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Who shares? Managerial knowledge transfer practices in British Columbia's ministry of health services

Gwendolyn Elizabeth Lock
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COLLEGE OF MANAGEMENT AND TECHNOLOGY

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ABSTRACT

Who Shares? Managerial Knowledge Transfer Practices in British Columbia's Ministry of

Health Services

by

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M.A., Royal Roads University, 2002

M.P.A., University of Victoria, 1996

B.Sc., University of Victoria, 1981

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

Walden University

May 2010

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Abstract

The British Columbia government's Ministry of Health Services will experience significant loss of operational knowledge from an aging managerial workforce, increased staff turnover, and difficulties in recruitment. The purpose of this study is to provide the ministry's Strategic Human Resources Planning branch staff with a map and description of knowledge transfer practices used by approximately 40 managers within the ministry's Health Sector Information Management/Information Technology division and its Vital Statistics Agency. The study is a mixed-methods case study of knowledge retention and transfer practices founded on a knowledge management and social network theoretical foundation. To understand the ministry's complex nature of knowledge transfer, research questions examined the characteristics of an effective knowledge sharing network, associated knowledge sharing similarities and dissimilarities, and perceived knowledge sharing enablers and inhibitors. Social network and thematic analysis were used to collect, map, and analyze perceived informal knowledge transfer practices. Findings indicated that face-to-face communication, visual and verbal cues, and individuals who had a few powerful neighboring connections were influential knowledge resources. The social implications from these findings will act as a catalyst to shift prevalent cultural knowledge management practices thereby positively affecting workload and resource management. Employees will more clearly understand their knowledge management roles and how their actions affect service delivery to citizens. Acting as a knowledge transfer model, the ministry could positively influence the government's Public Service Agency, other ministries, health authorities, and private sector organizations to adopt effective knowledge transfer practices to improve managerial and managerial/staff communication and trust.

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Dedication

This study is dedicated to my loving parents, Peggy and Bus, who have supported and provided love, guidance, and inspiration throughout this life journey. Thank you so very much.

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There have been so many people that supported me through this long journey. First, I want to extend my appreciation, thanks, and gratitude to Dr. Lilburn Hoehn for his mentoring, advice, guidance, and belief in my skills – thank you! I also want to extend my sincere thanks to my dissertation committee members, Dr. Joseph Barbeau and Dr. Howard Schechter, for your feedback and support throughout the dissertation process. I also want to extend my sincere thanks to my project sponsors, Sharon Stewart and Elaine McKnight, for your insights and belief in me. All of the managers in my study who graciously gave their time, insights, and thoughts – without you, there would not have been a study! Special thanks are due to Al, Bev, Deb, and Lina, who helped shepherd my study through the bureaucracy, and my team (Bonnie, Wayman, Doug, Patti, and Sandra) who patiently listened to my daily woes and celebrated my milestones. To the many Walden faculty, students, and other mentors, including Dr. Stan Amaladas, and Dr. Andrew Seary who helped me along the way, thank you for your generosity and insights. Finally, thank you to my friends, family (Aunt Gwen), and parents Peg and Bus, who continued to believe in me and support me in so many ways. Words can not express my deepest gratitude.

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Chapter 1: Introduction to the Study

Introduction

This chapter contains a description of the problem and study purpose related to the identification of informal knowledge transfer practices being used by managers in the British Columbia government's Ministry of Health Services. The knowledge sharing problem is captured through the perspective of a fictional middle manager, Bob, on a typical day in the Ministry of Health Services: *As Bob was on his way back to the office, he sees Tim, who he has been unsuccessfully trying to arrange a meeting with, to discuss pressing project issues. "Tim, do you have a minute, I'd like to quickly check with you about an issue that has come up earlier this week." Both managers quickly converse on the sidewalk in front of the ministry building and continue to their original destinations after a few minutes. As Bob continues to his office, he reflects on the brief encounter and how productive it was. When Bob reaches his office, he sinks into his chair and unlocks his workstation, to find that he has 20 new e-mails, three marked urgent. He sighs as he starts to read and then remembers that he has to call Sally to arrange a meeting that he has been trying to setup for a week. He quickly looks up her phone number in the global address list, dials her number, and lets the phone ring – no answer. He leaves a voice mail message for her to contact him and resumes reading his e-mail. He reflects on the productivity of resolving the issue with Bob, and thinks "There is so much to do – why is it so hard to reach others?"*

Bob's situation illustrates the complex organizational behaviors and knowledge sharing practices that are common in many 21st century public and private sector

organizations. Early theoretical inquiries regarding organizational behavior focused on the role of formalized structures to simplify choice and optimize resources (Weber, 1947). Later theorists, such as Bateson (1977) and Holland (1995), explored organizational patterns and identified information transmission as an important aspect to contextual pattern consistency. Yet it was Nonaka and Takeuchi's (1995) examination of knowledge transfer in Japanese auto firms that revealed the importance of middle managers in the knowledge creation process. Further exploration on the role of human relationships on the knowledge transfer process and the type of knowledge shared was explored in-depth by several theorists, including Birk (2005), Carpentier and Ducharme (2007), Cross and Cummings (2004), Hatala (2006), Morrow (2006), Richards (2004), and Scalzo (2006). Few of these theorists, such as Birk (2005), Carpentier and Ducharme (2007), and Morrow (2006), explored the knowledge transfer process within a public sector context. This study's significance in relation to knowledge loss within the ministry's management environment is explored. Key study assumptions, limitations, and study terms are contained within this chapter.

Problem Statement

Over the next 10 years, the Ministry of Health Services will experience significant and escalating management loss primarily at executive and middle manager levels. Corporate government expects that 45% of its managerial workforce will retire by 2015, an estimate that may escalate to 62% in some organizations (BC Public Service Agency, 2008a, pp. 27-28). Exacerbating this projected knowledge loss are escalating staff and contractor turnover and difficulties in recruiting (Ministry of Health Services, 2009). For

example, the ministry estimates that “within the next decade, it is projected that for every two people retiring, less than one person will be available to take their place” (Ministry of Health Services, 2009, pp. 24-25). Inherent in this loss is the significant loss of operational knowledge (Ministry of Health Services, 2009, p. 33). The British Columbia (BC) government’s restructuring initiatives after the 2001 election resulted in a loss of several thousand managers and employees. The effects from this loss of critical operational knowledge is now reverberating across many areas in government. Organizations that clearly identified their knowledge management, knowledge transfer practices, and established relationship networks were effective in stemming knowledge loss (Birk, 2005; Girard, 2005; Groves, 2006; Murphy, 2003; Scalzo, 2006; Small, 2005). Knowledge management, retention, and transfer practices are rapidly becoming government priorities. Effective knowledge management practices, including identifying key knowledge sources, implementing new social networking technologies, and leveraging informal networks through communities of practice, are being planned or implemented in a few ministries, including Finance and Forests (BC Public Service Agency, 2008a).

I am a fulltime manager within the British Columbia Provincial government Ministry of Health Services (formerly known as the Ministry of Health prior to June 24, 2008). The ministry’s mandate is to “guide and enhance the province’s health services to ensure British Columbians are supported in their efforts to maintain and improve their health” (Ministry of Health, 2008). The ministry provides guidance and oversight to six regional health authorities that provide publicly funded health care services to the

Province's 4.3 million citizens (Ministry of Health, 2008). The ministry faces many challenges in delivering cost effective services, including an aging population and workforce, and increased technological advancements in health care delivery.

In the ministry's 2008/09 – 2010/11 strategic services plan, of the three identified goals, Goal 3 "A Sustainable, Affordable, Publicly Funded Health System" is directly relevant to this study. Within the description of Goal 3, several human resources development strategies describe the need for a positive retention and recruitment work environment that prepares future ministry leaders for leading within a complex health sector (Ministry of Health, 2008). The problem is that the British Columbia government's Ministry of Health Services will experience significant loss of operational knowledge from an aging managerial workforce, increased staff turnover, and difficulties in recruitment. First, the Ministry of Health Services has an incomplete map of existing knowledge management (including retention and transfer practices) used by middle managers and executive directors. Second, there is an incomplete understanding of the effectiveness of known knowledge transfer practices and a gap regarding unknown practices that are being used. I will inquire into the existing knowledge retention and transfer practices to complete the map and surface effective practices that could be used throughout the ministry to support Goal 3's succession planning and knowledge management objectives.

Background to the Study

Researchers in several relevant applied studies have intensely explored the knowledge transfer process in the public and private sectors (Anderson, Crabtree, Steele,

& McDaniel, 2005; Birk, 2005; Cross & Cummings, 2004; Ipe, 20003; McGill, 2006; Pratt, 2006; Richards, 2004; Scalzo, 2006). Pattern and relationship analysis for improving organizational performance were critical for understanding knowledge flows (Anderson et al., 2005; Birk, 2005). Multiple theorists found that valuation of the relationship, the knowledge, and knowledge sources were influential factors in the knowledge exchange process (Cross & Cummings, 2004; Ipe, 2003; Pratt, 2006, pp. 126-138; Scott et al., 2008). Other notable knowledge sharing factors included the knowledge sharing or team context, type of knowledge to be shared, respect, proximity, external linkages, and the knowledge transfer mechanism (i.e., in person or technological; Birk, 2005; Cross & Cummings, 2004; Ipe, 2003; Morrow, 2006; Pratt, 2006, pp. 124-126). For example, McGill (2006) found that indirect knowledge transfer channels, such as hands-on activities and mentoring were favored (91%) over formal transfer changes, such as mentoring (71%; pp. 119-121). Scott et al. (2008, p. S198) found that effective knowledge flows and network performance enabled a community to reduce instances of smoking. Within organizations, Richards (2004) found that middle managers were key knowledge sharing conduits and senior managers were important behavioral facilitators for other individuals to absorb knowledge (p. 221).

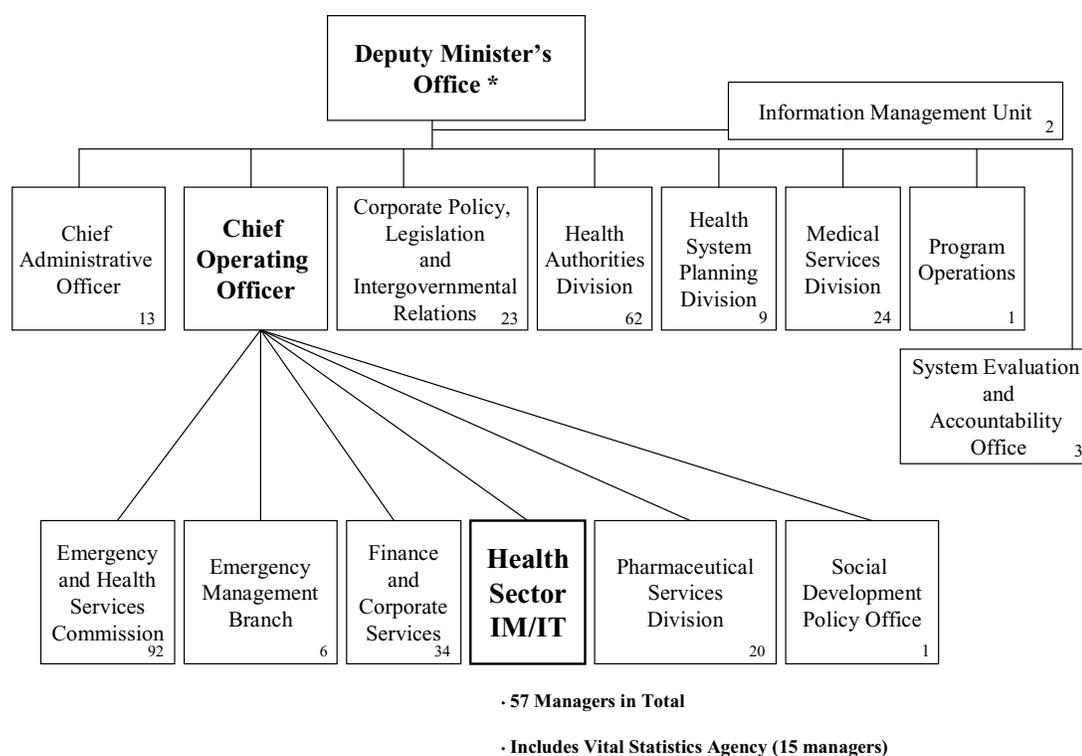
Collectively, these studies illustrated the importance of understanding the type of knowledge, influencing factors, environmental context, and interpersonal relationship networks that were needed for effective knowledge transfer. Although each study provided different aspects that are directly relevant to the intended study, only Birk (2005) and Morrow's (2006) studies appeared to be relevant. None of the remaining

studies specifically explored the knowledge transfer process between public sector managers using social network analysis.

