing the Database

A knowledge management database (Churcher, 2007) was developed using Microsoft Access. Content tables were developed based on the categories of information established in the taxonomy. Records in each content table included an identification number for the record and fields related to the category. For example, each record in the Employees table included an employee identification number, the employee's first, middle, and last names as well as the username and password assigned to the employee. Combined with appropriate programming code, these data could be used to validate the username and password input on a login page, grant permission to enter the tool, and retrieve and display the user's first and last name on subsequent pages.

Relationship tables (Churcher, 2007), also referred to as association tables, were developed to identify the relationships among data in the various content tables and facilitate the management of information. Two types of relationship tables were developed. One type of table related information between two categories of information. For example, a table was developed to identify the relationships between units and subunits by listing all subunits in a unit (see Figure 3).

unit_subunit_id	unitid	subunitid
1	3	17
2	1	3
3	2	3
4	1	5
5	5	12

Figure 3. Database table relating two categories of information.

A second type of table related information between many categories of information. For example, a table was developed to identify the relationship between all of the categories of information in the taxonomy (see Figure 4).

master_assoc_table_id	employeeid	unitid	subunitid	positionid	jobid	taskid	stepid	questionid	responseid
13	4	3	17	1	3	12	1	4	1
14	4	3	17	1	3	12	1	9	2
15	4	3	17	1	3	12	1	5	3
16	4	3	17	1	3	12	1	35	4
17	4	3	17	1	3	12	1	36	5
18	4	3	17	1	3	12	1	37	6
19	4	3	17	1	3	12	1	27	7

Figure 4. Database table relating multiple categories of information.

Twenty-five mapping tables were developed to document the database tables that are the source of information displayed in the interface and the destination for information collected by the interfaces. Due to the size of the administrator's module, the mapping tables were developed only for the contributor's module. For each interface within the contributor's module, a mapping table indicated each piece of information that was retrieved from the database and displayed in the interface, the table in the database that provided the information, the information that was collected on each interface, and the table where the collected information needed to be stored (see Appendix V).

Implementation

Prior to implementation the content and association tables in the database were pre-loaded with data. Information from the intended implementation context, described in the

previous chapter, was collected and input into the appropriate content tables. Information related to the associations between and among this data was input into association tables. Queries (Churcher, 2007) were developed to provide a means to retrieve information from the database. The developed queries supported some of the content management functionalities discussed in a previous section.

As discussed in the previous chapter, the implementation of the knowledge management component prototype was limited and involved a trial administrative user. One administrative employee of the implementation context participated. Implementation took place in one day and involved a try-out of the database by using the pre-built queries associated with the database to retrieve information from the database as well as adding new information into database tables.

Evaluation

An initial formative evaluation of the knowledge management component was conducted to determine compliance and functionality (Dick & Carey, 1996; Richey & Klein, 2007). The purpose of this evaluation was to determine actual compliance and functionality for some features within the knowledge management component and apparent functionality for other features. This approach was necessary because the actual processes performed by the knowledge management component are not visible to the administrator; only the inputs, infrastructure, and results can be viewed. The inputs are visible at the time they are entered and the results are visible after they have been produced. The infrastructure generally is visible only by viewing the underlying elements and the manner in which those elements are related. For example, comparisons of data entry boxes in input forms with relevant database tables and fields should permit a knowledgeable reviewer to determine if a component's infrastructure will support

specific tasks. Also, because creation of the programming code necessary to demonstrate full functionality was beyond the scope of this study, apparent functionality was all that could be determined in some cases.

Compliance Evaluation of the Knowledge Management Component

The three external experts that participated in the evaluation of the knowledge harvesting component for actual compliance and apparent functionality also participated in the compliance evaluation of the knowledge management component. All three evaluators asked to participate in this compliance evaluation responded. The compliance evaluation was conducted over an eight-day period.

The evaluation was conducted using an online survey (Anderson & Kanuka, 2003). The survey incorporated multiple-choice and open-ended questions, as in the compliance evaluation of the knowledge harvesting component. The contributor's module was used as the source for the images demonstrating the operationalization of the specifications.

Compliance Evaluation Survey

The first part of the knowledge management compliance evaluation survey collected the same general information as in the knowledge harvesting compliance evaluation survey. The second part of the survey included six sections. Each section dealt with one of the six specifications and several elements of each specification were included. Each section included one or several images representing an operationalized element of the specification. Following each example was a multiple-choice question in which the evaluator indicated agreement, disagreement, or uncertainty that the example was designed to include the element. The evaluators were asked to explain any disagreement or uncertainty they determined in

compliance. At the end, the survey provided the evaluator the opportunity to add comments about the prototype.

Findings from the Compliance Evaluation

Surveys were completed from a mobile phone, work, and home; on an iPhone, PC, and Mac; and using Safari, Microsoft Internet Explorer, and Firefox browsers. Results of the compliance evaluation of the knowledge management component indicate that, with the exception of one item, all evaluators agreed the component prototype met the design-based specifications (see Table 7). One evaluator indicated uncertainty that the component related prompting questions with a step.

Comments from the Compliance Evaluation

Evaluators were asked to explain a response of uncertainty or disagreement in the compliance evaluation as well as enter any general comments regarding the component. In explaining his uncertainty response, the evaluator stated that "This section addresses some of the comments I made...on timing of the tasks...where timing for later steps seems to always become an obstacle when trying to document or capture the process from employees". Based on this comment, the uncertainty was not about the prototype's ability to relate these two categories of information, but provided the opportunity to clarify previous comments and elaborate on the importance of harvesting the timing of tasks during the task analysis process. This evaluator added a general comment, stating that he "still [sees] a missed opportunity on defining a task timeline, of sorts, although tasks and jobs are nicely addressed here". Another evaluator commented that his responses were in response to the images included in the online survey and "not....an actual functioning version of the tool". He added that "based on what I see, it will be a very intuitive and useful tool".

Table 7

Compliance of the Knowledge Management Component with Design-based Specifications

Specification	Agree	Disagree	I'm not sure
Collects information			
using content input areas	3		
through drop-down menus	3		
using content editing areas	3		
Stores information			
that was collected	3		
that was corrected	3		
that was selected from a drop-down menu	3		
Relates information			
password with username	3		
units with username	3		
subunits with unit	3		
positions with subunit	3		
jobs with position	3		
tasks with job	3		
knowledge harvesting steps with task	3		
prompting questions with a step	2		1
responses with a prompting question	3		
Provides access to information			
through validation of information	3		
through navigation links	3		
through option selected from drop-down menu	3		
Filters information			
by option selected from drop-down menu	3		
by a navigation link	3		
by information collected in content input area	3		
Distributes information			
by filtering and storing for repeated use	3		
by filtering and displaying information that is editable	3		
by filtering and displaying information that is non-editable	3		

Findings from the Functionality Evaluation

The evaluation for actual functionality was conducted by an administrator through the try-out (Richey & Klein, 2007) of the database during the implementation phase. The findings indicated that the queries functioned as designed and that the database provided the functionality that would allow an administrator to manage information in the database.

Findings from the Review of Database Materials

The review of database materials (Dick & Carey, 1996) for actual and apparent functionality was conducted by a programming/database expert who is employed by the institution where the implementation occurred. The evaluation took place over eight days. The findings indicated that the developed database tables and interfaces aligned with basic database principles. In addition, the combination of input forms and the database structure was able to support the content management functionalities required of the comprehensive tool. The review of the documents also indicated that the database, interfaces, and mapping tables provided an infrastructure sufficient to contribute to the later development of a fully functioning comprehensive tool with two conditions. First, an expert programmer is needed to add the programming required to establish communication between the interfaces and the database. Second, the process of establishing communication may require changes to the database or the interfaces, but this cannot be determined until the programming is underway.

Summary of the Findings for the Knowledge Management Component

In summary, the compliance evaluation of the knowledge management component indicated that the component complied with the design-based specifications for collecting, storing, providing access, filtering, and distributing information. The evaluation indicated that the component complied with the design-based specifications for relating information, with one

exception. One evaluator was uncertain that the component related prompting questions to a step. In his additional information he explained that examples provided in this section of the survey addressed comments he made in the knowledge harvesting compliance survey regarding the timing of tasks and the sequence of the procedure needed to complete the task.

The evaluation of the functionality of the component indicated that the database and the queries developed for the database function to support management of the content.

It was determined that the database, interfaces, and mapping tables will be able to contribute to the development of a comprehensive tool when combined with additional programming to establish communication between the interfaces and the database tables.

CHAPTER 5: DISCUSSION and LESSONS LEARNED

This study explored the design and development of the knowledge harvesting and knowledge management components of a tool that harvests, stores, and delivers employee knowledge of the day-to-day work performed within an organization. Through this study, the literature-based characteristics of a comprehensive tool were determined, the design-based specifications of a knowledge harvesting and a knowledge management component were operationalized and evaluated, and lessons were learned from these actions.

This chapter addresses the third research question, which was: What lessons could be learned from the operationalization and subsequent evaluation of design-based specifications for a knowledge harvesting component and a knowledge management component? The lessons learned from the operationalization and evaluation of the components are discussed in the following sections.

Operationalization of the Knowledge Harvesting Component

The operationalization of the knowledge harvesting component followed the ADDIE (Gustafson & Branch, 2002; Seels & Richey, 1994; Molenda, 2003) model. As part of the analysis phase, characteristics for a knowledge harvesting process and environment were determined. In the design phase, the knowledge harvesting prompting questions (Rosenberg, 2006; Wong & Radcliffe, 2000) were modified and sequenced (Jonassen, Tessmer, & Hannum, 1999) and a taxonomy (Choksy, 2006) for the content was determined. In the development phase, developed storyboards (Holtzblatt, 2003; Smaldino, et al., 2005) contributed to the

development of web-based interfaces for a prototype of the component represented in a contributor's module.

The operationalized component prototype was implemented by employees of the context and evaluated by these users for functionality (Richey & Klein, 2007). In addition, the prototype was evaluated for compliance with design-based specifications (Dick & Carey, 1996). It was determined that the prototype was compliant with most of the design-based specifications by at least two of the three evaluators.

Comments collected from the compliance evaluators and the implementers provide insight into the effectiveness of the operationalization of the component. For example, it was suggested that prompting questions focusing on perceived skill level and length of time performing the task be added to enhance the emergence of organizational-related knowledge. Neither perceived skill level nor length of time performing the task was represented in the literature-based prompting questions used in this study. Skill level was one of the items suggested by inclusion in continuity books (Nascimento, n. d.), but Jonassen, Tessmer, and Hannum (1999) suggest that it is the analyst examining the information collected by the task description method of task analysis that determines the competencies needed to perform the task.

Another comment suggested that the modified Wong and Radcliffe (2000) prompting questions might lead to short responses. The evaluator's comment does not include a description of a short response or criteria with which to determine a short response. It was noted in the literature review that this set of modified prompting questions appear to enhance the knowledge harvested by the modified Rosenberg (2006) prompting questions. The sequencing of the complete set of modified prompting questions appeared to support this statement. While short responses may indicate a less than optimal elicitation of organizational-related knowledge, they

may, in fact, be appropriate and acceptable if used to enhance information that was harvested by prior prompting questions.

It also was suggested that additional wording may be needed to convey the concept that a job is divided into tasks and that the prompting questions refer to one of the tasks. At the point in the survey where this comment was input, the evaluator did not have the opportunity to view any images of the interfaces developed for the tool. It is possible that the use of a hierarchical navigation type (Galitz, 2002) in the work navigation scheme as well as the placement of the selected job and task at the top of the interaction area will inform the user that tasks are associated with a specific job and that prompting questions are associated with a task. If it is deemed necessary to modify the navigation scheme or the placement of information, such adjustments can be accommodated within the interfaces of the comprehensive tool. Furthermore, because much of the interface content is downloaded from a database, these adjustments can be accomplished with minimal or possibly no adjustments to the database content.

