THE ROLE OF TACIT KNOWLEDGE NETWORKS IN A STATE AGENCY: AN ANALYSIS BASED ON A GROUNDED THEORY APPROACH

by

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Abstract

This research study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of critical functions for a state agency. Employees participate in both strong and weak networks in which tacit knowledge is shared. Strong networks are primarily restricted to immediate geographical areas resulting from lack of time and resource allocations to support participation. Network membership or isolation, the type of knowledge shared, introduction to networks, and roles in networks vary according to tenure within the organization. Networks are strongly impacted by the agency culture and its role as a government organization. Sharing of knowledge results in improved processes, shared workloads and eased work assignments. Networks were strongly impacted by retirements and attrition over the last decade resulting in dissolution or weakening of these connections.

Dedication

This project is dedicated to the memory of my husband, Mitch, who always believed I could do anything and provided me with unconditional support, and to my four awesome children, Rose, Lee, Lewis and Kelly, whose patience, support, enthusiasm and understanding has been much appreciated.

Acknowledgments

I thank my chair, John Whitlock, for his support and guidance throughout this process, and the members of my committee, Mary Evans, Carol Rusaw and Martha Hale for their time, feedback and support. This study would not have been possible without the support, encouragement and assistance of many people including Gary Allen, Harry Carter, Barb Neyman, Patricia Locke, and Michelle Eichorn.

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CHAPTER 1. INTRODUCTION

Introduction to the Problem

Organizational knowledge is evidenced in documents and within individual employees' experience and know-how. Senior employees often hold the most unwritten knowledge and engage in the most diverse and extensive networks to share that knowledge. To be valuable to the organization, the knowledge must be shared and available to all who have need of it. Management must be aware of and support these networks and the knowledge held to leverage it to benefit the organization. Knowledge of these networks is especially vital to government agencies given the high percentage of employees eligible for retirement within the next five years.

Knowledge within an organization can reside in many locations and in different formats. The knowledge found in written formats such as procedure manuals is referred to as explicit knowledge while the knowledge that resides within individuals is commonly referred to as tacit knowledge. Polanyi (1966) defines tacit knowledge as knowing more than we can express or put into words, that we are aware of or understand but would find it difficult to explain to others how or why. Tacit knowledge originates with the individual and it is necessary for that knowledge to transfer from person to person to be used by the organization. Nonaka and Takeuchi (1995) refer to this as socialization, the sharing of experience to create shared mental models as through apprenticeships. As it is not always written down, the transfer of tacit knowledge relies on the willingness and ability of the individuals and the organization to share what is known with others. It is only through this sharing that the organization can benefit from tacit knowledge (Alavi & Tiwana, 2001). Walsh and Ungson (1991) describe five repositories for knowledge in

organizations: individuals, roles and organizational structures, standard operating procedures and practices, culture, and the physical structure of the workplace.

Knowledge management evolved as an approach to addressing the need to preserve organizational knowledge to benefit the organization. Knowledge management is the identification, collection, organization and dissemination of critical knowledge within an organization. According to Ives, Torrey and Gordon (1998), knowledge management is an attempt to identify what knowledge an organization holds, who has need of it and ensuring that it is provided at the right time. Rubenstien-Montano, Buchwalter and Liebowitz (2001), provide eight key indicators that a knowledge management initiative is needed: 1) the average age of employees is senior; 2) lack of a mentoring program between experts and novices; 3) little funding for development and training; 4) lack of time for informal knowledge sharing; 5) loss of knowledgeable employees; 6) lack of capture and documentation of knowledge; 7) lack of knowledge about what other departments do; and 8) large amounts of time spent looking for information. All of these indicators are present in the proposed study location.

Explicit knowledge is readily available to the organization and to employees through document repositories found online and on desks; tacit knowledge is not. Frappaolo and Wilson Todd (2000) referenced a 1999 survey by Delphi Group that asked companies about their primary knowledge repositories and responses indicated that on average, 42 per cent of the corporate knowledge was within the minds of employees. This percentage indicates the need for a major focus of a knowledge management program to be on identifying and facilitating the transfer of tacit knowledge. Risk of tacit knowledge loss can occur both when a large percentage of employees are eligible for retirement and when a functional area is staffed by a limited

number of employees (McBriar, et. al., 2003). If undocumented, knowledge is not easily shared within the organization and instead may only be available within small groups of employees. The value of tacit knowledge to the organization can only be realized if it identified and appropriately shared.

Knowledge transfer refers to identifying knowledge held by an individual or group and sharing that knowledge with another individual or group, resulting in a change of how the business process is approached, considered or handled (Argote & Ingram, 2000). The transfer benefits the receiver and the organization, but the source of the knowledge may perceive it as costly as knowledge may be seen as a source of power or insurance that the organization will not be able to replace them thereby securing longevity in the workplace (Davenport, Eccles and Prusak, 1992; Jarvenpaa and Staples, 2001; Reagans & McEvily, 2993; Szulanski, 1996) and therefore be unwilling to share it with the organization. The individual controls what knowledge is shared, not the organization (Bhatt, 2002, p. 33). According to Jarvenpaa and Staples (2001)

> Social exchanges of information and knowledge are similar to economic exchanges in the sense that there is an expectation of some future return for sharing. But unlike economic exchanges, there is no understanding of the value of what has been shared and no clear expectation of exact future return…. Individuals participate in social exchanges to maintain future relationships, the balance of power, and image (p. 153).

Okhuysen and Eisenhardt (2002) argue that for groups to be effective, "knowledge that is 'owned' by individual members of such groups must spiral up to groups and even organizations, where it can be exploited to further the goals of the organization" (p. 370). It is only through

sharing that knowledge and incorporating it into organizational processes and procedures that the organization can realize the financial benefit (Clarke & Rollo, 2001).

One way that tacit knowledge is shared is through employee networks, in which members share more effective methods to perform tasks (Choi & Lee, 2003; Cross, Davenport & Cantrell, 2003). Membership in these networks provide employees with access to new and supporting knowledge and the opportunity to share knowledge with others based on network roles (Davern, 1997). Identifying and supporting the role of networks within the agency will assist in maintaining the flow of knowledge between employees and provide an outlet for the long-term knowledge to become a part of the institutional structure. "Managers must accept the inevitability of employee turnover, and through an understanding of social networks, make structural changes to their organization which promotes the diffusion of knowledge before crucial information is lost" (Droege & Hoobler, 2003, p. 59). Public entities in particular need to focus on capturing this tacit knowledge held by employees as evidenced by the rising human capital crisis resulting from the eligibility of over half the U.S. government employees (Liebowitz, 2003). These statistics are echoed in the employee demographics of state and local governments as well.

The presence and support of networks within the organization support knowledge sharing by creating opportunities for employees to exchange information and insight informally as well as formally (Bhatt, 2000; Connelly & Kelloway, 2003). Often, the size of the organization influences how easily and readily employees share information. The smaller the organization, the more likely employees will share as they know and trust each other (Connelly & Kelloway, 2003; Knowledge Management Working Group, 2001). Senior people are more experienced in

sharing knowledge due to larger networks and investing time in assisting new employees to build these networks in the first three to five years of employment is a profitable investment by the organization (Connelly & Kelloway, 2003; Sveiby & Simons, 2002).

While knowledge may be found in written documents, it is the undocumented knowledge that is most valuable to an organization. Transferring the knowledge held by individuals to other employees and making it available to the organization requires management to acknowledge its existence and to support mechanisms to transfer it. Given the increasing number of employees eligible for retirement, especially within the public sector, transferring knowledge held by long-term, experienced employees is a priority to mitigate the risk of losing valuable organizational knowledge. Recognizing the role and supporting employee networks as a conduit for knowledge sharing within organizations can lead to more effective and efficient work performance.

Background of the Study

The Virginia Department of Transportation has just over 9000 employees of whom approximately twenty-eight percent are eligible for retirement within the next five years.

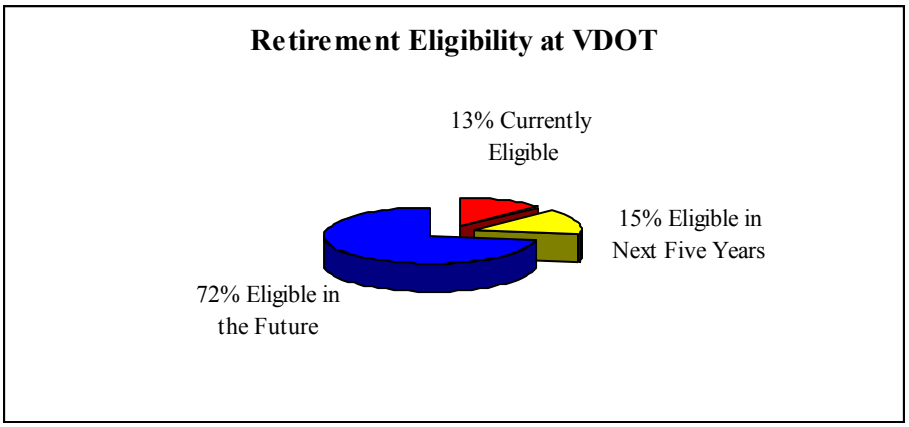

Figure 1: Retirement Eligibility at VDOT

The agency experienced a previous loss of knowledge in the mid-90s during a statewide workforce reduction resulting in a loss of productivity and effectiveness. To mitigate the loss, the agency hired former employees as contractors to continue the work. These former employees are now approaching second retirements, which will also impact the agency. To prevent a recurrence, the agency instituted a knowledge management division in late 2003 to address critical knowledge identification, collection, organization and dissemination.

Statement of the Problem

The state agency is anticipating a significant loss of knowledge with impending retirements of approximately twenty-eight percent of employees in the next five years. Employees hold valuable, undocumented knowledge and to benefit the organization, it must be shared. Identifying existing employee networks and the role the networks play in disseminating valuable, tacit knowledge in a state government organization will assist leadership in facilitating wider knowledge dissemination and retaining critical organizational knowledge.

Purpose of the Study

This research study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of a state agency. Results will be used by the specific agency to develop and implement future programs and interventions to identify, collect, organize and disseminate organizational knowledge. What is learned in this study may provide insight to researchers and practitioners examining knowledge management practices and programs in similar settings. It will extend the understanding of the knowledge management field in understanding how knowledge is shared and used specifically within a government

organization and provide researchers and practitioners with insight into the development of programs and interventions to encourage knowledge sharing between government employees.

Rationale

Grounded theory supports discovery and explanation of actual events at a specific location. "One of the strengths of grounded theory is that it explains what is actually happening in practical life at a particular time, rather than describing what should be going on" (McCallin, 2003, p. 203). In a grounded theory study, the variables are not known and are dependent on the context. The researcher is attempting to discover patterns of behavior of a specific group of people within a specific context. This approach allows the researcher to begin with a general question that narrows, focuses and becomes more specific as data is collected.

Grounded theory has been used in previous research studies involving knowledge management. Awazu (2004) used a grounded theory approach to develop propositions regarding the affect of informal social network roles on distributed knowledge management in high technology firms. Berends, van der Bij, Debackere and Weggeman (2003) used grounded theory to analyze observations of the origination mechanisms of knowledge sharing in two industrial research groups. Janczak (1999) used the approach to understand middle managers' activities and the implications for organizational knowledge and learning. Mohrman, Tankasi, and Mohrman (2003) employed grounded theory to explore the role of social networks in organizational change in eight companies while Simoni (2003) used a grounded theory approach to look at an engineering firm's capitalization of knowledge in research and development projects.

Research Questions

This research study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of critical functions in a state agency. Research questions in grounded theory identify the phenomenon to be studied (Backman & Kyngas, 1999). Several research questions covering cause, context, conditions, interactions and consequences were explored to assist in this discovery and understanding.

1. In what types of networks do employees in VDOT participate?
2. What types of knowledge are shared within the networks?
3. What are the employees' roles within the networks?
4. How do employees become aware of the existence of networks?
5. When do employees become aware of the existence of networks?
6. How do employees become a part of a network?
7. How do managers view employee networks?
8. How do the networks impact assigned work tasks and functions?
9. What is the affect on employee productivity and effectiveness if the network dissolves?
10. How are networks used to disseminate knowledge within the organization?

Significance of the Study

Knowledge held by the organization is reflected in operating procedures and systems, it is how the organization performs its work (Bryant, 2003). Knowledge held by the individual is a reflection of expertise, a knowing that informs the individual how to best accomplish a task (Constant, Kiesler & Sproull, 1994). Knowledge, particularly tacit knowledge, provides organizations with unique assets contributing to competitiveness and affecting financial returns.

The involuntary loss of organizational knowledge is costing companies millions of dollars every year. When a company finds itself in the situation of having to reinvent or buy knowledge it once had, resources are wasted. In that situation, not only is the time and money spent developing those skills lost, but there is also an opportunity cost (de Holan, Phillips and Lawrence, 2004, p. 45)

Turnover of employees will occur in all organizations due to retirements, new opportunities for the employee and unforeseen circumstances. To prevent the loss of knowledge, organizational support of employee networks to transfer critical knowledge and information is needed. "Managers must accept the inevitability of employee turnover, and through an understanding of social networks, make structural changes to their organization which promotes the diffusion of knowledge before crucial information is lost" (Droege & Hoobler, 2003, p. 59). According to Lang (2001), bureaucratic organizational cultures have formal, hierarchical knowledge exchanges, which limit access and participation by any other than top management.

Very little research has been done in this area in government organizations that are impacted by cyclical leadership, politics and bureaucratic structure. Much of the literature on knowledge management in government focuses on the use of technology, promotion of knowledge management, strategy and explicit knowledge (Goral, 2000; Liebowitz, 2003; Nicholson-O'Brien, 2000; Rubenstein-Montano, 2001; Wiig, 2002). This study contributes to the knowledge of the field by highlighting how tacit knowledge networks contribute to the exchange and dissemination of critical knowledge used to perform work within a government organization.

Definition of Terms

Knowledge: According to Webster's New World Dictionary of the American Language (1966), knowledge is defined as "the act, fact, or state of knowing; specifically, *a)* acquaintance or familiarity (with a fact, place, etc.). *b)* awareness. *c)* understanding" (p. 809). In this study, knowledge is defined as the technical, social and political information individuals have learned through formal and informal learning.

Explicit Knowledge: According to Webster's New World Dictionary of the American Language (1966), explicit means "clearly stated; distinctly expressed; leaving nothing implied; definite" (p. 513). Combine with the definition of knowledge given above. In this study, explicit knowledge is defined as information available in written format such as policies, procedures and memoranda.

Tacit Knowledge: According to Webster's New World Dictionary of the American Language (1966), tacit is defined as "not expressed or declared openly, but implied" (p. 1483). Combine with the definition of knowledge given above. In this study, tacit knowledge is defined as the experience and know-how held by an individual that is not available in written format.

Tacit Knowledge Network: According to the Webster's New World Dictionary of the American Language (1966), a network is any arrangement or fabric of parallel wires, threads, etc., crossed at regular intervals by others fastened to them so as to leave open spaces … or a thing resembling this in some way" (p. 986). Combine with the definition of tacit and knowledge given above. In

this study, a tacit knowledge network is defined as individuals who connect to share experience, know-how, and unwritten knowledge with others.

State Agency: An organization of a state of the U.S. with a specific charge or responsibility in service to the people of the state, such as transportation. A state agency relies on funding by the legislature and is accountable to the legislature for the services and products provided.

Assumptions and Limitations

It was assumed that participants in the study provided accurate information regarding personal tacit knowledge networks used in the course of work. It was further assumed that employees within the state agency participate in multiple networks through which a significant proportion of knowledge is obtained. A limited number of participants who are members of critical career groups were included in the study and were expected to be representative of employees in the agency. It was assumed the participants would have varying levels of technical, social and political experience within the agency. Some would function as resources to other employees for critical organizational knowledge while others would seek knowledge. Participants were identified and interviewed until categories of collected data are saturated. Representatives rather than the entire population were interviewed to keep the volume of data manageable. The theory generated from the data collected from these participants is specific to the agency studied and may not be applicable to other state organizations.

The researcher conducted the study within the organization in which she is employed, the Virginia Department of Transportation. This provided the empathy and an insider's perspective called for by grounded theory to support a theoretical sensitivity to the data. However, it was

important to maintain an awareness of the possible bias to the data as a result of the familiarity. This was done through the use of memoing to assist the researcher in recognizing when familiarity was supporting understanding of the data and when it was influencing the interpretation of the data. Data was collected through interviews, observations, and analysis of available documents. This triangulation supported the validity of the data.

Nature of the Study, or Theoretical/Conceptual Framework

According to the Knowledge Management Working Group of the Federal Chief Information Officers Council (2001), there are several reasons employees do not share knowledge. People may not know what they know, how to share or with whom to share, or sharing may be seen as too difficult or time consuming. In a study, Chiem (2001) found that government employees may perceive knowledge sharing as just more work and may resist the building of a knowledge sharing culture. Employees may be intimidated about sharing by the presence of superiors. "Employees will not share knowledge among all group members if the groups are constrained by hierarchies or perceived power imbalances—people are inhibited by their superiors" (Connelly & Kelloway, 2003, p. 295).

Following an analysis of the literature, a conceptual framework of factors affecting tacit knowledge networks in a state agency was developed to guide the researcher in the study. This framework is represented within Figure 2.

People form tacit knowledge networks, which contribute to the creation and sharing of knowledge within the organization. It was expected that the political environment, management, employees' physical locations, potential retirements of long-term employees, the organizational culture, and employees' positions would affect the role of the networks.

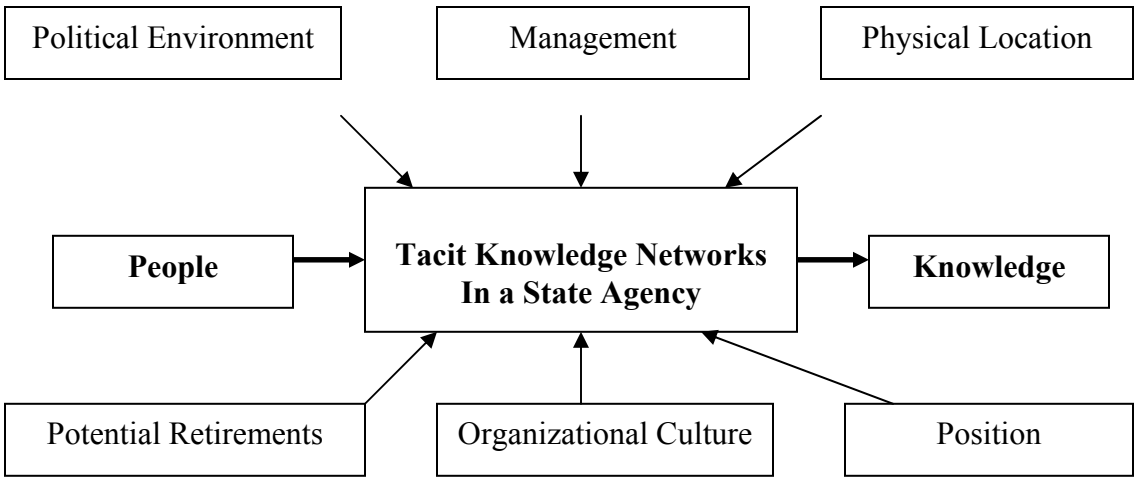

Figure 2: Factors Affecting Tacit Knowledge Networks in a State Agency

Organization of the Remainder of the Study

Chapter two reviews the relevant literature and research impacting the study. Chapter three outlines the methodology employed in the study. Chapter four presents the analysis of the data. Chapter five presents the theory grounded in the data of the study, conclusions and suggestions for further research.

CHAPTER 2. LITERATURE REVIEW

Introduction

The initial literature review was performed to provide background that might be used during the constant comparison of the data to provide varying perspectives and to stimulate ideas. It was also performed to delineate what is known and unknown about the role of tacit knowledge networks in public organizations and to ensure that the proposed study addresses a gap in the research base. The exploration of tacit knowledge and its impact on an organization is one dimension of the field of knowledge management and thus it was important to define first what knowledge management is and then explore the role of tacit knowledge particularly in public organizations. As this research focused on tacit knowledge networks, the role of networks and members was examined along with impact on an organization, the type of knowledge shared within networks, and management perceptions.

Knowledge Management

Knowledge management emerged in the late 1980s and early 1990s as a response to the realization that valuable organizational knowledge, the collective knowledge that makes a company unique, was at risk and that the loss could compromise a company's ability to compete or operate in an increasingly complex environment. "In the mid-1980s, individuals and organizations began to appreciate the increasingly important role of knowledge in the emerging competitive environment" (Wiig, 1997, p. 6). The original focus was on the private sector and the non-tangible assets of a company. In 1991, Skandia created a position of Director of Intellectual Capital and during the 1990s articles and books on corporate knowledge management began to appear (Wiig, 1997). The federal government and public organizations

such as the military branches began to pursue knowledge management a few years later. In 1999, the federal government appointed its first chief knowledge officer for the General Services Administration (Federal CIO Council; Rubenstein-Montano, 2001). In 2000, there were only four knowledge officers in the government, the GSA, the state department, the Navy and the Coast Guard (Matthews, 2000).