Within the Ministry of Health Services, discussions with Strategic Human Resources (SHR) Division managers indicated that it is challenging to transfer information or knowledge from senior managerial levels through to the staff, including in the reverse direction. The 2008 government employee workforce survey suggested that workload and stress were problematic for many areas in government, particularly within the Ministry (Ministry of Health, 2007). An aging senior executive population and the pending loss of critical knowledge are exacerbating these knowledge transfer challenges. Although SHR identified some managerial relationship networks and knowledge transfer practices, SHR does not have a toolset for identifying such networks nor in-depth analysis of associated knowledge transfer practices. With respect to the BC public service, ongoing operations and overall service delivery could be negatively impacted from inadequate understanding of key knowledge sources and effective sharing practices. Such negative consequences could be exacerbated with the public services' projected loss of 45% of its managerial workforce by 2015 and increased rates of workers that are retiring at an earlier age (BC Public Service Agency, 2008a, 2008b). For the Ministry of Health Services, these potential negative repercussions could be mitigated through embarking on strategies that identify the ministry's key knowledge sources and informal information sharing practices. As the ministry is large, focusing these knowledge management strategies to a division that provides corporate services will assist SHR

planners in identifying knowledge management strategies that could be replicated and refined throughout the remainder of the organization.

Discussions with SHR managers indicated that effective knowledge transfer practices were being used by the Vital Statistics (VStats) special operating agency, part of the large Health Sector Information Management/Information Technology (HSIMT) division that provides information management and technology services to the ministry. HSIMT is one of two large divisions within the ministry's chief operating officer's mandate (Figure 1).



* Managerial totals current as of October 14, 2008 from Government Internet Directory <http://www.dir.gov.bc.ca>

Figure 1. Ministry organization chart.

Note. Adapted from the “B. C. Government Directory.” Retrieved from <http://www.dir.gov.bc.ca>

The other large division, the Emergency and Health Services Commission (EHSC), provides ambulance services and telehealth services, including access to registered nurses and dietitians. The EHSC continues to evolve and stabilize its organizational structure from the mid-2008 incorporation of several telehealth services. The EHSC was not selected as a potential study target population based on its evolving structure and its focus. HSIMT was chosen based on its breadth of service across the ministry, its uniqueness, and 2008 ministry engagement results. Understanding the HSIMT divisional knowledge transfer practices would be ideal for an in-depth study, as VStats operates as a separate special operating agency within the division, yet reports to a common divisional assistant deputy minister. At an organizational level, visualization of the informal relationship networks being used within the division may reveal insights that would otherwise not have been possible. Together, these findings could be used to adjust organizational workloads and enhance existing knowledge transfer processes.

Purpose of the Study

The purpose of this study is to provide ministry SHR Planning staff with a map and description of knowledge transfer practices for middle managers and executive directors. Currently, the ministry does not have a comprehensive map that identifies what informal knowledge sharing processes are being used. To create such a map requires collection of existing knowledge transfer practices being used. Once created, this map provides a visual illustration of key individuals who act as knowledge sources or

nodes that may be peripheral to the network. In-depth analysis of map patterns could reveal commonalities and differences in how knowledge is being transferred across the different managerial groups. Collectively, these results would assist SHR planners in developing strategies to address the project knowledge loss and recruitment challenges.

Theoretical Foundation

Knowledge sharing within organizations emerged from early twentieth century behaviorists' exploration of human/organizational interactions. Bateson (1977), Parsons (1971), and Weber's (1947) study into bureaucratic structures were used to simplify or make sense of choice and human behavior in dynamic organizational environments.

Weber's (1947) focus was on the role of bureaucratic structures as efficient tools that assisted in the rationalization of an organization's human and capital resources.

Although this perspective was somewhat mechanized, Weber's (1947) views highlighted the importance of formal structures as a form of information sharing conduits, albeit with respect to authority and division of labor. Parsons (1971) inquiry into an organization's value and cultural environments revealed how these intertwined systems were supported by information exchange zones (p. 9). Yet it was Bateson (1977) and Holland's (1995) in-depth exploration of patterns that suggested information transmission was an important aspect to contextual pattern consistency, a concept supported by later theorists such as Beck and Cowan (2005) and Wilber (2001).

Within the organizational and human contexts, pattern exploration revealed the influences and interdependencies associated with information sharing. Within the organizational realm, symmetrical organizational subsystem linkages were essential in

sharing resources, such as information (Marion, 1999). An organization's visible and invisible structures influenced and shifted the context to define "what is visible to us" (Yolles, 2006, p. 679). As important was how information was applied in conjunction with an individual's values, beliefs, assumptions, insights, and experiences, collectively known as knowledge, to support critical decision making (Bateson, 1977; Bennis, 1966; Davenport & Prusak, 2000, pp. 4-5). Hall's (2005) discussion of self-regeneration or autopoiesis in biological systems provided insights regarding how individuals simplified information, reshaped their context, and associated relationships to facilitate the emergence of new opportunities, including knowledge generation (Holland, 1995; Wheatley, 1999, pp. 20-21; Yolles, 2006, p. 70).

Nonaka and Takeuchi (1995) intensely examined the knowledge creation process used in Japanese auto firms, focusing on how invisible knowledge or tacit knowledge was converted to visible or explicit knowledge. In their view, knowledge generation was iterative and cyclic, starting with external social influences as the trigger for externalizing tacit knowledge (Nonaka & Takeuchi, 1995, p. 64). Through dialogue and interaction with others, the explicit knowledge was systematically combined and subsequently re-internalized as new tacit knowledge (Nonaka & Takeuchi, 1995, pp. 67-69). Within organizations, Nonaka and Takeuchi noticed that middle managers were a critical catalyst in this process (p. 130).

In particular, the role of formal and informal relationship networks were identified as critical aspects of effective knowledge transfer, leadership, and organizational viability (Dixon, 2000; Lahaie, 2005; Maddock, 2002). For example, Dixon (2000) noted that

electronic expert location forums established human and electronic sharing networks which positively affected knowledge transfer more than just searching for stored information (p. 138). Lahaie (2005) noted that key managerial functions combined with knowledge sharing practices were more effective in mitigating the negative organizational effects from knowledge loss. Inquiry into effective organizational learning practices revealed the importance of social relationships and informal knowledge sharing practices as learning enablers and tools that provided greater understanding of information exchange processes (Groves, 2006; Jones, 2006; Tichy, 1983). Hammond and Glenn's (2004) comparison of Chinese and Western approaches to self-organizing behaviors revealed the importance of trusted, informal relationships and location as important information transfer factors.

Closer examination of informal workplace relationships revealed that employees that shared similar values or beliefs had higher density information exchanges (Johnson-Cramer, Parise, & Cross, 2007). Relationship reciprocity and the strength of the relationship were important influences on the type of knowledge that was shared. For example, Muthusamy and White (2005, pp. 443-434) found that reciprocity, commitment, and trust were essential for effective organizational alliance partnerships. Complex tacit knowledge sharing most often occurred in relationships that had strong linkages or ties (Mulder & Whiteley, 2007; Reagans & McEvily, 2003).

Enhanced understanding of these informal relationship and information exchange networks was facilitated through the application of graph theory and analysis of social network maps or sociograms (Burt, 1992; Cross & Parker, 2004; Tichy, 1983, pp. 70-71).

Burt's (1992) examination of relationship strength and redundant network contacts highlighted the need for organizations to understand their informal network structures and information flows. Without such an understanding, organizations risked losing competitive advantage or delivering less than adequate services through inefficient resource usage and poor information sharing practices.

Research Design

The research design included a mixed-methods case study approach that used questionnaires, interviews, and document analysis research methods. The quantitative aspect included a questionnaire to collect participant information regarding their workplace informal relationship networks. Network analysis was used to help SHR management understand informal network structures, rather than determining if the network was “good” (Anklam, 2007, p. 176). In-depth interviews were conducted with specific participants to understand their knowledge sharing approaches. Document analysis was used to determine the explicit knowledge sharing practices and/or conditions within the study context. Social network analysis and case study techniques provided me with a visual perspective of existing networks, which then facilitated an in-depth questioning of individuals who appeared to be part of central or peripheral networks. A combination of techniques allowed me to acquire a focused review of specific divisional informal networks and obtain a broader perspective of why these were meaningful relationships. Case studies provide a flexible tool that can be used to obtain specific information within a bounded context (Creswell, 2007; Stake, 1995; Yin, 2003). Together these approaches were used to generate new knowledge and meaning, a key

aspect of the case study methodology (Creswell, 2007; Stake, 1995; Yin, 2003). These combined techniques have been validated by recent research studies, including those by Birk (2005), Carpentier and Ducharme (2007), Cross, Laseter, Parker, and Velasquez (2006), Hatala (2006), and Omran and Van Etten (2007).

Assumptions

Key study assumptions are predicated on integrated organizational knowledge sharing structures and human factors. Integrated formal and informal organizational structures are assumed to support knowledge transfer practices. Formal structures, such as organizational charts, strategic plans, and administrative forms provide distinctive frameworks that support or hinder knowledge transfer throughout the ministry (Dixon, 2000; Maddock, 2002). Informal structures, such as teams and public sector values, are presumed to facilitate knowledge flows between the formal structures. For example, teams are assumed to be effective knowledge sharing conduits within branches and divisions. In particular, public sector values are presumed to provide a strong foundation for sharing knowledge, as all government employees are presumed to conduct themselves professionally and ethically. Within the ministry, it is assumed that providing effective health care governance and stewardship are fundamental aspects of all ministry activities (Ministry of Health, 2008). Internal or external changes in the integrated knowledge sharing structure are assumed, as the ministry is a dynamic organization. For example, legislative changes may affect the ministry's formal organizational structures so that new participants are added to the study or existing participants leave. Intact teams may be

separated if they are moved to different floors with in the same office location, thereby affecting knowledge flows.

Human factors, such as commitment and trust, are vital study assumptions. It is critical that the ministry sponsors, SHR and the HSIMT divisional executive, continue to value the study as being worthwhile. Without their explicit support, few participants will perceive that ministry executives approve the study, and as a result, may choose not to participate. Inconsistent trust levels could affect the provision of accurate and complete questionnaire information, which may invalidate the network analysis results. Lack of trust and a willingness to share information could negatively affect participation rates and response accuracy (Anklam, 2007). An accurate depiction of the informal network structure requires high participation levels. Some participants may be reluctant to disclose details regarding their information networks, which could negatively affect the overall picture of their division's informational relationship network. Increased workloads and strategic project deadlines may preclude some individuals from participating. Finally, it is assumed that individuals will prefer to share knowledge with others that have similar characteristics or attributes, a principle known as homophily (Casciaro & Lobo, 2005; Kadushin & Kotler-Berkowitz, 2006; Mergel, Huerta, & van Steele, 2007). For example, individuals who have a similar technical background and are perceived as trusted experts may seek each other's knowledge first before other individuals within the team or branch. Mapping these informal peer networks may reveal new knowledge sources that would be beneficial to the division and overall ministry.

Scope and Limitations

The inquiry scope will focus on one division (HSIMT) within the Ministry of Health Services. Within the chief operating officer's mandate, HSIMT is one of two large divisions, yet the only one that includes the ministry's special operating agency (Vital Statistics) that provides Provincial vital statistical information, such as births, deaths, and marriages. HSIMT provides the information management and technological expertise to all ministry divisions, including core records management, privacy, information security, and data access services. As such, these organizational entities are unique within government, which may limit the transferability of the study findings. As HSIMT represents a portion of the ministry's overall management cadre, findings will not reflect the extent of the ministry's informal management relationship network structure. Although ministry managers are classified using the same job titles used in other ministries, the ministry's managerial roles may be slightly different (S. Stewart, personal communication, May 23, 2008). It was expected that these differences would not be significant impediments to the overall findings or transferability of the approach within the ministry. As the study was conducted at a point in time, underlying conditions may be difficult to replicate, such as preelection conditions. As such, study findings will not be exhaustive. Questionnaires were provided to approximately 40 individuals who were classified in three managerial streams: strategic leadership, business leadership, and applied leadership. Senior executives, including assistant deputy ministers (ADMs) are in the strategic leadership stream, directors and middle managers are in the business leadership stream, and lower level managers and supervisors are in the applied leadership

stream. In-depth interviews of 20 or more individuals allowed for in-depth analysis of the key knowledge sharing factors that were being used. However, if repetitive information consistently emerged from subsequent interviewees, then the remaining interview sessions were not conducted, as information saturation had occurred. The duration of the data collection phase was approximately 3 months.

Several study limitations need to be identified as the study was conducted in a dynamic environment that continues to reverberate from significant ministry initiatives and post June 2008 organizational restructuring activities. First, as a significant portion of the HSIMT managerial division (including myself) were involved in strategic ministry projects and new postrestructuring operational issues, time, and scheduling limitations may have precluded questionnaire participation and lengthy (e.g., 60 minutes) in-depth interview sessions with senior managers and/or other participants.