Although reactions to some prompting questions varied, the evaluator and participant comments suggested an "ideal" set of questions that can be used in all contexts does not exist. Instead, it is more likely the knowledge harvesting questions will vary by organizational context (Bertalanffy, 1950). The study demonstrated a need for the ability to add to the initial pool of knowledge harvesting questions derived from the literature review and the need for a feature to modify the wording of existing questions. The ability to add additional questions and edit existing questions is a feature of the knowledge management component of the study's tool.

In addition to the above issues, interaction within the knowledge harvesting process (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005) also was noted as an issue. These comments were not completely unexpected. Full functionality was not

provided in the prototype reviewed in the compliance evaluation. Even though the evaluators were aware they were not viewing a working prototype in the survey, their comments probably were affected by, and also reflected, more recent views of interaction. Although the interaction characteristic used in the tool is consistent with the views of the term used at the time the cited research was conducted, perceptions of interaction within interfaces have changed in recent years (Smaldino, et al., 2005). In early uses of the term, the ability of users to respond to a question or prompt presented on a computer screen was viewed as interactive. As capabilities have increased, perceptions of what constitutes interaction also have changed. Due to the ubiquity of web-based forms that collect information, users have come to implicitly understand interaction as their actions with an interface for the purpose of communicating with the database (Gunawardena, 1999; Smaldino, et al., 2005). Also, the ways in which interaction are provided in the tool were not explicitly stated in the survey. This issue could be addressed by additional information explaining interaction in the tool or, simply, the implementation of a prototype that provides the user the ability to interact with the database.

Operationalization of the Knowledge Management Component

As with the knowledge harvesting component, the operationalization of the knowledge management component followed the ADDIE model (Gustafson & Branch, 2002; Seels & Richey, 1994; Molenda, 2003). As part of the analysis phase, characteristics for knowledge management were clarified. These clarifications were necessary because the literature did not provide all the information needed to operationalize the characteristics. Consequently, researcher decisions were required to reflect current, actual contexts. In the design phase, design-based specifications for the knowledge management characteristics were determined.

Also, additional content management functionalities for the administration of the content were determined and operationalized. In the development phase, developed storyboards (Holtzblatt, 2003; Smaldino, et al., 2005) contributed to the development of web-based interfaces for a prototype of the component represented in an administrator's module, and the database (Churcher, 2007), mapping tables, and queries were developed.

The operationalized component prototype was implemented by an employee of the context. The prototype was evaluated by experts (Dick & Carey, 1996) for compliance with design-based specifications as well as by the implementer (Richey & Klein, 2007) and a database expert for functionality. In general, the component prototype complied with design-based specifications. The evaluations for functionality indicated that the database queries performed as expected and that the developed component materials will contribute to the development of a comprehensive tool provided additional programming occurs to establish communication between the interfaces and the database tables. They also substantiated the practicality of designing infrastructure prior to development of the facilitating code needed to produce a fully functional tool.

Lessons Learned Regarding the Knowledge Harvesting Component

Several lessons were learned regarding the knowledge harvesting component. These lessons emerged from the comments collected in the compliance evaluation survey and documents from the implementation and evaluation of the prototype. These lessons involve the prompting questions, the knowledge to be harvested, the responses to the prompting questions, and support for the users.

First, not all prompting questions are the "right" questions (DeLong, 2004) for the implementation context. From a continuity management standpoint, the right prompting questions depend on the needs of the context. It was noted in the literature review that continuity management factors for an organization differ simply because organizations differ (Bertalanffy, 1950). It follows then that the organizational-related knowledge will differ and some prompting questions used to elicit this organizational-related knowledge may need to differ as well. In fact, it is possible that the right prompting questions will differ within units and subunits of an organization. This study does not suggest that all of the modified prompting questions incorporated into the knowledge harvesting process are the right questions. In fact, the identification of similar question by both the compliance evaluators and the contributors suggests that some of the questions used in this study may not have been appropriate for the implementation context.

Terms used in prompting questions also may be confusing. For example, reviewer comments indicated that the terms "information", "knowledge", "technique", and "theory" used in the modified prompting questions may be confusing. While it is possible that employees in the intended implementation context may not associate a theory or technique with the work they perform, it is conceivable that employees in other subunits within the same organizational unit will make this association. For example, if the tool were to be implemented in a research subunit, then the application of techniques that support the research being performed becomes a relevant issue to be addressed in a knowledge harvesting tool.

Also, the prompting questions need to be understood by all participants in the knowledge harvesting process. Evaluators noted prompting questions that may be confusing to users of the tool. Likewise, contributors noted confusion with certain prompting questions and the type of

information that was expected. A lack of familiarity with the knowledge harvesting prompting questions and environment may have resulted in confusion for the contributors. From her research on mindfulness, Langer (1989) found that people were able to express their thoughts clearly when they were discussing a familiar topic or had time to think about an unfamiliar issue. Allowing contributors an opportunity to seek clarification and providing the time to become familiar with the expectations of the tool, the knowledge harvesting environment, and the prompting questions may reduce confusion with the prompting questions and enhance the effectiveness of the knowledge harvesting component.

Second, the level and complexity of knowledge to be harvested may impact the effectiveness of the process. Although Sternberg and Wagner (1986) recommend identifying the experts in the organization to involve in the knowledge harvesting process, it may be the expert knowledge they have that impacts the elicitation and expression of the knowledge. Langer (1989) contends that having expert knowledge of the performance of a task can result in the individual not being able to express how the task is performed. It may have been expert knowledge that resulted in contributor's confusion with certain prompting questions and uncertainty in composing a response however this issue was beyond the scope of this study.

Additionally, although information must be organized to be accessible (Choksy, 2006), the organization scheme used by the organization must make sense to the employees. It is uncertain if the taxonomy used to organize information helped or negatively impacted the knowledge harvesting process. The taxonomy emerged from this researcher's analysis of aspects of the knowledge harvesting component. It was helpful to this researcher as it seemed the content needed an organizational scheme. And yet, the taxonomy, specifically the difference between jobs and tasks, appeared to confuse contributors. In retrospect, it would have been

useful to involve some context-appropriate employees in the content organization process prior to distribution of the taxonomy to a larger group.

Task-based classification schemes, as were used in this study, can be subjective, difficult to maintain, and difficult to use (Rosenfeld & Morville, 2002). The knowledge harvesting component designed and developed for this study allowed the contributor to identify the jobs and tasks performed. However, this organizational-related knowledge was built by the individual, is categorized in a way that is unique to the individual, and a reflection of how the individual understands the world in which he or she lives and works (Langer, 1989). As an organizational tool for continuity management, additional information concerning organizationally-defined jobs and tasks may reduce the potential for harvested information that is less than complete or muddled, improve the accessibility of information by new employees or temporary replacements, and enhance the effectiveness of the knowledge harvesting process.

Third, responding to the knowledge harvesting prompting questions requires time and skill. As a tool to maintain continuity, the responses that are input into the tool need to be usable by a new hire or temporary replacement in the performance of the task (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003). However, contributors expressed confusion in how to comprehend certain prompting questions. Communication with the contributors revealed that each attempted to respond to every question for a task in one sitting. This was neither required nor expected. Responding to all 49 prompting questions in one sitting may have tested the contributor's patience and recall (Eisenhart, 2001). The effectiveness of future implementations could be enhanced by informing users that the knowledge harvesting process could require several repetitions (Eisenhart, 2001), and that the tool provides functionality allowing them to

manage their time in the knowledge harvesting process as well as the ability to edit previous input.

Additionally, the component prototype required contributors to respond to the prompting questions through a written response. The ability to express knowledge and communicate this information via the written word is a skill, and, in general, skill levels vary from individual to individual (Langer, 1989). Incorporating the means to collect information in a variety of formats, for example audio or video recordings, could provide options to users as they contribute their organizational-related knowledge and enhance the effectiveness of the harvesting process to harvest as much information as possible (Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986).

Fourth, users of the tool may benefit from encouragement and support. It became apparent through the email communication with the contributors that these users needed encouragement as they interacted with the knowledge harvesting process. All of the contributors expressed concern about completing the form correctly and wanting to respond to all of the prompting questions. Langer (1989) argues for placing attention on the process to reach the intended outcome rather than the outcome alone. When focused on the outcome, there is a "preoccupation with success or failure" (p. 34); when focused on the process, the outcome is understood in light of the steps taken to get there. Because the purpose for the knowledge harvesting component is to elicit organizational-related knowledge, focusing on the process could enhance the effectiveness of the component. Encouraging contributors during the process of interacting with the prompting questions could reduce stress by removing the focus from the success or failure of having responded to the prompting questions.

Comments from the evaluations also suggested users could benefit from information regarding the organization's need for the tool. As was noted in the literature review, knowledge harvesting is an intentional process that serves to support organizational goals (Davenport & Prusak, 1998; Eisenhart, 2001). As contributors of organizational-related knowledge that will be used to maintain continuity in the organization, users should have access to information about the organizational goals for continuity management and the organizational need for harvesting knowledge.

Evaluation comments also indicated users need to be familiar with relevant continuity management terminology. Information regarding continuity management terminology, specifically events and interruptions as were noted in compliance evaluation comments, could support users as they respond to the prompting questions. Also, a pre-determined list of organizationally-defined jobs and tasks could reduce confusion from the self-selection of jobs and tasks. However, the contributor should continue to have the opportunity to add jobs or tasks for work performed that is unknown to the organization.

Lessons Learned Regarding the Knowledge Management Component

Three lessons were learned regarding the knowledge management component. They emerged from the analysis of the evaluation documents, communication with implementer and evaluators, and experiences of this researcher.

First, the capabilities provided by the knowledge management component in this study do not include the ability to immediately respond to a contributor's response with a follow-up question (Eisenhart, 2001). While the tool does provide the functionality to leave and return to the knowledge harvesting process and edit responses entered to any prompting questions,

administrators would need to identify responses that require more detail and contributors may need encouragement to return to the tool to add details to previously entered responses. In this study, feedback to study participants was provided through email outside of the KM component. However, the amount and frequency of this feedback made it clear the KM component in this study would be improved if provisions for prompt feedback were included as part of the tool.

Second, knowledge management systems can provide much information to an organization, but the structure of the database must be precise. Knowledge management systems have the ability to retrieve information from databases (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006). However, the success of retrieval is based on the ability of the queries to accurately filter and distribute the information that is requested. Accuracy in retrieving information from a query requires precision in the design and development of the structure of the database. This researcher's experiences while building the content, association, and mapping tables, as well as the queries for this database served to emphasize this point.

Third, while the database must be precise, it must also be flexible. Because organizations are dynamic entities (Bertalanffy, 1950; Kast & Rosenzweig, 1972), changes will be needed to information that is harvested as well as information that is input to integrate the tool into the organization. Changing information was also an integral part of the development of the interfaces and the database and the pre-loading of the database prior to its implementation. Multiple iterations were required to ensure that the interfaces and database were developed according to the design-based specifications for the knowledge management component, that the information in the database was accurate, that the database would accept and retrieve information, and that the content and association tables aligned.

Conclusions

This study addressed three research questions. The first question identified the characteristics of a system that incorporates continuity management, knowledge harvesting, and knowledge management. Five characteristics were noted, which include contextually holistic, temporally holistic, responsive, opportunistic, and usable.