The risk of knowledge loss emerged as management within organizations turned away from an apprentice/mentoring approach in developing employees. "From very early times, wise people have secured sustained succession by transferring in-depth knowledge to the next generation" (Wiig, 1997, p. 7). Such trends as rightsizing and reorganizations destroyed or compromised tacit knowledge networks along with the pending retirements of long-term employees and the mobility of the new workforce, where the informal contract between the company and an employee moved from employment for life to employment for as long as there is mutual benefit (Smith, 2001). Knowledge management is an attempt to identify what knowledge an organization holds, who has need of it and ensuring that it is provided at the right time (Ives, Torrey & Gordon, 1998).

Knowledge management is also defined as the identification, collection, organization, dissemination and utilization of critical knowledge within an organization. Knowledge management provides organizations with the means to be competitive and efficient. "The reasons why companies invest in KM [knowledge management] are that it either gives them a temporal effectiveness or efficiency advantage over their competitors, or they do it to try to negate the competitive advantages of others" (Marr, Gupta, Pike & Roos, 2003, p. 773). It also provides the means to transfer knowledge between individuals and groups. Knowledge transfer refers to

identifying knowledge held by an individual or group and sharing that knowledge with another individual or group, resulting in a change of how the business process is approached, considered or handled. "Although knowledge transfer in organizations involves transfer at the individual level, the problem of knowledge transfer in organizations transcends the individual level to include transfer at higher levels of analysis, such as the group, product line, department, or divisions" (Argote & Ingram, 2000, p. 151). The transfer of knowledge is evidenced when a change in performance of the organization results. "Knowledge transfer in organizations manifests itself through changes in the knowledge or performance of the recipient units" (Argote & Ingram, 2000, p. 151).

Tacit Knowledge

Knowledge held by the individual is a reflection of expertise and experience, influences the attitudes of individuals and is a knowing that informs the individual how to best accomplish a task (Constant, Kiesler & Sproull, 1994). Tacit knowledge is based on experience and is affected by context. Individuals may be unable to express the knowledge held that assists in making decisions or performing tasks, the know-how (Koskinen, 2003). "Knowledge is information combined with experience, context, interpretation, and reflection" (Davenport, De Long & Beers, 1998, p. 43). It is difficult to transfer because it is not easily written or expressed. "Because tacit knowledge is difficult to convey, its transfer requires greater effort" (Reagans and McEvily, 2003, p. 245). Polanyi (1966) defines tacit knowledge as knowing more than we can express or put into words, that we are aware or understand but would find it difficult to explain to others how or why. Therefore, tacit knowledge is more easily expressed using metaphors or through demonstration. It is tacit knowledge that is most valuable to an individual or organization

because it is unique and scarce. "… organizational knowledge can be intangible, tacit, path dependent, and idiosyncratic. All these features make knowledge a valuable asset and a source of competitive advantage" (Patriotta, 2004, p. 5).

Tacit knowledge originates with the individual and it is necessary for that knowledge to transfer from person to person to be useful to the organization. One way of transferring is described by Nonaka and Takeuchi (1995) as socialization, the sharing of experience to create shared mental models as through apprenticeships. Alavi and Tiwana (2001) state

> Clearly, knowledge assets are of value only to the extent that they are actually applied in the operations of an organization. Since the most valuable of any organization's knowledge is tacit, its members' ability to pool and apply their tacit knowledge is the most pronounced predictor of its value (p. 6).

However, tacit knowledge must be applied carefully. According to Bontis (1999), much of the literature fails to acknowledge that while tacit knowledge can contribute to the competitiveness of an organization it can also limit its competitiveness if that knowledge does not fit the context of the desired industry.

Frappaolo and Wilson Todd (2000) referenced a 1999 survey by Delphi Group that asked companies about their primary knowledge repositories and responses indicated that on average, 42 per cent of the corporate knowledge was within the minds of employees. "Across industries during 1998 and 1999, there developed a clear perception that the tacit knowledge base could account for the majority of an organisation's collective knowledge" (Clarke and Rollo, 2001, p. 209). This knowledge might be transferred between individuals or groups but may not be as accessible to everyone in the organization as codified knowledge. According to Ruddy (2000),

> A great deal of knowledge in an organization is undocumented and therefore isn't easily available to everyone. It may be shared among a few individuals or within local groups, but rarely migrates outside those circles. This is especially so for 'practical know-how', but also true for more formal kinds of knowledge that people discover and create every day (p. 38).

Tacit knowledge can be shared through apprenticeships and opportunities for employees to work together and share common experiences to in turn, share that experience with others in the organization. While it might not be possible to write the knowledge down, it may be possible to demonstrate it.

Tacit knowledge is produced by the individual and changed by experience. Cook and Brown (1999) say that "part of the conventional understanding of knowledge in our culture: the idea that knowledge, particularly anything that might pass as rigorous knowledge, is something that is held in the head of an individual" (p. 384). The knowledge is dynamic and can change frequently and take on new meaning as a result of new experiences (Davenport, De Long & Beers, 1998). Bhatt (2002) states that an organization cannot dictate tacit knowledge sharing, so it becomes critical to provide incentives to employees to persuade them to share knowledge and add to the organization's knowledge.

Tacit Knowledge and Culture in Public Organizations

Bartlett (2003) conducted a study of innovation in the public sector that revealed "most of the information which was generated tended to be treated on a very informal basis and resided mainly in the heads of the individuals most closely concerned with the innovation" (p. 355). Public entities in particular need to focus on capturing this tacit knowledge held by employees.

"Throughout the U.S. government, the federal civil servant population is facing a human capital crisis as over half the workforce will be eligible to retire in the next few years" (Liebowitz, 2003, p. 71). These statistics are echoed in the employee demographics of state and local governments as well.

Holsapple and Joshi (2002) state that "an organization's values, principles, norms, and unwritten rules and procedures comprise its cultural knowledge resource …[which] influences each participant's use of knowledge as well as the interactions among participants' knowledge" (p. 53). Culture affects knowledge by determining how it is used and shared within the organization. "Culture embodies all the unspoken norms, or rules, about how knowledge is to be distributed between the organization and the individuals in it" (DeLong & Fahey, 2000, p. 118). Knowledge creation and sharing is affected by the organizational culture. "An organizational culture that enforces a policy of command and control to create an order seldom provides opportunities to create knowledge" (Bhatt, 2000, Managing knowledge section, ¶1). This command and control may inhibit the informal exchange of knowledge. Sveiby and Simons (2002) found that "a culture of trust and collaboration improves knowledge sharing and organizational effectiveness in general is argued by several authors, who also link trust, collaboration and knowledge sharing" (p. 421). Participants of a senior knowledge managers' focus group "described a knowledge-sharing culture as one where people share openly, there is a willingness to teach and mentor others, where ideas can be freely challenged and where knowledge gained from other sources is used" (Smith & McKeen, 2003, Section 2, ¶ 2).

According to DeTienne and Jackson (2001), effective and successful sharing of tacit knowledge "will usually not come from a knowledge management team dictating what

knowledge to share nor from well-constructed databases, but rather from cultivating a corporate culture that encourages sharing among employees and by facilitating communication throughout the organization" (p. 6). Fahey and Prusak (1998) note that when management recognizes that knowledge is part of a process rather than an object, it will be recognized that it is affected by the organization's structure and systems. Often knowledge sharing is confined to small groups of employees who have developed a trusting relationship over the years. "A great deal of knowledge in an organization is undocumented and therefore isn't easily available to everyone. It may be shared among a few individuals or within local groups, but rarely migrates outside those circles" (Ruddy, 2000, p. 38).

According to Chiem (2001), presenting knowledge sharing as a way to make jobs easier can assist is making the practices appealing to government employees. McAdam and Reid (2000) found that the public sector organizations viewed the major benefits of knowledge management to be improved efficiency and quality and public employees received intrinsic benefits related to job enrichment from participation. "The non-information sharing culture of many government agencies is perhaps one of the greatest barriers that many agency directors will face" (Auditore, 2003, p. S4). According to the Knowledge Management Working Group of the Federal Chief Information Officers Council (2001), there are several reasons employees do not share knowledge. People may not know what they know, how to share or with whom to share, or sharing may be seen as too difficult or time consuming. In a study, Chiem (2001) found that government employees may perceive knowledge sharing as just more work and may resist the building of a knowledge sharing culture. Employees may be intimidated about sharing by the presence of superiors. "Employees will not share knowledge among all group members if the

groups are constrained by hierarchies or perceived power imbalances—people are inhibited by their superiors" (Connelly & Kelloway, 2003, p. 295). According to Chatzkel (2002), knowledge sharing in government organizations must contend with the 'not invented here' syndrome and the 'knowledge is personal power' issues. For others, sharing knowledge seems like a lot of work for little return. "Knowledge sharing provides intangible and uncertain rewards, is not always noticed by influential others, and may involve more significant effort or sacrifice" (Connelly & Kelloway, 2003, p. 294).

According to Adler, Goldoftas and Levine (1999), management's task is to create an environment that promotes interaction between the individual and the organization to share knowledge. Brief and Motowidlo (1986), state that leadership style and organizational climate affect prosocial organizational behavior. Prosocial behavior supports knowledge sharing. Leaders determine what activities are rewarded by role modeling and supporting wanted behavior. "Leaders have direct control over what activities are rewarded, what behaviors are encouraged and how work will be valued in the organization. These factors all influence workers' motivation and ability to develop new knowledge" (Bryant, 2003, p. 35). "Leaders usually start to evolve organizational culture by influencing the visible part of the culture (artifact), which then gradually causes the invisible part to start changing too. Leaders set the desired behavior by using symbols and signals to influence the corporate culture" (Ribiere & Sitar, 2003, p. 43).

Transformational leaders excel at building relationships. "Transformational leaders create an atmosphere conducive to knowledge creation, sharing and exploitation. In particular, by using charisma, encouraging intellectual development and by paying individual attention to

workers, transformational leaders motivate their workers to create and share knowledge" (Bryant, 2003, p. 37). Transactional leaders are focused on establishing and meeting goals. According to Bryant (2003), "transactional or non-charismatic leaders aspire to achieve solid, consistent performance that meets agreed upon goals" (p. 37). Both types of leadership impact knowledge management and ideally, both types will be present within the organization to be made available when the need arises. The transformational leader will inspire employees to share knowledge while the transactional leader will support specific knowledge sharing activities that impact the goals of the organization.

Gupta, Dirsmith and Fogarty (1994) conducted a study on the effect of institutional forces in a work unit setting, Results indicated support for "the institutional theory position that government and professional organizations apply bureaucratic control that is unrelated to work-unit performance, while backstage they coordinate and control and improve work-unit performance through the more social and idiosyncratic personal and group modes" (p. 277). In other words, within a bureaucratic organization that focuses on goals, leadership supports the personal interactions necessary to promote knowledge sharing beneath the surface while publishing and enforcing rigid processes and procedures in the more visible arena. The emphasis of the organization as a whole is to apply rigid controls to the work while individual managers decide whether or not to empower employees to be creative and innovative in performing work. According to Cristol (2002), "public service is often stymied by complacent workers, low standards, poor training, and unreasonable hiring and promoting practices" (p. 13). In contrast to this view, Chiem (2001) found that "public sector workers are apt to respond positively to an initiative that they perceive as contributing to the organization's overall mission. [Therefore] a

successful and widely deployed knowledge management program must link strongly to their organization's goals" (A sense of mission section, ¶ 3).

Government organizations have a regular change in leadership based on election cycles with leadership often being political appointees. As these organizations face impending knowledge crises due to the loss of long-term employees, it is necessary to establish a knowledge sharing culture that will survive changing leadership and assist the organization in meeting its goals. Placing civil employees in management positions that are not affected by the election cycle to ensure that these processes stay in place will benefit government institutions. These senior managers will need to focus on the employees. According to Rubenstein-Montano, Buchwalter and Liebowitz (2001), "the notion of people/culture over technology is particularly relevant for KM initiatives in the government because the U.S. government is 'facing a people crisis'" (2. Knowledge management section, ¶ 4).

In a case study of the Social Security Administration, Rubenstien-Montano, Buchwalter and Liebowitz (2001) identified the following barriers to sharing knowledge: 1) lack of resources; 2) failure to recognize individual contributions; 3) assignment to leadership positions that were not based on merit or experience; 4) hierarchical organizational structure; and 5) an organization driven by legislation" (7. Findings and conclusions section, ¶ 2). Chatzkel (2002), states that the main barriers to knowledge sharing in government organizations are the 'not invented here' syndrome and personal power issues. Government employees hoard knowledge to support the security of their role in the institution. To combat this, leadership needs to establish a performance culture that rewards employees for sharing knowledge.

> Agencies that expect to make the best use of their human capital will need to establish a strong performance culture—including appropriate performance measures and rewards and a focus on continuous learning and knowledge management—that supports employees in the accomplishment of their organizational mission (Walker, 2001, p. 8).

Focusing on human capital within government organizations and promoting the sharing of knowledge will assist these institutions with continuing fulfillment of the mission despite the loss of long-term employees. "The key change for agency leaders who hope to improve their agencies' human capital management is to focus on people as a strategic asset" (Walker, 2001, p. 10).

Changing the infrastructure of a government agency to make knowledge sharing easier will be difficult. "Unlike their peers in private enterprise, government workers must also complete paperwork for even the simplest tasks. This demand can potentially hamper workers' productivity and create an institutional tendency to perform only the minimum job requirements" (Chiem, 2001, ¶ 3). To counteract this, government agencies will need to put in place senior management who can lead the organization through the changes in political leadership while maintaining support for knowledge sharing and ensuring the agency meets its mission. This senior management will need to be comprised of both transformational and transactional leaders who can support both goals. According to Bryant (2003), transformational leadership encourages knowledge creation and sharing while transactional leadership encourages the exploitation of existing knowledge through the establishment of systems and structures.

According to the Knowledge Management Working Group of the Federal Chief Information Officers Council (2001), "approximately 71% of federal senior executives will be

eligible to retire by 2005. And unless the knowledge of those leaving is retained, service to citizens will likely suffer" (Executive Summary section, ¶ 11). State government mirrors the demographics of the federal government leading to the possibility of large amounts of critical knowledge walking out the door unless steps are taken to preserve it within the organization. One step is to encourage the exchange of knowledge to share what is known and to facilitate the creation of new knowledge. "The need to share some practice to be able to share new ideas reveals the challenge of workplace communication and coordination" (Brown & Duguid, 2001, p. 204).

Networks

It is the very elusiveness of tacit knowledge that contributes to the difficulty in studying how it is transferred within an organization as it often occurs within the social networks that have been formed among employees. The transfer requires that members of the network share a common framework to effectively share knowledge (Augier & Vendele, 1999). According to Swan, Newell, Scarbrough and Hislop (1999), "knowledge has to be continuously negotiated through interactive social networking processes." It is the organization's responsibility to establish a culture or environment that supports the forming of these networks, both loose and tight, to encourage the sharing of knowledge (Droege & Hoebler, 2003; Swan, Newell, Scarbrough & Hislop, 1999). The American Productivity & Quality Center (1999) identified six factors that influence knowledge sharing: 1) tying it to strategic business goals; 2) the presence of human networks within the organization; 3) the behavior of leaders, especially senior leaders; 4) organizational culture; 5) the integration of knowledge sharing with daily work; and 6) reinforcing knowledge sharing through the use of rewards, recognition, training and practice.

The presence and support of networks within the organization supports knowledge sharing by creating opportunities for employees to exchange information and insight informally as well as formally. "Multiple interactions are important because they facilitate the process of 'knowing,' by allowing organizational members to build different realties and readjust their belief systems in fast changing environments" (Bhatt, 2000, What is knowledge section, ¶ 4). "When people who work together talk to each other, the subject of their conversation inevitably returns to what they have most in common; their work. The inevitable non-work related conversations are not a waste of time: they serve to increase trust" (Connelly & Kelloway, 2003, p. 295). Often, the size of the organization influences how easily and readily employees share information. The smaller the organization, the more likely employees will share as they know and trust each other (Connelly & Kelloway, 2003; Knowledge Management Working Group, 2001). "Employees' ages and career stage may also affect their knowledge sharing behaviors through the size and utility of their social networks" (Connelly & Kelloway, 2003, p. 297). Sveiby and Simons (2002) found that senior people are more experienced in sharing knowledge than junior people due to larger networks and that investing time in assisting new employees to build these networks in the first three to five years of employment is a profitable investment by the organization.

Within organizations, informal or social networks connect employees within and across functional areas and departments. According to Davern (1997), "a social network consists of a series of direct and indirect ties from one actor to a collection of others, whether the central actor is an individual person or an aggregation of individuals (e.g., a formal organization). A network tie is defined as a relation or social bond between two interacting actors" (p. 288). Castell (2000)

defines networks as "a set of interconnected nodes. A node is the point where the curve intersects itself. Networks are very old forms of social organization. But they have taken on a new life in the Information Age by becoming information networks, powered by new information technologies" (p. 15). Within organizations, these networks transmit information and knowledge needed by employees to perform work tasks, be aware of shifts in the environment and to prepare for change. The node is an individual within the social network. According to Castells (2000), the importance of a network node is based on its ability to process and share information quickly which leads to trust by others in the network.

These connections between nodes, or people, provide individuals with access to others that might not otherwise be possible.

> In the 1960s, an American psychologist named Stanley Milgram tried to form a picture of the web of interpersonal connections that link people into a community. To do so, he sent letters to a random selection of people living in Nebraska and Kansas, asking each of them to forward the letter to a stockbroker friend of his living in Boston, but he did not give them the address. To forward the letter, he asked them to send it only to someone they knew personally and who they thought might be socially "closer" to the stockbroker. Most of the letters eventually made it to his friend in Boston. Far more startling, however, was how quickly they did so—not in hundreds of mailings but typically in just six or so. … Milgram's findings became famous and passed into popular folklore in the phrase "six degrees of separation (Buchanan, 2002, p. 3.)

Individuals have contacts and direct relationships that can be tapped to perform tasks and through these relationships there is also access to a wider array of resources. Davern (1997)

states "resources are a function of the actor's own resources as well as the resources of all of his or her contacts" (p. 290). These resources may be used to benefit the organization.

According to Lesser and Prusak (2001), when organizations downsize, it is often the most knowledgeable employees who leave first resulting in damaged critical social network and an increase in time needed for knowledge transfers. This often occurs when organizations offer buy-outs and early retirement incentives without considering the knowledge held by those designated as eligible, which is what occurred in the state agency for this study. These knowledgeable employees have built and maintained extensive networks used to share knowledge. "What really distinguishes high performers from the rest of the pack is their ability to maintain and leverage personal networks. The most effective knowledge workers create and tap large, diversified networks that are rich is experience and span all organizational boundaries" (Cross, Davenport & Cantrell, 2003, p. 20). Awareness of and support for these networks and the individuals within is a critical function of leadership and management as the networks are used daily in completion of work. "The traditional organization chart may show who reports to whom, but often who talks to whom is more important in getting work done and generating new ideas" (Foster & Falkowski, 1999, p. 53).

According to Bogenrieder and Nooteboom (2004), networks have three components: structure, peoples' positions within the network and the strength of ties. Structure refers to how dense the network ties are or how many ties bind individuals within the network together. According to Rowley (1997) "in sparsely connected networks, some sections of the network may become isolated, or segregated cliques develop, restricting communication between actors" (p. 897). Positions indicate the role played by individuals within the network. A central position

indicates multiple connections. “This has implications for power, in terms of access to alternative members, bargaining power, control of information and gossip, coalition formation, and a policy of ‘divide and rule’” (Bogenrieder and Nooteboom, 2004, p. 292). This is echoed by Davern (1997), who states that power is derived from position within the social network structure and breadth of access to exchange partners. According to Burt (as cited in Bogenrieder and Nooteboom, 2004) “structural holes refer to gaps in the network structure, with some participants isolated from other participants” (p. 292).

Another position is that of the boundary spanner, contacts who have ties with other networks and support knowledge diffusion through the networks across the organization (Foster & Falkowski, 1999). Granovetter (1973) refers to this position as a bridge between two sectors. Hislop, Newell, Scarbrough and Swan (2000) state external networking and the use of spanners leads to the introduction of change and innovation while internal, intra-organizational networking contributes to the formation of coalitions and using internal knowledge. A third position is found on the periphery of the network and may be occupied by agency experts who are tapped for knowledge as needed. It is also where the unconnected or isolated individual resides. Most individuals are general nodes of the clusters within the network-binding people together.