Second, some participants may have been reluctant to participate in the study because of the could perceived workload and subsequent operational issues associated with participating in another workforce study. As a result, incomplete, inaccurate, or less than expected questionnaire returns could negatively affect the visual representation and subsequent analysis of the network. This limitation was mitigated through continuous dialogue with the study sponsor and privacy and security diligence throughout the research design, data collection, analysis, and reporting phases to enhance participate confidence (Creswell, 2007; Stake, 1995). Finally, it was unknown what specific relevant documents were available within HSIMT, as the division had undergone several restructuring initiatives within the past 2 years. Lack of available documents could have

negatively affected the documentation analysis component. Finally, as the study context was unique within government, there could be possible transferability issues to other ministries.

Despite these noted limitations, I incorporated as many mitigating procedures as possible into the design. Potential study ramifications from the ongoing organizational restructuring and strategic projects with unknown implications from a spring 2009 Provincial election were particularly worrisome. Yet, based on my previous experiences, effective mitigation strategies that were planned and/or used included adopting multiple contingency plans, ongoing stakeholder communication, and being flexible. As I am a middle manager that has ministry information security officer (MISO) responsibilities, my professional and scholarly roles could have been perceived as being biased and possibly coercive by some participants. Although no such perceptions surfaced throughout the study, I had a contingency strategy prepared such that I would have immediately discussed any emerging ethical issues with SHR and my directors of privacy and security executive.

Definition of Terms

Throughout this study, the following key terms will be used:

Actor: Represents an individual or group of individuals, such as a work unit or groups (Brass, Galaskiewicz, Greve, & Tsai, 2004, p. 795). “Social entities ... [that are] discrete, individual, corporate, or collective social units” (Wasserman & Faust, 1994, p. 17).

Alter: “The nodes to whom [the] ego is directly connected to (these are called ‘alters’) plus the ties, if any, among the alters” (Borgatti, 2000). Retrieved from <http://www.analytictech.com/networks/egonet.htm>.

Arc: In a graph, “a line represents ties between actors” whereas in graph theory, “lines are also known as *edges* or *pairs*” (Wasserman & Faust, 1994, pp. 94-95).

Centrality: “The number of links going into (referred to as ‘in-degree’) or coming out of (referred to as ‘out-degree’) a node in a network” (Parise, 2007, p. 367). When viewing a sociogram, centrality is the key individual in a group (Cross et al., 2002, p. 69). Centrality is also known as degree centrality.

Density: “The ratio of the number of actual information ties in a network to the maximum number of ties possible” (Hanneman & Riddle, 2005, Chapter 7, Basic Demographics section; Hirsch, 1979, p. 266; Parise, 2007, p. 367; Wasserman & Faust, 1994, p. 101).

Ego-centered network: “Consists of a focal actor, termed *ego*, as set of alters who have ties to [the] ego and measurements on the ties among these alters” (Wasserman & Faust, 1994, p. 42).

Explicit knowledge: “Knowledge that can be laid out in procedures, steps, and standards — explicit knowledge. It can be translated into checklists and specifications.” (Dixon, 2000, p. 26).

Information: “Discrete, objective facts about events” that are intended to make a difference to the recipient. The discrete and objective facts are collectively known as data (Davenport & Prusak, 2000, pp. 3-4).

Knowledge: “A fluid mix of frames, experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of the knowers” (Davenport & Prusak, 2000, p. 5).

Knowledge transfer: The method by which knowledge is transferred across “time and space” (Dixon, 2000, p. 19). The type of knowledge, context similarity, and task type influence how knowledge is transferred (Dixon, 2000, pp. 145-146).

Network: “A set of nodes and the set of ties representing some relationship, or lack of relationship, between nodes” (Brass et al., 2004, p. 795). A network can comprise an individual or ego or all individuals in an organization, the latter known as a complete network (Cross & Cummings, 2004, p. 928).

Node: In a graph, an actor (Brass et al., 2004, p. 795; Wasserman & Faust, 1994, p. 94).

Path: A walk where “all nodes and all lines are distinct (Wasserman & Faust, 1994, pp. 106-107).

Relation: A “collection of ties of a specified link among members of a group” (Wasserman & Faust, 1994, p. 20).

Social networks: “A finite set or sets of actors and the relation or relations defined on them” (Wasserman & Faust, 1994, p. 20).

Social network analysis: A “visual display of group structure and a probabilistic model of structural relations” (Wasserman & Faust, 1994, p. 12).

Tacit knowledge: “Knowledge that is primarily in the heads of people —tacit knowledge” (Dixon, 2000, p. 26).

Tie: “... establishes a linkage between a pair of actors” (Wasserman & Faust, 1994, p. 18). Ties can be acquaintances or *weak* or close (i.e., strong), such as associated with friendships (Granovetter, 1982, p. 105). In a graph, “*lines* represent ties between actors” (Wasserman & Faust, 1994, p. 94).

Walk: A “sequence of adjacent nodes” (Wasserman & Faust, 1994, pp. 106-107).

Research Questions

Answers to the following questions were sought from social network analysis questionnaires results, from document analysis and interviews. The social network will be graphically displayed, with all other analysis being descriptive.

1. What are the characteristics of an effective knowledge sharing network?
2. How similar or dissimilar are the knowledge sharing practices being used by senior executives and managers?
3. What are the perceived knowledge sharing enablers or inhibitors within the study context?

Significance of the Study and Relationship to Social Change

This study will be significant to the Ministry of Health Services in that the ministry does not have a clear understanding of how to identify and leverage its vast knowledge assets. Without such an understanding, the ministry may be misallocating resources or unaware of key knowledge sources and effective knowledge sharing conduits. As a result, key knowledge sharing individuals may become over burdened and

become less productive, ill, or leave the ministry. Lack of awareness of effective knowledge sharing practices reinforces ineffective practices that may isolate individuals and inhibit effective knowledge sharing within and across divisions. Collectively, these results could lead to individuals becoming dissatisfied with the ministry, becoming ill, or leaving to find other ministries that value the individual's knowledge and knowledge sharing practices. Such negative perceptions regarding the ministry could be exacerbated through the use of informal grapevine networks that negatively affect the ministry's recruitment and retention activities (Plickert, Cote, & Wellman, 2007).

By understanding how to identify its knowledge assets, the ministry can begin to explore what knowledge sharing practices exist, which ones appear to be effective or less effective, and what new practices should be incorporated. Having a visual map of informal knowledge sharing practices will provide SHR managers with insights regarding potential workload bottlenecks and underused or isolated individuals. As increasing numbers of managers and employees retire from the government, this tool allows human resources personnel to identify new emerging knowledge networks within the workplace. Understanding the type of knowledge and how and where it is shared provides insights regarding effective knowledge sharing practices that can be leveraged across the ministry or identification of gaps that need addressing. From these insights, SHR managers will be able to explicitly communicate and demonstrate the value of knowledge and knowledge sharing. Such activities are needed to shift prevalent cultural practices while embedding new individual and organizational unit knowledge valuation practices within the ministry's culture (Argyris & Schon, 1996; Bateson, 1977; Cross & Thomas, 2009).

As a result, the ministry would be more effective in leveraging its knowledge resources to meet strategic goals. Within government and the broader health sector, the ministry's ability to identify and utilize effective knowledge sharing practices could be collectively shared and discussed. For example, the approach and insights could be distributed throughout other public sector ministries, including Finance and Forests, and central government agencies, such as the Public Service Agency. More broadly, these insights could be shared with the ministry's broader health sector partners, such as the Provincial Health Leadership Councils, health authorities, and private sector organizations.

Summary and Overview

This chapter contains an overview of the study that will provide the ministry with a clearer picture of the HSIMT division's informal managerial knowledge transfer practices. Results from the ministry's 2008 workforce engagement identified that the division's Vital Statistics agency employed effective knowledge transfer practices, which could be more broadly applied throughout the ministry to improve workflow and staff engagement. The study used a questionnaire and interviews to collect information from divisional managers regarding how and when they shared knowledge, and what type of knowledge was shared. Visual maps of the division's knowledge sharing networks combined with qualitative analysis of interview data will provide the ministry's human resources practitioners with in-depth perspectives on why certain knowledge transfer practices were used. Study results could be used to leverage effective knowledge sharing practices throughout the ministry, adjust existing recruitment and retention strategies, and begin to positively affect the overall organizational culture. Chapter 2 contains a review

of relevant knowledge transfer literature and explores the role of social network analysis as a tool that can be used to reveal the human dynamic within social networks. Chapter 3 contains a description of the mixed-methods case study research methodology and data collection instruments. Chapter 4 provides a description of the data collection, analysis approach, and study findings. Chapter 5 provides a summary of the study findings, conclusions, and recommendations.

Chapter 2: Literature Review

Introduction

The previous chapter provided an overview of the study of the ministry's informal social networks within a bounded context. This chapter of the research study contains a review of current and foundational literature concerning knowledge transfer, contextual complexity, and social networks. The literature review provides the theoretical basis for the research.

My interest in knowledge transfer and social networks started several years ago from reflections regarding the year 2000 technological activities and British Columbia's provincial downsizing staffing activities. Personal experiences with the downsizing initiatives sparked an interest in the future ramifications from thousands of public servants who voluntarily or involuntarily left the public service from 2001 through 2004. I reflected that although this knowledge loss was significant, this loss was small in comparison to the potential knowledge loss from an aging public service managerial and senior executive workforce. Similar to the last minute technological remedies that averted computer program problems in the year 2000, I realized that the potential knowledge loss within the government was a significant rolling year 2000 problem, with immediate and long term ramifications. Initial research suggested that most studies of knowledge loss focused on the private sector's usage of technological tools and strategies, with little reference to the public sector. Fewer studies used social network analysis within the public sector as a method to identify existing knowledge sources and associated knowledge transfer practices. Multiple studies suggested that the first step in

understanding organizational knowledge flows was to map existing knowledge transfer practices using social network analysis techniques (Birk, 2005; Carpentier & Ducharme, 2007; Cross et al., 2006; Cross & Parker, 2004; Martin, 2004; Murphy, 2003; Schultz-Jones, 2007). From this initial step, the knowledge flow insights could be used to develop knowledge management or knowledge retention strategies.

Searches for relevant studies were done iteratively through online databases and reviews of dissertations and publications. Several online databases, primarily EBSCOhost, Emerald, ABI/INFORM Global, Academic Search Premier, Business Source Premier, and Sage, were searched for relevant articles using keywords *complexity theory, chaos theory, knowledge, knowledge sharing, knowledge transfer, organizational networks, organizational network analysis, social networks, and social network analysis*. From these searches, numerous peer-reviewed articles and their key references were used to identify often cited sources, which were further researched through the online databases or from academic publications in institutional or workplace libraries. Using the ProQuest online database, relevant doctoral dissertations were searched using keywords *case study, knowledge, knowledge loss, knowledge sharing, knowledge transfer, organizational network analysis, ONA, public sector, social network analysis, and SNA*. Within each dissertation, the literature and methodology sections were reviewed for common terms, themes, and references, the latter of which was used to obtain additional relevant academic articles and publications. From all of these academic sources, three key theoretical themes emerged: knowledge, organizational complexity, and social networks, each of which will be described in the following sections.

Knowledge

The first step in an inquiry regarding knowledge transfer practices starts with the definition of knowledge; knowledge may be information or something deeper. An overview of current knowledge management articles described the organizational benefits of efficiently managing organizational information assets (Lamont, 2008), knowledge or intellectual capital (Mouritsen, Thorbjørnsen, Bukh, & Johansen, 2004; U.S. Office of Personnel Management, n.d.) or structured information that included the “collective wisdom of the community” (KMworld, 2008, para. 2). On the surface, these articles suggested that information and knowledge were interchangeable entities that included attributes such as wisdom. In-depth inquiry revealed that information and knowledge appeared to be connected, yet with key differences.

Both Davenport and Prusak (2000) and Dixon (2000) concurred that knowledge was the highest level of a three-tiered structure that included data and information. At the base of this structure were elements otherwise known as data that were “discrete, objective facts about events” (Davenport & Prusak, 2000, p. 2), an assertion supported by other theorists (Polanyi, 1966; Tiwana, 2002). The modern term, data, is rooted in the singular definition of data or datum, a term that originated in Euclid’s geometry based *Dedomena*, with *dedomena* as the Greek term for data (Floridi, 2007, para 1.3). Floridi’s modern translation of datum corresponds to “a putative fact regarding some difference or lack of uniformity within some context” (para 1.3) whereas Merriam-Webster’s definition states that the plural of data, datum, is “something given or admitted especially

as a basis for reasoning or inference” (Data, n.d., para. 1). Both definitions capture the essence of the concept and context of data.

At the second level within the knowledge structure, data elements were arranged and sorted into a meaningful, structured sequence otherwise known as information (Dixon, 2000, p. 13). The focus on information’s structure and codification aspects was illustrated through Pfeffer and Sutton’s (2000) exploration of the current state of knowledge management practices. In their view, the central aim of organizational knowledge management initiatives was to acquire, codify, distribute, measure, and understand how to use knowledge and information (p. 16). The need for a structured format for information as a precursor to knowledge was echoed through Davenport and Prusak’s (2000) five-step transformational process model. In this model, data were contextualized, categorized into a structured format, statistically analyzed or calculated, corrected for errors, and finally condensed, a process known as 5C. Floridi’s (2007, para. 1.2) General Definition of Information captured the three essential components of information: data, structure, and meaning. Although similar in nature, these theoretical perspectives illustrated the challenges of clearly defining the term information.