The second question addressed the operationalization of the knowledge harvesting and knowledge management components of a comprehensive tool. The compliance evaluation of each component indicates that the operationalization of the design-based specifications was, for the most part, successful. Several comments regarding the operationalization were noted and summarized earlier in this chapter. Although operationalization of the characteristics and specifications was possible, more work is needed to make the operationalized form consistently understandable to all users.

The third question addressed the lessons learned from this study. The discussion noted four lessons regarding the knowledge harvesting component. First, the right questions for the organization should be determined by the organization and its members based on the need for the information and the nature of the information needed. Additionally, the questions that are used by the organization must be understood by all participants within the context where the tool is implemented. Second, expert knowledge of the work performed could impact harvesting this knowledge as it may be more difficult to express or may be organized by the knower differently than is presented in the tool. Third, time to express knowledge in written form is required by the users and options for contributing information in non-written formats may be needed. Finally,

users may benefit from encouragement and support to proceed though the process and to understand organizational goals and needs for the harvested knowledge.

The discussion noted three lessons regarding the knowledge management component. First, the capability to provide a prompt follow-up question to a contributor's response could improve the effectiveness of the tool. Second, precision is required in the structure and development of the database content tables, association tables, and queries to support an accurate retrieval of information. Finally, while the database must be precise, it must also be flexible and accurately accommodate changes to the content.

In the end, this research project demonstrated that instructional technology principles can be used to address a current and vital issue within many organizations, including educational organizations. Literature-based components for an information management mechanism to support organizational continuity were designed, developed, and evaluated, and processes to operationalize a knowledge harvesting component and a knowledge management component of a comprehensive tool were created and applied as part of the design and development phases. As a result, the comprehensive tool offers a practical solution to a problem many organizations are facing, that of the loss of employee knowledge of day-to-day operations, by providing the means to harvest and manage this knowledge which, in turn, can support the continuity of the organization.

REFERENCES

Alavi, M., & Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly, 25*(1), 107-136.

Allison, D. H., & DeBlois, P. B. (2008). Current Issues Survey Report, 2008. *Educause Quarterly,* (2), 14-30.

Anderson, T., & Kanuka, H. (2003). *e-Research: Methods, strategies, and issues*. New York: Allyn and Bacon.

Andrews Air Force Base (1996). Development of a hazardous materials emergency planning and response plan (Hazmat Plan), asbestos management plan, and hazardous waste management plan update. Retrieved February 20, 2008, from www.afcee.brooks.af.mil/eq/programs/summary.asp?rscID=505

Baldwin, D. A., Wilkinson, F. C., & Barkley, D. C. (2000). *Effective management of student employment: Organizing for student employment in academic libraries*. Englewood, CO: Libraries Unlimited.

Barnes, J. C. (2001). *A guide to business continuity planning*. New York: John Wiley & Sons, Ltd.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99-120.

Beazley, H., Boenisch, J., & Harden, D. (2002). *Continuity management: Preserving corporate knowledge and productivity when employees leave*. Hoboken, NJ: John Wiley & Sons.

Beazley, H., Boenisch, J., & Harden, D. (2003). Knowledge continuity: The new management function. *Journal of Organizational Excellence, 22*(3), 65-81.

Beckman, T. J. (1999). The current state of knowledge management. In J. Liebowitz (Ed.), *Knowledge management handbook* (pp. 1-1 - 1-22). New York: CRC Press.

Bergeron, B. (2003). *Essentials of knowledge management*. New York: John Wiley & Sons, Inc.

Bertalanffy, L. (1950). An outline of general system theory. *The British Journal for the Philosophy of Science, 1*(2), 134-165.

Bertalanffy, L. (1972). The history and status of general systems theory. *The Academy of Management Journal, 15*(4), 407-426.

Bureau of Labor Statistics (2009). Jobs openings and labor turnover survey. Retrieved April 24, 2009, from http://www.bls.gov/jlt/

Burke, W. W. (1994). *Organization development: A process of learning and changing* (2nd ed.). New York: Addison-Wesley Publishing Company.

Camp, J. S., & DeBlois, P. B. (2007). Current Issues Survey Report, 2007. *Educause Quarterly*(2), 12-31.

Campbell, K. (2002). Kinder, gentler tactics for reducing unscheduled employee absences. Retrieved March 26, 2009, from http://www.nfib.com/object/3246496.html

Carr, T. L. (2007). A study of local governments participating in the pre-disaster mitigation (PDM) program and populations served. *Journal of Homeland Security and Emergency Management, 4*(2), 1-34.

Cerullo, V., & Cerullo, M. J. (2004). Business continuity planning: A comprehensive approach. *Information Systems Management, 21*(3), 70-78.

Charters, I. (2007). Good practice guidelines 2007. Retrieved October 6, 2007, from http://www.thebci.org/gpg.htm

Choksy, C. E. B. (2006). *Domesticating information: Managing documents inside the organization*. Lanham, MD: Rowman & Littlefield Publishers, Inc.

Churcher, C. (2007). *Beginning database design*. Berkeley, CA: Apress.

Cline, M. (2007). *Institutions of higher education continuity of operations (COOP) planning manual*. Richmond: Commonwealth of Virginia.

Copeland, B. J. (2000). A brief history of computing Retrieved February 19, 2010, from http://www.alanturing.net/turing_archive/pages/Reference%20Articles/BriefHistofComp.html

Cornish, M. (1999). The business continuity planning methodology. In A. Hiles & P. Barnes (Eds.), *The definitive handbook of business continuity management* (pp. 93-130). New York: John Wiley & Sons, Ltd.

Cowley-Durst (1999). Gathering knowledge for your knowledge management system. *Performance Improvement, 38*(7), 23-27.

Creswell, J. W. (2003). *Research design* (2nd ed.). Thousand Oaks, CA: Sage.

Cummings, T. G., & Worley, C. G. (1997). *Organization development and change* (6th ed.). Cincinnati, OH: South-Western College Publishing.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know*. Boston, MA: Harvard Business School Press.

DeLong, D. W. (2004). *Lost Knowledge: Confronting the threat of an aging workforce*. New York: Oxford University Press.

Dewey, B. I., & DeBlois, P. B. (2006). Current IT Issues Survey Report, 2006. *Educause Quarterly*(2), 12-30.

Dick, W., & Carey, L. (1996). *The systematic design of instruction* (4th ed.). New York: Longman.

Disaster Recovery Journal, & DRI International (2007). Generally accepted practices for business continuity practitioners. Available from www.drj.com/GAP/gap.pdf

Disaster Recovery Journal Glossary (2007). Retrieved March 10, 2009, from http://www.drj.com/index.php?option=com_glossary&func=display&letter=D&Itemid=297&catid=35&page=1

Driscoll, M. P. (2000). *Psychology of learning for instruction*. Boston: Allyn and Bacon.

Edmiston, A. H. (2007). The role of systems and applications monitoring in operational risk management. *BT Technology Journal, 25*(1), 68-78.

Edmonds, G. S., Branch, R. C., & Mukherjee, P. (1994). A conceptual framework for comparing instructional design models. *Educational Technology Research and Development, 42*(4), 55-72.

Eisenhart, M. (2001, April). Gathering knowledge while it's ripe. *Knowledge Management,* 48-53.

Elliott, D., Swartz, E., & Herbane, B. (2002). *Business continuity management: A crisis management approach*. New York: Routledge.

Expecting the unexpected: Disaster preparedness strategies for small businesses (2007). Delray Beach, FL: Office Depot, Inc.

Feldman, S., & Sherman, C. (2001). *The high cost of not finding information*. Framingham, MA: IDC.

FFIEC (2003). Business continuity planning: IT examination handbook. Retrieved October 23, 2007, from http://www.ffiec.gov/ffiecinfobase/booklets/bcp/bus_continuity_plan.pdf

Field, A. (2003). When employees leave the company, how can you make sure that their expertise doesn't? *Harvard Management Communication Letter, 6*(4), 3-5.

Foster, S. P., & Dye, K. (2005). Building continuity into strategy. *Journal of Corporate Real Estate, 7*(2), 105-119.

Freeze, R. D., & Kulkarni, U. (2007). Knowledge management capabilities: Defining knowledge assets. *Journal of Knowledge Management, 11*(6), 94-109.

Galitz, W. (2002). *The essential guide to user interface design* (2nd ed.). New York: John Wiley & Sons, Inc.

Galitz, W. (2007). *The essential guide to user interface design* (3rd ed.). Indianapolis, IN: Wiley Publishing, Inc.

Gibb, F., & Buchanan, S. (2006). A framework for business continuity management. *International Journal of Information Management, 26*(2), 128-141.

Gibb, F., Buchanan, S., & Shah, S. (2006). An integrated approach to process and service management. *International Journal of Information Management, 26*(1), 44-58.

Gunawardena, C. N. (1999). *The challenge of designing and evaluating "interaction" in web-based distance education*. Paper presented at the WebNet World Conference on the WWW and Internet.

Gustafson, K. L., & Branch, R. M. (2002). What is instructional design? In R. A. Reiser, & Dempsey, J. V. (Ed.), *Trends and issues in instructional design and technology* (pp. 16-25). Upper Saddle River, NJ: Pearson Education.

Hammer, M., Leonard, D., & Davenport, T. (2004). Why don't we know more about knowledge? *MIT Sloan Management Review, 45*(4), 14-18.

Hayes, J. S., Tyler-Ball, S., Cohen, S. S., Eckes-Roper, J., & Puente, I. (2002). Evidence-based practice and heat loss prevention in trauma patients. *Journal of Nursing Care Quality, 16*(4), 13-16.

Heath, J. (2003). Harvesting and using corporate knowledge. *Work Study, 52*(4), 184-189.

Hiles, A. (1999). Foreword and introduction. In A. Hiles & P. Barnes (Eds.), *The definitive handbook of business continuity management* (pp. xi-xvi). New York: John Wiley & Sons, Ltd.

Hiles, A., & Barnes, P. (Eds.). (1999). *The definitive handbook of business continuity management*. New York: John Wiley & Sons, Ltd.

Hislop, D. (2005). *Knowledge management in organizations: A critical introduction*. New York: Oxford University Press.

Holtzblatt, K. (2003). Contextual design. In J. A. Jacko & A. Sears (Eds.), *The human-computer interaction handbook: Fundamentals, evolving technologies, and emerging applications* (pp. 941-963). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Inland Empire Group 3 Civil Air Patrol (n. d.). Continuity books. Retrieved February 20, 2008, from http://gp3.cawg.cap.gov/ig_continuitybooks.html

Isaacs, C. (1999). The value of leveraging Y2K inventory information for corporate risk management and model-based contingency planning. *International Systems Frontiers, 1*(2), 163-172.

Jennex, M. E. (Ed.). (2007). *Knowledge management in modern organizations*. Hershey, PA: Idea Group Publishing.

Johnson, R. A., Kast, F. E., & Rosenzweig, J. E. (1964). Systems theory and management. *Management Science, 10*(2), 367-384.

Jonassen, D. H., Tessmer, M., & Hannum, W. H. (1999). *Task analysis methods for instructional design*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Kast, F. E., & Rosenzweig, J. E. (1972). General systems theory: Applications for organization and management. *The Academy of Management Journal, 15*(4), 447-465.

Keyes, J. (2006). *Knowledge management, business intelligence, and content management: The IT practitioner's guide*. New York: Auerbach Publications.

Kidwell, J. J., Vander Linde, K. M., & Johnson, S. L. (2000). Applying corporate knowledge management practices in higher education. *Educause Quarterly*(4), 28-33.