Ties determine how closely related nodes are within the network. According to Granovetter (1973) “the strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie” (p. 1361). (parentheses in original) The stronger the tie between two actors, the more the ties held with others are similar, creating a redundancy in knowledge (Granovetter,

2003). According to Hansen (1999), ties among team members are considered weak when they have distant relationships and their interactions are infrequent. These weak ties lead to more innovation and creativity as connections bring together non-redundant knowledge. Dense ties imply a shared context and environment between members. "The more shared experience people have, the greater cognitive similarity will be, and communication can take place efficiently, in 'short-hand' communication with jargon that can be taken for granted, while not making sense to outsiders" (Bogenrieder and Nooteboom, 2004, p. 291). However, this same similarity may interfere with the community's ability to be innovative and to create new knowledge, which requires looser ties. (Furlong & Johnson, 2003).

Networks allow individuals to access more knowledge than what may be available individually through personal education or experience or through immediate co-workers. "External memories are accessed through directories held in the mind of individual team members that identify existence, location, and mechanisms for retrieval of knowledge held by other team members or in various storage devices" (Alavi and Tiwana, 2001, p. 11). These connections may be direct or indirect. "In contrast to formal organizations networks represent loose couplings among the entities included" (Augier and Vendele, 1999, p. 254). Networks also support the creation of new knowledge through access to individuals with different expertise and experience brought together for special projects or to brainstorm. "Most knowledge creation occurs within the context of social systems such as problem-solving groups and project teams" (Alavi and Tiwana, 2001, p. 3).

Networks support the exchange and dissemination of knowledge. What is exchanged or shared depends on what individuals are connected. According to Cowan and Jonard (2003), "the

details of who is connected to whom will clearly effect what type of information is passed, how much, and how efficiently" (p. 1558). Organizations may construct networks through the use of communities of practice or encourage employees to belong to networks that span organizations. According to von Hippel, Hicks and Schrader (as cited in Cowan and Jonard, 2003) "in-depth empirical research indicates that most industries have a well-established informal network through which knowledge is traded: even among competitors knowledge is exchanged, but in a barter arrangement" (p. 1559).

According to Brown and Duguid (2001), networks that cut across the organization horizontally are where knowledge flows. Knowing which individuals are contained within the network or what expertise the individual has is necessary for managers to construct project teams to create or manage solutions to organizational challenges. It is also useful to know when the knowledge does not exist within the organization, but rather outside it and who within has access to it. "Thus, a prerequisite for effective knowledge integration in teams is knowing who has the required knowledge and expertise, where the knowledge and expertise are located, and where they are needed" (Alavi and Tiwana, 2001, p. 10). In addition, knowledge of these networks and expertise can be used to provide new employees with access to necessary knowledge to perform work tasks. "New staff and staff in new roles can be productive much more quickly by accessing the institutional knowledge base" (Burk, 2000, p. 18). When the network is disrupted due to retirements, downsizing or restructuring, or when management is unaware of the existence of the network, access to organizational knowledge and expertise by new staff or staff placed in new roles is blocked. "New staff or staff facing new problems are unaware of these ad-hoc communities and are unable to tap into their expertise. Expertise learned from experience is lost

with retirement. Staff turnover and restructuring break down the informal networks to the point where even long-term staff do not know who to call" (Burk, 2000, p. 18). "Just as the apprentice learns the tools of the trade from a master, businesses gain from the knowledge shared by mentors, supervisors, co-workers, project team members, and long-tenured employees" (Droege & Hoobler, 2003, p. 50).

Access to experts within the organization is important to problem solving, building the knowledge base of employees and innovation in product construction or delivery. "The role of experts is important as they are ultimately the source of the innovations or knowledge that is being diffused. Consequently, they form local peaks in the knowledge distribution, and agents directly connected to them benefit, becoming second-order experts" (Cowan & Jonard, 2003, p. 1568). By sharing knowledge with others, the demand on the time of experts is lessened freeing the expert to focus on high value projects. It also supports the redundancy of knowledge within the organization ensuring that knowledge does not walk out the door. Lesser and Prusak (2001), state that

> our research and experience at the Institute for Knowledge Management has shown that social networks play a critical role in helping people identify, share and work with corporate knowledge. Through such networks, individuals identify experts, provide referrals for those seeking answers and facilitate knowledge transfer among groups. Downsizing disrupts the structures and causes 'potholes' that impede and often block the flow of knowledge. Individuals who previously connected disparate groups may leave (Damage to Social Networks section, ¶ 1).

Employees leave organizations for a variety of reasons: personal, professional advancement and retirement. “Managers must accept the inevitability of employee turnover, and through an understanding of social networks, make structural changes to their organization which promote the diffusion of knowledge before crucial information is lost” (Droege & Hoobler, 2003, p. 59). Support of the informal or social network by management encourages the sharing and retention of knowledge by the organization. Lubit (as cited in Droege & Hoobler, 2003), states that “because the sharing of tacit knowledge requires high levels of individual interaction through reciprocity exchange relationships, it is advantageous that individual relationships be strongly embedded within a firm’s social structure” (p. 55).

Knowledge is a critical component of an organization’s ability to perform effectively and efficiently. Much of this critical knowledge is held by individuals within the organization in tacit form, many of whom are long-term employees nearing retirement. According to Carey (2003)

> The Bureau of Labor Statistics notes that 19 percent of baby boomers holding executive, administrative, and managerial positions are expected to retire in just the next five years, and the number of boomers who become eligible for retirement will remain steady—at 12,480 per day—from 2010 until the mid-2020s. And believe it or not, the public sector has a more immediate crisis: By 2005, more than half of the 1.8 million federal government employees will be eligible for retirement, including 71 percent of those within the senior executive ranks (¶ 4).

The ability of the organization to support knowledge transfer between employees to preserve the knowledge within the organization is key to organizational performance. The role of management is to ensure that the networks, which connect individuals, are accessible. “Rather

than being an issue of controlling and directing flows of knowledge, then the task of managing knowledge networks is one of creating accessibility" (Augier &Vendele, 1999, p. 255). Another role for management is to create opportunities for employees to enter networks and build relationships. "Although higher performers seem to have a natural ability to find points of commonality with others, managers can also help employees forge productive relationships" (Cross, Davenport & Cantrell, 2003, p. 20). This can be accomplished by providing opportunities for employees to work together, connect on non-work related items, include personal interests in expert directories, and include personal dimensions in face-to-face meetings (Cross, Davenport & Cantrell, 2003).

According to Nardi, Whittaker and Schwarz (2004), organizational change, which can be manifested in downsizings, mergers, acquisitions and restructuring results in established role-based structures no longer being available to workers with a labor or information need as these changes have altered or eliminated the traditional structures. According to Shah (2000), layoffs damage existing organizational networks, both social and advice, leading to a decrease in productivity as employees rebuild the necessary networks to aid in task completion. It is management's role to be aware of and support these established networks during times of change and to support the forging of strong and weak ties to exchange knowledge. Strong ties allow for the exchange of complex knowledge and lead to redundancy. Weak ties support creativity and innovation by bringing together employees operating within different contexts and with different knowledge bases. According to Granovetter (1973), weak ties are efficient for knowledge sharing because they give access to new information by bringing together groups and individuals in organizations that do not interact regularly. Weak ties lead to innovation and creativity.

However, weak ties also make it difficult to absorb complex, tacit knowledge (Augier and Vendele, 1999).

According to Ciborra (as cited in Augier and Vendele, 1999), "the role of management in relation to knowledge networks is that of suiting the organization to cope with unpredictability and chaotic environments where sudden events can tilt established patterns of routines and capabilities" (p. 258). Droege and Hoobler (2003) "suggest that three conditions—interaction, collaboration, and access to non-redundant tacit knowledge—are necessary for embedding tacit knowledge within the knowledge, skills, and abilities of employees" (p. 56). Therefore, the organization needs to support networks with clusters of strong ties and bridges to other networks operating under different contexts and with different knowledge bases to enable knowledge redundancy and to create opportunities for creation and innovation.

Summary

The knowledge management field emerged in the early 1990's in response to the loss of critical organizational knowledge resulting from the loss of long-term employees and the mobility of the new workforce. A 1999 Delphi Group study of companies found that on average forty-two percent of corporate knowledge resided within the minds of employees underlining the value of tacit knowledge and the need to address its retention and develop methods to ensure its transfer between employees and groups. Successful knowledge transfer is measured by change in the knowledge or performance of the recipient.

Tacit knowledge is a reflection of the expertise and experience of an individual and informs the individual of how to best perform a task. It is not easily transferred to explicit, or codified, knowledge, but can be shared through verbal discussions and demonstration, both of

which can be accomplished within a network. The role of management is to support and extend the transfer so that the organization retains critical knowledge. Since the transfer of knowledge is often contained within personal networks, part of management support should be to identify networks, encourage participation by employees and to develop methods to transfer knowledge between networks in support of organizational retention of critical and unique knowledge.

Culture affects how knowledge is used and shared within the organization. State government organizations tend toward a bureaucratic, command and control culture that relies heavily on published procedures and policies, at least on the surface. However, managers and leaders within these organizations can support and encourage knowledge sharing within personal networks and assist in transferring that knowledge beyond individual networks. Studies have demonstrated that if the transferred knowledge results in improved quality and efficiency of work that public sector employees will support and participate in the activity as there is intrinsic value in doing so. There is a need for strong, dense networks to support redundancy of knowledge and for weaker networks with loose ties to support creativity and innovation. Network positions indicate roles played by employees in coordinating or contributing to knowledge sharing within the network and between networks.

The majority of research conducted in tacit knowledge sharing and networks has occurred in the corporate world. There were no studies revealed in the literature review that looked specifically at tacit knowledge networks within government agencies and thus no research conducted to determine if these networks function the same or differently from those in the corporate world. Given the more rigid culture often found in government agencies that are mandated to perform work in prescribed ways as directed by law, it is possible that networks will

function and be viewed by management differently than in the corporate environment. Understanding the role of these networks in a government agency can provide necessary knowledge to management to develop tools and techniques to support continued knowledge sharing and to mitigate the loss of knowledge resulting from the increasing departure of long-term and key employees.

CHAPTER 3. METHODOLOGY

Purpose of the study

The risk of knowledge loss emerges as organizations face the loss of tacit knowledge held by long-term employees to retirement and other types of separation, like movement to positions in other organizations. Such trends as 'rightsizing' and reorganizations have destroyed or compromised tacit knowledge networks along with the pending retirements of long-term employees and the mobility of the new workforce where the informal contract between the company and an employee moved from employment for life to employment for as long as there is mutual benefit (Smith, 2001). Organizations must accept employee turnover but must also determine how to transfer the tacit knowledge held by employees to others so that it is not lost. "Managers must accept the inevitability of employee turnover, and through an understanding of social networks, make structural changes to their organization which promotes the diffusion of knowledge before crucial information is lost" (Droege & Hoobler, 2003, p. 59).

Knowledge management is an attempt to address how to identify, collect, organize and disseminate the knowledge within an organization. Identifying tacit knowledge and how it is shared across the organization is part of the purpose. Employee networks appear to contribute to the dissemination of personal and organizational tacit knowledge. "From very early times, wise people have secured sustained succession by transferring in-depth knowledge to the next generation" (Wiig, 1997, p. 7). This research study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of a state agency.

Research questions

This research study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of critical functions in a state agency. Research questions in grounded theory identify the phenomenon to be studied (Backman & Kyngas, 1999). Several research questions covering cause, context, conditions, interactions and consequences were explored to assist in this discovery and understanding.

1. In what types of networks do employees in VDOT participate?
2. What types of knowledge are shared within the networks?
3. What are the employees' roles within the networks?
4. How do employees become aware of the existence of networks?
5. When do employees become aware of the existence of networks?
6. How do employees become a part of a network?
7. How do managers view employee networks?
8. How do the networks impact assigned work tasks and functions?
9. What is the affect on employee productivity and effectiveness if the network dissolves?
10. How are networks used to disseminate knowledge within the organization?

Research design

This study used a grounded theory approach to develop a substantive theory, one that concentrates on a specific social process based in a narrow setting (Chiovitti & Piran, 2003). A substantive theory has relevance for the population involved and may be modified (Backman & Kyngas, 1999). Grounded theory "emerged as an alternative strategy to more traditional approaches to scientific inquiry which relied heavily on hypothesis testing, verificational

techniques, and quantitative forms of analysis which were particularly popular in the social sciences at that time [1960s]" (Babchuk, 1997, p. 1). It begins with a broad question which narrows and focuses during the course of the research as concepts and relationships emerge. "What most differentiates grounded theory from much other research is that it is explicitly emergent. It does not test a hypothesis. It sets out to find what theory accounts for the research situation as it is" (Dick, 2002, p. 4). Following the initial data collection, provisional hypotheses and concepts were formed which guided further data collection and analysis. Therefore, an inductive process was used to form initial concepts and additional data which led to a deductive process to develop the substantive theory.

Rationale for methodology

Grounded theory bases the explanation of the phenomena within the body of data. It then takes into account organizational complexities and the resulting theory looks at the process and change related to organizations and social interactions. It is an inductive, iterative approach to developing theory (Janczak, 1999; Orlikowski, 1993). The use of this methodology to conduct an in-depth study of the role of tacit knowledge networks within a government institution was the best choice as the purpose was to learn how these networks are formed and structured and the role they play in knowledge transfer in the organization through the eyes of the participants.

To provide new insight into management problems and to develop new models, researchers turn to the development of new theory. Indeed the grounded theory approach is intellectually challenging and relevant to management researchers. The grounded theory approach forces the researcher to think in both analytical and conceptual ways, and can be used

by management academics as a basis for teaching new ways to interpret and evaluate the existing management theory (Trim & Lee, 2004).

> The argument put forward for the application of grounded theory methodology in management research is that micro level concerns such as complexity and context and other unique variables, gravitates towards applying research methods that explicate interpretive understanding and accounts for what is occurring and why. Grounded theory particularly orients towards eliciting deep rather than general connotations (Douglas, 2003, p. 51).

This methodology permitted the researcher to explore phenomena that had not been addressed within the existing body of knowledge and which did not lend itself to the formulation of testable propositions (Cunha & da Cunha, 2003).

Grounded theory has been used within the knowledge management field to explore knowledge creation, how organizations share knowledge, and the role of management and networks (Awazu, 2004; Berends, van der Bij, Debackere, & Weggeman, 2003; Janczak, 1999; Mohrman, Tankasi & Mohrman, 2003; Simoni, 2003). Primarily, these studies have used interviews, observation and document analysis for data collection and followed the rigorous guidelines for constant comparison during analysis. Each study was conducted within the private sector to study knowledge programs within existing environments. According to Janczak (1999, p. 27), "The challenging part of the research process was to create an interpretation that was neither simply the application of some preexisting theory to the data nor only a description of how the members of a culture understood particular phenomena." And Paintanida, Tananis and Grubs (2002) found that

> The procedures of grounded theory provide interpretive researchers with a disciplined process, not simply for generating concepts, but more importantly for coming to see possible and plausible relationships among them. It is the researcher's portrayal of these conceptual relationships that constitute a grounded theory (p. 3).

Past success in using this methodology to develop theory about various facets of knowledge management in private industry as noted earlier indicated that it was an appropriate approach to explore the concept within a state government organization. In addition, the focus on the social network as a conduit for knowledge sharing leant itself to an approach that allowed the researcher to delve deep to discover what was occurring within these networks and why.

It was expected that data about employees' social networks would emerge through the interview process as well, including information about members and the roles played. These networks were analyzed to determine individuals' roles, connections between networks, and knowledge flow within the organization. The addition of this data presentation provided a view of the networks that supplemented an analysis of the role of the networks as perceived by the interviewees.

Target population and participant selection

The target population for this study was employees of critical functions (engineering technology, architecture and engineering services, and transportation operations) of the Virginia Department of Transportation. Of the 9150 agency employees, 6362 employees are assigned to these career groups. A representative sample size of this population, with a confidence interval of five and a confidence level of 95% would be 362. At the beginning of the study, purposive

sampling was used to determine which members of the sample population were interviewed. Participants were selected based on membership in one of the critical career groups. The participants represented diverse geographical locations and varying lengths of service. Following initial analysis of the early data, theoretical sampling was used. Grounded theory uses theoretical sampling, which requires the researcher to give attention to the relevance and purpose of the sample in relationship to the developing theory. The sample is not definitively selected prior to the research but rather participants are chosen as research progresses. This incorporated selecting participants that extended or supported the theory as well as questioned it (Orlikowski, 1993). Sampling continued until there was saturation of the categories and subcategories and all variations could be explained (McCann and Clark, 2003). Seventeen participants were interviewed.

Planned interviews included employees and managers at the Virginia Department of Transportation. Initial participants were selected from a functional area common across agency districts. The participants did not fall within the researcher's management chain. Participants' length of service with the agency and positions varied to ensure a variety of levels of technical, social and political knowledge. As the interviews progressed, additional participants were selected based on the data and evolving central code to further explain or to disprove the emerging theory. These participants were employees. Participants continued to be selected until saturation was reached.

Procedures for consent to participate, participants at risk and confidentiality

An informed consent document was developed and provided to participants for signature. This document provided a description of the study, contact information for more information and

an explanation of how confidentiality of the interviews and data would be maintained. Copies of the interview were made for back up and the original tape was provided to a transcriber. The transcription was then compared to the tape and the back up tape was destroyed following verification of an accurate transcription. The original tape and transcriptions will be stored for seven years in a secure file in the home of the researcher and then destroyed. Names and identifying information were removed from all references to the data to ensure confidentiality.

Methods and procedures for data collection, data analysis and data presentation

Data collection involved unstructured and semi-structured interviews, researcher observations and analysis of supporting documentation. Interview guides for the semi-structured interviews changed over time as theory emerged from the data supporting the constant comparative method provided by Strauss and Corbin (Gibbert & Probst, 2002). It was this change that allowed for the grounded theory to evolve in that the data was "subjected to continuous, cyclical, evolving interpretation and reinterpretation that allows patterns to emerge" (Mohrman, Tankasi & Mohrman, 2003, p. 305). This constant comparison of the data provided a rich description of the phenomena to develop from which the researcher identified categories, patterns and generates theory. The researcher constantly moved back and forth between data collection and analysis comparing what emerges with what was collected and consciously looked for data that would contradict the analysis to strengthen it (Strauss & Corbin, 1998). Constant comparison occurred within individual interviews of employees, between interviews of employees, within individual interviews of managers, between interviews of managers and employees, and between pairs of employee plus managers and the entire group. This step-by-step approach increased the credibility and traceability of the research (Boeije, 2002).

Douglas (2003) states, “theory generation occurs around one or more core categories, with evidence of properties of these categories and therefore patterns of behaviour to be found in the research phenomenon studied” (p. 46). As the analysis matured, a central category emerged to which all other categories were related. The constant comparison and the search for contradictory data assisted in minimizing bias in the study. Strauss and Corbin (1998) stressed the importance of questioning everything; what was said, what was read, relationships between concepts and whether the emerging theory addressed all of the conditions and how.

Unstructured interviews were used in the grounded theory during initial data collection to encourage interviewees to share stories and to collect initial data. Following the analysis of the first interviews, the researcher used semi-structured interviews. In semi-structured interviews, the researcher began the discussion with a general question and used prompts to encourage the interviewee to expand or explore a topic in depth that was of interest to the emerging theory (Duffy, Ferguson & Watson, 2003). Questions and prompts were developed to avoid interviewer influence and the interviewer strove to avoid providing reactions to what was said (Wimpenny & Gass, 2000). A decision trail was constructed to describe why interviewees were encouraged to develop more depth in responses in certain areas (Wimpenny & Gass, 2000). Copies of the interview were made for back-up and the tape was provided to a transcriber. The benefit of employing someone to do the initial transcription was in the comparison made by the researcher between what was recorded on the tape and what was on the transcription, it allowed for the identification of errors in what was transcribed and ensures that the transcription was an accurate reflection of what was said. The transcription was then compared to the tape and the back-up was

destroyed following verification of an accurate transcription. While waiting for the transcription, the researcher listened to the tape multiple times to begin the process of data immersion.

The transcript was read and reread and the data was initially examined and analyzed word for word and line by line and given codes. “These are names or labels given by the researcher to events, activities, functions, relationships, contexts, influences and outcomes (Douglas, 2003, p. 47)”. The names reflected in vivo codes, which were directly related to the language used by the interviewees (Strauss and Corbin, 1998). This use of interviewees’ words supported the credibility of the research process by keeping the product close to the data (Chiovitti & Piran, 2003).