At the third and highest level, information was broadened to include various attributes, such as values, beliefs, and experiences that collectively influenced and changed perceptions and perspectives. Bateson’s (1977) view of information consisted of “differences that make differences” (p. 5), whereas Beckman’s (2005) was more definitive by stating that information was comprised of filtered data that was formatted and applied (pp. 1-5). Davenport and Prusak (2000) extended this definition to include

contextual information and beliefs. Nonaka and Takeuchi (1995) provided a similar definition that identified the need for commitment and meaning that was bounded by the specific context. At this aggregate level, knowledge served as an inclusive term to represent structured data elements and human attributes, such as meaning. Pfeffer and Sutton (2000) and Tiwana (2002) supported this concept and added that through a complex mélange of questioning, meaning, and actions; knowledge was generated through learning by doing. Implicit in these perspectives was the generation of meaning through internal actions, primarily reflection and feedback, and from multiple external information sources, such as observation (Bandura, 1977). Together these actions linked specific, tangible knowledge with broader, more complex intangible knowledge; components that were separate yet inextricably linked.

Know-What and Know-How

Tangible and intangible knowledge components were previously identified by early twentieth century German psychologists as *wissen* or know-what and *können* or know-how (Polanyi, 1966, p. 7). At one level, the details or know-what are internally filtered and tested (Bandura, 1977; Polanyi, 1966). At a higher level, these details are integrated into existing patterns, resulting in new connections or know how, much of what cannot be expressed linguistically as the knowledge resides in the “minds of the knowers” (Davenport & Prusak, 2000, p. 5). Multiple theorists, including Birk (2005), Dixon (2000), Davenport and Prusak (2000), Haldin-Herrgard (2000), and Nonaka and Takeuchi (1995), labeled this tangible know-what component as explicit knowledge, with the intangible know-how component labeled as tacit knowledge.

Fundamentally, the main difference between explicit and tacit knowledge was in the codification and transmittal processes. As explicit knowledge did not contain patterns associated with meaning or emotions, explicit knowledge was easier than tacit knowledge to codify, format, and transmit using linguistic or visual techniques. In contrast, tacit knowledge was very difficult to codify as individualistic emotions, values, and meaning were attached to the explicit knowledge, which meant that the complete articulation of the tacit component was impossible, a concept supported by several theorists such as Davenport and Prusak (2000), Haldin-Herrgard (2000), and Tiwana (2002). Scott et al. (2008) extended this concept of tacit knowledge to include “what we do not know we know; unconscious lessons from experience” (p. S199). Although these theorists remained aligned on the labeling of explicit and tacit knowledge, there were a few interesting contrasts with respect to knowledge generation and transmission within organizations.

Martin’s (2004) inquiry of leadership and knowledge processing in higher education proposed a three-tiered knowledge life cycle model of policies, organizational models, and behaviors. Closer examination of this model suggested that the model’s primary focus was to support the codification of knowledge within an organization. In comparison, Tiwana’s (2002) three-tiered model focused on the acquisition, sharing, and usage aspects of knowledge. Tiwana identified two additional components, know-why and care-why, that acknowledged the importance of cognitive and self-motivated creativity factors essential for knowledge generation and usage. However, my further review of the model indicated that only the initial tier focused on the internal acquisition

of knowledge, whereas the remaining tiers focused on the externalization of the acquired knowledge. In contrast, Szulanski's (1996) four-tiered knowledge transfer model focused on the internalized processes that preceded knowledge transfer. Szulanski viewed that the first tier was to identify the existence of a knowledge gap, with subsequent tiers supporting the decision to proceed and ensuring that the acquired knowledge filled the gap. Jones's (2006) four-tiered model blended aspects from Szulanski's and Tiwana's models, namely that knowledge was acquired, embedded, transferred, and exploited or used. In contrast, Dixon's (2000) model focused on the tasks and contextual conditions that influenced how knowledge transfers supported routine, non-routine, or infrequent tasks in the same or similar contexts. Reflection on these various models suggested that knowledge transfer relied upon integrated internal or informal and external or formal processes and structures.

Knowledge Transfer Structures

Internal structures, such as embedded patterns, supported the identification of a knowledge gap and would enable knowledge to be acquired to remove this gap. Externalized behaviors were used to translate tacit knowledge to an explicit format that could be transferred and used to acquire additional knowledge that was collectively re-internalized to generate new knowledge, a concept supported by Pfeffer and Sutton (2000) and Polanyi (1966). The emergence of such an integrated internal infrastructure was proposed by several theoretical studies that explored how organizational bureaucracies simplified or made sense of choice and human behavior in fluid environments (Bateson, 1977; Parsons, 1971; Weber, 1947). Weber's (1947) somewhat

mechanistic views highlighted the importance of formal structures as a form of information sharing conduits, albeit with respect to authority and division of labor. Parsons's (1971) inquiry into organizational value and cultural environments revealed how formal structures and human systems were supported by information exchange zones. Yet it was Bateson's (1977) and Holland's (1995) exploration of patterns that indicated information transmission was an important support for pattern consistency, a concept supported by later theorists such as Beck and Cowan (2005) and Wilber (2001). Bateson (1977) found that pattern alignment with contextual conditions signaled that individual expectations would be rewarded and that the new pattern could be retained rather than be discarded. Thus, pattern retention required contextual influences to influence decision making.

Inclusion of what information was expected to be present in the context, rather than what matched existing patterns, signaled that different choices were needed, behavioral adaptation concepts proposed by Bateson (1977) and extended by Piaget (1978). For example, Bateson's (1977) example of a picture frame illustrated how expectations were established for interpretation of the picture contained within the frame or bounded context. Organizational learning theorists, such as Argyris and Schon (1996), Senge (1990), and Skinner (1965) viewed that contextual influences, combined with explicit knowledge shaped the type of knowledge shared and the sharing process. Davenport and Prusak (2000) found that informal conversations in a relaxed context, such as technologists sharing work related conversations around the office water cooler were effective in sharing tacit information and experiences. Dixon (2000) found that

Texas Instrument and Monsanto effectively shared explicit and tacit information through codified webpage or database materials combined with newsgroups that simulated interpersonal tacit knowledge sharing. The latter example illustrated the effectiveness from using explicit knowledge, codified in web-pages or as technological terms, to support interpersonal knowledge sharing.

The knowledge sharing benefits were illustrated through health sector examples (Murray, 2003; Singh, 2005) and private sector organizations, such as Chevron (O'Dell & Grayson, 1998) and Japanese automakers (Nonaka & Takeuchi, 1995). Reagans and McEvily (2003) extended this argument by stating that the success of the tacit knowledge exchange required “the right person with the right connection at the right place” (p. 263). March and Simon (1993) extended this concept by arguing that once this connection was deemed to be effective, the more that it would be used, such as when two individuals used common terms to support their conversations. Within organizations, middle management was the most often cited influential knowledge sharing enabler and catalyst for knowledge creation and usage, a finding supported by several researchers, including Fowler and Pryke (2003), Nonaka and Takeuchi (1995) and Sorenson, Rivkin, and Fleming (2006).

Implicit in these exchange examples was the need for contextual cues and exchange factors, such as dialogue and common language, as explicit factors needed in the translation and transferal of tacit information to the intended audience(s). Inclusion of an individual's stored experiences, values, and beliefs regulated and restricted pattern and knowledge choices were implicit factors that supported actions to achieve a specific

goal or purpose (Bateson, 1977) that was meaningful (Yolles, 2006). Reagans and McEvily (2003) found that gaps in an individual's social relationship network could pose potential knowledge sharing barriers. Together, these explicit and implicit factors supported the knowledge creation process and individual embedded learning process, the latter known as deuterio-learning (Bateson, 1977) or double-loop learning (Argyris & Schon, 1996).

The continuous nature of learning implied that an individual was continually evaluating the usefulness and meaningfulness of stored patterns and tacit/explicit knowledge in relation to external environmental influences, creating new behaviors, a concept supported by Mischen and Jackson (2008) and Yolles (2006). Nonaka and Takeuchi's (1995) theory of knowledge creation encapsulated the human dynamic and environmental interactions needed to convert tacit to explicit knowledge in the learning process (Figure 2). Their four-quadrant model captured the conversion of tacit to explicit information through external socialization processes and influence from environmental influences, such as visual and verbal cues (Nonaka & Takeuchi, 1995). This contextualized knowledge was then combined and translated into a format suitable for re-internalization as new knowledge, a process commonly referred to as SECI. This knowledge generation concept mirrored the integrated deuterio- and double-loop learning approaches, cornerstones of modern learning theory. In Nonaka and Takeuchi's view, this knowledge generation process created an escalating spiral to higher levels of aggregate knowledge, a concept that paralleled Beck and Cowan's (2005) spiral dynamics view of individual and organizational learning.

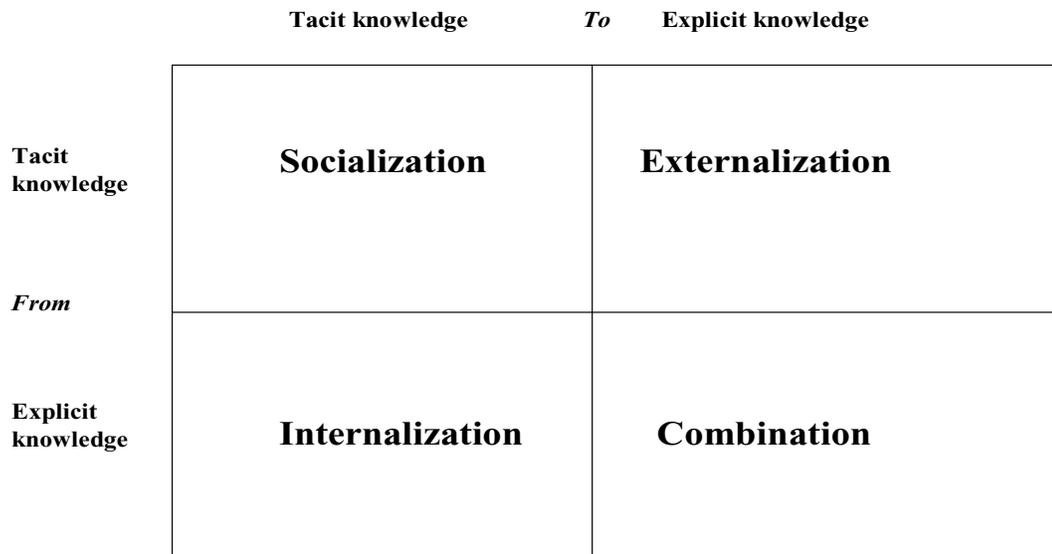


Figure 2. SECI knowledge conversion model.

From “The Knowledge-creating company: How Japanese companies create the dynamics of innovation” by I. Nonaka and H. Takeuchi, 1995, p. 62. Reprinted with permission from the authors.

Nonaka and Takeuchi (1995) stated that five key enabling conditions were necessary for sustaining the knowledge spiral: intention, autonomy, fluctuation and creative chaos, information redundancy, and maximization of variety, the latter known as requisite variety (pp. 74-82). These conditions provided the criteria for assessing the value of the transferred knowledge concomitantly with providing new opportunities that could be exploited. The creative chaos criteria highlighted the importance of stable and unstable knowledge transfer environment elements that acted as explicit-to-tacit knowledge conversion agents to co-facilitate the emergence of multiple shared

relationships, otherwise known as Ba, a concept supported by both Nonaka, Reinmoeller, and Senoo (1998) and Yolles (2006). Both Ba and the Chinese equivalent of Guanxi illustrated the tight coupling of human and personal qualities, such as trust and respect, with external visible relationships, such as those in families or friendships (Hammond & Glenn, 2004). Marion (1999, p. 158) aptly defined the nature of coupling within a system as “the number of links among the units of a system ... or it refers to the nature — including the strength — of relationships between units.”

Collectively, the resultant relationship network provided an efficient knowledge transfer mechanism with embedded trust and meaning levels. Hammond and Glenn (2004) illustrated the importance of personal relationships as a mechanism to enable increased trust and meaning. In their view, increased trust supported the transfer of complex and accurate knowledge that would otherwise not have been shared within distant or less trusted relationships. In these personal relationship networks, verbal and visual cues assisted in the filtering, acquisition, and generation of new knowledge. Marion (1999) indicated that positive feedback from these cues assisted in the transition of the system, such as a relationship, to a new level of stability, whereas negative feedback inhibited such transition. Yolles (2006, p. 583) extended the Ba concept to multiple levels of connectivity that may exist in cyber form through remote communication technologies. It was the combination of deep-level trust, multiple cues, meaning, and the oneness of Ba that facilitated the generation of creative chaos or complex adaptive systemic conditions that supported emergent behaviors.