Korea Region BOSS Forum (2006). 2006 Korea region BOSS forum competitions: Continuity book. Retrieved February 20, 2008, from mwr.korea.army.mil/BOSS/Continuity%20Book/Continuity%20Book%20Criteria%202006.doc

Kutler, P., Skerl, K., Linde, C., Smith, C. A., Rosenschein, S., & Goldstein, H. (2005). *Space technology knowledge capture.* Paper presented at the 1st Space Exploration Conference: Continuing the Voyage of Discovery, Orlando, FL.

Lam, A. (2000). Tacit knowledge, organizational learning, and societal institutions: An integrated framework. *Organization Studies, 21*(3), 487-513.

Langer, E. J. (1989). *Mindfulness*. New York: Addison-Wesley Publishing Company, Inc.

Lee, W. L., & Krayer, K. J. (2003). *Organizing change: An inclusive, systematic approach to maintain productivity and achieve results*. San Francisco: Pfeiffer.

Lilley, S., Lightfoot, G., & Amaral, P. (2004). *Representing organization: Knowledge, management, and the information age*. Oxford, England: Oxford University Press.

Lundgren, E. F. (1974). *Organizational management: Systems and processes*. New York: Canfield Press.

Macintosh, A. (1999). Knowledge management. Retrieved May 10, 2009, from http://www.aiai.ed.ac.uk/~alm/kamlnks.html

Marion, R. (2005). *Leadership in education: Organizational theory for the practitioner*. Long Grove, IL: Waveland Press, Inc.

Markus, M. L. (2001). Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success. *Journal of Management Information Systems, 18*(1), 57-91.

Maltz, L., & DeBlois, P. B. (2005). Trends in Current Issues, Y2K-2005. *Educause Quarterly,* (2), 6-23.

McCrackan, A. (2005). *Practical guide to business continuity assurance*. Boston, MA: Artech House, Inc.

Millman, R. W. (1964). Some unsettled questions in organization theory. *The Academy of Management Journal, 7*(3), 189-195.

Molenda, M. (2003). In search of the elusive ADDIE model. *Performance Improvement, 42*(5), 34-36.

Mooradian, N. (2005). Tacit knowledge: Philosophic roots and role in KM. *Journal of Knowledge Management, 9*(6), 104-113.

Mulder, U., & Whiteley, A. (2007). Emerging and capturing tacit knowledge: A methodology for a bounded environment. *Journal of Knowledge Management, 11*(1), 68-83.

Nadler, D. A., Shaw, R. B., Walton, A. E., & Associates (1995). *Discontinuous change: Leading organizational transformation.* San Francisco: Jossey-Bass.

Nascimento, L. (n. d.). Building a useful continuity book. Retrieved February 15, 2008, from http://cawg.cap.gov/html/Pa/bucb.pdf

NFPA (2007). NFPA 1600: Standard on disaster/emergency management and business continuity programs. Retrieved October 6, 2007, from www.nfpa.org/assets/files/PDF/NFPA1600.pdf

Nguyen, F., & Woll, C. A. (2006). A practitioner's guide for designing performance support systems. *Performance Improvement, 45*(6), 37-48.

Nielsen, J. (2005). Ten usability heuristics. Retrieved February 25, 2008, from http://www.useit.com/papers/heuristic/heuristic_list.html

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*(1), 14-37.

Ormrod, J. E. (1999). *Human Learning* (3rd ed.). Upper Saddle River, NJ: Merrill.

Palmer, I., Dunford, R., & Akin, G. (2006). *Managing organizational change: A multiple perspectives approach*. New York: McGraw-Hill.

Pirani, J. A., & Yanosky, R. (2007). Shelter from the storm: IT and business continuity in higher education - Key findings. Retrieved Oct. 10, 2007, from http://www.educause.edu/ecar

Polanyi, M. (1966). *The tacit dimension*. New York: Doubleday & Co.

Pugh, K., & Dixon, N. M. (2008). Don't just capture knowledge - put it to work. *Harvard Business Review, 86*(5), 21.

Reigeluth, C. M. (1999). What is instructional-design theory and how is it changing? In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2, pp. 5-29). Mahwah, NJ: Erlbaum.

Richey, R. C., & Klein, J. D. (2007). *Design and development research: Methods, strategies, and issues*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Richey, R. C., Klein, J. D., & Nelson, W. A. (2003). Developmental research: Studies of instructional design and development. In D. H. Jonassen (Ed.), *Handbook of Research for Educational Communication and Technology* (2nd ed.). Washington, DC: The Association for Educational Communications and Technology.

Rosenberg, M. J. (2006). *Beyond e-learning: Approaches and technologies to enhance organizational knowledge, learning, and performance*. San Francisco: Pfeiffer.

Rosenfeld, L., & Morville, P. (2002). *Information architecture for the world wide web* (2nd ed.). Cambridge, MA: O'Reilly.

Rossett, A. (2000). From training to training and performance. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (pp. 123-132). Upper Saddle River, NJ: Pearson Education, Inc.

Scott, W. R. (2003). *Organizations: Rational, natural, and open systems* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Seels, B., & Richey, R. C. (1994). *Instructional technology: The definition and domains of the field*. Washington, DC: Association for Educational Communications and Technology.

Seidman, W., & McCauley, M. (2005). Saving retiring knowledge workers' "secret sauce". *Performance Improvement, 44*(8), 34-38.

Shackelford, B. (2002). *Project managing e-learning*. Alexandria, VA: ASTD.

Smaldino, S. E., Russell, J. D., Heinich, R., & Molenda, M. (2005). *Instructional technology and media for learning* (8th ed.). Upper Saddle River, NJ: Pearson Education, Inc.

The State of DR Preparedness (2008). Retrieved October 27, 2008, from http://www.drj.com/index.php?option=com_content&task=view&id=794&Itemid=159&ed=10

Sternberg, R. J., & Wagner, R. K. (1986). *Practical intelligence: Nature and origins of competence in the everyday world*. New York: Cambridge University Press.

Stogdill, R. M. (1966). Dimensions of organizational theory. In J. D. Thompson (Ed.), *Approaches to organizational design* (pp. 1-56). Pittsburgh, PA: University of Pittsburgh Press.

Stogdill, R. M. (1967). Basic concepts for a theory of organization. *Management Science, 13*(10), 666-676.

Swanson, M., Wohl, A., Pope, L., Grance, T., Hash, J., & Thomas, R. (2002). *Contingency planning guide for information technology systems*. Washington, DC: U. S. Department of Commerce.

Tracey, W. R. (2003). *The human resources glossary: The complete desk reference for HR executives, managers, and practitioners*. Boca Raton, FL: CRC Press.

Trochim, W. M. K. (2001). *The research methods knowledge base* (2nd ed.). Cincinnati, OH: Atomic Dog Publishing.

Tschannen-Moran, M., & Nestor-Baker, N. (2004). The tacit knowledge of productive scholars in education. *Teachers College Record, 106*(7), 1484-1511.

Vancoppenolle, G. (1999). What are we planning for? In A. Hiles & P. Barnes (Eds.), *The definitive handbook of business continuity management* (pp. 3-23). New York: John Wiley & Sons, Ltd.

Walsh, K. (2008). 5 ways to build a business case for business continuity. Retrieved April 6, 2008, from http://www.csoonline.com/article/221615/_Ways_to_Build_a_Business_Case_for_Business_Continuity?contentId=221615&slug=&

Wasonga, T. A., & Murphy, J. F. (2006). Learning from tacit knowledge, The impact of the internship. *International Journal of Educational Management, 20*(2), 153-163.

Webb, G. R., Tierney, K. J., & Dahlhamer, J. M. (2000). Businesses and disasters: Empirical patterns and unanswered questions. *Natural Hazards Review, 1*(2), 83-90.

Wilson, T. D. (2002). The nonsense of 'knowledge management'. *Information Research, 8*(1). Retrieved from http://informationr.net/ir/8-1/paper144.html

Witty, R. J. (2005). 2005 BCM/DR Survey Results. Retrieved October 27, 2008, from http://www.drj.com/index.php?option=com_content&task=view&id=814&Itemid=500&ed=11

Wong, W. L. P., & Radcliffe, D. F. (2000). The tacit nature of design knowledge. *Technology Analysis & Strategic Management, 12*(4), 493-512.

Yoshida, K., & Deyle, R. E. (2005). Determinants of small business hazard mitigation. *Natural Hazards Review, 6*(1), 1-12.

APPENDICES

Appendix A: Resources Used in Identifying Factors for Continuity Management

A guide to business continuity planning (n.d.). Retrieved October 7, 2007, from http://www.getprepared.ca/_fl/bcont_e.pdf

Barnes, J. C. (2001). *A guide to business continuity planning*. New York: John Wiley & Sons, Ltd.

Beazley, H., Boenisch, J., & Harden, D. (2002). *Continuity management: Preserving corporate knowledge and productivity when employees leave*. Hoboken, NJ: John Wiley & Sons.

Bielski, L. (2002). Thinking the unthinkable: Often dismissed as mere "insurance", disaster recovery ought to be considered part of the lifeblood of any business. *ABA Banking Journal, 94*(1), 44-48.

Bork, D., Jaffe, D. T., Lane, S. H., Dashew, L., & Heisler, Q. G. (1996). *Working with family businesses*. San Francisco: Jossey-Bass.

Cassidy, A. (2006b). *A practical guide to information systems strategic planning*. New York: Auerbach Publications.

Cerullo, V., & Cerullo, M. J. (2004). Business continuity planning: A comprehensive approach. *Information Systems Management, 21*(3), 70-78.

Charters, I. (2007). Good practices guidelines 2007 Available from http://www.thebci.org/gpg.htm

Christopher, J. E. (1998). Minority business formation and survival: Evidence for business performance and viability. *The Review of Black Political Economy, 26*(1), 37-73.

Cline, M. M. (2007). *Institutions of higher education continuity of operations (COOP) planning manual*. Richmond, VA: Virginia Department of Emergency Management.

Cornish, M. (1999). The business continuity planning methodology. In A. Hiles & P. Barnes (Eds.), *The definitive handbook of business continuity management* (pp. 93-130). New York: John Wiley & Sons, Ltd.

DeLong, D. W. (2004). *Lost Knowledge: Confronting the threat of an aging workforce*. New York: Oxford University Press.

Devargas, M. (1999). Survival is not compulsory: An introduction to business continuity planning. *Computers and Security, 18*, 35-46.

Disaster recovery: Business tips for survival (2003). Retrieved January 25, 2008, from http://www.blackburn.gov.uk/upload/pdf/lcc_disaster_recovery.pdf

Elliott, D., Swartz, E., & Herbane, B. (2002). *Business continuity management: A crisis management approach*. New York: Routledge.

Epstein, M. J., & Roy, M. (2001). Sustainability in action: Identifying and measuring the key performance drivers. *Long Range Planning, 34*, 585-604.

FEMA (2006). Emergency management guide for business and industry Retrieved October 12, 2007, from http://www.fema.gov/business/guide/index.shtm

FFIEC (2003). Business continuity planning: IT examination handbook Retrieved October 23, 2007, from http://www.ffiec.gov/ffiecinfobase/booklets/bcp/bus_continuity_plan.pdf

Gibb, F., & Buchanan, S. (2006). A framework for business continuity management. *International Journal of Information Management, 26*(2), 128-141.

Horne, J. F., III (1997). The coming of age of organizational resilience. *Business Forum, 22*(2-3), 24-28.