The next step was to regroup the data in a process called axial coding. “Axial coding identifies relationships between open codes, for the purpose of developing core codes” (Douglas, 2003, p. 47). During this stage, concepts were grouped into categories or clusters. At this stage of coding, the researcher began to identify the similarities and differences within the data. According to Glaser (2002),

> for GT [grounded theory], a concept is the naming of an emergent social pattern grounded in research data. For GT, a concept (category) denotes a pattern that is carefully discovered by constant comparing of theoretically sampled data until conceptual saturation of interchangeable indices. It is discovered by comparing many incidents, and incidents to generated concept, which shows the pattern named by the category and the subpatterns, which are the properties of the category” (p. 4).

The third step, called selective coding,

> requires the selection of the focal core code, that is, the central phenomenon that has emerged from the axial coding process. All other core codes derived from that axial coding process must be related in some way to this focal core code, either directly or indirectly (Douglas, 2003, p. 48).

As the core or central code emerged, it became the focus of data collection and analysis as the researcher actively looked for conflicting data and determined how the other codes would help explain the central code. This regrouping of data was not be forced, but rather the connections and linkages emerged from the data (Strauss, 1998). These stages of coding were cyclical and were simultaneous as more data was collected and the research begins to coalesce (McCann & Clark, 2003; Woods, Priest & Roberts, 2002). To ensure the confidentiality of the interviews, the researcher did all coding.

Throughout the process, memos were written to assist the researcher in recording and explaining the developing theory. It assisted the researcher in analyzing the data and questioning the emerging theory and perceptions. It also allowed for the integration of the literature to compare and contrast the developing theory with what other researchers have found. The memos were a discussion between the data, the researcher and the emerging theory (Backman & Kyngas, 1999). The use of memos also supported credibility by outlining the researcher's thoughts during the data collection and analysis stages and describing the stages of theory evolvement (Chiovitti & Piran, 2003). A significant technique of the constant comparative method was the importance of observation notes developed during data collection. This significance was made clear when reading the comments made by a researcher doing

confessional ethnography. As Schultze (2000, p. 16) has noted, "I made my impressions, reactions, and interpretations as explicit as possible, pretending that they would be used by someone who was unfamiliar with my field site." While this was written about ethnography and this study used grounded theory for an in-depth exploration of a facet of organizational knowledge management, the principle of accurate and complete observation notes holds true for all qualitative methodologies. The record of interviews, observations and the recording of memos done during research were vital to support the evolvement of theory. Memos were written throughout the process and were questions, summaries, hypotheses and thoughts that assisted the researcher in synthesizing what had been collected and analyzed and traced the emergence of theory (Douglas, 2003).

The presentation of the new theory will influence how, and whether, the new theory is acted upon (Trim & Lee, 2004). The use of graphs and visual diagrams to help explain the relationships between the data and how the theory evolved assists the reader in determining its applicability to the area in question. Supporting quotations from the interviews and descriptions of the environment and individuals all provide the reader with a richer picture of the phenomena studied. A detailed description of how the research was done, the steps taken, the ways in which the categories emerged, how the theoretical sampling evolved, how relationships were identified, when did the evolving hypotheses not explain the data and how the core category was selected assist in answering questions about the verification of the research (Cresswell, 1998; Strauss & Corbin, 1998).

Issues related to validity, reliability, credibility and utility

One particular bias that can enter the field is that of the effect the researcher has on participants. An ethnographic researcher warns of the danger of imposing unknown concepts on the participant through words and body language that might influence behavior (Schultze, 2000). It was important that the researcher note any biases that were held that may have affected the conclusions that were drawn from the study.

Validity was addressed within the phases of grounded theory. The traditional definition of internal validity is based on demonstrating causal relationships and may not be applicable in a qualitative study (Yin, 2003). However, it may be argued that internal validity is addressed through the rigorous process of coding and a complete record of how the theory evolved and the analysis employed. According to Glaser (2002), "validity is achieved, after much fitting of words, when the chosen one best represents the pattern. It is as valid as it is grounded" (p. 4). External validity is concerned with the domain for which the results of the study can be generalized beyond the specific case explored. This type of validity was addressed by an accurate description of the steps involved, which allows others to replicate the study and test it in other settings (Yin, 2003). Construct validity was addressed by employing multiple data collection methods, through the review of the literature and an explanation of how the developed theory fits within the body of knowledge as well as a definitive description of the domain in which the findings can be generalized (Yin, 2003). It was also addressed through the use of interview and observation guides (Pandit, 1996). The employment of multiple data collection methods addressed triangulation by providing multiple perspectives and allowed for the cross checking of information (Orlikowski, 1993; Gibbert, 2002). According to Dick (2002),

> Grounded theory has its own sources of rigour. It is responsive to the situation in which the research is done. There is a continuing search for evidence which disconfirms the emerging theory. It is driven by the data in such a way that the final shape of the theory is likely to provide a good fit to the situation (p. 4).

There have been critical success factors identified with the use of this methodology. These include avoiding preconceptions and focusing on emerging theory, the value of the researcher's familiarity with the phenomena or environment being studied to assist with coding, the need for creativity combined with theoretical analysis and an awareness of when a category is saturated with no new themes emerging with the introduction of new data (Estevas, Ramos & Carvalho, 2002). Strauss and Corbin (1998) would add that the researcher needs to be secure in drawing on experience during analysis, flexible, open, able to tolerate ambiguity while the theory emerges, sensitive to the words and actions of the respondents, able to step back and critically analyze situations, able to recognize the tendency toward bias, able to think abstractly and absorbed in and devoted to the grounded theory process. The researcher's findings are subjective rather than objective, in that the researcher is more likely to be attached to the study rather than a distant observer or tester (Robson, 2002).

The researcher's familiarity with the field being studied and with government organizations supported the rigorous coding requirements of the methodology. Indeed, the rigor of the methodology should lend the findings credibility (external validity) with a conservative, bureaucratic organization; and the credibility of grounded theory will be enhanced within its practitioner and scholarly community (internal validity) as it is applied in more public sector organizations.

CHAPTER 4. DATA COLLECTION AND ANALYSIS

Introduction

This research study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of a state agency. Grounded theory supports the discovery and explanation of actual events at a specific location. "One of the strengths of grounded theory is that it explains what is actually happening in practical life at a particular time, rather than describing what should be going on" (McCallin, 2003, p. 203). In a grounded theory study, the variables are not known and are dependent on the context. The researcher was attempting to discover patterns of behavior of a specific group of people within a specific context. This approach allowed the researcher to begin with a general question that narrowed, focused and became more specific as data was collected. "In any grounded theory study, while the nature of the research problem is unknown, the researcher begins work with a general focus from the outset" (McCallin, 2003, p. 205).

The grounded theory approach supported the researcher in the development of a substantive theory, one that concentrated on a specific social process based in a narrow setting (Chiovitti & Piran, 2003). "What most differentiates grounded theory from much other research is that it is explicitly emergent. It does not test a hypothesis. It sets out to find what theory accounts for the research situation as it is" (Dick, 2002, p. 4).

The researcher contacted human resources and received a list of employees who fall within the identified critical functions (engineering technology, architecture and engineering services, and transportation operations) of the agency. Of the 9150 agency employees, 6362 employees are assigned to these career groups. The researcher made the decision to use only

employees with email access for the study population since it was determined that those without email were most likely crew members who do not interact with employees outside the immediate work group. This resulted in a population of 2720 employees. The list was sorted by length of service and then last name. The list was divided by length of service: less than ten years (35%), ten to less than twenty years (36%), twenty to less than thirty years (16%) and thirty or more years (13%) and the percentage of each group in the entire group was calculated. The number of employees represented in each percentage for a final group of 100 was then calculated and the researcher used a random calculator (www.randomizer.com) to calculate random numbers within each age group that corresponded to line numbers in the spreadsheet. The employees corresponding to the line numbers were included in the email requesting voluntary participation in the study. The email was sent by the Chief, Technology, Research and Innovation to potential participants, with carbon copies to the chiefs, district administrators and division administrators, and participants were invited to contact the researcher. This first email was followed by an email sent by the researcher to provide further information on the study and contact information. Twenty-six volunteered to participate, eight declined and there was no response from the remaining sixty-six. Seventeen of the original twenty-six were interviewed: less than ten years (29%), ten to less than twenty years (35%), twenty to less than thirty years (24%) and thirty or more years (12%). The researcher was unable to arrange an interview time with the remaining eight potential participants due to scheduling conflicts. Of those interviewed, four were from the central office (headquarters) and thirteen represented the nine districts (Table 1). Four participants were managers (two from the central office and two from the districts) and thirteen were non-managers (two from the central office and eleven from the districts) (Table 2).

Table 1: Breakdown of Participants

Location	Number
Central Office	4
District	13
Managers	4
Non-managers	13
< 10 Years	5
10 < 20 Years	6
20 < 30 Years	4
30+ Years	2

Table 2: Breakdown Between Managers and Non-Managers

Location	Managers	Non-Managers
Central Office	2	2
Districts	2	11

The researcher conducted semi-structured interviews using the research questions as the guide for conversations. Each interview lasted approximately one and one-half hours. The researcher listened to the interview tapes multiple times and then read through the transcripts assigning open codes to phrases, sentences and passages. Comparisons were made within individual interviews and axial coding was done using constant comparison between transcripts. Interviews were refined to reflect the coding to explore categories in-depth and to seek contradictions and additional contexts and conditions. The researcher employed memos to assist in refining categories and to understand the data. Each new interview transcript was coded to saturate the categories and to determine if additional categories emerged. Categories were refined and further related until there were eleven remaining categories: network types,

knowledge types, employee roles, network introductions, network membership, management awareness, network impacts, network dissolution, culture, and government.

Research Question 1

The first research question was "In what types of networks do employees in VDOT participate?" The type of networks employees participate in varies according to tenure. Employees with less than ten years service with the agency have established strong, external networks through internet forums, with previous co-workers, and with friends. Employee "I" discussed a work-related internet forum he accessed frequently, "… is a forum I have talked to several different people on and I know their names, or at least I think I do, but I don't know who they are. But they give good information…" Regarding previous co-workers, participant "Q" stated, "…even colleagues at my former jobs especially the engineering firm, I can network with him and each one of us has people from prior experiences that we are able to network with, people within the state or other agencies…" Employee "Q's" network of friends led to a career change, "I had friends out in … and they said there is an engineering firm hiring … that they saw in the newspaper so I pursued it and was hired." Other networks with frequent interactions are dependent on the requirements of the position held and include immediate co-workers, across functions, and with consultants. Weak networks have been established with counterparts in other geographic locations, localities (cities, towns and counties served by the agency within the immediate geographical area), colleagues in professional associations, and vendors. When asked if employee "I" had contact with counterparts in other districts, the response given was, "[w]e do by phone, basically. Most of the time our contact is made through the central office and occasionally through other meetings that we may even run across each other and we kind of

bounce things off on the side at breaks or whatever." There are also employees who are isolated and do not participate in any networks internal to or connected with the agency. As participant "Q" stated, "That's right, and I am kind of introverted in the sense that when I come to work I sit at my desk I do my own thing, I enjoy it I am comfortable I am in my realm … and I am happy, not that I don't enjoy conversation or talking to people but I am not one to go out and really seek out the conversation, even on breaks."

Employees with ten to less then twenty years of service have strong networks with frequent interactions with personal friends, localities, through internet forums, with consultants, and with colleagues within the same geographical location. Participant "X" talked about the advantage of working in the same geographical location throughout his career, "… most of my work has been in … county so I still know a lot of people that I worked for, worked with, too." Weak networks with infrequent interactions have been established with employees who hold positions within the same agency function, previous co-workers and counterparts in other geographical areas. When talking about counterparts, the response from participant "Y" was, "Well occasionally they could help me out." Some employees within this tenure bracket are isolated and do not participate in any networks internal to or connected with the agency. As stated by participant "Z", "I don't know what everybody does …I just don't try to find out how those things work."

Employees with twenty to less then thirty years of service have strong networks with localities, immediate co-workers, consultants, and with colleagues within the same geographical location. Regarding localities, participant "V" commented, "… because more and more I share now with the county on what we are doing." Weak networks with infrequent contact include

former co-workers and functional areas. Employee "L", "Yes, we [employees in same function] will usually get together once a year for what they call our round table meeting and discuss a lot of stuff..."

Employees with thirty plus years of service have strong networks with counterparts in other geographical areas, with consultants, and with colleagues within the same geographical area. Participant "H", "I know all the guys in … here, I mean, they are all friends and we deal with each other all the time." Weak networks with infrequent contact are present within functional areas. According to participant "H"

> It is a one-day deal per year, it used to be two days. We would actually stay overnight, and actually we would have round tables and we would have presentations and people would get together and eat dinner that night and kind of get to know each other, what each other is doing. Now with the money we cannot do that, the last five, six years that has all ended and so we…

Managers and non-managers participate in the same type of strong networks with friends, immediate co-workers, across functions, with colleagues in the same geographical area, within localities and with consultants. Managers participate in weak networks with previous co-workers, employees in the same functional area, and counterparts in other geographical locations. Non-managers participate in the same type of weak networks as managers along with localities, vendors and colleagues in professional organizations. Both manager and non-manager participants indicate isolation from networks as well.

Participants' responses to this research question are summarized in the Table 3.

Research Question 2

The second research question was "What types of knowledge are shared within the networks?" The data collected indicate that the type of knowledge shared within networks varies

according to tenure and by type of network. The knowledge shared is tacit or a combination of tacit and explicit as when sharing functional knowledge or interpreting explicit knowledge.

Table 3: Summary of Network Types

Network Type	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Across Functions	S				S	S
Colleagues in Professional Organizations	W					W
Colleagues in Same Geographic Area		S	S	S	S	S
Consultants	S	S	S	S	S	S
Counterparts in Other Geographic Locations	W	W		S	W	W
Employees in Same Agency Functional Area		W	W	W	W	W
Friends	S	S			S	S
Immediate Co-Workers	S				S	S
Internet Forums	S	S				S
Localities	W	S	S		S	S & W
Previous Co-Workers	S	W	W		S & W	W
Vendors	W					W
Isolation	X	X			X	X

S=Strong W=Weak X=Exists

Employees with less than ten years of service with the agency share career, functional, technical, and institutional knowledge within strong networks. According to participant "I", "[o]ur personal group it is great we share all the information that we have and consult each other with anything that is going on so it's no problem in the group as far as I know." Functional, institutional, knowing who knows what, and professional knowledge are shared within weak networks. Employee "I" stated, "[w]hat has been done before, although it is not fully

documented or there is no way of saying yes this it, this is the right way. … from what they know and what information can be gathered from what they have done before."

Employees with ten years to less then twenty years service with the agency share career, functional, and how-to knowledge, who knows what, and the interpretation of explicit knowledge in strong networks. According to participant "X",

> Yeah, we do ask questions, like knowledge type questions but I think a lot of it is how we get it done, how do I work this out hey we got this detour coming up how are we going to deal with the railroad, I know you deal with the railroad more then I do, how did you do it, who did you talk to, you know stuff like that. … So I think that is a key to be able to ask somebody that went through it before or whatever and say, 'How did you get through this?'

Functional, technical, historical, and cross-functional knowledge are shared within weak networks. Participant "Z' stated the functional network will get together "if somebody has [new] ways of doing things." As stated by participant "O", "[o]r they will call me up and they will say "do you remember back when you on such and such a job what did you guys do?" … They will call me up and they will say 'this is what we are doing today, who do I need to call?'… I can lead them in the right direction."

Employees with twenty years to less then thirty years of service with the agency share who knows what, experience and referrals within strong networks. Participant "L" talked about checking in with a contact from another functional group within the same geographical area to determine a location for conducting an experiment with a new material knowing the other employee would have some ideas based on past experience in working with him. Functional knowledge is shared within weak networks. As stated by participant "L", "[h]e might send out an email and want to get everybody's opinion on something, so everybody will start emailing him

but usually they will cc everybody to let them know what their opinions are also. So you get to find out how other parts of the states do things."

Employees with thirty plus years of service with the agency share institutional knowledge, who knows what and experience within strong networks. Participant "U" refers to sharing institutional knowledge, "[h]ow the department wants it done. I mean they may know how to do it, but may not be the way the department is doing things." Regarding who knows what, participant "U" states, "[a]gain a lot of things is the individuals knowing who to contact." Describing the sharing of experience, employee "H" said, "Yes, right, we talk about what everybody is doing, and how are you doing this, and have you done this, and what do you think about what is going on…" Functional knowledge is shared within weak networks.

Managers share career, functional, technical, institutional, and how-to knowledge, lessons learned, experience and referrals within strong networks. Non-managers share all of these types of knowledge within strong networks along with the interpretation of explicit knowledge. Managers share technical and historical knowledge within weak networks. Non-managers share the same types of knowledge along with functional knowledge within weak networks.

Participants' responses to this research question are summarized in Table 4.

Research Question 3

The third research question was "What are the employees' roles within the networks?" Employees with less than ten years service in the agency are active members within strong networks and take a central role if the strong network is comprised of friends or if required by the position held. Participant "E" said regarding playing an active role and building strong

networks, "[I] found out, even since I was a trainee and throughout, it is critical how we build relationships."

Table 4: Types of Knowledge Shared

Type of Knowledge	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Career	S	S			S	S
Cross-Functional		W			W	
Experience			S	S	S	S
Functional	S & W	S & W	W	W	S	S & W
Historical		W			W	W
How-to		S			S	S
Institutional	S & W			S	S	S
Interpret Explicit Knowledge		S				S
Lessons Learned	W					W
Professional	W				W	
Referrals			S		S	S
Technical	S	W			S & W	S & W
Who Knows What	W	S	S	S	S	S

S=Strong W=Weak X=Exists

Employees take a peripheral or spanner role in weak networks. As described by participant "E",

> … apparently what happens now and then in the industry … companies they already know how the process works and sometimes they want to come and find out and I think by word of mouth they heard there is a guy in VDOT. Call this guy his name is …or whatever and they come to me and I know what they are looking for and all that.

There are employees within this population segment who are isolated. According to participant "Q", "… looking at it from my perspective as a new employee … while you have somebody in the center, if you have somebody on the outside, myself considered, I mean, not very many

people are going to come to me for things simply because they don't know I exist. They don't know who I am."

Employees with ten years to less then twenty years service with the agency have an active role within strong networks. According to participant "O", "[w]e try to pass it on, I have people calling me all the time…" Within both strong and weak networks, employees in this population segment may have a central role. According to participant "Y", "[w]ell, I guess now I am the one who is supposed to be called." Employees may also be isolated.

Employees with twenty years to less then thirty years service with the agency have active, central or spanner roles within strong networks and peripheral roles within weak networks. Participant "V" stated, "I have had them ask me, 'You are not going to leave until,' this is district personnel that I work mostly with … You are not going to leave until we get this thing through and tell me you are not going to leave…" Employees in this population segment may be isolated as well. Employees with thirty years plus service with the agency have active roles in strong networks and peripheral roles in weak networks. Participant "H" stated, "I know all the guys in … pretty much, but I don't know the people in…"

Managers have central, active and spanner roles within strong networks and peripheral and spanner roles in weak networks. Non-managers have central and active roles in strong networks and central, peripheral and spanner roles in weak networks. Both managers and non-managers may be isolated.

Participants' responses to this research question are summarized in the Table 5.

Table 5: Employees' Roles in Networks

Role	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Active	S	S	S	S	S	S
Central	S	S & W	S		S	S & W
Peripheral	W		W	W	W	W
Spanner	W		S		S & W	W
Isolated	X	X	X		X	X

S=Strong W=Weak X=Exists

Research Question 4

The fourth research question was "How do employees become aware of the existence of networks?" Employees with less then ten years service with the agency became aware of the strong network in which they participate through family members who work for the agency, previous experience with networks and the engineer trainee program. According to participant "I", "[b]ut his father is a project engineer at … residency so he had a way of knowing how things flowed." Awareness of weak networks came through long-term employees, managers and by invitation.

Employees with ten years to less then twenty years service with the agency became aware of strong networks through family members, mentors, or when it was required by the job or tenure. According to participant "Y", "[y]es, I started out as a trainee and a lot of it depends, I think, who you go with on your first couple of jobs. If you are with somebody who is really knowledgeable and knows what they are doing, you can learn a whole lot and if you get with somebody you can learn what not to do, too, I suppose." Awareness of weak networks came

through tenure, from a predecessor or through participation on special projects. According to participant "O", "I knew somebody, I had been around long enough that I knew somebody…"

Employees with twenty years to less then thirty years service with the agency became aware of strong networks through family members, on-the-job training or by invitation. As stated by participant "V", "[o]r their father worked or their mother and they heard of VDOT all their life from the time they were growing up and they went on with it." Awareness of weak networks came through reputation and participation in special projects.