Throughout this knowledge transfer process, emotions, and organizational structures collectively influenced organizational knowledge retention decisions, a concept known as stickiness (Ipe, 2003, p. 38). For example, unproven knowledge or lack of clarity regarding how the to-be-acquired knowledge would be used, otherwise known as causal ambiguity could prevent the initial knowledge transfer (Connell, Klein, & Powell, 2003; Szulanski, 1996). Other important knowledge transfer inhibitors included the lack of trust, motivation to share or to withhold knowledge, the latter known as knowledge hoarding. Possible knowledge transmission or acceptance inhibitors included lack of absorptive capacity, ineffective sender or receiver relationship, and organizational structures, such as bureaucracies, rules, and information silos, factors identified by multiple authors such as Dixon (2000), Jones (2006) and Szulanski (1996). Of these identified factors, Szulanski (1996) found that a lack of absorptive capacity, causal ambiguity, and ineffective relationship networks were critical knowledge transfer and generation barriers. These illustrative examples suggested that effective knowledge exchange was supported by a stable, yet flexible structure that was shaped by humanistic factors, contextual complexity, and knowledge sharing enablers. These latter two components will be explored in the following sections.

Contextual Complexity and Knowledge Sharing Enablers

Increased theoretical interest regarding the organizational learning implications from human behavior and contextual influences revealed the importance of system and subsystem linkages in the knowledge transfer process. At an aggregate level, systemic boundaries regulated the rate of change that occurred in organizational subsystems, a

perspective supported by multiple authors such as Marion (1999), Martin (2004), and Wheatley (1999). Marion (1999) found that subsystem and associated linkage levels ensured resource adequacy and the rate of systemic knowledge flows. In Marion's view, depending on the degree of system interdependencies, external changes introduced into a system may not have any impact, a moderate or severe impact on the interconnected systems, a perspective supported by Holland (1995). Marion (1999) argued that loosely linked or coupled systems acted as inhibitors to rapid change and knowledge flows, whereas tightly linked systems could not control flow rates, possibly resulting in cascading, potentially catastrophic systemic change.

In-depth inquiry regarding whole system effects revealed that system boundaries that moderated knowledge flows and subsequent changes supported "chaos creation" conditions that stabilized the environment while facilitating the emergence of new knowledge (Nonaka, Reinmoeller, & Senoo, 1998, p.40). This organic approach to knowledge creation was supported through Marion's (1999) network coupling concepts and Yolles's (2006) cognitive turbulence concept that resulted from conflicting norms, beliefs, and logical systems. Within knowledge transfer networks, similar structures acted as legitimate knowledge sources and valuable knowledge flow regulators, such as Burt's (1992) structural hole relationship networks and Marion's (1999) stable intermediate systems. These transfer networks could exist within specific organizational subgroups, such as teams, yet could span the organization to external organizations, the latter used to control organizational uncertainty and provide stability (Marion, 1999). As

critical to regulating organizational knowledge flows were visible and invisible regulating mechanisms, including beliefs, values, embedded patterns, and absorptive capacity.

Knowledge Sharing Enablers and Inhibitors

Knowledge sharing enablers comprised a broad set of visible and invisible mechanisms and tools, that when combined, regulated the knowledge transfer process. Fundamental to the effectiveness of these enablers was the presumption that similar individuals tended to interact with each other, based on their mutual trust, predictability, and reciprocity, a perspective supported by multiple theorists such as Brass et al. (2004), Hammond and Glenn's (2004) Guanxi and Mischen and Jackson (2008). Enablers, such as organizational hierarchies and rule systems, electronic media, language, and symbols comprised visible enablers. Invisible enablers, such as an organization's cultural practices, sense making, and trust levels influenced the type of knowledge and degree to which it was shared. Both Perrow (1979) and Weber (1947) believed that organizational structures, rule systems, and technological media acted as control filters that influenced resources associated with learning, and more subtly, knowledge sharing. Murray (2003) found that certain technological media were preferred over others for sharing different knowledge types. For example, Murray found that face-to-face dialogue and mentoring were preferred if tacit or complex knowledge was being shared, whereas e-mail or videoconference were acceptable if explicit or simple knowledge was being shared.

Invisible enablers also included linguistic tools, such as stories, narratives, and learning histories, which could be used to frame knowledge within a meaningful context for an intended audience (Gardner, 1995 & 2004, Obstfeld, 2005; Treleaven & Sykes,

2005). Aural and visual cues triggered the recall of specific stored patterns and ordered behavioral responses to make sense of context and prepare the individual for sharing or receiving knowledge (Weick, 1995) or taking specific actions (Dixon, 2000). Several theorists, including Gardiner (1995), Mischen and Jackson (2008), O'Dell and Grayson (1998) and Pfeffer and Sutton (2000) identified the importance of stories as a powerful knowledge sharing tool. Stories that evoked meaning illustrated the use of informal communication mechanisms that structured the information into a format, which when combined with visual and verbal cues, provided powerful linkages with intended audience (Boal & Schultz, 2007). For example, General Electric's former Chief Executive Officer Jack Welch used language, stories, and a combination of tones, metaphors, and gestures to frame and deliver knowledge to promote action and decision making (Dixon, 2000, p. 60).

Powerful linkages could also act as tags (Holland, 1995) or brokers (Burt, 1992) that could be used to support the knowledge network over a period of time, maintaining its relevancy within the context. For example, prior to the Industrial Revolution, in-person storytelling used to be a primary knowledge transfer mechanism. In the Internet era, in-person storytelling now includes new digital, audio, and visual tools, that when combined, evokes a localized near-real time virtual presence or TelePresence that facilitates storytelling (BCSGlobal, 2008; Cisco Systems, 2008). This example illustrated how an anchor point could endure and adapt to sustain a knowledge transfer network over time, a key consideration for organizational knowledge retention and recruitment initiatives. Piktialis and Greenes (2008) suggested that emerging

technologies, such as blogs, wikis, micro-nets, and instant messaging collaborative tools may forge similar enduring anchor points for younger, technologically proficient workers. Organizational histories (Mischen & Jackson, 2008) and structures, such as communities of practice (O'Dell & Grayson, 1998; Rosenberg, 2006) provided frameworks that blended past and present knowledge and supported the emergence of new knowledge. Pfeffer and Sutton (2000) however, cautioned that over reliance on organizational histories could negatively affect organizations from moving forward and remain trapped in the past, such as illustrated by General Motor's Saturn initiative.

Murray's (2003) analysis revealed the complex nature of the linkages and interdependencies between the knowledge sharing environment, transfer mechanisms, human relationships, and the type of knowledge being transferred. This perspective was confirmed through Bate and Robert's (2002, p. 69) inquiry into collaborative knowledge sharing practices in the United Kingdom's National Health Service and Birk's (2005) Idaho National Laboratory inquiry. Bate and Robert (2002) found that relationship strength and trust levels within shared networks or communities of practice between care givers, clinicians, and researchers, resulted in quality and effective knowledge exchanges and improved patient care. Birk's (2005) findings suggested that social proximity to subject matter experts and external resource linkages were essential for effective knowledge sharing. Increased knowledge complexity coupled with inadequate organizational structures increased the degree of summarization needed throughout the transmission process to ensure that the knowledge was properly received (March & Simon, 1993). Synergies between knowledge transfer and creativity formed powerful

organizational influences that generated new learning opportunities that were not possible within the previous context, a creative chaos concept that was supported by multiple theorists such as Marion (1999), Mischen and Jackson (2008), and Nonaka and Takeuchi's (1995) SECI and Nonaka et al.'s (1998) Action-Reflex-Trigger (ART) models. For example, Dixon (2000) noted that electronic forums that were linked to human experts allowed organizations to harness the energy of its members, which affected knowledge transfer more than just searching for stored information (p. 138). My analysis of Dixon's electronic forum examples revealed that other less obvious or invisible knowledge sharing enablers could also significantly influence the knowledge transfer process.

Invisible tools, such as sense making, organizational identity, trust, and time could enable or restrict knowledge flows and generation of new knowledge. Sense making was critical for aligning sensory inputs with stored internal patterns and knowledge that facilitated the simplification and understanding of the current context, which prepared the individual for change, a concept supported by Senge (1990) and Weick (1995) and by Argyris and Schon's (1996) learning theory. Brass et al. (2004) and Singh (2005) noted that other invisible tools, such as personality factors, and proximity or geographic locations could affect the effectiveness and sustainability of social interactions and relationships that acted as filters and/or knowledge transfer barriers. Individuals, such as managers or leaders, acted as boundary shapers or tags that both filter knowledge or facilitate its transfer within and across groups, thereby extending knowledge flows, a finding that was aligned with concepts proposed by Allen, James, and

Gamlen (2007), Boal and Schultz (2007), and Morrow (2006). Physical proximity, combined with visual, verbal, and non-verbal cues, such as body language and gestures, supported the transfer of knowledge between individuals (Giddens, 1984; Obstfeld, 2005). Organizational culture and identities within units could act as boundary filters to restrict or facilitate knowledge flows and subsequent change (Wheatley, 1999). For example, Ipe (2003) found that a lack of a common identity or shared view was detrimental to knowledge sharing. In contrast, Maddock (2002) found that a lack of effective social networks and associated knowledge sharing practices could jeopardize an organization's ability to recruit and retain staff, resulting in reduced competitiveness, productivity, and overall viability. Several theorists, Cross and Thomas (2009), Snowden (2005a) and Svendsen and Laberge (2005) found that within a trusted context, nonlinear learning emerged to build a shared solution through incremental or radical change. With respect to tacit knowledge, Haldin-Herrgard (2000) noted that lack of time to reflect and embed such knowledge was an invisible knowledge sharing barrier. Numerous theorists, including Antonacopoulou (2006), Barrette, Lemyre, Cornell, and Beauregard (2007), Carlisle and McMillan (2006), and Groves (2007) found that organizational sense making and awareness of the implications from these enablers were critical in formal roles, such as leadership positions and informal knowledge sharing practices, such as mentoring. Collectively these invisible organizational and behavioral factors supported the usage of social capital as a knowledge sharing tool.

Social Capital

Although meaning and sense making were important for knowledge generation, human interaction through formal and informal relationships forged powerful knowledge sharing filters and linkages, a concept that several theorists labeled as social capital (Akrich, Callon, & Latour, 2002; Argyris & Schon, 1996; Bate & Robert, 2002; Birk, 2005; Hammond & Glenn, 2004). Marx (1933, p. 28) indicated that connections and the subsequent benefits that could emerge from human relationships was a form of capital that enabled the production of new materials from a mix of labor, raw materials, and economic resources. Bourdieu (1986, pp. 248-249) refined this concept of social capital to be an aggregation of individual resources from exchange relationships, such as within a family, community, or group that had something in common. In Bourdieu's view, an individual's social capital was based on the individual's number of connections and the amount of other types of capital, such as economic or cultural, possessed by the individual from these connections (Bourdieu, 1986). In contrast, Coleman's (1988, p. S98) view of social capital focused on the importance of the relationship structure "between actors and among actors", rather than an economic capital that may be produced from the exchange. Bourdieu's (1988) concept of social capital implicitly included the importance of expecting something of value from the exchange process, a view shared by Simmel (1950) and later theorists including Koniordos (2008), and Portes and Sensenbrenner (1993). Expectations may emerge from individuals within the exchange or from the group structure that the individual was associated with, the latter view espoused by Durkheim (1984). A more refined definition of social capital proposed

by Putnam (1995, p. 67) stated that networks, norms, and trust acted as exchange coordinators so that both parties mutually benefited from the exchange process.

Intensive scholarly review of these various perspectives resulted in contemporary definitions by Westlund (2006) and Lin (1999). Westlund's (2006, p.8) definition identified that social capital is "*non-formalized* norms and values but also as bearers of these values, i.e., the actors and the relations, links, networks they form." With respect to knowledge sharing, Westlund linked the importance of social networks as a mechanism that enabled the deliberate and unintentional transfer of knowledge. Erickson (1996) found that individuals who used a variety of networks to different groups and across organizations had greater cultural variety than what could be achieved from being in a specific class structure, such as a professor or senior business manager. Lin's (1999, pp. 17-19) definition of social capital as an "investment in social relations by individuals through which they gain access to embedded resources to enhance expected returns of instrumental or expressive actions and processes" emphasized the importance of embedded resources within the social relationship, a view shared by other theorists such as Burt (1992) and Kilduff and Tsai (2003). Collectively, these definitions implied the importance of exchange and value within relationship networks.

Presumptive within these relationship networks was the presence of reciprocity. Entering into a relationship required varying levels of trust, often initially tentative trust if the sender and recipient did not know each other. However, over time, trust levels increased as the sender and receiver became familiar with each other. Yet with increased trust was the need for exchange partners to reciprocate knowledge sharing, a self-

reinforcing process (Ball, 2009; Chan & Liebowitz, 2006; March & Simon, 1993).

Without reciprocation, one partner created a dependency on the other partner, which could erode existing trust levels, a finding supported by Ipe (2003). Trust, however, was not the only important enabler within relationship networks.