Howe, J. (1999). Project initiation and management. In A. Hiles & P. Barnes (Eds.), *The definitive handbook of business continuity management* (pp. 107-130). New York: John Wiley & Sons, Ltd.

Jacobson, P. D., Dalton, V. K., Berson-Grand, J., & Weisman, C. S. (2005). Survival strategies for Michigan's health care safety net providers. *Health Services Research, 40*(3), 923-940.

Landsberg, I. (1999). *Succeeding generations*. Boston, MA: Harvard Business School Press.

Laszlo, K. C., & Laszlo, A. (2007). Fostering a sustainable learning society through knowledge-based development. *Systems Research and Behavioral Science, 24*(5), 493-503.

Le Breton-Miller, I., Miller, D., & Steier, L. P. (2004). Toward an integrative model of effective FOB succession. *Entrepreneurship Theory and Practice, 28*(4), 305-329.

Mackie, R. (2001). Family ownership and business survival: Kirkcaldy, 1987-1970. *Business History, 43*(3), 1-32.

Maser, C. (1997). *Sustainable community development: Principles and concepts*. Delray Beach, FL: St. Lucie Press.

McCracken, A. (2005). *Practical guide to business continuity assurance*. Boston, MA: Artech House, Inc.

Mera, L. G. (2005). Explaining Mercosur's survival: strategic sources of Argentine - Brazilian convergence. *Journal of Latin American Studies, 37*(1), 109-141.

Minkoff, D. C. (1993). The organization of survival: women's and racial-ethnic voluntarist and activist organizations, 1955-1985. *Social Forces, 71*(4), 887-909.

Moffatt, I. (1996). *Sustainable development: Principles, analysis, and policies*. New York: Parthenon Publishing Group.

Munier, N. (2005). *Introduction to sustainability: Road to a better future*. New York: Springer.

NFPA (2007). NFPA 1600: Standard on disaster/emergency management and business continuity programs Retrieved October 6, 2007, from www.nfpa.org/assets/files/PDF/NFPA1600.pdf

Open for Business (2006). Retrieved Oct. 6, 2007, from http://www.ibhs.org/business_protection/

Perrina, F., & Tencati, A. (2007). Stakeholder management and sustainability evaluation and reporting system (SERS): A new corporate performance management framework. In P. Sharma, M. Starik & B. Husted (Eds.), *Organizations and the sustainability mosaic: Crafting long-term ecological and societal solutions* (pp. 168-192). Northampton, MA: Edward Elgar.

Ramaprasad, A., Ambrose, P., & Komarov, M. (1998). The power of stakeholders in IS continuity. *Disaster Recovery Journal, 11*(4), ??

Rands, G., Ribbens, B., Casagrande, D., & McIlvaine-Newsad, H. (2007). Envisioning an ecologically sustainable society: An ideal type and an application. In P. Sharma, M. Starik & B. Husted (Eds.), *Organizations and the sustainability mosaic: Crafting long-term ecological and societal solutions* (pp. 22-59). Northampton, MA: Edward Elgar.

Romanelli, E. (1989). Environments and strategies of organization start-up: Effects on early survival. *Administrative Science Quarterly, 34*(3), 369-388.

Schoomaker, P. J. (2006). U. S. Army continuity of operations (COOP) program policy and planning Retrieved October 8, 2007, from www.army.mil/usapa/epubs/pdf/r500_3.pdf

Scott, W. R. (2003). *Organizations: Rational, natural, and open systems* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Smith, M., & Sherwood, J. (1995). Business continuity planning. *Computers and Security*, *14*(1), 14-23.

Swanson, M., Wohl, A., Pope, L., Grance, T., Hash, J., & Thomas, R. (2002). *Contingency planning guide for information technology systems*. Washington, DC: U. S Department of Commerce.

Upton, N., Teal, E. J., & Felan, J. T. (2001). Strategic and business planning practices of fast growth family firms. *Journal of Small Business Management, 39*(1), 60-72.

Wold, G. H. (1997). Disaster recovery planning process, part 1 of 3. *Disaster Recovery Journal* Retrieved January 3, 2008, from http://www.drj.com/new2dr/w2_002.htm

Appendix B: Classifications of Factors for Continuity Management

Classification	Factors
Physical	Equipment, supplies, technologies and telecommunications, physical facilities, geographic location, raw materials, transportation, and staff
Organizational	Training; organizational knowledge; organizational goals; organizational norms, policies, and strategies; size, age, and history; stakeholders; financial support; legislation and regulations; professional and community norms; organizational roles; division of labor and coordination; standardized work processes and operating procedures; rewards; organizational design and structure; hierarchy; distribution of authority; decision-making; change, innovation and adaptation; number and type of tasks; contracts; reputation of the firm; product cost; projects; market environment; data and information; public relations and the media; security and law enforcement; insurance, liability and safety; and contact information
Human	Knowledge and insight, skills, abilities, personality, attitude, values, motivation, demographics, and leadership ability

Appendix C: First Twenty Continuity Factors, Ranked by Times Mentioned

Factors	Resource classification	Frequency of mentions
Equipment	Physical	18
Physical facilities	Physical	16
Telecommunications	Physical	15
Staff	Physical	15
Stakeholders	Organizational	15
Organizational norms, policies, strategies	Organizational	12
Data and information	Organizational	12
Raw materials	Physical	11
Standardized work processes, operating procedures	Organizational	11
Financial support	Organizational	9
Knowledge, insight	Human	8
Division of labor, coordination	Organizational	8
Supplies	Physical	7
Organizational knowledge	Organizational	7
Security, law enforcement, insurance, liability, safety	Organizational	7
Geographic location	Physical	6
Skills, abilities	Human	6
Organizational goals	Organizational	6
Transportation	Physical	5
Training	Organizational	5

Appendix D: Continuity Management/Knowledge Management Tools

for the Organization

Continuity Management Product (company)	Format	Customizable	In Academia
RecoveryPAC, RecoveryPAC Web, RiskPAC (CPACS, LLC)	Database	Yes	
Toolkit (eBRP Solutions)	Database		
MyCOOP (COOP)	Database	Yes	
Phoenix (Binomial International)	Database and templates	No	No
The Comprehensive Crisis and Continuity Program (Disaster Management, Inc.)	Microsoft Word templates	No	Specifically for academic environment
Contingency Pro (LBL Technology Partners)	Database	No	
OpsPlanner (Paradigm Solutions International)	Microsoft Word-like format		No
TrueContinuity (RecoveryPlanner)	Web-accessible database		Limited to response to and communication during an event
LDRPS 10 (Strohl Systems)	Database	Yes	

Appendix E. Characteristics of Continuity Books.

Continuity Book	Format of the document	Focus for the document	Individuals supported	Positions supported
Desktop Knowledge Management - Electronic Continuity Book (1)	electronic	position	single	single
US Marine Corps Bahrain Training Section (2)	electronic document	position	single	single
Andrews Air Force Base Hazardous Materials Emergency Planning, Response, and Management Program (3)	electronic document	program operations	multiple	multiple
Nascimento (4)	paper	position	single	single
Korea Better Opportunities for Single Soldiers (BOSS) program (5)	paper	program	multiple	any
US Air Force Institute of Technology – Education with Industry program (6)	paper	student information	single	single
The Mask Costume Continuity Binder (7)	paper	project	multiple	single
US Air Force Auxiliary, Civil Air Patrol Pennsylvania Wing Group 3 (8)	paper	position	single	single
Harry Potter Continuity Books (9)	paper	project	multiple	single
UCLA Student Fee	website	organizational issues	multiple	any

Advisory Committee (10)				
University of Utah Army ROTC (11)	-	position	multiple	multiple
Civil Air Patrol Cadets (12)	-	position	single	single
Korsgaden (13)	-	position	single	single

Sources:

(1) Lewis, B. (2001). Desktop knowledge management: The role of office continuity systems in retaining corporate memory. *Inside Knowledge*, *5*(4). Retrieved from http://www.ikmagazine.com/xq/asp/txtSearch.desktop+knowledge/exactphrase.1/sid.5973F997-96E6-4F1A-889D-142C1AEF0C61/articleid.582F89D9-5C62-40ED-A4CD-DAEEAB2435E1/qx/display.htm

(2) OMC Bahrain Training Section Continuity Book (n. d.). Retrieved April 21, 2008, from http://www.disam.dsca.mil/itm/SAO/sao_examples/BA%20Tng%20Cont%20NB.pdf

(3)Andrews Air Force Base (1996). Development of a hazardous materials emergency planning and response plan (Hazmat Plan), asbestos management plan, and hazardous waste management plan update. Retrieved February 20, 2008, from www.afcee.brooks.af.mil/eq/programs/summary.asp?rscID=505

(4) Nascimento, L. (n. d.). Building a useful continuity book. Retrieved February 15, 2008, from http://cawg.cap.gov/html/Pa/bucb.pdf

(5) Korea Region BOSS Forum (2006). 2006 Korea region BOSS forum competitions: Continuity book. Retrieved February 20, 2008, from mwr.korea.army.mil/BOSS/Continuity%20Book/Continuity%20Book%20Criteria%202006.doc

(6) Air Force - Education With Industry Handbook. (2007). Retrieved from http://www.afit.edu/cip/docs/2007_EWI_Handbook.pdf

(7) The Mask: Costume Continuity Binder (2000). Retrieved April 21, 2008, from http://www.propstore.com/product-Costume-Continuity-Binder.htm

(8) Lopez, O. (2007). Aerospace Newsletter. Retrieved April 21, 2008, from http://www.pawingcap.com/gp3/gp3ae_newsletter_001_new.htm

(9) National Public Radio (2007). How to Spell the Spells: Continuity in Harry Potter [audio interview]. Washington, D.C.: National Public Radio.

(10) UCLA Student Fee Advisory Committee (2007). Continuity Book. Retrieved February 20, 2008, from http://sfac.studentaffairs.ucla.edu/continuity_book/cb.html

(11) Frederick, E. L. (2004). Army Reserve Officer Corps: UTE Warrior Batallion Handbook. Retrieved February 20, 2008, from www.milsci.utah.edu/pdf/ch-handbook.pdf

(12) wiki.cadetstuff.org. Category: Task. Retrieved April 21, 2008, from http://wiki.cadetstuff.org/index.php?title=Category:Task_Guides

(13) Korsgaden, T. (2004). Staff training for best agency results - Part 3. Retrieved February 20, 2008, from http://www.roughnotes.com/rnmagazine/2004/july04/07p32.htm

Appendix F: Operationalizing a Contextually Holistic Comprehensive Tool

	KM											KH
	Human-Computer Interaction Capabilities					Data Processing Capabilities						
Indicators	Display non-editable content (1)	Display content input area (1)	Display content editing area (1)	Provide multiple methods for displaying related items (1)	Provide controls to initiate action (1)	Provide access with permission (2)	Organize content (3)	Encode, collect, store (3)	Retrieve and display (3)	Filter content in response to requests (3)	Preserve original content through edits (3)	Prompting Questions (4) and Process (5)
Encompasses an organizational unit (Disaster Recovery Journal & DRI International, 2007; NFPA, 2007)	●	●	●		●	●		●	●		●	
Is integrated into the organization (McCrackan, 2005)	●	●	●		●	●	●	●	●	●	●	
Includes all subunits (McCrackan, 2005; Vancoppenolle, 1999)	●	●	●	●	●	●	●	●	●	●	●	
Includes all operations (McCrackan, 2005; Vancoppenolle, 1999)	●	●	●	●	●	●	●	●	●	●	●	●