Employees with thirty years or more of service with the agency became aware of strong and weak networks through mentors and tenure. One participant indicated that employees remained in positions and there was less movement to new positions historically so awareness of networks remained stable. According to participant "H", "[t]here was not much rotating here once they knew that you knew what you were doing, they didn't want to mess with something like that."

Managers became aware of strong networks through previous experience with networks, the engineer trainee program, mentors, tenure or because it was required by the job. Awareness of weak networks came through tenure and reputation. Non-managers became aware of strong networks through family, previous experience with networks, participation in the engineer trainee program, on-the-job training, mentors, tenure, invitation or it was required by the job. Awareness of weak networks came through long-term employees, managers, predecessors, tenure, reputation or participation in special projects.

Participants' responses to this research question are summarized in Table 6.

Table 6: How Employees Become Aware

Means of Awareness	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Engineer Trainee Program	S				S	S
Family	S	S	S			S
Invitation	W		S			S
Long-Term Employee	W					W
Manager	W					W
Mentor		S		S	S	S
On-the-Job Training			S			S
Predecessor		W				W
Previous Experience with Networks	S				S	S
Required by Job		S			S	S
Reputation			W		W	W
Special Projects		W	W			W
Tenure		S & W		S	S & W	S & W

S=Strong W=Weak X=Exists

Research Question 5

The fifth research question was "When do employees become aware of the existence of networks?" All employees indicated that awareness of networks came within the first year. The means through which awareness occurs is answered in research question four.

Research Question 6

The sixth research question was "How do employees become a part of a network?" The responses to this question were combined with research questions four and five, which asked how and when employees became aware of the existence of networks. Employees became part of networks when awareness emerged.

Employees with less then ten years service with the agency became part of networks while in the engineer trainee program or by invitation. Employees with ten years service to less

then twenty years service became part of networks when it was required by the job, as a result of longevity in position, through introductions by predecessor and by invitation. According to participant "K", I think it just takes time just to get to know." Employees with twenty years service to less then thirty years service with the agency became part of networks through on-the-job training, by invitation and by participation in special projects. Employees with thirty or more years of service with the agency became part of the network through tenure in position.

Managers became part of networks through the engineer trainee program, if required by job and through longevity in position. Non-managers became part of networks through the engineer training program or on-the-job training, if required by the job, through tenure in the position, if introduced by predecessor or by invitation from others, and when participating in special projects.

Participants' responses to this research question are summarized in Table 7.

Table 7: When Employees Become Part of Networks

Means of Awareness	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Engineer Trainee Program	S				S	S
Invitation	W		S			S
On-the-Job Training			S			S
Predecessor		W				W
Required by Job		S			S	S
Special Projects		W	W			W
Tenure		S & W		S	S & W	S & W

S=Strong W=Weak

Research Question 7

The seventh research question was "How do managers view employee networks?" Managers indicate awareness of employee networks but also feel that senior management is less aware and is focused on getting the job done. According to participant "Z", "[w]hether they actually know that it exists at various levels may not even be their concern." According to participant "X",

> Yes, I think they have an awareness. I think they do because they know, they have probably seen them try to get something done… I think that they are glad that you can come in there and do that. It takes a little bit of effort to get everything coordinated and everybody talk, how they can work if you put the effort in there.

Non-managers indicate that middle management is aware of networks but are focused on getting the job done or do not devote time to employee networks, and that senior management is less aware and focused on numbers. Participant "O" stated, "[t]hey are aware of it, but they are not aware, they are aware of it but their back is against the wall, you know how it is when we've only got so many people, I mean I've heard that, 'well we've only got so many people.'" Non-managers also indicated that it was felt if management had come up through the ranks, there was a greater awareness and understanding. According to participant "X",

> You know sometimes you don't think so, maybe they do. I think it depends on who your manager is, I mean, I've had some that, you know, as long as you're doing it, they probably don't know what it takes to do it to that level … I think that the ones that come up through the ranks know, but I think the ones that come in and don't really realize and don't come down there and talk to you…

Participant X also stated, "I think it helped me because I started right from the bottom all the way up, I know what it is like to have to do the work, come on up through, how to schedule the work, what it takes for them to do their job and for them to do my job I think that helps."

Participants' responses to this research question are summarized in Table 8.

Table 8: How Managers View Employee Networks

Level of Awareness	Managers	Non-Managers
Aware	X	
Middle Management Aware But Focused on Getting Job Done		X
More Understanding Because Came Up Through the Ranks		X
Senior Management Less Aware and Focused on Getting Job Done	X	
Senior Management Less Aware and Focused on the Numbers		X

Research Question 8

The eighth research question was "How do the networks impact assigned work tasks and functions?" Employees with less then ten years with the agency indicate that networks ease the work. Participant "E" stated he "… knew a lot of people personally and I had worked with them so it was good it made it really a lot easier." Employees with ten years to less then twenty years service with the agency indicate that networks assist in streamlining processes, sharing workloads, knowing the questions to ask, and that it indicated that the agency valued experience. According to participant "X"

> I know for myself I think I got a little advantage because with working with different crews coming up through there now there is some guys that might have worked on a crew and they might be running that section now or something like that so if I need a favor … Where if you didn't know that guy he would probably say 'okay you send it to my boss and let him take a look at it and we'll see if we can schedule it' where as if you know him you can pretty much say 'hey I want to do you a favor you do me one' and it works out good because you know the guy.

Employees with twenty to less then thirty years with the agency indicate that networks support knowing the function, who does what and institutional knowledge. According to participant "V", "[y]ou had better take care of the competency, you better hold onto it because you may lose it and once it is gone you are not going to get it back …" Employees with thirty or more years with the agency state that networks support knowing who does what and act as the knowledge keepers of the organization. Both managers and non-managers view networks as supporting functional knowledge and knowing who knows what. Managers also view networks as easing work assignments, streamlining work processes and sharing workloads. Non-managers view networks as keepers of the knowledge, supporting knowing what questions to ask and where expertise is valued.

Participants' responses to this research question are summarized in Table 9.

Table 9: Impact of Networks

Impact	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Ease Work Assignments	X				X	
Expertise Valued		X				X
Know Function			X		X	X
Know Institutional Knowledge			X			X
Know Questions to Ask		X				X
Know Who Does What			X	X	X	X
Knowledge Keeper				X		X
Shared Workload		X			X	
Streamline Work Processes		X			X	

Research Question 9

The ninth research question was "What is the affect on employee productivity and effectiveness if the network dissolves?" Employees with less then ten years of service in the agency view dissolution of networks as impacting knowing who to ask, lost contacts, lost institutional knowledge, and negatively impacting communication. Participant "E" talked about a retired employee who came back to the agency to work part-time.

> Well recently I have, with the people that I work with or coordinate activities with, they are the most senior people who are retiring. Like I work very closely with … there was one gentleman who retired and he has a wealth of knowledge in terms of I don't know what you call it? [institutional knowledge] Exactly, for example when you are talking about …We are at the meeting, in the past VDOT has allowed other … to go there based on, he is like if you don't let them go in there, they are going to go to court and they will win because somebody else did that, there is no other way to cross if there was it just like it is going to break their backs. So you ask and get what you can. No one in there had this knowledge… and no one knew it except him…

Participant "Q" stated,

> apparently a short timer someone that is going to be retiring next month has been with VDOT I don't know how many years at least thirty years or so and he was mentioning that, I am leaving my post, I don't know exactly what this guy does … he has a lot of networks, a lot of connections and what he was surprised at is the fact that he is leaving and he is not going to be able to train or mentor anybody to fit his role by the time he is gone and the new person comes into his role he is gone, so when you think about what you are losing you're potentially losing networking connections and like you said the system can dissolve every time that happens if the system is not in place to gradually pull in somebody.

Employees with ten years to less then twenty years service see the dissolution of networks as impacting knowing who to ask, resulting in lost contacts, lost institutional knowledge and causing a lack of communication. According to participant "K", "… because you have lost connection, you are losing connection with the people it is too much and that is it, there is no more laid back and let's talk about this, there is no more of that." Participant "Y" stated, "[y]ou

used to be able, you knew that if you called a certain person they would know the answer, now a days, you don't know the person. You don't know because all of the reorganization. You don't know who to call, you're lucky if they even know what you are talking about." Participant "O" observed

> … we lost a lot of our support people, the people that had the knowledge that they could of built on, in other words I always had somebody I could go to, if I didn't know something I had somebody I could go do and I could say 'what does this mean? What am I supposed to do here?' all of a sudden there was nobody and people were coming to me and I had no clue. … I mean we did not have the people to go to.

Participant "X" stated in talking about the early retirement package offered in the mid-90s said, "… we lost a lot of experience, none of the people that you really want to get rid of left during that time." According to participant "N", "…because I know that when … left he gave me a little book that he had some stuff written in but that wasn't probably one percent of what he knew or knows and it is kind of a shame that there isn't someway that we can't tap into that…" Regarding the lack of communication, participant "O" said, "[o]kay, you've got somebody way over here, and you've got somebody way over here, and what you got is there is no communication in-between."

Employees with twenty years to less then thirty years service with the agency view network dissolution as limiting employees to knowing own function only, a loss of old contacts and the appearance of periodic, temporary networks.

Employees with thirty or more years of service with the agency see lost knowledge and lost contacts with the dissolution of networks. Participant "H" stated, "…almost makes you mad to see that they don't pay attention and just let everybody go and then pick up from the ground

floor and it's like going through the cave man era every thirty, forty years and learning how to build a fire, learning how to make a bow and arrow."

Managers view the dissolution of networks as resulting in the loss of institutional knowledge and the limiting of knowledge to immediate function only. Non-managers view network dissolution as resulting in these with the addition of loss of contacts and not knowing who to ask, a low awareness of organizational issues and a lack of communication.

Participants' responses to this research question are summarized in Table 10.

Table 10: Disruption of Networks

Type of Disruption	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Do Not Know Who To Ask	X	X				X
Know Function Only			X	X	X	X
Lack of Communication		X				X
Lost Institutional Knowledge	X	X		X	X	X
Low Awareness of Organizational Issues	X					X
Old Contacts Gone		X	X	X		X

Research Question 10

The tenth research question was "How are networks used to disseminate knowledge within the organization?" Networks are used to assist employees in developing relationships and contacts that assist in performing tasks efficiently. Or as stated by participant "H", "… [the] quicker they can get to the right people and get trained the quicker they are going to get efficient and do their job." Networks also contribute to disseminating technical and organizational knowledge. As stated by participant "Q", "[w]hen you're losing out on the history and what's

come before to make this a great place and if somebody's put in 30 years I would like to believe that they have been doing something. They are really knowledgeable in their craft; they know the ins and outs of things."

Culture and Government

All employee groups stated that there was a high workload with reduced staff, which has resulted in a lack of time to document knowledge and to participate in events that would provide them with opportunities to exchange knowledge with employees outside of the immediate geographic area. Talking about the workload, participant "Y" stated, "recently, it's more work with less people, same amount or more work but you don't have the same amount of people so it is more work to do." Other cultural characteristics as perceived by participants and cited by all groups included the change to outsourcing work, a command and control management, lack of people skills in management, failure to recognize or reward employees, the differences in generations, lack of retention of newer employees, and the impact of retirements of long-term, knowledgeable employees. In discussing lack of retention, participant "W" stated "[t]hey're going to come in with high expectations to get what they need and leave and that's what VDOT is faced with that's one reason that they're probably looking at privatization of everything." Regarding outsourcing, according to participant "W",

> That is VDOT anybody can see it coming they're going to become like a minimal management type agency where they don't have the overhead to manage and keep up with and everything they do, they've already made the decision that I'm already seeing the steps of it where they're going to send out maintenance they're going to contract it out.

The use of acronyms and organizational terminology as a barrier to sharing knowledge was cited by employees with less then ten years service in the agency, ten years to less then twenty years service, managers, and non-managers. According to participant "Y",

> Well see the state is great on speaking in acronyms and if you got ten people and you spit out an acronym probably nine of them wouldn't know, but they would act like they would, I would. That they will look like they don't know what it means and they will think that people will wonder why did we hire him?

Communication barriers in general were cited by employees with ten years to less then twenty years and employees with thirty or more years of service, and by both managers and non-managers.

Non-managers with over twenty years service with the agency cited animosity between functions or as stated by participant "H" "it's turf protection type of thing." Managers and non-managers of all employee groups with the exception of those with twenty to less then thirty years service cited geographical barriers. As participant "H" stated, "it is strange because it is almost like every district is their own highway department sometimes." Non-managers with less then ten years of service or twenty years to less then thirty years of service discussed the failure of managers to share contextual knowledge while those with less then ten years services cited failure of management to share knowledge down. According to participant "A", right now there is no trickling down [of knowledge]." Managers with ten years to less then thirty years service felt that management did share context.

Managers and non-managers with less then ten years service also cited a bureaucratic structure, functional silos, resistance to change and a slower pace for change and action, and a preference for explicit knowledge (which included the transfer of tacit to explicit). Non-managers with less then ten years of service talked about a lack of time to document and the lack

of socializing between employees but also cited the stability in working for the state. According to participant "G" regarding the lack of time to document, "[t]here's like, it seems like there's not extra time being made for it." Or "G" states, the employees are told, "you have the time basically, you just have to manage your time better and that's not the case." The number of reorganizations was cited by non-managers with less then twenty years service in the organization as a barrier to knowing who did what. Non-managers with ten years to less then twenty years service discussed the complexity of the organization and bending rules when needed. Participants said they liked the work but they worried about downsizing, felt the agency had lost focus and that there was now more management than workers. Managers and non-managers within this tenure group also talked about the leftover good old boy network. According to participant "O", "[w]ith VDOT, yes and it was because they were still transitioning away from the good old boy system. [Do you think it has transitioned all the way?] No." Non-managers with twenty years to less then thirty years service in the agency talked about documenting as protection. According to participant "L", "[o]ne of my mottos is, if it ain't written it never happened so we try to cover our butts by writing out a report and putting it in the files, send a copy to them."

Non-managers with ten years or more of service talked about the pride and ownership felt about the organization and were joined by managers within this tenure group in citing the security felt in working for the state. Participants' responses to this research question are summarized in Table 11.

Table 11: Culture

Element	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Acronyms and Terminology a Barrier	X	X			X	X
Animosity Between Functions			X	X		X
Bending Rules		X				X
Bureaucratic	X				X	X
Change to Outsourcing	X	X	X	X	X	X
Command and Control Management	X	X	X	X	X	
Communication Barriers		X		X	X	X
Complexity		X				X
Differences in Generations	X	X	X	X	X	X
Document to Protect			X			X
Encounter Resistance to Change	X				X	X
Explicit Information Overload	X		X			X
Functional Silos	X				X	X
Geographical Differences	X	X		X	X	X
Good Old Boy Network		X			X	X
High Workload	X	X	X	X	X	X
Knowledge Not Shared Down	X					X
Lack of Budget Support		X		X		X
Lack of Employee Retention	X	X	X	X	X	X
Lack of People Skills	X	X	X	X	X	X
Lack of Recognition by Management	X	X	X	X	X	X
Lack of Time to Document	X					X
Leadership Shares Context of Orders		X			X	
Little Socializing	X					X
Like What They are Doing		X				X
Lost Focus		X				X
More Management Then Workers		X				X
Not Given Contextual Knowledge	X		X			X
Preference for Explicit Knowledge	X	X			X	X
Pride and Ownership		X	X	X		X
Reorganizations	X					X
Retirements	X	X	X	X	X	X
Security in Job		X	X	X	X	X
Slower Pace for Change and Action	X				X	X
Stability	X				X	X
Value Education Over Experience		X	X	X	X	X
Worry About Downsizing		X				X

The impact of being a government agency was also discussed by each of the participants. Managers and non-managers of all tenure groups stated that the change in state leadership and the agency commissioner results in a change of direction for the agency and impacts work at the higher levels of the organization but doesn't necessarily flow down through the organization. Participant "H" stated that

> Right and it doesn't help that every four years we get a new governor and then a new commissioner possibly and he has his own ways and then by the time he actually gets to the point that he's getting something done and people understand what he wants, then he goes and here comes another one. Now he doesn't want to do anything like that, he wants to go back to something that we did 18 years ago and so it is like throttle back and you can't operate. You can't do it, not the way they want us to work. They need to get a commissioner that is probably a full time job. That is his job and he is not going to leave unless he is really is just a very poor leader.

While participant "O" said

> We are still building roads, bridges still go over roads, none of the basics have changed. It still snows most of the time in the winter and it still gets 90 degrees in DC in August so nothing has changed, we're still doing our jobs. We're still going to plug away. It doesn't affect us; we are at the bottom of the food chain. It's just that every once in awhile it gets kind of irritating because they come up with some fancy new rule or something and its like; what an inconvenience, but you go on.

Managers and non-managers of every tenure group with the exception of employees with thirty years or more cited the amount of paperwork, and rules and regulations that have to be followed as impacting the job. As stated by participant "G", "there's also the hoops you have to jump through." Participant "P" stated, "so you have to fill out these papers if you're going to get them, get these items and you got to fill out these papers."

Managers and non-managers with less then ten years service cited the non-financial benefits of working for the state and the desire to give back to the community. Non-managers

with twenty to less then thirty years service felt there was more freedom in the daily work in government as opposed to private industry, although none had worked in private industry. This group also stated that control in the agency was within the central office.

Other commonly stated attributes to working for the state included the legislature's control of employee salaries, political pressure from localities and the impact of politics in general on the agency's direction and initiatives. According to participant "U", "[t]he department has become much more political then it used to be, other words, when I first … I mean just, I've seen projects that have been just because the politics is there, the money wasn't there, but politics was there." Non-managers with ten years to less then twenty years talked in-depth about the lag in the use of technology in a state agency. According to participant "O",

> We need to keep up pace with the people that are in the private industry and we're not. We're trying hard to catch up … We're lagging because we're suspicious of it and I spend a lot of time helping other people in our section getting them up to speed because they are afraid of it, they are suspicious of it.

Participants' responses to this research question are summarized in Table 12.

Summary

The constant comparison and levels of coding within and between transcripts of semi-structured interviews allowed the main categories and substantive theory to emerge from the data in this grounded theory study of the role of tacit knowledge networks within a state agency. Employees of this agency have varying roles in both strong and weak networks through which tacit knowledge involving multiple types of knowledge is shared. Employees are also isolated from networks. Employees become aware of and a part of networks through varying mechanisms such as job requirements, personal relationships, mentors and tenure.

Table 12: Government

Element	<10 Years Service	10<20 Years Service	20<30 Years Service	30+ Years Service	Managers	Non-Managers
Central Control			X			X
Change in Leadership Results in Change in Direction of Agency and Work at Higher Levels But Doesn't Affect Daily Tasks	X	X	X	X	X	X
Give Back to Community	X				X	X
Lag in Use of Technology		X				X
Legislature Impacts Salary	X	X		X		X
More Freedom Than in Private Sector			X			X
Non-Financial Benefits	X				X	X
Paperwork	X	X	X		X	X
Political Pressure from Localities				X	X	X
Politics Affect Direction of Agency and Initiatives		X	X		X	X
Rules and Regulations	X	X	X		X	X

Knowledge and participation are impacted by agency culture, particularly those characteristics resulting from its status as a state government organization. Management is aware of the networks but their focus is on getting the job done and the financials of the agency rather than on how the networks impact employees' performance and effectiveness. Networks do impact the work within the agency by alerting employees to who does what, understanding of different functions, shared work, more effective work processes and an awareness of institutional knowledge. The loss of networks results in a loss of shared institutional knowledge, a lack of awareness of who has expertise and can be consulted and an isolation within functions.

The researcher interviewed a representative sample of employees, both management and non-management, within the organization's critical career groups. Efforts were made to ensure that participants reflected the tenure demographics of the organization although the study's

percentage of the employee group with tenure of less then ten years is slightly lower (6%) and the percentage of the employee group with ten years to less then thirty years service is slightly higher (8%). Participants were selected from employees with email access since it was determined that those without email were most likely crew members who do not interact with employees outside the immediate work group. The choice to exclude those employees without email access may be a limitation of the study. The researcher continued interviews until all categories were saturated and contradictions and support of each category were identified. The results are reflective of the perspectives and experience of participants. A senior executive in a non-engineering role with the education and skills to observe for communication patterns, networking and cultural signs and symbols was interviewed as a check to assure the researcher that analysis was objective. Interview data confirmed findings. The barriers revealed in interviews, particularly the lack of time, indicate more deterrents to the sharing of tacit knowledge than support.