Beliefs and value systems supported individual and organizational commitment levels and meaning associated with the shared knowledge (Bennis, 1966). Stonerock (2003) found that access and an individual's perceptions regarding the value of knowledge sharing could contribute to a reluctance to share. Similarly, individual and organizational belief and ethical systems could motivate or inhibit knowledge sharing practices associated with learning or organizational change, a model supported by multiple theorists including Argyris and Schon (1996), Ball (2009), Senge (1990) and Wheatley (1999). Beliefs could facilitate an individual's willingness to receive new knowledge if such knowledge could assist the individual in becoming more self-aware (Wheatley, 1999). Even so, a desire to receive new knowledge could be overshadowed by an individual's lack of capacity to absorb, re-integrate, and use the new knowledge.

Filtering could occur at different levels, which could affect subsequent pattern selection. For example, embedded memory patterns, feedback mechanisms, and meaning associated with past and current practices could regulate the type of knowledge to be transferred and choice of transfer actions (Argyris & Schon, 1996). Bandura (1977) noted that such filtering actions could be influenced by direct experience or through observation of other individual's behaviors and the associated consequences. Choice could be based on sensory input or on unconscious selection from stored patterns or

habits, each selection resulting in different outcomes (Argyris & Schon, 1996) or organizational cultural shifts (Tichy, 2002).

Lack of individual and organizational absorptive capacity may inhibit the acquisition, management, transfer, and generation of new knowledge, a finding supported by Currall and Judge (1995), Dixon (2000), Marion (1999), and Yolles (2006). Tichy (1983, p. 126) further argued that insufficient absorptive capacity could negatively affect individuals and organizations from learning from past practices, thereby reducing their ability in reacting to change and uncertainty, an argument previously identified by Jones (2006) and Szulanski (1996). Lack of information exchange between organizational groups hampers the emergence of opportunities, innovation, and new knowledge generation, a concept known as structural holes (Burt, 1992, 2004 & 2007). Pfeffer and Sutton (2000) noted that over the long term, effects from these visible and invisible enablers could subtly positively or negatively affect the individual, team, and overall organizational knowledge sharing practices. Given the multileveled aspects of knowledge sharing within interconnected formal and informal networks, negative effects at one level could rapidly permeate throughout the system through coupling structures (Marion, 1999). In an increasingly complex and competitive environment for scarce knowledgeable resources, understanding the internal and external organizational changes from network change is crucial (Brass et al., 2004). The next section contains a description of the important role of these informal human relationships or social networks in the knowledge sharing process.

Social Networks

Throughout the previous sections, the effectiveness of human relationships or social networks was identified as a critical knowledge transfer enabler or inhibitor. Interest in the organizational implications from social networks originated from Moreno's 1930 psychological and social measurement or sociometric studies (Rogers, 1987; Scott, 1991; Wasserman & Faust, 1994). The term sociometry is derived from the Latin words *socius* meaning associate or companion and *metrum* meaning measure (Rogers, 1987, p. 287). Thus, the field of associate measure or sociometry expanded in the 1950's primarily through Simmel's studies and White's research in the 1960s (Wellman, 1988). Additional disciplines from mathematics and anthropological disciplines were added as social scientists attempted to understand the importance of relationship patterns and proximity within organizational and societal groups. The strength of social networks is predicated on their capacity to store relational information of who is connected to whom, and indicate information flow patterns or where individuals are positioned within a networked information structure, a concept supported by several theorists including Ebener et al. (2006), Rogers (1987), and Wasserman and Faust (1994). Insights from these information flow patterns could be used to support decision making processes, improve organizational performance (Chan & Liebowitz, 2006) and understand key knowledge sources.

Within the organizational context, social networks could occur in various formats, including individuals acting as social catalysts or tags (Boal & Schultz, 2007; Hatala & Fleming, 2007; Holland, 1995), groups or *dyads*, informal peer networks

(Antonacopoulou, 2006), and small teams, with 12 to 15 members (Grobman, 2005). These invisible structures could be used for a variety of individual and organizational functions, including supporting decision making practices, acting as organizational subcultures, providing messaging consistency, and establishing social linkages (Mehra, Dixon, Brass, & Robertson, 2006; Mischen & Jackson, 2008; Tichy, 2002). The effectiveness of these invisible structures also influenced information flows.

Relationship network effectiveness was based on establishing and sustaining linkages related to relationship or tie strength. Strong ties were associated with close relationships, such as those established and sustained by friendship or familial linkages. In contrast, weak ties were associated with infrequent relationship connections, such as those from acquaintances (Granovetter, 1973 & 1982; Li, Xi, & Yao, 2008). Further exploration of the knowledge transfer implications from strong or weak ties by several theorists revealed that weak ties were crucial for linking previously disconnected networks and sharing explicit information (Chan & Liebowitz, 2006; Granovetter, 1973 & 1982; Hansen, 1999; Li et al., 2008; Liebowitz & Liebowitz, 2008). Individuals who were centrally positioned within densely connected information sharing network structures were often perceived to be influential information sources (Mehra, et al., 2006; Obstfeld, 2005). Theorists de Vita and Conaldi (2009) and Obstfeld (2005) concurred that such densely connected structures were often crucibles for innovation and facilitated the sharing of hard-to-share or complex information. Flexible relationship networks also acted as mechanisms that challenged the status quo or facilitated the emergence of organizational power structures. These flexible network structures could be examined

from an individual or ego-centric perspective or from an overall, holistic network perspective (Mehra et al., 2006; Wellman, 1988). Wasserman and Faust (1994) added that within the social network context, an underlying assumption was that relationships and influences from one or more factors, such as individuals or groups, were important. Yet other factors, such as context, were also influential.

Contextual conditions (Marion, 1999) combined with inflexible structures, such as bureaucracies (Perrow, 1979), strengthened existing power structures, and entrenched patterns, resulting in the expenditure of scarce resources that were needed to overcome these structural challenges. Challenging the status quo tested relationship strength against prevalent conditions. Resultant tension or conflict forced relationship partners to seek alliances with other relationships, which strengthened or weakened the network, as tension resolution consumed scarce resources (Anand, Glick, & Manz, 2002). Ineffective relationships fed incomplete streams of environmental information to individuals, which restricted the individual's overall scope of awareness and choices (Marion, 1999). In contrast, networks with centralized focal points could be efficient knowledge exchange conduits in the short-term, yet could become problematic bottlenecks over the long-term, as other individuals within the network were underutilized (Cross, Nohria, & Parker, 2002). Yet identification of organizational resources, such as powerful or underutilized knowledge sources and potential bottlenecks were not the only influences on organizational network structures.

Changing environmental conditions could positively or negatively affect visible and invisible organizational structures. For example, positive changes could reveal

hidden problems, which shift the context and “in turn defines what is visible to us” (Marion, 1999, p. 171). Through self-production or autopoiesis, individuals reshape their context and meaningful relationships, which may engender growth opportunities (Enriquez, 2008; Wheatley, 1999; Yolles, 2006). Reshaping simplified information and reduced complexity such that issues that may once have been difficult to consider were now within the realm of possibility, a notion supported by Holland (1995) and Yolles (2006). Reshaping provided a sense of stability such that linkages to past actions continued to support and inform “learning, analysis, and reproduction” (Marion, 1999, p. 238). With this contextual change, however, new issues and implications could emerge, themselves new opportunities for growth or potential challenges to organizational stability (Yolles, 2006). Using a holistic network approach, Enriquez’s (2008) review of online forums revealed that learning could occur from active posting as well as implicitly from reading and not posting, otherwise known as lurking (p. 123).

Organizations that incurred some degree of instability or turbulence provided an environment that was conducive for innovation and growth to emerge. For example, Tichy (1983) suggested that although such initial organizational turbulence appeared problematic, this uncertain environment could facilitate increased understanding between different groups. Marion (1999, p. 239) extended this concept by stating that this uncertain environment allowed “creativity and innovation [to] emerge from somewhat unstructured, idiosyncratic behaviour.” Both of these theorists identified the importance of an unstructured, dynamic environment as an important factor that supported creativity

and innovation, concepts supported by several theorists including Adkins (2008), Birk (2005), Carmean (2008), Nonaka and Takeuchi (1995), and Wheatley (1999).

In this unstable context, meaningful information could combine with small changes, forming larger aggregate or change units that push through zonal boundaries into the broader systemic context (Wheatley, 1999). In this respect, change may precipitate further changes in the new context at the same or different rates, depending on the degree of interconnectedness (de Vita & Conaldi, 2009) or centrality. In the broader context, such centrality may enable certain individuals or relationships between individuals to act as information brokers or bridges between groups that would have been otherwise disconnected (Burt, 2004). Interestingly, knowledge diffusion may be dampened in specific integrated peer networks if there were pervasive levels of distrust. For example, Jarvenpaa and Majchrzak (2008) found that knowledge sharing between national security professionals was less effective as these professionals did not know what knowledge should and could be shared, given the potential harm that could result. This example was particularly relevant within the study as many of the participants had specific technical and business knowledge that if not shared, could negatively impact strategic ministry projects.

From these diverse theoretical perspectives, context, and the existence of formal structures and informal relationships appeared as important aspects to enable or inhibit organizational knowledge sharing. Changes that appeared to be isolated within informal individual networks could ripple across interconnected networks, affecting the performance of other groups or the entire organization. To more deeply understand

relationship implications from an individual, group, or entire network perspective, analytical techniques, such as social network analysis, are required.

Data Collection

Social network analysis combines mathematical concepts, graph theory, and visual social network representations that facilitate an in-depth understanding of informal communication networks and information flow patterns (Allen, James, & Gamlen, 2007; Birk, 2005; Brass et al., 2004; Cross & Cummings, 2004; Ebener et al., 2006; Krebs, 1998; Liebowitz & Liebowitz, 2008; Schultz-Jones, 2007). Although social network analysis uses some traditional descriptive statistical analysis tools, such as the mean and standard deviation, different tools are required to analyze relationship networks.

Network data may be collected for individuals or specific groups within the network or for the entire network (Adkins, 2008; Wasserman & Faust, 1994). Similar to experimental or quantitative research methodologies, social network analysis may collect data using a variety of methods, such as questionnaires and interviews.

One of the often cited data collection methods is to use questionnaires (Adkins, 2008; Birk, 2005; Cross & Parker, 2004; Hatala & Fleming, 2007; Morrow, 2006; Schultz-Jones, 2007). Yet several studies used a variety of other data collection methods, including interviews, observations, archival records, diaries, snowballing, small world, and Episodic Communication Channels in Organizations (ECCO; Winegarden, 2008; Zwijze-Koning & de Jong, 2005). Questionnaires were used to obtain self-reported information regarding an individual or actor and their contacts, including contact proximity and ease of access (Carpentier & Ducharme, 2007; Cross & Parker, 2004).

Within the questionnaire instrument, multiple theorists identified that name generation was a common technique used to collect information on an actor's relationship network (Birk, 2005; Carpentier & Ducharme, 2007; Cross et al., 2002; Cross & Parker, 2004; Hirsch, 1979; Morrow, 2006; Schultz-Jones, 2007; Vehovar, Manfreda, Koren & Hlebec, 2008; Wasserman & Faust, 1994). Within this name generation technique, a list of individuals or roster were provided for participants to indicate the presence or absence of a relationship, or allow participants to name individuals, the latter technique known as free recall (Marsden, 2005; Wasserman & Faust, 1994). To understand relationship or tie strength, response ratings, such as 0 = *do not know this individual* through to 5 = *I contact this person very often*, or rankings may be used, a common approach used by several theorists including Cross and Parker (2004), Liebowitz and Liebowitz (2008), and Wasserman and Faust (1994). Actor attributes, such as age, gender, length of time in an organization, and location, could be collected to assist in the understanding of an individual's or actor's relationship with other actors, a technique used by Hatala and Fleming (2007) and Wasserman and Faust (1994). The length of time that the participant had known a listed name was an important factor in the sustainability of a relationship (van Duijin, van Busschbach, & Snijders, 1999). Name generation using social support questions, such as for access and availability, appeared to be used by numerous theorists (Adkins, 2008; Birk, 2005; Carpentier & Ducharme, 2007; Cross & Parker, 2004; Hatala, 2006; Hatala & Fleming, 2007; Hirsch, 1979; Schultz-Jones, 2007). Tracy and Catalano (1990) noted that using vague social support questions, such as "Who do you work with?" might result in less stable network indicators. With respect to the free recall

technique, Veohvar et al. (2008) noted that the number of provided spaces influenced the number of participant responses, which could be problematic. Measurement error concerns may arise from using fixed lists (Wasserman & Faust, 1994). These notations indicated that careful instrument selection and question construction were important to provide stable indicators and reduce measurement error.