Includes all resources (McCrackan, 2005; Vancoppenolle, 1999)	●	●	●	●	●	●	●	●	●	●	●	●
Includes all interactions inside the organization (McCrackan, 2005; Vancoppenolle, 1999)	●	●	●	●	●	●	●	●	●	●	●	●
Includes all interactions outside the organization (McCrackan, 2005; Vancoppenolle, 1999)	●	●	●	●	●	●	●	●	●	●	●	●
Includes all procedures to maintain operations (Charters, 2007; McCrackan, 2005; NFPA, 2007; Vancoppenolle, 1999)	●	●	●		●	●	●	●	●	●	●	●
Includes all outputs (McCrackan, 2005; Vancoppenolle, 1999)	●	●	●		●	●	●	●	●	●	●	●

Includes all current threats to the organization (Charters, 2007; McCrackan, 2005; NFPA, 2007; Vancoppenolle, 1999)	●	●	●		●	●	●	●	●	●	●	●
Includes potential interruptions from the actualization of any identified threat (Charters, 2007; McCrackan, 2005; NFPA, 2007; Vancoppenolle, 1999)	●	●	●		●	●	●	●	●	●	●	●

Note:
(1) (Galitz, 2002)
(2) (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986)
(3) (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)
(4) (Rosenberg, 2006; Wong & Radcliffe, 2000)
(5) (DeLong, 2004; Heath, 2003; Jonassen, et al., 1999; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)

Appendix G: Operationalizing a Temporally Holistic Comprehensive Tool

	KM											KH
	Human-Computer Interaction Capabilities					Data Processing Capabilities						
Indicators	Display non-editable content (1)	Display content input area (1)	Display content editing area (1)	Provide multiple methods for displaying related items (1)	Provide controls to initiate action (1)	Provide access with permission (2)	Organize content (3)	Encode, collect, store (3)	Retrieve and display (3)	Filter content in response to requests (3)	Preserve original content through edits (3)	Prompting Questions (4) and Process (5)
Includes past information (Elliott, et al., 2002)	●	●	●		●	●	●	●	●	●	●	●
Includes present information (FFIEC, 2003; Gibb & Buchanan, 2006)	●	●	●		●	●	●	●	●	●	●	●
Includes information for the future (FFIEC, 2003; Gibb & Buchanan, 2006)	●	●	●		●	●	●	●	●	●	●	●

Note:
(1) (Galitz, 2002)
(2) (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986)
(3) (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)
(4) (Rosenberg, 2006; Wong & Radcliffe, 2000)
(5) (DeLong, 2004; Heath, 2003; Jonassen, et al., 1999; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)

Appendix H: Operationalizing a Responsive Comprehensive Tool

	KM											KH
	Human-Computer Interaction Capabilities					Data Processing Capabilities						
Indicators	Display non-editable content (1)	Display content input area (1)	Display content editing area (1)	Provide multiple methods for displaying related items (1)	Provide controls to initiate action (1)	Provide access with permission (2)	Organize content (3)	Encode, collect, store (3)	Retrieve and display (3)	Filter content in response to requests (3)	Preserve original content through edits (3)	Prompting Questions (4) and Process (5)
Includes changes to organizational structure (Hiles & Barnes, 1999; McCrackan, 2005; Swanson, et al., 2002)	●	●	●	●	●	●	●	●	●	●	●	
Includes changes to organizational functions (Hiles & Barnes, 1999; McCrackan, 2005; Swanson, et al., 2002)	●	●	●	●	●	●	●	●	●	●	●	
Provides access to tool (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)	●	●			●	●			●			

Provides access to content (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)	●	●		●	●	●	●		●	●		
Provides navigation of content (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)	●	●	●	●	●	●	●	●	●	●	●	
Provides access any time (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)	●					●						
Provides access from any location (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)	●					●						

Codifies, collects, and stores input (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)					●			●				
Classifies content contextually and temporally (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)					●		●	●				
Filters content in response to requests (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)	●	●		●	●		●	●		●		
Distributes content (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)	●	●	●	●	●		●	●	●	●		

Preserves original content through edits (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)			●		●		●	●			●	

Note:
(1) (Galitz, 2002)
(2) (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986)
(3) (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)
(4) (Rosenberg, 2006; Wong & Radcliffe, 2000)
(5) (DeLong, 2004; Heath, 2003; Jonassen, et al., 1999; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)

Appendix I: Operationalizing an Opportunistic Comprehensive Tool

	KM											KH
	Human-Computer Interaction Capabilities					Data Processing Capabilities						
Indicators	Display non-editable content (1)	Display content input area (1)	Display content editing area (1)	Provide multiple methods for displaying related items (1)	Provide controls to initiate action (1)	Provide access with permission (2)	Organize content (3)	Encode, collect, store (3)	Retrieve and display (3)	Filter content in response to requests (3)	Preserve original content through edits (3)	Prompting Questions (4) and Process (5)
Harvests knowledge while an employee is employed (Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986)	●	●	●	●	●	●	●	●	●			
Harvests organizational-related knowledge of day-to-day operations (Cornish, 1999)	●	●	●	●	●	●	●	●	●	●	●	●
Harvests as much organizational-related knowledge as possible (Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986)	●	●	●	●	●	●	●	●	●		●	●

Harvests organizational-related knowledge at any time (Macintosh, 1999)	●	●	●	●	●	●			●			
Harvests organizational-related knowledge from any location (Macintosh, 1999)	●	●	●	●	●	●			●			
Provides an interactive environment (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)	●	●	●	●	●		●	●	●	●		●
Provides an iterative environment (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)	●	●	●	●	●		●	●	●	●		●
Asks the right questions (DeLong, 2004)	●	●	●	●	●		●	●	●	●	●	●
Provides enough time for responses (DeLong, 2004)												
Uses appropriate vocabulary and language (DeLong, 2004; Heath, 2003; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)	●	●	●	●	●		●	●	●	●	●	●

Note:
(1) (Galitz, 2002)
(2) (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986)
(3) (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)
(4) (Rosenberg, 2006; Wong & Radcliffe, 2000)
(5) (DeLong, 2004; Heath, 2003; Jonassen, et al., 1999; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)

Appendix J: Operationalizing a Usable Comprehensive Tool

	KM											KH
	Human-Computer Interaction Capabilities					Data Processing Capabilities						
Indicators	Display non-editable content (1)	Display content input area (1)	Display content editing area (1)	Provide multiple methods for displaying related items (1)	Provide controls to initiate action (1)	Provide access with permission (2)	Organize content (3)	Encode, collect, store (3)	Retrieve and display (3)	Filter content in response to requests (3)	Preserve original content through edits (3)	Prompting Questions (4) and Process (5)
Facilitates current employees' contribution of organizational-related knowledge and management of organizational-related knowledge and information (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003)	●	●	●	●	●	●	●	●	●	●	●	●

Facilitates a new hire's or temporary replacement's location and retrieval of organizational-related knowledge and information (Beazley, et al., 2002; DeLong, 2004; Eisenhart, 2001; Field, 2003)	●	●		●	●	●	●	●	●	●		

Note:
(1) (Galitz, 2002)
(2) (Cornish, 1999; Eisenhart, 2001; Mulder & Whiteley, 2007; Rosenberg, 2006; Sternberg & Wagner, 1986)
(3) (Alavi & Leidner, 2001; Beckman, 1999; Bergeron, 2003; Cowley-Durst, 1999; Jennex, 2007; Keyes, 2006)
(4) (Rosenberg, 2006; Wong & Radcliffe, 2000)
(5) (DeLong, 2004; Heath, 2003; Jonassen, et al., 1999; Mulder & Whiteley, 2007; Seidman & McCauley, 2005)

Appendix K: Original and Modified Rosenberg Prompting Questions

Original Prompting Questions	Modified Prompting Questions
What precisely is it that you do?	What jobs do you perform? What tasks do you perform?
How often do you do it?	*(For each task identified above)* How often do you perform this task?
How important is it?	How important is this task?
How did you learn to do what you do?	How did you learn to perform this task?
Can you demonstrate what you do?	Can you demonstrate the performance of this task?
What tools and resources do you use to do what you do?	What equipment do you use to perform this task?
Can you or have you ever taught others to do what you do?	Can you or have you ever taught this task to others?
If you had the time and proper support, could you document what you do so that others could do it as well? (1)	Have you documented the performance of this task? Where is this information located?
What have you learned by doing what you do (recommendations, advice to others, lessons learned)?	What have you learned by doing this task? What advice do you have for others who may be performing this task?

Note:
(1) Since this question characterizes the goal of the comprehensive tool, the modified version of the question focused on documentation of the task that may already exist within the organization.
Source: Rosenberg, M. J. (2006). *Beyond e-learning: Approaches and technologies to enhance organizational knowledge, learning, and performance*. San Francisco: Pfeiffer.

Appendix L: Original and Modified Wong and Radcliffe Prompting Questions

Original Prompting Questions	Modified Prompting Questions
What information/knowledge/technique is required in the current situation?	What information is needed for this task? What do you need to know to perform this task? (2) What technique is needed for this task? (2)
What additional factors need to be considered?	What factors need to be considered before you perform this task? What factors need to be considered while you are performing this task?
What equipment/document is required?	What documents can assist in performing this task and where are they located? What equipment is needed to perform this task? (2)
What effect the design task has on the organization, systems, and so on?	What impact does this task have on the organization?
Where should the information/knowledge/technique be applied?	At what point in the process of performing this task is the information needed? (2) At what point in the process of performing this task is the knowledge needed? (2) At what point in the process of performing this task is the technique needed? (2)
Where can the information/knowledge/skills be acquired?	Where can the information needed to perform this task be acquired? Where can the knowledge needed to perform this task be acquired? Where can the skills needed to perform this task be acquired?
Where is the design task to be carried out?	Where do you need to be located to perform this task?
When is the design task to be carried out?	When is this task done?

When shall we use particular information/knowledge/technique?	At what point in the process of performing this task is the information needed? (2) At what point in the process of performing this task is the knowledge needed? (2) At what point in the process of performing this task is the technique needed? (2)
Why do we need to carry out the design task?	Why is this task done?
Why is the particular knowledge/theory/technique used/applicable in this case?	Why is this knowledge needed to perform this task? Why is this theory needed to perform this task? Why is this technique needed to perform this task?
Who will be the most appropriate person for conducting the task?	Who is the most appropriate person to perform this task?
Whom should be contacted for information/knowledge/ technique required?	Who has information that may help you perform this task? Who has knowledge of this task that may help you? Who is familiar with the technique needed for this task?
Who will use the results/products of the task?	Who receives the output from this task?
Which route should be chosen?	Where is the output from this task saved or stored? How is the output delivered?
Which knowledge/theory/technique should be used?	Which knowledge should be used to perform this task? (2) Which theory should be used to perform this task? Which technique should be used to perform this task? (2)
Which equipment/document is required for conducting the task?	Which equipment is needed to perform this task? (2) Which document is needed to perform this task?
Which format is used for presenting the results of the task?	Which format is used for the output for this task?
How to conduct the design task?	What steps are involved in performing this task?

How can the knowledge/theory/technique be applied?	How can the knowledge be applied in the performance of this task? How can the theory be applied in the performance of this task? How can the technique be applied in the performance of this task?
How do we analyze the data obtained and present the results?	How do we analyze the data from this task? How do we present the results of the data analysis?

Note:
(2) The response to this question duplicates information elicited from another question. Only one of the duplicated questions was used in the sequencing. Source: Wong, W. L. P., & Radcliffe, D. F. (2000). The tacit nature of design knowledge. *Technology Analysis & Strategic Management, 12*(4), 493-512.