CHAPTER 5. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of a state agency. The state agency is anticipating a significant loss of knowledge with impending retirements of approximately twenty-eight percent of employees in the next five years. Employees hold valuable, undocumented knowledge and to benefit the organization, it must be shared. Identifying existing employee networks and the role the networks play in disseminating valuable, tacit knowledge in a state government organization will assist leadership in facilitating wider knowledge dissemination and retaining critical organizational knowledge. It will extend the understanding of the knowledge management field in understanding how knowledge is shared and used specifically within a government organization and provide researchers and practitioners with insight into the development of programs and interventions to encourage knowledge sharing between government employees. The initial literature review led the researcher to develop the research study and provided background that was used during the constant comparison of the data to provide varying perspectives and to stimulate ideas. It was also performed to delineate what is known and unknown about the role of tacit knowledge networks in public organizations and to ensure that the proposed study addresses a gap in the research base.

The knowledge management field emerged in the early 1990's in response to the loss of critical organizational knowledge resulting from the loss of long-term employees and the mobility of the new workforce. A 1999 Delphi Group study of companies found that on average forty-two percent of corporate knowledge resided within the minds of employees underlining the

value of tacit knowledge and the need to address its retention and develop methods to ensure its transfer between employees and groups. Successful knowledge transfer is measured by change in the knowledge or performance of the recipient.

Tacit knowledge is a reflection of the expertise and experience of an individual and informs the individual of how to best perform a task. It is not easily transferred to explicit, or codified, knowledge, but can be shared through verbal discussions and demonstration, both of which can be accomplished within a network. The role of management is to support and extend the transfer so that the organization retains critical knowledge. Since the transfer of knowledge is often contained within personal networks, part of management support should be to identify networks, encourage participation by employees and to develop methods to transfer knowledge between networks in support of organizational retention of critical and unique knowledge. The role of networks in sharing tacit knowledge and the awareness of management emerged out of the data.

Culture affects how knowledge is used and shared within the organization. State government organizations tend toward a bureaucratic, command and control culture that relies heavily on published procedures and policies as revealed in this study. Studies have demonstrated that if the transferred knowledge results in improved quality and efficiency of work that public sector employees will support and participate in the activity as there is intrinsic value in doing so. There is a need for strong, dense networks to support redundancy of knowledge and for weaker networks with loose ties to support creativity and innovation. Network positions indicate roles played by employees in coordinating or contributing to knowledge sharing within the network and between networks.

The majority of research conducted in tacit knowledge sharing and networks had occurred in the corporate world. There were no studies revealed in the literature review that looked specifically at tacit knowledge networks within government agencies and thus no research conducted to determine if these networks function the same or differently from those in the corporate world. Given the more rigid culture often found in government agencies that are mandated to perform work in prescribed ways as directed by law, it is possible that networks will function and be viewed by management differently than in the corporate environment. Understanding the role of these networks in a government agency can provide necessary knowledge to management to develop tools and techniques to support continued knowledge sharing and to mitigate the loss of knowledge resulting from the increasing departure of long-term and key employees.

This research study used a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of a state agency. The researcher was attempting to discover patterns of behavior of a specific group of people within a specific context. The grounded theory approach supported the researcher in the development of a substantive theory, one that concentrated on a specific social process based in a narrow setting (Chiovitti & Piran, 2003). The researcher contacted human resources and received a list of employees who fall within the identified critical functions (engineering technology, architecture and engineering services, and transportation operations) of the agency. Seventeen participants were interviewed, four were from the central office (headquarters) and thirteen represented the nine districts Four participants were managers (two from the central office and two from the districts) and thirteen were non-managers (two from the central office and eleven from the districts). The researcher

conducted semi-structured interviews using the research questions as the guide for conversations. Each interview lasted approximately one and one-half hours. Comparisons were made within individual interviews and axial coding was done using constant comparison between transcripts. The researcher employed memos to assist in refining categories and to understand the data. Categories were refined and further related until there were eleven remaining categories: network types, knowledge types, employee roles, network introductions, network membership, management awareness, network impacts, network dissolution, culture, and government.

The agency's culture is formed based on management style and practices, historical events, its role as a state government agency and is viewed through the perspectives and experiences of its employees. All of these establish the environment in which tacit knowledge networks operate. From the perspective of the participants, the agency has a command and control management style, which evolved from a management style from forty years ago and is described by participant "H" as, "it was like being in the army … he was the warden, even though he was a nice guy, but he was the captain and he knew it, and we knew it." Management is perceived as lacking people skills and not recognizing employees.

This is further impacted by the rules, regulations, bureaucracy and amount of paperwork found in a government agency operating under legislative authority. The organization is also impacted by local politics and pressure in the communities it serves and employees state that there are geographical differences in how and in what work is performed. State leadership changes every four years following elections and as the agency commissioner is an appointed position, the individual filling the position has changed as well. This results in changes in direction for the agency depending on the interest and focus of the incumbent although little

change is seen in the day-to-day work. The agency has reduced the number of employees in the last ten years resulting in higher workloads. It has shifted from performing the work with state employees to outsourcing the work. The perception is that a higher value is now placed on education over experience as a result of this shift. Employees have pride and ownership in their work and have traditionally perceived their employment as having high security because it is with that state. However, it was also stated that the organization is no longer retaining newer or younger employees who leave once they are trained. Generational differences were mentioned frequently during interviews. In addition, the agency is experiencing a high retirement rate and anticipates that will continue over the next five years. Management is aware of the networks but is focused on financials and getting the work done today with the staff that they have. These cultural characteristics and the agency's status as a government organization have impacted the types of networks, strengths of the networks, type of knowledge shared, employee roles in the networks, how and when employees have been introduced to networks depending on when the employee began working for the agency.

Employees with thirty or more years of service indicate having active roles in networks with strong ties (frequent interaction) with colleagues in the same geographical location as themselves, with counterparts in other geographical locations and with consultants. Strong networks share institutional knowledge, experience and inform employees of who knows what. These long-term employees also participate in networks with weak ties (infrequent interactions) as peripheral members with employees within the same functional area in which functional knowledge is shared. These employees are the experts who are consulted or who offer knowledge and advice upon request. Employees became aware of these networks through

mentors and as a result of long tenure with the agency. There was management support for regular face-to-face interactions with contacts and for informal knowledge sharing. As contacts retire, the networks are dissolving and interaction is decreasing. The long-term employees have a strong desire to share institutional knowledge, expertise and experience with newer employees but do not perceive that management has allocated time or budget resources to support the activity in the last decade.

Employees with twenty years to less then thirty years service with the agency indicate having active, central and spanner (links between networks) roles in networks with strong ties with colleagues in the same geographical area, with localities and with consultants. Strong networks share experience, provide referrals and inform employees of who knows what. These employees also participate in networks with weak ties as peripheral members with previous co-workers and with employees in the same functional area in which functional knowledge is shared. Employees became aware of networks through family members who also worked for the agency, on-the-job training, by invitation, involvement in special projects or because of reputation. There was management support for regular face-to-face interactions with contacts and for informal knowledge sharing during early years with the agency but that diminished over the last ten to fifteen years. Participation supports these employees in knowing the function, institutional knowledge and informing them of who does what. As networks dissolve through retirements, positions changes and through departures from the agency, employees lose contacts and knowledge is limited to the immediate functional area. Periodic, temporary networks are relied upon. Employees perceive that management support for participation has decreased dramatically.

Employees with ten years to less then twenty years service with the agency indicate having active and central roles within networks with strong ties with friends, colleagues in the same geographical area, localities, consultants and on internet forums. Strong networks share career information, functional knowledge, how-to knowledge, interpretations of explicit knowledge and inform employees of who knows what. The employees also participate in networks with weak ties in central roles with previous co-workers, employees in the same functional area within the agency, and with counterparts in other geographic locations in which functional, technical, historical and cross-functional knowledge is shared. There are employees within this tenure group who are isolated from networks, primarily by choice. Employees became aware of networks through family members who also worked for the agency, mentors, job requirements, tenure, predecessors or participation in special projects. There was support for participation in networks if required by the job or encouraged by mentors although support has decreased in the last ten years due to budget and staff cuts. Management is focused on getting the job done today. Participation supports these employees in streamlining work processes, sharing workloads, knowing the questions to ask and in demonstrated value of expertise. Dissolution of networks has resulted in lack of communication, loss of contacts, lost institutional knowledge and no longer knowing who to ask.

Employees with less then ten years services with the agency indicate having active or central roles within networks with strong ties with friends, immediate co-workers, previous co-workers, across functions when required by the job, with consultants, and through internet forums. Strong networks share career information, functional knowledge, technical knowledge, and institutional knowledge. These employees also participate in networks with weak ties in

peripheral or spanner roles with counterparts in other geographic locations, localities, vendors and colleagues in professional associations. Knowledge shared within networks with weak ties include functional, institutional, and professional knowledge, lessons learned and inform the employee of who knows what. There are employees who are isolated but wish to be more involved. Isolation can be attributed to fear of providing wrong information as well. Employees became aware of networks through family members who work for the organization, the engineer trainee program, previous experience with networks, long-term employees, managers, and by invitation. Employees perceive there is management support if required by the job or if it results in improved technical knowledge. Lack of support is attributed to the unavailability of budget allocations to support networking. Participation in networks eases work assignments. Dissolution of networks results in lost institutional knowledge, not knowing who to ask and a low awareness of organizational issues.

Managers indicate having active, central or spanner roles in networks with strong ties with friends, immediate co-workers, previous co-workers, across functions, with colleagues in the same geographical area, localities and consultants. Strong networks share career, functional, technical, institutional, and how-to knowledge, inform managers of who knows what, share experience and provide referrals. Managers also participate in peripheral or spanner roles in networks with weak ties with previous co-workers, employees within the same agency function, and counterparts in other geographic areas. Knowledge shared within networks with weak ties includes technical, professional, and historical knowledge. There are some instances of isolation by choice. Managers became aware of networks through previous experience with networks, the engineer trainee program, mentors, job requirements, tenure, and by reputation. Managers

perceive that there is awareness within management of networks, but that senior management is less aware and focused on getting the job done. Managers perceive networks as easing work assignments, streamlining work processes, sharing workloads, knowing the function and knowing who does what. Dissolution of networks results in lost institutional knowledge and knowing only the immediate function.

Non-managers indicate having active or central roles in networks with strong ties with friends, immediate co-workers, previous across functions, with colleagues in the same geographical area, localities, consultants and through internet forums. Strong networks share career, functional, technical, institutional, and how-to knowledge, inform employees of who knows what, share experience, interpret explicit knowledge, and provide referrals. Non-managers also participate in central, peripheral or spanner roles in networks with weak ties with previous co-workers, employees within the same agency function, counterparts in other geographic areas, through internet forums and with colleagues in professional associations. Knowledge shared within networks with weak ties includes functional, technical and historical knowledge and lessons learned. There are some instances of isolation although employees would like to be more involved. Non-managers became aware of networks through family members who also work for the agency, previous experience with networks, the engineer trainee program, on-the-job training, long-term employees, managers, mentors, job requirements, tenure, predecessors, by invitation, reputation, and through participation in special projects. Non-managers perceive that there is low awareness within management of networks although managers who came up through the ranks have better understanding and higher awareness, but that middle management is focused on getting the job done and senior management is focused on the financials. Non-

managers perceive networks as supporting knowing what questions to ask, valuing expertise, knowing the function, knowing who does what, institutional knowledge and as knowledge keepers. Dissolution of networks results in not knowing who to ask, lost institutional knowledge, a low awareness of organizational issues, loss of contacts, knowing only the immediate function, and lack of communication.

Conclusions

The grounded theory model for the role of tacit knowledge networks in a state agency is shown in Figure 3.

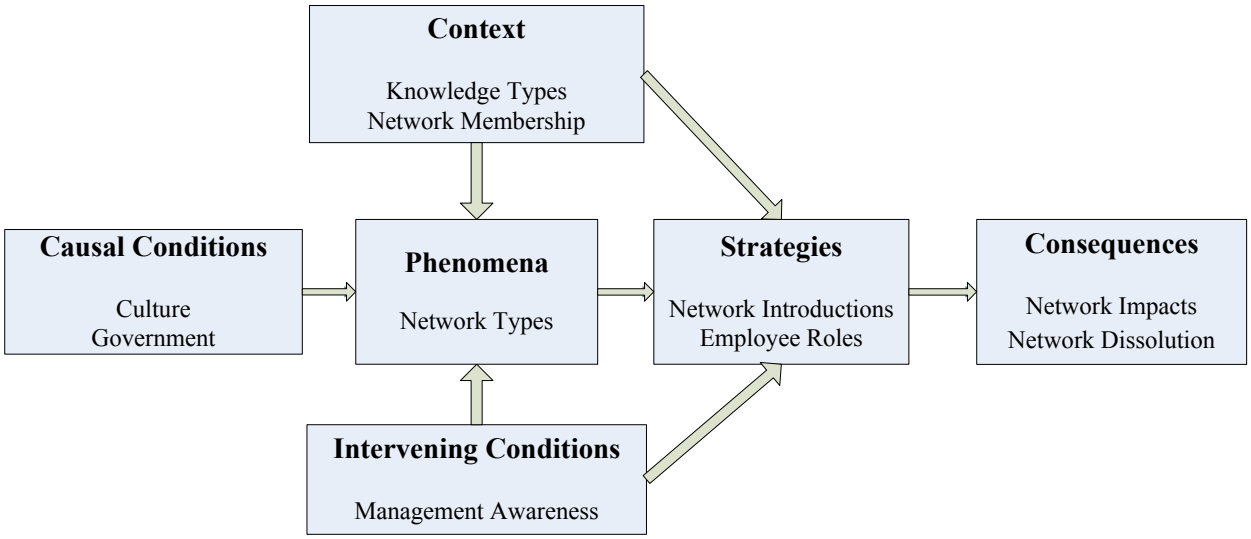

Figure 3: Theoretical Model for the Role of Tacit Knowledge Networks in a State Agency

Causal Conditions

Two types of causal conditions emerged from the data, (a) the culture of the agency and (b) its status as a state government organization which led to the types of networks employees engage in. The agency culture is one of command and control, a lack of people skills in management, a high workload with reduced staff, geographical differences, a change to

outsourcing work, failure to recognize or reward employees, generational differences, lack of retention of newer employees, retirements of long-term employees, valuing education over experience, job security, and pride and ownership in work. The command and control approach is described by participant "H" as "Yes, he was the warden, even though he was a nice guy but he was the captain and he knew it, and we knew it…" or by participant "V" as "you know when somebody is the boss they're the boss." This was confirmed by the interview with the senior executive. "… it seems like we manage to certain extent, manage by memo … memos are sent out, or policies are sent out and the expectation is okay that's going to happen." As stated by the senior executive regarding management and people skills, "I think it may be more tied to you know what is the nature of the work that we do and the type of skill sets that we recruit for and hire…"

Talking about the workload, participant "Y" stated, "recently, it's more work with less people, same amount or more work but you don't have the same amount of people so it is more work to do." Participant "X" echoed this in saying, "[y]es reducing the work force and ever since then we have never recovered and right now kind of like the joke around the office now was we've started off doing more with less and now we're expected to do everything with nothing." Participant "H" describes the geographical differences as "[y]es, it is strange because it is almost like every district is their own highway department sometimes." Regarding outsourcing, participant "V" stated,

> [a]nother thing that could be the way we are going is that you see the management the positions they are coming open up top, way up high, we are not seeing much in the way of field forces. So I think there is a goal that VDOT will have a skeleton emergency response group and then everything else will be contracted out. And be just supervising the contracts and supervising or overseeing the contractors activities …

A failure to reward or recognize employees for service, work, or experience is addressed by participant "X" as "you don't seem like you're rewarded for long service which you think that they would desire to a degree especially if you are somebody that is doing a good job…" New employees are trained and leave for higher pay with consultants or because of frustration that they are unable to move up more quickly. Stating the difference between long-term employees and new employees and how they perceive the job and organization, participant "H" said, "people kind of lose their point of interest and it is just a job and it's not picked up on how the pride or how we got here, and when you lose your pride in your job, in your organization, it's not the same."

Its status as a state government organization results in changes in direction of the agency when there is a change in state leadership and the agency commissioner. The changes affect the higher levels of the organization but do not affect daily tasks. These daily tasks are impacted by heavy paperwork, rules and regulations. As state employees, salary increases are determined by the legislature. Participant "H" describes the impact of leadership changes in the state as,

> Right, and it doesn't help that every four years we get a new governor and then a new commissioner possibly and he has his own ways and then by the time he actually gets to the point that he's getting something done and people understand what he wants. Then he goes and here comes another one now he doesn't want to do anything like that, he wants to go back to something that we did 18 years ago and so it is like throttle back and you can't operate you can't do it, not the way they want us to work…

An example of paperwork is described by participant "L", "[a]nd so then you have to fill out these long requisition things and had to look at a list that … would stock if they weren't on there then you had to make out another list to send out to … district shop…" Regarding rules and regulations governing work, participant "I" said "…this is too much for one person to go through

for this one little thing, this is not feasible, we had several different steps and different steps within steps to find out if you needed to do that step."

Phenomena

These causal conditions impacted the type of networks in which employees participated. Employees engaged in strong networks with frequent or regular interaction, weak networks with infrequent interaction, or were isolated from networks by choice or circumstances. The type of network available to employees is limited by the decrease in staff and high workload, which reduces the amount of time available to network. Retirements and employee turnover result in changes of who is doing what where. Changes in leadership alter the focus of what employees need to know or of what they need to be aware.

Context

Employees with ten years or more service engaged in strong networks within the same geographical area resulting from restrictions of budget and time resources to travel and meet employees elsewhere. All employees engage in networks with consultants resulting from the move to outsourcing while employees with less then thirty years service also participate in networks with localities, a necessity given the impact local politics have on the agency. Employees with less then twenty years participate in networks through the internet. Additional strong networks included counterparts for employees with thirty or more years service, a carryover from a time when traveling to meet was more supported; friends; immediate and previous co-workers; and across functions if required by the job.

Weak networks included within the same functional area for employees with more then ten years service, with counterparts for employees with less then twenty years service, and with

previous co-workers, localities, vendors and colleagues in professional associations. Employees are isolated by choice, by lack of support by management, and because they are new to the organization.

Knowledge types shared within strong networks include institutional, functional, technical and how-to knowledge, experience, knowledge on who to call and who knows what, referrals, career information, and interpretations of explicit knowledge. Knowledge types shared within weak networks include functional, technical, historical, professional, cross-functional and institutional knowledge, lessons learned, and knowledge on who to call and who knows what.

Intervening Conditions

Management awareness or lack of awareness of networks impacts the support employees receive to engage in networks. Middle management is seen as aware but focused on getting the job done that is due today. As participant "O" stated, "[t]hey are aware of it, but they are not aware. They are aware of it but their back is against the wall. You know how it is when we've only got so many people, I mean I've heard that, 'well we've only got so many people.'" Senior management is seen as being less aware of networks. However, managers who have come up through the ranks are viewed as having a greater understanding of network roles. Participant "X" stated,

> You know sometimes you don't think so maybe they do I think it depends on who your manager is, I mean I've had some that you know as long as you're doing it they probably don't know what it takes to do it to that level … I think that the ones that come up through the ranks know, but I think the ones that come in and don't really realize and don't come down there and talk to you.

Strategies

Introductions to networks vary according to tenure. Employees with greater then thirty years service became aware of and a part of networks through mentors and as a result of tenure in position. Employees with twenty to less then thirty years service were introduced to networks through on-the-job training, participation in special projects, family members, by invitation and due to reputation. Employees with ten to less then twenty years service were introduced through family members, mentors, predecessors, because of job requirements, participation in special projects or tenure in position. Employees with less then ten years service were introduced to networks through family members, long-term employees, managers, by invitation, through previous experience with networks or participation in the engineer trainee program. Common themes include introductions for employees with less then thirty years service by family members also employed by the agency, and job training or requirements for employees with ten to less then thirty years service. All but employees with twenty to less then thirty years mention mentors or managers as introducing networks.

Employees have primarily active or central roles in strong networks with employees with twenty to less then thirty years service also mentioning spanner roles. In weak networks, employees with greater then twenty years or less then ten years service, have peripheral roles. Employees with less then ten years also have spanner roles while employees with ten to twenty years of service indicate central roles in weak networks.

Consequences

Involvement in networks results in sharing of knowledge across the organization and positive impacts on work, including streamlining processes, sharing workloads, and easing work assignments because knowledge is available.

Network dissolutions through retirements, employee departures, reorganizations and changes in management support result in lost knowledge, failure to know where to access knowledge, unawareness of other functional areas or organizational issues and a lack of communication across the organization.

Discussion

This study revealed that strong tacit knowledge networks in this state agency are primarily restricted to local groups due to a lack of time, budget restrictions, reduction in staff, high workload, the weight of paperwork, rules and regulations, and lack of management support. The assumption is that employees would share more if more time and resources were allotted to support the transfer of knowledge. Networks that do go outside the local area, primarily weak networks, result in more efficient and effective work practices. However, because these are weak networks with infrequent interaction, the agency does not fully benefit from the collective knowledge of its employees.