Both Bernardi and Hollstein (2009) and Wasserman and Faust (1994) indicated that observation, in person and telephone interviews may be used to collect data, yet these methods were resource intensive for both the researcher and participants. Instead, archival records, observations, and diaries may be used to understand the similarities and differences as compared to the self-reported information (Marsden, 2005). Diaries were more effective for longitudinal inquiries regarding relationship network changes (Wasserman & Faust, 1994). Privacy issues, time, and inaccurate event recording posed challenges in using interviews, observations, diaries, or archival records. Snowballing was often cited as a data collection technique by several theorists, including Adkins (2008) and Wasserman and Faust (1994). Snowballing uses an initial sample to collect participant responses, which are used to collect more data, resulting in an expanding response set. Small world analysis and ECCO analysis involve recording the recipients and explicit or simple information flows to a specific individual to understand the number of actors that are distant from a specific actor (Zwijze-Koning & de Jong, 2005). Wasserman and Faust (1994) illustrated usage of this technique through the tracking of delivering an object, such as a memo, to an unknown individual. The originating actor must use their social network contacts as being the most likely to know how to deliver the

object to the targeted individual. As the small world and ECCO analysis techniques are recent, their viability and applicability within organizations continues to emerge (Zwijze-Koning & de Jong, 2005). These examples illustrate the notion that social network data collection instruments must be carefully chosen based on a variety of external factors, such as privacy, and study related factors, such as ease of use, distribution, reliability, and validity.

Reliability and Validity

The key reliability concern relates to information recall issues. Reliability was difficult to measure as social networks are dynamic and not static, which results in challenges in drawing general inferences (Wasserman & Faust, 1994). At least one study used test/retest comparisons and comparison of alternative question formats and reliability of actor choices to measure reliability (Wasserman & Faust, 1994). Centrality measures appeared to be robust in comparison with measures such as betweenness, the latter which may be affected by the level of change within a network (Borgatti, Carley & Krackhardt, 2006). Self-reported data posed several challenges, including social desirability, recall, perception, location, and status issues that may affect the validity of study findings, as identified by Bernardi and Hollstein (2009) and Zijze-Koning and de Jong (2005). For example, Huisman (2009) found that degree bias increases with increased levels of missing data. Question structure and questionnaire administration may impose artificial constraints on participants if limited name lists were used. For example, generic or vague social network questions, such as “Who do you share information with?” lacks specificity regarding recall time-boundaries and what type of

information is being shared (Zwijze-Koning & de Jong, 2005, p. 434). Zwijze-Koning and de Jong (2005) and Wasserman and Faust (1994), however, noted that these concerns could be mitigated through the use of specific questions and response scales.

Review of the relevant literature suggested that there was limited research regarding the validity of social network analysis (Wasserman & Faust, 1994). Marsden (2005) noted that validity on name generators may be problematic because “criterion data from other sources are unavailable” (p. 12). Notwithstanding this concern, Marsden (2005) noted that reviews of social network instruments focus on practical issues, such as question construction, comprehension, and ease of completion. Analysis can be conducted for a specific actor, otherwise known as ego-centric or across the entire network to understand tie strength, an approach used by several theorists including Hatala (2006), Hatala and Fleming (2007), Scott (1991), and Wasserman and Faust (1994). Within the public sector context, social network analysis assists in the identification of workflow communication processes and relationships used for creating and sharing knowledge, critical elements for service delivery and innovation (Hartley & Benington, 2006; Krebs, 1998) and to determine critical knowledge experts (Adkins, 2008; Birk, 2005; Cross et al., 2006; Schultz-Jones, 2007). Throughout these practical applications of social network analysis was the ability to comprehensively visualize the network using a sociogram.

Sociograms provide a visual representation of nodes or actors that are linked by relationships or lines and information flows or directional arrows on the lines (Figure 3), as was used by multiple theorists, including Allen et al. (2007), Hatala (2006), Scott

(1991), and Wasserman and Faust (1994). Sociograms are useful for determining key individuals who facilitate knowledge transfer across group, department, or organizational boundaries as brokers or boundary spanners, a common approach used by multiple theorists (Adkins, 2008; Allen et al., 2007; Bate & Robert, 2002; Birk, 2005; Cross et al., 2001; Krebs, 1998; Liebowitz & Liebowitz, 2008; Parise, 2007; Scott, 1991).

Sociograms are also useful for understanding network cohesion between actors or “the distance or number of lines to reach nodes in a network” (Parise, 2007, p. 367). For example, Figure 3 identifies that individual 1234 is a critical knowledge resource between two groups as this individual receives information, as indicated by multiple directional arrows, as indicated by ←, that originate from other individuals to individual 1234. Individual 1234 is also a source of information to others, as indicated by directional arrows that originate from individual 1234, as indicated by →. In Figure 3, a double-headed arrow indicates that an individual gives and receives information.

Closer inspection of Figure 3 reveals that individual 156 appears to be isolated or an isolate and that individual 189 does not reciprocate information sharing with individual 178, both events which may be problematic for efficient organizational information and knowledge flows. Collected data is translated from a sociogram to a matrix format or sociomatrix for in-depth mathematical analysis. Most common is the usage of a nominal or binary level of measurement, regarding the presence or absence of a relationship between adjacent individuals or nodes, an approach supported by Hanneman and Riddle (2005, Chapter 1, Binary Measurement of Relations) and Wasserman and Faust (1994).

Individual 1234 appears to be central across multiple groups

Is this individual a conduit or possible bottleneck? Over worked? What knowledge and cohesion are lost if 1234 leaves?

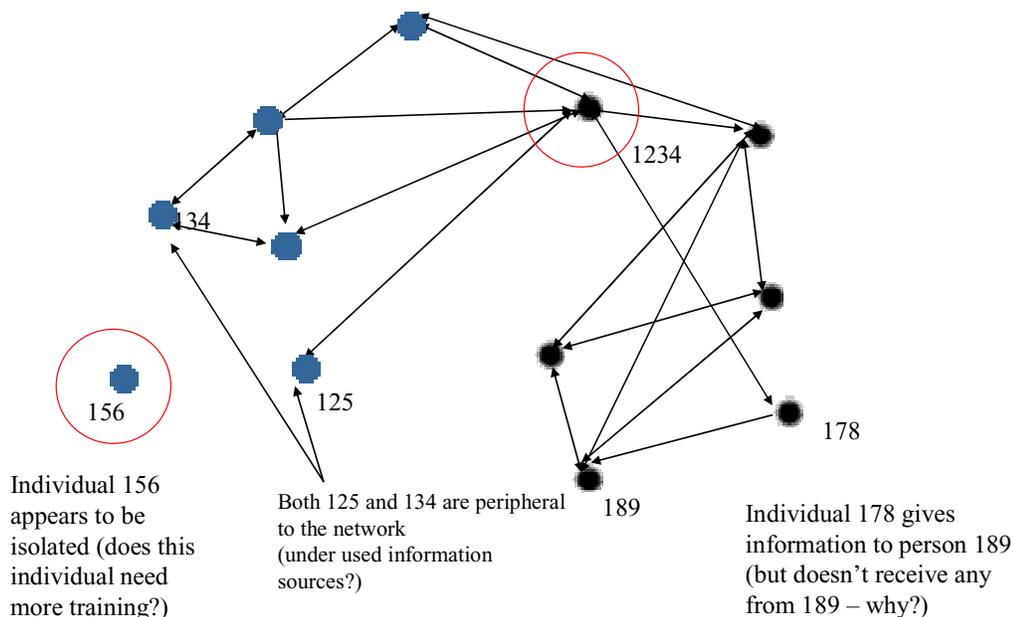


Figure 3. Sociogram.

For example, Figure 4 illustrates a directed graph or sociogram that indicates relationships between Alice and Bob, Bob and Carol, but not Alice and Carol. Using a nominal level of measurement, the presence of a relationship between adjacent individuals is indicated by a sociomatrix cell value of 1 with the absence indicated by a 0 (Figure 4). Signed values and interval measures could be used to measure the strength of a relationship, using archival data to corroborate informal exchange information (Hanneman & Riddle, 2005; Wasserman & Faust, 1994). Sociomatrix cell value manipulation facilitates the calculation of relationships within a network otherwise known as density, overall cohesiveness, and individuals who appear to be more central in

the network, based on their relationship ties (Hanneman & Riddle, 2005; Hirsch, 1979; Krebs, 1998; Scott, 1991; Wasserman & Faust, 1994). Statistical techniques, such as factor analysis, correlation and regression analysis could be used to explore network patterns.

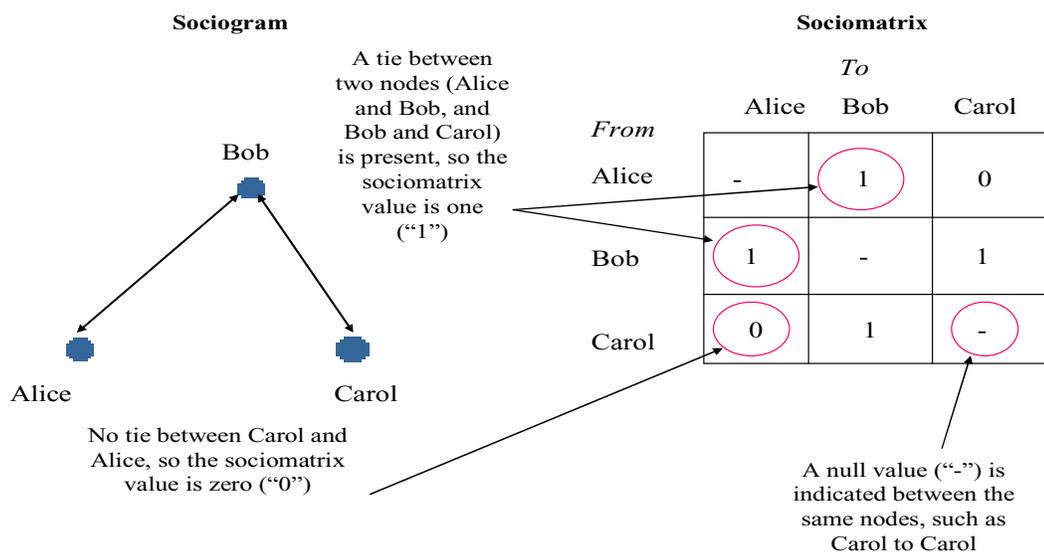


Figure 4. Directed graph (sociogram) and sociomatrix.

For knowledge intensive organizations, understanding knowledge flows could support corporate succession planning activities, workflow management, and generate new information exchange networks that support organizational change activities, a perspective supported by multiple theorists (Adkins, 2008; Birk, 2005; Cross & Cummings, 2004; Cross & Sproull, 2004; Cross, Parker, & Borgatti, 2002; Cross, Parker, Prusak, & Borgatti, 2001; Hatala, 2006; Schultz-Jones, 2007). More subtly, social network analysis findings could reveal unusual inter- and intraorganizational communication patterns, trust, and informational legitimacy issues associated with formal

and informal social networks (Cross, Parker, & Sasson, 2003). For example, social network analysis could reveal organizational technical experts (Adkins, 2008), communication paths (Birk, 2005), or enhance performance (Cross & Cummings, 2004) and service delivery (Schultz-Jones, 2007). Sociograms could reveal the presence of individuals who might be external to the immediate network, yet who might be able to provide nonredundant information from other networks, a knowledge infusion that could lead to innovation (Brass et al., 2004; Burt, 1992; Granovetter, 1973 & 1982). Hirsch (1979) and Reagans and McEvily (2003) found that tie strength and network density were important factors for understanding what type of knowledge ought to be transferred (e.g., strong ties are critical for sharing tacit knowledge). These examples illustrated the diverse uses of social network analysis as an organizational analysis tool and as an approach to reveal communication paths and knowledge sharing practices.

Summary and Comments

Reflection on the key themes of knowledge, contextual complexity, and social networks revealed insights and literature gaps. First, knowledge is a complex mix of hard-to-codify or tacit and easily shared or explicit components commingled with experiences and beliefs (Nonaka & Takeuchi, 1995; Davenport & Prusak, 2000). Second, knowledge sharing is influenced by the type of knowledge shared, external environmental conditions, internalized patterns, and personal relationship networks (Adkins, 2008; Birk, 2005; Hammond & Glenn, 2004; Nonaka & Takeuchi, 1995; Murphy, 2003; Schultz-Jones, 2007). In particular, trust, reciprocity, and absorptive capacity are enabling factors that support the successful transfer of knowledge within

interpersonal or informal networks. Finally, exploring the intricacies of fluid social networks required approaches that could reveal differences in relationship strength, centrality, and overall network cohesion (Scott, 1991; Wasserman & Faust, 1994).

Social networking methodologies using mathematical manipulation and visual graphical techniques facilitate the in-depth exploration of informal relationship networks, such as those used in knowledge transfer. However, most of the literature focused on the application of social network analysis within the private sector, rather than the public sector. Using social network analysis techniques within the Ministry of Health Services would augment the scientific knowledgebase regarding applied social network analysis in the public sector. Approaches and lessons learned would benefit my current human resources and knowledge sharing practices, and other similar professionals within the Provincial government. Chapter 3 contains a description of the research plan, approach, purpose, and limitations associated with case study and social network analysis approach.