Appendix M: Adapted Descriptions of the Task Description Method of Task Analysis

Sequence of the Task Description Method	Jonassen, Tessmer, and Hannum (1999) Description	Adapted Description
1. Identify the job	Identify the job to be analyzed	Identify the name of the job
2. Identify tasks that are performed	Identify the tasks that make up that job	Identify the names of the tasks for a selected job
3. Develop a general description for each task	Develop a task description (includes environmental conditions and contingencies)	Identify the aspects of the task when it is viewed as a part of the organization
4. Develop a detailed description of each task	Develop a detailed task description (includes initiation cues, response cues, equipment, specific actions, feedback)	Identify the aspects of the task related specifically to the task
5. Requirements of the task	Analyze each task to determine the requirements (determine the requirements for success)	Identify what is needed to perform the task
6. Determine the structure for performing the task	Determine the structure for the performance	Identify the steps in performing the task, influences on these steps, and handling the output

Note:
Source: Jonassen, D. H., Tessmer, M., & Hannum, W. H. (1999). *Task analysis methods for instructional design*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Appendix N: Alignment of the Modified Prompting Questions with the Task Description Method of Task Analysis

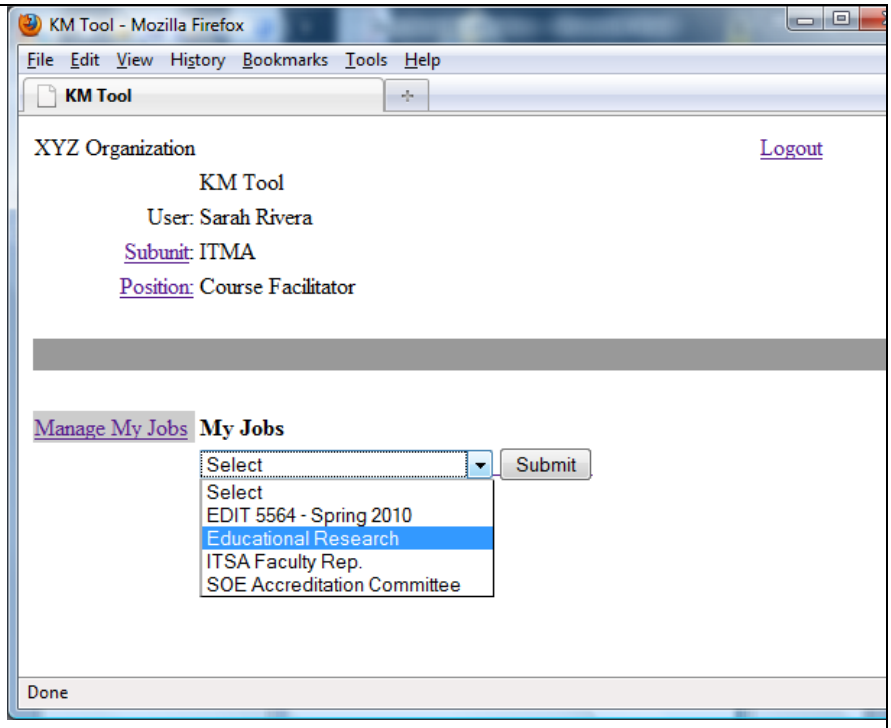
Sequence of the Task Description Method	Modified Prompting Questions	Source		
		Rosenberg	Wong & Radcliffe	Continuity Management Literature
1. Identify the job.	What jobs do you perform?	●		
2. Identify tasks that are performed	What tasks do you perform?	●		
3. Develop a general description for each task	Why is this task done?		●	
	How important is this task?	●		
	What impact does this task have on the organization?		●	
	Who is the most appropriate person to perform this task?		●	
	Can you demonstrate the performance of this task?	●		
	Can you or have you ever taught this task to others?	●		
	What events can threaten the performance of this task?			●
	What interruptions can impact the performance of this task?			●
	What factors need to be considered before you perform this task?		●	
4. Develop a detailed description of each task	When is this task done?		●	
	How often do you perform this task?	●		
	How did you learn to perform this task?	●		
	Have you documented the performance of this task? Where is this information located?	●		
	What have you learned by doing this task?	●		
	What advice do you have for others who	●		

	may be performing this task?			
	What factors need to be considered while you are performing this task?		●	
	Who has information that may help you perform this task?		●	
	Who has knowledge of this task that may help you?		●	
	Who is familiar with the technique needed for this task?		●	
5. Requirements of the task	What do you need to know to perform this task?		●	
	Why is this knowledge needed to perform this task?		●	
	How can the knowledge be applied in the performance of this task?		●	
	Where can the knowledge needed to perform this task be acquired?		●	
	What information is needed for this task?		●	
	Where can the information needed to perform this task be acquired?		●	
	Which theory should be used to perform this task?		●	
	Why is this theory needed to perform this task?		●	
	How can the theory be applied in the performance of this task?		●	
	What technique is needed for this task?		●	
	Why is this technique needed to perform this task?		●	
	How can the technique be applied in the performance of this task?		●	
	Where can the skills needed to perform this task be acquired?		●	
	What documents can assist in performing this task and where are they located?		●	
	Which document is needed to perform this task?		●	
	Where do you need to be located to perform this task?		●	
	What equipment is needed to perform this task?		●	
	What equipment do you use to perform this task?	●		
6. Determine	What steps are involved in performing		●	

the structure for performing the task	this task?			
	At what point in the process of performing this task is the information needed?		●	
	At what point in the process of performing this task is the knowledge needed?		●	
	At what point in the process of performing this task is the technique needed?		●	
	How is the data from this task analyzed?		●	
	How are the results of the data analysis presented?		●	
	Which format is used for the output from this task?		●	
	Where is the output from this task saved or stored?		●	
	Who receives the output from this task?		●	
	How is the output delivered?		●	

Appendix O: Sample Storyboard for the Contributor's Module

Page #: 0D



Page Name:	Select Job
Page Description:	This page allows the user to select a specific job associated with the position selected in the previous screen. This page also allows the user to access the Manage My Jobs page. Selecting a job allows the user to view the tasks associated with the job.
Tool Actions:	Tool displays all jobs associated with the position selected in the previous screen.
User:	Contributor
User Actions:	User selects a job from the list. The jobs are those performed by the user, according to the criteria selected to this point (unit, subunit, and position).
Features:	Contextually holistic: an organizational unit Temporally Holistic: present information Responsive: access to content; filter content in response to requests; navigate content Usable: current employees

Appendix P: Knowledge Harvesting Component Prototype

Knowledge Harvesting & Management Tool
Task Form

Directions: All of the information entered on this form refers to the task identified. Please enter your response to a question in the box beside the question. The size of the box does not suggest a limit on the amount of information you may enter. In some instances, the information to enter is provided.

User Identification

First Name:	
Middle Name or Initial:	
Last Name:	
Unit:	CITSIE
Subunit:	ITMA
Position:	Course Facilitator

Work Identification

What jobs do you perform? (Enter one per form) *(Example: Educational Research)*	
What tasks do you perform? (Enter one per form) *(Example: Grade Lesson 3)*	

Knowledge Harvesting

Step 1: Develop a General Description for Each Task

Why is this task done?	
How important is this task?	
What impact does this task have on the organization?	
Who is the most appropriate	

person to perform this task?	
Can you demonstrate the performance of this task?	
Can you or have you ever taught this task to others?	
What events can threaten the performance of this task?	
What interruptions can impact the performance of this task?	
What factors need to be considered before you perform this task?	

Step 2: Develop a Detailed Description for Each Task

When is this task done?	
How often do you perform this task?	
How did you learn to perform this task?	
Have you documented the performance of this task? Where is this information located?	
What have you learned by doing this task?	
What advice do you have for others who may be performing this task?	
What factors need to be considered while you are performing this task?	
Who has information that may	

help you perform this task?	
Who has knowledge of this task that may help you?	
Who is familiar with the technique needed for this task?	

Step 3: Requirements of the Task

What do you need to know to perform this task?	
Why is this knowledge needed to perform this task?	
How can the knowledge be applied in the performance of this task?	
Where can the knowledge needed to perform this task be acquired?	
What information is needed for this task?	
Where can the information needed to perform this task be acquired?	
Which theory should be used to perform this task?	
Why is this theory needed to perform this task?	
How can this theory be applied in the performance of this task?	
What technique is needed for this task?	

Why is this technique needed to perform this task?	
How can the technique be applied in the performance of this task?	
Where can the skills needed to perform this task be acquired?	
What documents can assist in performing this task and where are they located?	
Which document is needed to perform this task?	
Where do you need to be located to perform this task?	
What equipment is needed to perform this task?	
What equipment do you use to perform this task?	

Step 4: Determine the Structure for Performing the Task

What steps are involved in performing this task?	
At what point in the process of performing this task is the information needed?	
At what point in the process is performing this task is the knowledge needed?	
At what point in the process of performing this task is the technique needed?	
How is the data from this task	

analyzed?	
How are the results of the data analysis presented?	
Which format is used for the output from this task?	
Where is the output from this task saved or stored?	
Who receives the output from this task?	
How is the output delivered?	

Appendix Q: IRB Approval Letter

VirginiaTech

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: September 17, 2010

TO: Kenneth R. Potter, Mary Ellen Pierson

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires June 13, 2011)

PROTOCOL TITLE: Knowledge Harvesting and Management: A Study Investigating the Design and Development of a Tool Incorporating Characteristics of Continuity Management, Knowledge Harvesting, and Knowledge Management

IRB NUMBER: 10-746

Effective September 17, 2010, the Virginia Tech IRB Chair, Dr. David M. Moore, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: **Exempt, under 45 CFR 46.101(b) category(ies) 2**
Protocol Approval Date: **9/17/2010**
Protocol Expiration Date: **NA**
Continuing Review Due Date*: **NA**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Appendix R: IRB Information Sheet

Participants,

As required by the Institutional Review Board, this Information Sheet will provide you with information about this study. Your consent to participate in this study will be implied from your completion of the implementation and evaluation forms.

Title of this Study
Knowledge Harvesting and Management: A study investigating the design and development of a tool incorporating characteristics of continuity management, knowledge harvesting, and knowledge management.

Purpose for the Study
The loss of knowledge built by employees while on the job is being recognized as a resource lost to the organization when employees separate from the organization. This lost knowledge is noted in the literature as a factor in managing the continuity of the organization. This developmental research study will attempt to design and develop a tool that incorporates characteristics of continuity management, knowledge harvesting, and knowledge management to address lost organizational knowledge.

Study Procedures
Your participation in the study may involve the evaluating the tool for compliance with knowledge harvesting and knowledge management specifications as noted in the literature or implementing the knowledge harvesting and management process and evaluating your experiences.

You will need a computer and internet access to complete your part of the study, however it may be completed from any location. The compliance evaluation should take approximately 30 minutes. Completion of the implementation forms may take approximately one hour. The evaluation of the implementation should take approximately 30 minutes.

Benefits
No promise or guarantee of benefits has been made to encourage you to participate in this study.

Freedom to Withdraw
You are free to withdraw from this study at any time without penalty. Please email any of the investigators should you want to withdraw.

Confidentiality
Confidentiality of all data collected will be maintained. Due to the use of email for communication and dissemination of documentation, you will be able to be identified via your email address. However, this information will only be available to the investigators.

Permission

I have read the Information Sheet and the conditions of this study. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent.