The participants perceive that the organizational culture is one of a command and control approach, which interferes with knowledge sharing and transfer through networks. “Culture embodies all the unspoken norms, or rules, about how knowledge is to be distributed between the organization and the individuals in it” (DeLong & Fahey, 2000, p. 118). Knowledge creation and sharing is affected by the organizational culture. “An organizational culture that enforces a

policy of command and control to create an order seldom provides opportunities to create knowledge" (Bhatt, 2000, Managing knowledge section, ¶1). Status as a government agency also impedes network participation as employees are overwhelmed with paperwork, rules and regulations. "Unlike their peers in private enterprise, government workers must also complete paperwork for even the simplest tasks. This demand can potentially hamper workers' productivity and create an institutional tendency to perform only the minimum job requirements" (Chiem, 2001, ¶ 3). According to Chiem (2001), presenting knowledge sharing as a way to make jobs easier can assist is making the practices appealing to government employees. In this study, employees with less then twenty years service do perceive knowledge sharing as making jobs easier. Employees do not know what to share or what is known until the opportunity to network with other employees arises and through discussion the knowledge is revealed. There is a perception that talking is not productive, this study reveals that it is. "The non-information sharing culture of many government agencies is perhaps one of the greatest barriers that many agency directors will face" (Auditore, 2003, p. S4). According to the Knowledge Management Working Group of the Federal Chief Information Officers Council (2001), there are several reasons employees do not share knowledge. People may not know what they know, how to share or with whom to share, or sharing may be seen as too difficult or time consuming. In this study, the recurring theme of more work with fewer people and lack of time to participate in networks supports this finding in the literature.

This study found lack of time, failure to recognize employees, rules and regulations produced by legislation as impacting networks. This finding is supported by a case study of the Social Security Administration, Rubenstien-Montano, Buchwalter and Liebowitz (2001), which

identified the following barriers to sharing knowledge: "1) lack of resources; 2) failure to recognize individual contributions; 3) assignment to leadership positions that were not based on merit or experience; 4) hierarchical organizational structure; and 5) an organization driven by legislation" (7. Findings and conclusions section, ¶ 2).

The strong networks revealed in this study were local with few networks reaching across geographical or functional locations. This finding is reflected in the literature. According to Ruddy (2000),

> A great deal of knowledge in an organization is undocumented and therefore isn't easily available to everyone. It may be shared among a few individuals or within local groups, but rarely migrates outside those circles. This is especially so for 'practical know-how', but also true for more formal kinds of knowledge that people discover and create every day (p. 38).

This restriction to local sharing of knowledge prevents the knowledge from being accessible to the rest of the organization. According to Brown and Duguid (2001), networks that cut across the organization horizontally are where knowledge flows.

Retirements, failure to retain employees, and reorganizations were all cited as contributors to knowledge loss and inability to know who to call. This finding is supported in the literature. "New staff or staff facing new problems are unaware of these ad-hoc communities and are unable to tap into their expertise. Expertise learned from experience is lost with retirement. Staff turnover and restructuring break down the informal networks to the point where even long-term staff do not know who to call" (Burk, 2000, p. 18). Employees with less then twenty years service may be isolated. This finding is supported in the literature. "Employees' ages and career

stage may also affect their knowledge sharing behaviors through the size and utility of their social networks" (Connelly & Kelloway, 2003, p. 297).

Fifteen of the seventeen participants interviewed indicated a desire for more participation in more networks, particularly those that go outside the local area. This contradicts Chatzkel (2002), who states that the main barriers to knowledge sharing in government organizations are the 'not invented here' syndrome and personal power issues. Government employees hoard knowledge to support the security of their role in the institution. These barriers did not appear in this study.

Management appears to be unaware or aware but not providing support or focus on the role of networks in sharing knowledge across the organization. The literature indicates that management effort and support are required for successful knowledge transfers. "Because tacit knowledge is difficult to convey, its transfer requires greater effort" (Reagans and McEvily, 2003, p. 245). "Leaders have direct control over what activities are rewarded, what behaviors are encouraged and how work will be valued in the organization. These factors all influence workers' motivation and ability to develop new knowledge" (Bryant, 2003, p. 35). It is the organization's responsibility to establish a culture or environment that supports the forming of these networks, both loose and tight, to encourage the sharing of knowledge (Droege & Hoebler, 2003; Swan, Newell, Scarbrough & Hislop, 1999). "Rather than being an issue of controlling and directing flows of knowledge, then the task of managing knowledge networks is one of creating accessibility" (Augier &Vendele, 1999, p. 255). "Although higher performers seem to have a natural ability to find points of commonality with others, managers can also help employees forge productive relationships" (Cross, Davenport & Cantrell, 2003, p. 20).

This study revealed that networks within this agency emerge out of the causal conditions of culture and status as a state government agency and are impacted by the intervening condition of lack of management awareness or support. The context of these networks is the type of knowledge shared and type of networks while roles and introductions to networks are the strategies employed. The networks that do exist are primarily local, strong networks, and provide institutional, functional, technical and how-to knowledge, as well experience, referrals, knowledge about who to call and interpretations of explicit knowledge. Employees play active and central roles, and for employees with twenty to less then thirty years service, spanner roles in the networks. Weak networks span geographical lines to share primarily functional, technical, and historical knowledge. Employees play peripheral roles in these networks. Employees become aware of networks through mentors, tenure, job requirements, on-the-job training, family members also employed by the agency, predecessors, long-term employees, managers, through the engineer trainee program, participation in special projects and by invitation. Introductions to networks differ according to tenure. The benefits of the networks are in sharing knowledge, improving effectiveness and efficiency of the work and knowing who the experts are in the agency that can be called on. When the networks dissolve through retirements, lack of employee retention, and reorganizations, institutional and cross-functional knowledge and contacts are lost.

Implications and Recommendations

Implications of this study that may be applicable to other organizations include: 1) barriers to knowledge sharing are greater than management support as evidenced by time allotted and resources provided for networking; 2) the loss of knowledgeable employees in the preceding decade through retirements and attrition resulted in dissolutions or weakening of networks

through which tacit knowledge was shared; 3) the continuing loss of employees further impedes the sharing and preservation of institutional knowledge; 4) government employees need the visible and articulated support of management to engage in knowledge sharing; 5) knowledge sharing results in benefits to the organization through improved processes, shared workloads, and easing of work assignments; 6) younger employees desire to have the institutional knowledge recorded and made available electronically whenever feasible or to make tacit knowledge explicit; and 7) long-term employees have a desire to share the knowledge gained over the years.

Recommendations resulting from this study for the agency are: 1) increase management awareness of the value and impact of networks on the work performed, 2) provide time and budget resources to support employee participation in cross-functional and cross-geographical networks to increase knowledge shared, 3) develop networks for knowledge sharing; 4) identify knowledge experts; and 5) transform tacit knowledge to explicit when feasible and make it accessible electronically.

Recommendations for Further Research

Recommendations for further research are: 1) identification of specific benefits and impacts on work performed resulting from knowledge sharing through networks, 2) the return on investment for budget and time allocations for knowledge sharing, 3) duplication of the study to other career groups within the agency, and 4) duplication of the study in other state agencies to determine if the theory is specific to one agency.

REFERENCES

Abrams, L.C., Cross, R., Lesser, E. & Levin, D.Z. (2003). Nurturing interpersonal trust in knowledge-sharing networks. *Academy of Management Executive, 17*, 64-76.

Alavi, M. & Tiwana, A. (2001). *Knowledge integration in virtual teams: The potential role of KMS.* (Goizueta Business School Paper Series). Atlanta, GA: Emory University. Retrieved July 15, 2004 from http://gbspapers.library.emory.edu/archive/00000025/.

Adler, P.S., Goldoftas, B. & Levine, D.I. (1999). Flexibility versus efficiency? A case study of model changeovers in the Toyota production system. *Organization Science, 10*, 43-68

American Productivity & Quality Center. (1999). *Creating a knowledge-sharing culture: Consortium benchmarking study: Best-practice report*. Houston, TX.

Argote, L. & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, *82*, 150-169.

Auditore, P.J. (2003, June). Governments worldwide poised to exploit knowledge management. *KM World*, (suppl), 4.

Augier, M, & Vendele, M.T. (1999). Networks, cognition and management of tacit knowledge. *Journal of Knowledge Management, 3*, 252-261.

Awazu, Y. (2004). *Knowledge management in distributed environments: Roles of informal network players.* Proceedings of the 37th Hawaii International Conference on System Sciences, Big Island, HI, January 5-8, 2004. Retrieved on June 2, 2004 from http://csdl.computer.org/comp/proceedings/hicss/2004/2056/01/205610025a.pdf.

Babchuk, W.A. (1997). *Glaser or Strauss?: Grounded theory and adult education*. Presented at the Midwest Research-to-Practice Conference in Adult, Continuing and Community Education, East Lansing, MI, October 15-17, 1997. Retrieved on June 2, 2004 from http://www.anrecs.msu.edu/research/gradpr96.htm.

Backman, K. & Kyngas, H.A. (1999). Challenges of the grounded theory approach to a novice researcher. *Nursing and Health Sciences, 1*, 147-153.

Bartlett, D. (2003). Producing organizational knowledge through innovation, performance and evaluation: The case of the public sector. *International Journal of Business Performance Management*, *5*, 350-361.

Berends, H., van der Bij, H., Debackere, K. & Weggeman, M. (2003). *A grounded theory on knowledge sharing in industrial research: Origination mechanisms and their effects.* Retrieved on June 2, 2004 from http://www.tm.tue.nl/ok/berends/OKLC2003Berends EtAl.pdf.

Bhatt, G.D. (2000). Information dynamics, learning and knowledge creation in organizations [Electronic version]. *The Learning Organization, 7*, 89.

Bhatt, G.D. (2002). Management strategies for individual knowledge and organizational knowledge. *Journal of Knowledge Management*, *6*, 31-39.

Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality & Quantity, 36*, 391-409.

Bogenrieder, I. & Nooteboom, B. (2004). Learning groups: What types are there? A theoretical analysis and an empirical study in a consultancy firm. *Organization Studies, 25*, 287-313.

Bontis, N. (1999). Managing organizational knowledge by diagnosing intellectual capital: Framing and advancing the state of the field. *International Journal of Technology Management*, *18*, 433-462.

Brief, A.P. & Motowidlo, S.J. (1986). Prosocial organizational behaviors. *Academy of Management Review, 11*, 710-725.

Brown, J.S. & Duguid, P. (2001). Knowledge and organization: A social-practice perspective. *Organization Science, 12*, 198-213.

Bryant, S.E. (2003). The role of transformational and transactional leadership in creating, sharing and exploiting organizational knowledge. *The Journal of Leadership and Organizational Studies, 9*(4), 32-44.

Buchanan, M. (2002). *Nexus: Small worlds and the groundbreaking science of networks*. New York: W.W. Norton & Company.

Burk, M. (2000, May/June). Communities of practice. *Public Roads*, 18-21

Carey, R. (2003). Fight the brain drain [Electronic version]. *Successful Meetings, 52*(2), 31-35.

Castells, M. (2000). Materials for an exploratory theory of the network society. *British Journal of Sociology, 51*, 5-24.

Chatzkel, J. (2002). Conversation with Alex Bennet, former deputy CIO for enterprise integration at the US Department of Navy. *Journal of Knowledge Management, 6*, 434-444.

Chiem, P.X. (2001, October 4). Knowledge management in the public sector. *Destination CRM.* Retrieved October 4, 2001 from http://www.destinationcrm,com/dcrm_ni_article.asp?id=560&art=mag&deptid=8.

Chiovitti, R.F. & Piran, N. (2002). Rigour and grounded theory research. *Methodological Issues in Nursing Research, 44*, 427-435.

Choi, B. & Lee, H. (2002). An empirical investigation of KM styles and their effect on corporate performance. *Information & Management, 40*, 403-417.

Clarke, T. & Rollo, C. (2001). Corporate initiatives in knowledge management. *Education & Training, 43*, 206-214.

Connelly, C.E. & Kelloway, E.K. (2003). Predictors of employees' perceptions of knowledge sharing cultures. *Leadership & Organization Development, 24*, 294-301.

Constant, D., Kiesler, S. & Sproull, L. (1994). What's mine is ours, or is it? A study of attitudes about information sharing. *Information Systems Research, 5*, 400-421.

Cook, S.D.N. & Brown, J. S. (1999). Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. *Organization Science, 10*, 381-400.

Cowan, R. & Jonard, N. (2003). Network structure and the diffusion of knowledge. *Journal of Economic Dynamics & Control, 28*, 1557-1575.

Cresswell, J.W. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks: Sage Publications.

Cristol, H. (2002, July-August). Making government work better. *The Futurist*, 13.

Cross, R., Davenport, T.H. & Cantrell, S. (2003, Fall). The social side of performance. *MIT Sloan Management Review*, 20-21.

Cunha, M.P.E. & da Cunha, J.V. (2003). Organizational improvisation and change: Two syntheses and a filled gap. *Journal of Organizational Change Management, 16*, 169-185.

Davenport, T.H., De Long, D.W. & Beers (1998). Successful knowledge management projects. *Sloan Management Review, 39*, 43-57.

Davenport, T.H., Eccles. R.G. & Prusak, L. (1992). Information politics. *Sloan Management Review, 34*, 53-65.

Davern, M. (1997). Social networks and economic sociology: A proposed research agenda for a more complete social science. *American Journal of Economics and Sociology, 56*, 287-302.

de Holan, P.M., Phillips, N. & Lawrence, T.B. (2004). Managing organizational forgetting. *MIT Sloan Management Review, 45*, 45-51.

DeLong, D.W. & Fahey, L. (2000). Diagnosing cultural barriers to knowledge management. *The Academy of Management Executive, 14*, 113-127.

DeTienne, K.B. & Jackson, L.A. (2001). Knowledge management: Understanding theory and developing strategy. *Competitiveness Review, 11*, 1-11.

Dick, B. (2002). *Grounded theory: A thumbnail sketch*. Retrieved on June 2, 2004 from http: //www.scu.edu.au/schools/gcm/ar/arp/grounded.html.

Douglas, D. (2003). Grounded theories of management: A methodological review. *Management Research* News, 26(5), 44-52.

Droege, S.B. & Hoobler, J.M. (2003). Employee turnover and tacit knowledge diffusion: A network perspective. *Journal of Managerial Issues, 15*, 50-64.

Duffy, K., Ferguson, C. & Watson, H. (2003). Data collecting in grounded theory – some practical issues. *Nurse Researcher, 11*(4), 67-78.

Estevas, J., Ramos, I. & Carvalho, J. (2002*) Use of grounded theory in information systems area: An exploratory analysis.* Proceedings of the European Conference on Research Methodology for Business and Management Studies. Retrieved on June 2, 2004 from http://baan.ittoolbox.com/browse.asp?c=BaanPeerPublishing&r=http://www.lsi.upc.es%2F~jesteves%2FEcrm.pdf.

Fahey, L. & Prusak, L. (1998). The eleven deadliest sins of knowledge management. *California Management Review,40*, 265-276.

Federal CIO Council. (n.d.). KM in the government. Retrieved on July 24, 2004 from http:// www.fgipc.org/02_Federal_CIO_Council/KMintheGov.htm.

Foster, F. & Falkowski, G. (1999). Organization network analysis: A tool for building a learning organization. *Knowledge and Process Management, 6*, 53-60.

Frappaolo, C. & Wilson Todd, L. (2000). *After the gold rush: Harvesting corporate knowledge resources*. Retrieved October 14, 2004 from http://www.intelligentkm.com/feature/Case1.

Furlong, G.P. & Johnson, L. (2003). Community of practice and metacapabilities. *Knowledge Management Research & Practice, 1*, 102-112.

Gibbert, M. & Probst, G.J.B. (2002). *Anticipating and managing three dilemmas in knowledge management: Insights from an in-depth case study of a major diversified firm*. Retrieved on June 2, 2004 from http://hec.info.unige.ch/recherches_publications/cahiers/2002/2002.08.pdf.

Glaser, B.G. (2002). Conceptualization: On theory and theorizing using grounded theory. *International Journal of Qualitative Methods, 1*(2), 1-31.

Goral, C.R. (2000, Winter). Knowledge management and the FAR: Charting a new course at GSA. *The Public Manager*, 29(4), 39-45.

Granovetter, M.S. (1973). The strength of weak ties. *American Journal of Sociology, 78*, 1360-1380.

Gupta, P.P., Dirsmith, M.W. & Fogarty, T.J. (1994). Coordination and control in a government agency: Contingency and institutional theory perspectives on GAO audit. *Administrative Science Quarterly, 39*, 264-284.

Holsapple, C.W. & Joshi, K.D. (2002). Knowledge management: A threefold framework. *The Information Society, 18*, 47-64.

Ives, W., Torrey, B. & Gordon, C. (1998). Knowledge management: An emerging discipline with a long history. *Journal of Knowledge Management, 1*, 269-274.

Janczak, S.M. (1999, October*). Knowledge integration: A new approach to the role of middle management.* Dissertation. Retrieved on June 2, 2004 from http://www.pum.umontreal.ca/theses/pilote/janczak/these_front.html.

Jarvenpaa, S.L. & Staples, D.S. (2001). Exploring perceptions of organizational ownership of information and expertise. *Journal of Management Information Systems, 18*, 151-183.

Knowledge Management Working Group of the Federal Chief Information Officers Council. (2001). *Managing knowledge at work: An overview of knowledge management.* Retrieved October 10, 2001 from http://www.km.gov.

Koskinen, K.U. (2003). Evaluation of tacit knowledge utilization in work units. *Journal of Knowledge Management, 7*(5), 67-81.

Lang, J.C. (2001). Managerial concerns in knowledge management. *Journal of Knowledge Management, 5*, 43-57.

Lesser, E. & Prusak, L. (2001). Preserving knowledge in an uncertain world [Electronic version]. *MIT Sloan Management Review, 43*, 101-102.

Levin, D.Z., Cross, R., Abrams, L.C. & Lesser, E.L. (2002). *Trust and knowledge sharing: A critical combination*. (G510-1693-00). Somers, NY: IBM Global Services.

Liebowitz, J. (2003). Aggressively pursuing knowledge management over 2 years: A case study at a U.S. government organization. *Knowledge Management Research & Practice, 1*, 69-76.

Marr, B., Gupta, O., Pike, S. & Roos, G. (2003). Intellectual capital and knowledge management effectiveness. *Management Decision, 48*, 771-781.

Matthews, W. (2000, March 13). Minding her business. *Federal Computer Week*. Retrieved on July 25, 2004 from http://www.fcw.com/fcw/articles/2000/0313/fcw-mgt-profile-03-13-00.asp.

McAdam, R. & Reid, R. (2000). A comparison of public and private sector perceptions and use of knowledge management. *Journal of European Industrial Training, 24*, 317-329.

McBriar, I., Smith, C., Bain, G., Unsworth, P., Magraw, S. & Gordon, J.L. (2003). Risk, gap and strength: Key concepts in knowledge management. *Knowledge-Based Systems, 16*, 29-36.

McCallin, A.M. (2003). Designing a grounded theory study: some practicalities. *Nursing in Critical Care, 8*, 203-208.

McCann, T.V. & Clark, E. (2003). Grounded theory in nursing research: Part 1 – Methodology. *Nurse Researcher, 11*(2), 7-16.

Mohrman, S.A., Tankasi, R.V. & Mohrman, A.M., Jr. (2003, September). The role of networks in fundamental organizational change: A grounded analysis. *The Journal of Applied Behavioral* Science, 39, 301-323.

Nardi, B.A. , Whittaker, S & Schwarz, H. (2004). It's not what you know, it's who you know: Work in the information age. *First Monday*. Retrieved on August 24, 2004 from http:// firstmonday.org/issues/issue5_5/nardi/index.html.

Nicholson-O'Brien, D. (2000, March/April). Government in the knowledge age: How governments can lead with knowledge. *Knowledge Management Review*, *3,* 30-33.

Nonaka, I. & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York: Oxford University Press.

Okhuysen, G.A. & Eisenhardt, K.M. (2002). Integrating knowledge in groups: How formal interventions enable flexibility. *Organization Science, 13*, 370-386.

Orlikowski, W.J. (1993, September). CASE tools as organizational change: Investigating incremental and radical changes in systems development. *Management Information Systems Quarterly, 17*(3). Retrieved on June 2, 2004 from http://misq.org/archivist/bestpaper/misq93.html.

Paintanida, M., Tananis, C. & Grubs, R. (2002). *Claiming grounded theory for practice-based dissertation research: A think piece.* Presented at the 2002 Conference on interdisciplinary Qualitative Studies in Athens, GA, January 3-5, 2002. Retrieved on June 2, 2004 from http://www.coe.uga.edu/proceedings/Qurg02-Proceddings/claim.pdg.