Contact Information

Investigators:
Dr. Ken Potter Learning Sciences and Technology, School of Education
kpotter@vt.edu
Mary Ellen Pierson Learning Sciences and Technology, School of Education
khmtest@vt.edu

If I have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email moored@vt.edu; address: Office of Research Compliance, 2000 Kraft Drive, Suite 2000 (0497), Blacksburg, VA 24060.

Appendix S: General Information for Compliance Evaluators

Knowledge Harvesting & Management Tool
General Information and Evaluation Instructions

Thank you for agreeing to participate in this study.

The Knowledge Harvesting & Management Tool is designed to support the continuity of an organization, especially during those times when an employee is not on-the-job. The information entered by a user should help the employee that may replace him or her. It is hoped that responses to the questions in the knowledge harvesting process will provide necessary, but unshared, information.

The implementation context for the KHM Tool will be ITMA, the Instructional Technology Master of Arts distance education program offered by the School of Education at Virginia Tech. The program employs individuals to grade one or more courses; the number of lessons and assignments varies among the courses. Images of the KHM Tool used in the survey demonstrate the use of the tool for the "Telecommunications and Distance Education" course. In these images, the person who grades assignments in a course has the position of "Course Facilitator"; the course is a job; and the assignments within the course, for example "Grade Final Project" and "Grade Final Exam", are tasks.

The purpose for this evaluation is to determine whether the KHM tool complies with the knowledge management and knowledge harvesting specifications identified in the review of the literature. The following notes may be helpful as you complete the evaluation.

Part 1: Knowledge Harvesting
The first part of the evaluation survey involves the interpretation of the knowledge harvesting (KH) specifications for the KHM Tool. The literature indicates that a knowledge harvesting process should include questions, be iterative, be interactive, and proceed in a general-to-specific sequence. Knowledge harvesting questions should prompt for the recall of knowledge and also allow organizational-related knowledge to emerge, allow for elaboration, and use vocabulary and language appropriate for the context.

The KH specifications survey is divided into four sections. In the first three sections you are asked to indicate your agreement, disagreement, or uncertainty that the information meets the specification. In the last section, you are asked to provide suggestions for additional knowledge harvesting questions as well as any additional comments you have about the knowledge harvesting process in the KHM Tool.

Part 2: Knowledge Management
The second part of the evaluation survey involves the interpretation of the knowledge management (KM) specifications for the KHM Tool. For this study, knowledge is considered that which is in the mind; it is personal. Knowledge that is expressed is information. The term

knowledge management is used in this study due to its ubiquity in the literature, realizing that it is information that is being managed.

The literature-based knowledge management specifications for this tool involve collecting, storing, relating, providing access, filtering, and distributing information. The KM Specifications survey is divided into a section for each of the six KM specifications, with several examples provided for each specification. You are asked to indicate your agreement, disagreement, or uncertainty that the KHM Tool incorporates the specification through the example provided in the image or images. At the end of the survey, please indicate any additional comments you have about the KHM Tool

Accessing the evaluation survey instrument
The knowledge harvesting compliance survey is available online at:
https://survey.vt.edu/survey/entry.jsp?id=1287508174866

The knowledge management compliance survey is available online at:
https://survey.vt.edu/survey/entry.jsp?id=1286818222830

No username or password is needed to access the survey.

Please complete the compliance evaluation by: Wednesday, November 3rd.

If you have any questions, please email me at: khmtest@vt.edu

Mary Ellen Pierson

Appendix T: General Information for Contributors

Knowledge Harvesting & Management Tool
General Information & Evaluation Instructions

Thank you for agreeing to participate in this study.

The purpose for this evaluation is to **identify any problems you experience** with the knowledge harvesting process as it is designed for the Knowledge Harvesting & Management Tool. The attached Task Form is a replica of the web-based prototype. It is designed to include all literature-based questions. As you proceed through the form, please keep a list of any problems or questions that arise. If you have any problems that need to be addressed immediately, please email me at the address below.

The following notes may be helpful as you complete the attached form.

- The work you perform for ITMA can be divided into jobs, and each job can be divided into tasks. The course (or courses) you facilitate is a job and the assignments you grade are the tasks for the job. For example, your job could be "Educational Research" and two of your tasks for this job could be "Grade the Research Report" and "Grade Lesson 3".

- The purpose for your responses to the questions is to help the next person grading your course. Your responses will provide necessary, but perhaps unshared, information and should be written so a new ITMA course facilitator will understand them.

- The Task Form is divided into three sections. The first involves identifying the user (you), the second involves identifying the work (a job and a task) you perform as an employee of ITMA, and the third involves the details regarding the performance of the task.

- The Task Form is designed to collect information regarding **one task**. One copy of the form is provided. **Please make copies of the form to complete the information for additional tasks**. For example, use one copy of the Task Form to respond to the items regarding your task "Grade Lesson 3", and another copy for your task "Grade the Research Report".

- For the purposes of this evaluation, please complete a Task Form for **three different tasks**. Since it is possible that you facilitate only one course, these tasks will relate to the same course. If you facilitate more than one course, the tasks you choose may relate to a single course or to different courses.

- It is possible that some questions may not be relevant to the work you perform. Make note of these questions, as this information will inform further development of the tool.

- You may contact me at any time during this evaluation (khmtest@vt.edu).

- When finished, please return your list of problems/questions along with the completed Task Forms to me via email. All problems addressed via email will be included in the final list of issues identified.

Appendix U: Application of Design Guidelines for the Administrator's Module

Design Guideline (Galitz, 2002)	Description	Application
Organization	• Logical and sequential user interactions • Natural progression of steps	• Taxonomy-based organization
Navigation	• Align and group elements to define structure • Supports logical and sequential flow • Progressive disclosure	• Location navigation includes unit and subunit • Category navigation based on taxonomy • Functionality navigation includes all functionality available for the content • Functionality navigation links are visible only within category • Multiple-step functions include step-based navigation within the interfaces for the function • User can return to category's main menu from category navigation
Control Placement	• Top-to-bottom, left-to-right flow of information • Hierarchical and simultaneous	• Same control placement scheme and types of navigation as in the contributor's module • Control to cancel the action is included on relevant pages
Visual Clutter and Amount of Information	• Reduce visual clutter by identifying unique elements • Present only necessary information on the page	• Interaction area same as in contributor's module • Information about the category is displayed on the main menu page for each category • Separate information area is provided

Focus, Emphasis, and Aesthetics	• Color for organization, identification, and emphasis • Graphics, icons, and images	• Same color scheme and layout as for the contributor's module

Appendix V: Sample Mapping Table

Webpage	Name of Database Field	Retrieved from DB table, master association table, memory	Storage location (DB table, memory)	Write to Association Table
kh-step1.html **kh-step2.html** **kh-step3.html** **kh-step4.html** *Purpose: after selecting a task, the contributor is taken to the first page of these four. These pages allow for responses to the prompting questions to be edited or new information input. All questions assigned to a step must be displayed.* *These pages serve as a template to demonstrate how the information should be displayed on the page.* *The user must have the ability to select any step of the 4-step process to respond to questions and manage previous responses.*	employeeid	memory		master
	username	memory		
	fname	memory		
	lname	memory		
	unitid	memory		master
	unit_name	memory		
	subunitid	memory		master
	subunit_name	memory		
	positionid	memory		master
	position_name	memory		
	jobid	memory		master
	job_name	memory		
	taskid	memory		master
	task_name (list of current)	tasks		
	stepid	steps		master
	step_name	steps		
	questionid	questions		master
	question	questions		
	responseid	master	responses (new)	master
	response	responses	responses	

Appendix W: Publisher's Permission to Reprint

From: Johnson, Bradley - Hoboken [mailto:bjohns@wiley.com]
Sent: Friday, March 13, 2009 1:44 PM
To: Mary Ellen Pierson
Subject: RE: Republication/Electronic Request Form

Mary,

This will be fine. In order to provide you with out agreement, please provide the URL where the thesis will appear. Access is not required, this information is used solely for licensing purposes only.

Thank You,

Brad Johnson, Permissions Assistant - John Wiley & Sons Inc. - 111 River St. - Hoboken, NJ 07030 - Mail Stop 4.02 - Ph: 201.748.6786 - Fax: 201.748.6008 - bjohns@wiley.com

Visit our website <http://www.wiley.com/go/permissions> for permissions information

-----Original Message-----
From: Mary Ellen Pierson [mailto:mapierso@vt.edu]
Sent: Friday, March 13, 2009 1:17 PM
To: Johnson, Bradley - Hoboken
Subject: RE: Republication/Electronic Request Form

Mr. Johnson,

Virginia Tech requires that dissertations be published in PDF format and uploaded into a database maintained by the library. Access to this information requires a Virginia Tech ID and password, and would be accessible by faculty, staff, and students. Access can be limited, but this is usually the decision of the student's committee. If this is something you would require, I can certainly convey this to my committee.

If print copies are wanted, they would be created only for the four faculty members of my committee.

I hope this information meets your needs. However, if more detail is needed, please let me know.

-Mary Ellen Pierson

-----Original Message-----
From: Johnson, Bradley - Hoboken [mailto:bjohns@wiley.com]
Sent: Friday, March 13, 2009 1:03 PM
To: mep@vt.edu
Subject: FW: Republication/Electronic Request Form

Dear Ms. Pierson:

Please describe how our content would be reused/distributed.

Thank You,

Brad Johnson, Permissions Assistant - John Wiley & Sons Inc. - 111 River St. - Hoboken, NJ 07030 - Mail Stop 4.02 - Ph: 201.748.6786 - Fax: 201.748.6008 - bjohns@wiley.com

Visit our website <http://www.wiley.com/go/permissions> for permissions information

-----Original Message-----
From: republication@wiley.com on www.wiley.com [mailto:webmaster@wiley.com]
Sent: Thursday, March 12, 2009 12:02 PM
To: Republication
Subject: Republication/Electronic Request Form

A01_First_Name: Mary Ellen
A02_Last_Name: Pierson
A03_Company_Name: Virginia Tech
A04_Address: 220 War Memorial (0313)
A05_City: Blacksburg
A06_State: VA
A07_Zip: 24061
A08_Country: US
A09_Contact_Phone_Number: 540-651-6313
A10_Fax:
A11_Emails: mep@vt.edu
A12_Reference:
A13_Book_Title: Beyond E-Learning: Approaches and Technologies to Enhance Organizational Knowledge, Learning, and Performance
A40_Book_or_Journal: Book
A14_Book_Author: Marc Rosenberg
A15_Book_ISBN: 978-0787977573
A16_Journal_Month:
A17_Journal_Year:
A18_Journal_Volume:
A19_Journal_Issue_Number:
A20_Copy_Pages: page 124, bulleted list
A21_Maximum_Copies: 5
A22_Your_Publisher: Virginia Tech
A23_Your_Title: no title at this time
A24_Publication_Date:
A25_Format: Other
A41_Ebook_Reader_Type:
A26_If_WWW_URL:
A27_If_WWW_From_Adopted_Book:
A28_If_WWW_Password_Access:
A45_WWW_Users:
A29_If_WWW_Material_Posted_From:
A30_If_WWW_Material_Posted_To:
A42_If_Intranet_URL:
A32_If_Intranet_From_Adopted_Book:
A33_If_Intranet_Password_Access:

A48_Intranet_Users:
A34_If_Intranet_Material_Posted_From:
A35_If_Intranet_Material_Posted_To:
A50_If_Software_Print_Type:
A60_If_Other_Type: Ph.D. Dissertation
A37_Comments_For_Request: In case it is not clear from the information above, I would like permission to adapt the questions presented in a bulleted list on page 124 of the indicated work.

Thank you.

Appendix X: Sample Interface for a Recipient