Pandit, N.R. (1996, December). The creation of theory: A recent application of the grounded theory. *The Qualitative Report*, *2*(4). Retrieved on June 6, 2004 from http://www.nova.edu/ssss/QR/QR2-4/pandit.html.

Patriotta, G. (2004). On studying organizational knowledge. *Knowledge Management Research & Practice, 2*, 3-12.

Polanyi, M. (1966). *The tacit dimension.* Garden City, NY: Doubleday & Company.

Reagans, R. & McEvily, B. (2003). Network structure and knowledge transfer: The effects of cohesion and range. *Administrative Science Quarterly, 48*, 240-267.

Ribiere, V.M. & Sitar, A.S. (2003). Critical role of leadership in nurturing a knowledge-supporting culture. *Knowledge Management Research & Practice, 1*, 39-48.

Robson, C. (202). *Real world research: a resource for social scientists and practitioner-researchers*, 2nd ed. Oxford: Blackwell Publishers.

Rowley, T.J. (1997). Moving beyond dyadic ties: A network theory of stakeholder influences. *Academy of Management Review, 22*, 887-910.

Rubenstein-Montano, B., Buchwalter, J. & Liebowtiz, J. (2001). Knowledge management: A U.S. Social Security Administration case study [Electronic version]. *Government Information Quarterly, 18*(3).

Ruddy, T. (2000). Taking knowledge from heads and putting it into hands. *Knowledge and Process Management, 7*, 37-40.

Schultze, U. (2000, March). A confessional account of an ethnography about knowledge work. *MIS Quarterly, 24*, 3-41.

Shah, P.P. (2000). Network destruction: The structural implications of downsizing. *Academy of Management Journal, 43*, 101-112.

Simoni, G. (2003). *Knowledge capitalization in R&D projects: An integrative and diversified approach: Summary of the doctoral research*. Retrieved on June 2, 2004 from http:// www.univ-aix.fr/lest/lesdocuments/lesdocumentsdetravail/simoni/knoledge.pdf.

Smith, E.A. (2001). The role of tacit and explicit knowledge in the workplace. *Journal of Knowledge* Management, 5, 311-321.

Smith, H.A. & McKeen, J.D. (2003, May). *Instilling a knowledge-sharing culture.* Unpublished manuscript, Queen's University, Kingston, Ontario, Canada. Retrieved October 10, 2003 from http://www.busines.queenssu.ca.

Strauss, A. & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*, 2nd ed. Sage Oaks: Sage Publications, Inc

Sveiby, K.E. & Simons, R. (2002). Collaborative climate and effectiveness of knowledge work—an empirical study. *Journal of Knowledge Management, 6*, 430-433.

Swan, J., Newell, S., Scarbrough, H., Hislop, D. (1999). Knowledge management and innovation: networks and networking. *Journal of Knowledge Management, 3, 262*-272.

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal, 17*, 27-43.

Trim, P.R.J. & Lee, Y.I. (2004). A reflection on theory building and the development of management knowledge. *Management Decision: Quarterly Review of Management Technology*, 43, 473-480.

Walker, D.M. (2001, February 1*). Human capital: Meeting the governmentwide high-risk challenge*. (GAO Publication GAO-01-357T). Washington, DC: U.S. General Accounting Office.

Walsh, J.P. & Ungson, G.R. (1991). Organizational Memory. *Academy of Management. The Academy of Management Review, 16*, 57-91.

Wiig, K.M. (1997, September). Knowledge management: An introduction and perspective. *The Journal of Knowledge Management*, *1*, 6-14.

Wiig, K.M. (2002). Knowledge management in public administration. *Journal of Knowledge Management, 6*, 224-239.

Wimpenny, P. & Gass, J. (2000). Interviewing in phenomenology and grounded theory: Is there a difference? *Journal of Advance Nursing, 31*, 1485-1492.

Woods, L., Priest, H. & Roberts, p. (2002). An overview of three different approaches to the interpretation of qualitative data. Part 2: Practical illustrations. *Nurse Researcher, 10*, 43-51.

Yin, R.K. (2003). *Case study research: Design and methods*, 3rd ed. Thousand Oaks: Sage Publications.

APPENDIX A: INSTITUTIONAL REVIEW BOARD APPLICATION

CAPELLA UNIVERSITY
Institutional Review Board
225 South 6th Street, 9th Floor
Minneapolis, Minnesota 55402

Institutional Review Board Application
(When this IRB application is completed, it is to be submitted with the research proposal for the next stage of review. The Provost, or designee, gives final approval. See the checklists at the end of this form to verify that you have completed all of the information for this application.)

Name __Maureen Hammer_____
Date____March 2005__
Address___3025 Morewood Lane_
_____Charlotttesville, VA 22901_
Phone (Work) __434-293-7386_____ (Home) __434-823-2659_____
Email Address(es)
____Maureen.Hammer@VDOT.virginia.gov_____
____mlhammer@adelphia.net_____
Field of Study *Organization and Management* Degree Program __PhD_____

Supervisor Name _____John Whitlock, PhD_____
Supervisor Title ___Mentor_____
Address_____Capella University 225 South 6th Street_____
_____Minneapolis, MN 55402_____
Phone (Work) *813-949-2662*_____ (Home) _____
Email Address(es)
_____John.Whtilock@capella.edu_____

Provost _____Shelley Robbins_____

___11/28/2004___Fill in date you successfully completed the online IRB Training required modules and optional modules appropriate to research topic

3. **Project Title**: (Use same title as Final Proposal)

__The Role of Tacit Knowledge Networks in a State Agency:_____

__An Analysis Based on a Grounded Theory Approach_____

2. **Inclusive dates of project**: *3/2005* **through** *6/2005*

3. **Abstract**

This research study will use a grounded theory approach to discover and understand the role tacit knowledge networks play for employees of a state agency. Several research questions covering cause, context, conditions, interactions and consequences will be explored to assist in this discovery and understanding: 1) In what types of networks do employees in VDOT participate?; 2) What types of knowledge are shared within the networks?; 3) What are the employees' roles within the networks?; 4) How do employees become aware of the existence of networks?; 5) When do employees become aware of the existence of networks?; 6) How do employees become a part of a network?; 7) How do managers view employee networks?; 8) How do the networks impact assigned work tasks and functions?; 9) What is the affect on employee productivity and effectiveness if the network dissolves?; and 10) How are the networks used to disseminate knowledge within the organization? An inductive process will be used to form initial concepts and additional data will lead to a deductive process to develop the substantive (one that concentrates on a specific social process based in a narrow setting) theory.

Initial participants will be selected using purposive sampling and will be employees of critical functions of the agency. Of the 9150 agency employees, 6362 employees are assigned to these career groups. A representative sample of this population, with a confidence interval of five and a confidence level of 95%, would be 362. Participants will be selected based on membership in one of the critical career groups. Actual number of interviews will depend on number of employees agreeing to participate. The participants will represent diverse geographical locations within the agency and varying lengths of service. Following initial analysis of the early data, theoretical sampling will be used based on the formation of provisional hypotheses and concepts, which will guide further data collection and analysis.

Data will be collected through unstructured and semi-structured interviews, researcher observations and analysis of supporting documentation. Interview guides for the semi-structured interviews will evolve out of the initial unstructured interviews and may change over time as theory emerges from the data. Employees will be interviewed and associated managers will be interviewed for related perspectives. Data will be analyzed using the constant comparative method provided by Strauss and Corbin (1998), comparing what emerges with what is collected and consciously looking for data that will contradict the analysis to strengthen it. Data is first examined and analyzed word for word and line by line and given codes. These codes are then compared and relationships between them are identified in a process called axial coding and grouped into categories or clusters. A central code emerges and becomes the focus of data collection and analysis.

Data about networks will also be gathered and analyzed using social network analysis software to aid in the presentation of data analysis and results.

4. **Participant/Subject Population (or Final Sample to be selected)**

a. Number: Male __unknown_ Female *unknown* Total __up to 362__

b. Age Range: 18 to *70*

c. Location of Participants:
(Check all that apply)

____ business

____elementary / secondary school

____outpatient

____hospital / clinic

____university / college

__X_other special institution / agency:
specify_Virginia Department of Transportation__ _____

d. Special Characteristics:
(Check all that apply)

*X*adults with no special characteristics

___Capella University learner, faculty, and/or staff

___inpatients

___outpatients

___prisoners

___students

___other special characteristics:
specify _____

A letter from the Chief, Technology, Research and Innovation for the Virginia Department of Transportation is attached documenting approval for the research to be conducted.

e. Recruitment of Participants/Subjects

Participants will be selected from identified critical career groups at the agency with varying levels of service and from different geographical areas within the agency as indicated by the organizational charts of the districts. Potential participants will be contacted through email requesting their participation in interviews for this research. The email will explain the purpose of the research and emphasize that confidentiality will be maintained. (email attached)

f. Approval for Use of Records

not applicable

g. Initial Contact with Participants/Subjects

The researcher will make initial contact with the potential participants via email. The email will contain the purpose and description of the research as written in the Informed Consent letter. It will emphasize the confidentiality of the interviews and that participation is voluntary. (email attached)

h. Inducements or Rewards to Participants/Subjects

not applicable

i. Activity for Control Group

not applicable

5. **Confidentiality of Data**

a. The researcher will do all coding to ensure confidentiality of the interviews. No descriptive or identifying information will be included on the recordings heard by the transcriber. Managers who are interviewed will be told that all interviews are confidential and no descriptive information regarding employees interviewed will be provided. Only the researcher will have access to the data.

b. Copies of the interview will be made for back up and the original tape will be provided to a transcriber. The transcription will then be compared to the tape and the back up tape will be destroyed following verification of an accurate transcription. The original tape and transcriptions will be stored for seven years in a secure file in the home of the researcher and then destroyed (erasing the tape prior to destruction and shredding all documents). Names and identifying information will be removed from all references to the data to ensure confidentiality.

Signature of Researcher

As a Researcher (e.g., Learner, Faculty Employee, Consultant, Directed Employee/Agent, Independent Contractor, Adjunct Faculty) you certify that:

- The information provided in this application form is correct and complete.
- You will seek and obtain prior written approval from the Committee for any substantive modification in the proposal.
- You will report promptly to your Supervisor any unexpected or otherwise significant adverse events in the course of this study.
- You will report to the Supervisor and to the participants/subjects, in writing, any significant new findings which develop during the course of this study which may affect the risks and benefits to participation in this study.
- You will not begin the research until final written approval is granted.
- You understand that this research, once approved, is subject to continuing review and approval by your Supervisor. You will maintain records of this research according to Supervisor guidelines. Substantive change requires submitting an addendum to a previously approved application. An addendum is a totally new application form with attachments. The cover letter with the addendum describes the changes that were made from the originally approved application.

If these conditions are not met, approval of this research could be suspended.

Signature of the Researcher:

_____ Date_____

Signature of Supervisor

As a Supervisor (e.g., Mentor, Instructor, Practicum Supervisor, Internship Supervisor, Staff Supervisor) you certify that:

- The information provided in this application form is correct and complete.
- You will review and provide prior written approval to your Supervisee for any substantive modification in the proposal. You will inform the committee members appointed to oversee the research and its results.
- You will receive reports from your Supervisee about any unexpected or otherwise significant adverse events in the course of this study. You will inform the committee members appointed to oversee the research and its results.
- You will review research records maintained by your Supervisee until the final written document is produced and approved by you and the oversight committee.
- You will inform the oversight committee about the progress of your Supervisee from the time of developing research questions, through the proposal, IRB

application, collection of data, writing results, and completing the documentation of the research.
- You will contact the Lead Subject Matter Expert (e.g., Chair of the Specialization, Faculty Director) if additional review is needed.
- You will make sure that this application has been completed by your Supervisee including all accompanying attachments before signing your name for approval.
- You assume responsibility for ensuring that the research complies with University regulations regarding the use of human participants/subjects in research.

If these conditions are not met, approval of this research could be suspended.

Signature of the Supervisor:

Name _____ Date_____

Title _____

Signature of Provost or Designee
As Provost, or designee, I acknowledge that this research is in keeping with the standards set by the university and assure that the researcher has met all requirements for review and approval of this research.

Signature of Provost or Designee

Name _____ Date_____

Completed forms should be sent as email attachments. Scan signature pages and attach as files. Send email messages with attachments to the designated IRB reviewers in one of the following schools representing your specialization affiliation:

Harold Abel School of Psychology
School of Business
School of Education
School of Human Services
School of Technology

Checklist: Form Completed

Use this form to verify that an application has all the necessary information completed in the Institutional Review Board (IRB) Application

3. _X_ all items answered (use NA where item is Not Applicable)
   - __X_ demographics of learner and supervisor
   - __X_ #1. Project Title
   - __X_ #2. Dates of Project
   - __X_ #3. Abstract (see checklist)
   - __X_ #4. Population
     - __X_ #4.a. number
     - __X_ #4.b. age range
     - __X_ #4.c. location of participants/subjects
     - __NA #4.d. special characteristics of participants/subjects
     - __X_ #4.e. recruitment of participants/subjects
     - __NA #4.f. approval for use of records
     - __X_ #4.g. initial contact with participants/subjects
     - __NA #4.h. inducements or rewards to participants/subjects
     - __NA #4.i. activity for non-participants/non-subjects (e.g., control group)
   - __X_ #5. Confidentiality of data
     - _X_ #5.a. establish, maintain confidentiality, access to data
     - _X_ #5.b. storage/destruction of data
   - ____ signatures
     - _ _ researcher
     - ____ supervisor

2. __X_ application attachments (use NA where item is Not Applicable)
   - __X_ approval from institution housing participants
   - _NA approval from institution housing records
   - _NA_ assent form for minor participants (see checklist)
   - _NA_ checklist for extracting information from files or records
   - _NA_ consent form for parent/guardian/adult participant (see checklist)
   - _NA_ cover letter for mailed consent form
   - _NA_ cover letter for mailed questionnaire
   - _NA_ cover information for questionnaire (see checklist)
   - _NA_ instrument(s) to elicit responses from participants
   - __X_ questions to be asked during interviews
   - __X_ script/letter/email message to recruit participants
   - ____ other _____

3. __X_ IRB Application complete
   - action: forward to School designee to review for approval
   - date of action _____

APPENDIX B: INFORMED CONSENT FORM

CAPELLA UNIVERSITY
Institutional Review Board
225 South 6th Street, 9th Floor
Minneapolis, Minnesota 55402
1-888-CAPELLA ext. 5732

Informed Consent Form

Project Title: The Role of Tacit Knowledge Networks in a State Agency:
An Analysis Based on a Grounded Theory Approach

Researcher: Maureen Hammer, MLS
PhD Candidate
Capella University

Purpose: This study is designed to discover and understand the role employee networks (employees talking to other employees) play in sharing knowledge that assists employees in doing their jobs. Results will be used by VDOT to develop and implement future programs and interventions to identify, collect, organize and disseminate organizational knowledge. What is learned in this study may provide insight to researchers and practitioners examining knowledge management practices and programs in similar settings.

Description: You were selected as a participant because you are an employee of and in one of the critical career groups for VDOT. If you volunteer to participate in this research you will be asked to meet with the researcher to complete a personal interview of approximately two hours. You will be asked to talk about how you share information with others, who you get information from, what kinds of information are shared, and how those conversations and contacts impact your work. The interview will be scheduled to accommodate your availability. With your permission, the interview will be tape recorded to ensure accuracy. If you agree to participate you will be asked to sign this form and return it to the researcher.

Costs: There will be no cost to you for your participation nor will you be paid for your participation.

Risks/Benefits: Risks to you are minimal and you may learn more about how your personal and professional relationships with others impact your work.

Participant Assurances: Your participation in this study is voluntary. You are free to refuse to answer any question and to withdraw from the study at any time. The interviews will be kept confidential and only the researcher will have access to the information. Your name and any information that could reveal your identity will not be attached to the data, used or shared.

Excerpts of the interviews may be made part of the final research report, but confidentiality of the participants will be maintained.

Authorization: By signing this consent form you have acknowledged that you have read the above, understand the nature of the study and agree to participate.

If you have any concerns about your selection for this study and how you are treated, you may contact Dr. John Whitlock at 813-949-2662 or through email at John.Whitlock@capella.edu or Maureen Hammer at 434-293-7386 or through email at Maureen.Hammer@VDOT.virginia.gov. You may also contact the chair of the Institutional Review Board, Tsuey-Hwa Chen, at Capella University at 1-888-CAPELLA ext. 5732 or through email at Tsuey-Hwa.Chen@capella.edu.

_____ Date: _____
Signature

_____
Printed Name
You will be provided with a copy of this signed consent form.

APPENDIX C: EMAILS REQUESTING PARTICIPATION

I am writing to ask for your help and cooperation in a study Maureen Hammer, Knowledge Management Director for VDOT, is conducting. The study will be valuable to VDOT and it is also part of completing her doctoral degree program.

Maureen's study is designed to discover and understand the role employee networks (employees talking to other employees) play in sharing knowledge that assists employees in doing their jobs. Results will be used by VDOT and the Knowledge Management Office to develop and implement future programs and ways to identify, collect, organize and disseminate organizational knowledge. This information can help to make VDOT more effective in the years ahead.

You are one of a number of employees who Maureen might contact to interview. If she does contact you, although your participation in this study is completely voluntary, I do encourage you to participate. You are among a group of employees whose knowledge and the way you do your job is important to VDOT's success. From this group, Maureen will select a maximum of twenty-five of you to interview.

Maureen will follow up with each of you in a separate e-mail to give you some additional important information about her study, along with her e-mail address, so that you can indicate whether you are willing to be included in the pool of employees from which she will select a small sample to interview. Not all of you will be included in the sample to interview. However, if you are contacted for an interview, your interview with her will be confidential and no data you provide her will be linked to you individually.

Thank you for your attention and help in the study.

Please note new e-mail address below

Gary

Gary R. Allen, Ph.D.
Chief, Technology, Research & Innovation
Virginia Department of Transportation
530 Edgemont Road
Charlottesville, VA 22903-2454

E-mail: Gary.Allen@VDOT.Virginia.gov
434.293-1938 804.786-9950

-- We Bring Innovation to Transportation --

Good evening,

Gary sent you a message this morning to tell you about a knowledge management (KM) study I will be conducting over the next month or two on discovering and understanding the role employee networks play in sharing knowledge that assists employees in doing their jobs. The results will be used by VDOT and the KM Office to develop and implement future programs designed to identify, collect, organize and disseminate organizational knowledge.

You were selected as a participant because you are an employee of and in one of the critical career groups for VDOT. If you volunteer to participate in this research you will be asked to meet with me to complete a personal interview of between one and two hours. You will be asked to talk about how you share information with others, who you get information from, what kinds of information are shared, and how those conversations and contacts impact your work. The interview will be scheduled to accommodate your availability. With your permission, the interview will be tape recorded to ensure accuracy.

Your participation in this study is voluntary. You are free to refuse to answer any question and to withdraw from the study at any time. The interviews will be kept confidential and only I will have access to the information. Your name and any information that could reveal your identity will not be attached to the data, used or shared. Excerpts of the interviews may be made part of the final research report, but confidentiality of the participants will be maintained.

Please reply to this email to let me know if you are willing to participate and I will work with you to identify a time that it would be convenient for you to talk. I very much appreciate your consideration of this request.

Thanks!
Maureen
****

Maureen Hammer, MLS
Knowledge Management Officer
Virginia Department of Transportation
1230 Cedars Court, Suite B
Charlottesville, VA 22903
Phone: 434.293.7386
Fax: 434.293.1429
Maureen.Hammer@VDOT.virginia.gov

APPENDIX D: PERMISSION LETTER FOR STUDY

February 17, 2005

Maureen Hammer
3025 Morewood Lane
Charlottesville, VA 22901

Dear Maureen,

This letter signifies the approval of the Virginia Department of Transportation (VDOT) for you to conduct a research study within VDOT on *The Role of Tacit Knowledge Networks in a State Agency: An Analysis Based on a Grounded Theory Approach*. The purpose of the research is to develop a substantive theory and the results will lead to the development and implementation of future programs and interventions to identify, collect, organize and disseminate organizational knowledge within VDOT. What is learned in this study may provide insight to researchers and practitioners examining knowledge management practices and programs in similar settings as well. We understand that you will be conducting interviews of employees and managers of the agency who fall within the critical career groups: engineering technology, architecture and engineering services, and transportation operations. Participation by employees will be voluntary and all data will be kept confidential. Names and any identifying information that could be linked to the participants will not be attached to the data, used or shared. Excerpts of the interviews may be made part of the final research report, but confidentiality of the participants will be maintained.

Gary Allen, PhD
Chief, Technology, Research and Innovation
Virginia Department of Transportation