Chapter 3: Research Method

Introduction

This chapter contains the methodology that was used to address the research questions described in chapter 1. Key components of the methodology will be described, including the research design, sampling strategy, data collection, analysis, and results presentation. The design component outlines the rationale for the mixed-methods case study within the organizational context. The sampling strategy contains a description of how individuals were selected for the case study's questionnaire and interview phases. The data collection component contains a description of data collection and protection aspects, including ethical considerations, instrument design, and implications from my workplace role. Methods used to analyze and present the collected data are described in the final methodology components.

Research Design

I used a mixed-methods case study approach to inquire into the knowledge transfer processes used by management within the HSIMT division, including the division's VStats special operating agency. To understand how knowledge is transferred within HSIMT, the informal knowledge transfer relationships must be identified using a quantitative questionnaire. Participant demographic information, such as length of service, leadership stream level, location, branch, gender, and age were solicited to determine the specific attributes of the participant's knowledge transfer or sharing practices. For example, long-service participants were expected to have many internal government rather than external connections, whereas participants that had been in

government for less than 5 years were expected to have fewer internal connections. Younger, technologically literate participants were expected to have a diverse range of social network connections. Participants who were clustered in similar locations were expected to have higher density networks. Collectively, these attributes were used to determine critical informal relationships and knowledge sources (Cross et al., 2002). Appendix A contains a description of the rationale for each questionnaire item.

Informal knowledge transfer processes are complex, as they include an individual's experiences, explicit knowledge, beliefs, and assumptions, a model supported by Davenport and Prusak (2000). Multiple theorists identified and explored key relationship networks using qualitative methods to understand the relationship's nuances and meaning within the organizational context (Adkins, 2008; Birk, 2005; Cross & Parker, 2004; Davenport & Prusak, 2000; Jarvenpaa & Staples, 2001; Schultz-Jones, 2007). As a Ministry of Health Services and HSIMT employee, I had access to internal processes, documents, electronic collaboration networks, and contexts that supported the research methodology. Although the collected data represented a snapshot of the informational relationship networks, the approach provided an organizational strategy that could be adapted to future similar inquiries for other divisions or the entire ministry.

Given these contextual requirements with unclear participant/contextual boundaries, a mixed-methods case study approach was the most appropriate design (Creswell, 2005; Stake, 1995). A case study design facilitated problem inquiry through multiple data sources and methods, an approach that was not feasible using linear quantitative designs, such as from using experiments (Adkins, 2008; Birk, 2005; Creswell,

2007; Singleton & Straits, 2005; Stake, 1995). Multiple methods provided me with a diverse toolset to obtain an overall contextual perspective while probing to gain insights and enhance understanding. From these methods, participants and I codiscover new knowledge and meaning, insights not possible from only using questionnaires or interviews, a view supported by several theorists, such as Adkins (2008), Birk (2005), Merriam (1988), Schultz-Jones (2007), Stake (1995) and Yin (2003). As a result, a mixed-methods approach was used in this study.

Codiscovery of new knowledge and reflexivity are integral aspects of case studies, as I could quickly adjust the study's design based on immediate participant feedback. For social network analysis studies, I must first identify existing knowledge transfer networks before understanding specific aspects of the relationship, such as centrality or relationship strength, an approach used by several theorists such as Adkins (2008), Birk (2005), Cross et al., (2001), and Schultz-Jones (2007). To gain this understanding required questionnaires and focused interviews to obtain a holistic participant perspective, an approach that was supported from using a case study design (Creswell, 2007). Insights gained from interviews and reflective journals, facilitated me in selecting appropriate participants who could significantly contribute to the understanding of knowledge sharing within the ministry, an approach supported by numerous theorists including Lincoln and Guba (1985), Merriam (1988), van Wynsberghe and Khan (2007) and Yin (2003). A case study design was also chosen based on the dynamic nature of the study environment.

With respect to the Ministry of Health Services, the research context was complex and naturalistic, rather than contrived and controllable. In this context, data collection and

analysis are iterative processes needed to facilitate the emergence of meaning and enhanced understanding of knowledge transfer practices (Denzin & Lincoln, 2005; Merriam, 1988; Yin, 2003). As this study focused on understanding knowledge transfer relationships, an intrinsic rather than instrumental case study approach was appropriate as relationships and issues could be explored (Stake, 1995). From these considerations, both Creswell (2007) and Stake (1995) identified that purely quantitative designs lacked the flexibility needed to adapt to a dynamic environment. As my study environment was influenced by changing organizational priorities, ongoing organizational restructuring, and a political context, having a flexible study design was an essential component and critical success factor.

A structured plan was used to ensure that the study remained aligned with the intended research goals, a process that was also used in quantitative designs. Within this planning process, the case study design incorporated features that enhanced the study's reliability, credibility, and transferability, concepts that were aligned with the quantitative research components of reliability and internal and external validity (Creswell, 2007; Singleton & Straits, 2005). Reliability was achieved through using a case study protocol, including detailed description of study sites, procedures, data analysis processes, and exception processes. Table 1 contains a summary of the key design elements, components, and strategies that were used to provide reliability, credibility, and transferability.

Table 1

Reliability, Credibility, and Transferability Components

Design Element	Component	Strategy
Reliability	Case study protocol	Use of invitation and consent forms (as per Walden University Institutional Review Board, IRB) and Ministry of Health Services (Privacy Impact Assessment, PIA) and/or Information Sharing Agreements, ISAs)
		Description of social network analysis questionnaire (Appendices A, B, C and permissions in Appendix D)
		Detailed documentation of processes, including journals and logs, resulting in an evidence chain
Credibility	Patterns (Internal validity) Case selection (External validity)	Analysis using UCINET/NetDraw and Atlas.ti Results were reviewed with strategic human resources (SHR) directors/executive directors to ensure that the findings reflected the contextual environment and conditions
		Study site – Ministry of Health Services Health Sector Information Management/Information Technology (HSIMT) and within the division, the Vital Statistics (VStats) special operating agency
		From the 2008 government employee engagement questionnaire, VStats appeared to have effective information sharing processes
Transferability	Narrative	Use of thick descriptions to allow reviewers to transfer findings to their context

Population

The case study's population is the Ministry of Health Services, an organization of approximately 1,000 individuals, comprised of union, managerial, and non-government or contract staff. As of July 2008, there were approximately 180 managers within the ministry; a population that included senior executives, such as assistant deputy ministers,

ADMs and executive directors, directors, managers, and supervisors. Within this managerial population, each Ministry division had one ADM, with one or more executive directors who were responsible for teams of directors, managers, supervisors, and included staff. Of the ministry's management population, there were approximately 10 ADMs, 20 to 30 executive directors, 100 to 120 directors/managers/project directors, and 20 supervisors. It is this group of 180 individuals who formed the target population.

Sampling Procedure and Sample Frame

The focus of the case study was to identify what knowledge transfer relationship networks existed within the ministry. Within the ministry, the chief operating officer oversees the ministry's largest cadre of managers who provide corporate ministry financial, emergency management, and information technology services (Figure 1). Within the scope of the chief operating officer's mandate, the HSIMT division and the Emergency and Health Services Commission (EHSC) contain the largest number of managers. Given EHSC's ongoing restructuring activities and focus on provincial ambulance and telehealth services, this organization was less suitable for being involved in a study of informal knowledge transfer practices. In contrast, HSIMT was a more suitable study candidate population given the division's stability, its corporate service delivery focus, and its uniqueness regarding the inclusion of the VStats special operating agency.

The sample frame for this study was the total population of 180 ministry managers, including all 41 HSIMT managers who were selected in the study sample. Out of these 41, 20 to 30 were approached for interviews. Managers were selected based on

their management classification streams of strategic leadership, business leadership, and applied leadership estimates as of August 24, 2008. January 2008 discussions with the ministry's director of strategic planning in the SHR division indicated that other divisions had potential sample populations, yet by mid-June 2008, ministry restructuring had reduced the numbers of managers in these divisions. By mid-June, VStats emerged as a potential study population, based on their very strong 2008 employee engagement results. As a result of these organizational changes and engagement results, HSIMT was purposively selected as the study sample population (S. Stewart, personal communication, June 5, 2008), and subsequently endorsed by the HSIMT ADM (S. Stewart, personal communication, August 8, 2008).

For the network analysis component, the entire HSIMT divisional managerial stream of approximately 41 individuals was invited to participate, as this provided more complete network information (Cross & Parker, 2004). This sample included HSIMT government employees with the job title containing one of the following terms: assistant deputy minister, executive, director, or manager. Individuals who were absent or positions that were vacant were not included in the final sample. Interviewees were selected using purposive, rather than random, sampling to ensure that the selected cases provided the most enhanced understanding and meaning for the ministry's stakeholders, an approach used by multiple theorists (Adkins, 2008; Birk, 2005; Creswell, 2007; van Wynsberghe & Khan, 2007; Stake, 1995; Schultz-Jones, 2007). As there were more managers in HSIMT than in VStats, the interview sample contained approximately two

HSIMT managers for every VStats manager. As no HSIMT job titles included the term supervisor, no supervisors were selected.

All selected individuals were asked to voluntarily participate in the research study questionnaire and interviews, including field testing processes (Appendix E).

Interviewee selection was based on (a) job title containing one of the following terms: assistant deputy minister, executive, director, or manager; and (b) that the participant was a government employee, rather than a nongovernment employee or contractor. Details regarding interview sampling selection according to key managerial job titles are contained in Table 2. Appendix F contains details regarding the sample population used for the questionnaire. I verified that prospective study participants were not contractors through searching the ministry's internal employee directory and/or consulting SHR managers. Where feasible, according to executive scheduling and availability, participants were purposively selected for interviews such that there was at least one senior executive, such as an assistant deputy minister or executive director, director, and manager (Table 2) for each branch. Interview selection was reviewed and revised based on discussions with SHR managers, with final interviewee selection based on availability according to the participant's schedule.

Table 2

Divisional Interview Sampling

Division (As of December 14, 2008 from Internet Directory)	ADM	Exec Dir	Dir- ectors ⁴	Man- agers ⁴	Selection Total	Total Available Mgmt. Pop.
HSIMT Division	1	5	15	9	30	51
HSIMT (Without VStats)	1	4	12	3	20	36
Executive	1 ³	1		1	3	6
BMO ¹		1	1		2	5
CMO ¹		1	6	1	8	8
DARS ¹			1		1	1
eHealth Branch		1	1		2	8
eHPSLO ¹			1	1	2	5
KID ¹			2		2	3
Vital Statistics Agency		1	3	6	10	15
CEO Office		1	1		2	2
IT Services			1		1	1
Support Services (SS) ²				1	1	1
Corporate Registries			1	1	2	2
Region 1 – Pr. George				1	1	2
Region 2 – Van. Is./Suns. Cst. ²				1	1	3
Region 3 & 4 – Vancouver ²				1	1	3
Region 5 – Kelowna				1	1	1

Note.

¹ CMO: Corporate Management Operations; BMO: Business Management Office;

DARS: Data Access and Research Stewardship; eHPSLO: eHealth Privacy, Security and

Legislation Office; KID: Knowledge Integration and Development. Branch groupings

based on December 14, 2008 displayed job titles and branches from the government's

Internet directory (<http://www.dir.gov.bc.ca>). See Appendix F for details on the sample

population.

² Includes assistant managers (Supervisor adjudication and office managers not included as unclear of exclusion).

³ ADM executive scheduling may preclude interviews with the ADM, thus total possible interviews are reduced. CMO directors in Business Planning and Application Management (BPAM), Program Evaluation, and Risk Management and managers in CMO Procurement. Participation in the questionnaire and interview sessions was subject to voluntary consent. Interviews are subject to the participant's time and scheduling.

⁴ Directors include project directors and managers include project managers.

As some branches had small managerial populations, there was the potential that all of these managers would have been interviewed. The number of individuals to be interviewed was between 20 to 30 individuals, subject to their voluntary consent and scheduling. In-person interviews were used, as most of the individuals were within the same geographic location, such as the city of Victoria. Telephone interviews were conducted for regionally-based VStats managers. For the in-person or telephone interviews, at least one individual in each management classification stream was sampled. If repetitive information consistently emerged from subsequent interviewees, then the remaining interview sessions were not conducted, as information saturation had occurred. Appendix F contains a summary of the managerial and staff populations within the target division.

Instrumentation

The social network analysis instrument will assess an individual's perceived relationship or ego-centric network, rather than assessing all of the organization's relationship networks. A complete assessment of the organization's network was infeasible at this time given resource constraints, increased workloads from strategic

projects, and from June 2008 organizational restructuring activities. In-depth interviews were conducted to provide insight into knowledge transfer approaches used within HSIMT. Appendix G contains the interview questions. Documents, including procedures, processes, and electronic sources were analyzed to determine the extent of supplemental resources that could be used within the knowledge transfer process. The ego network was assessed using the name generator questionnaire technique that was commonly used within social network research (Adkins, 2008; Birk, 2005; Hatala, 2006; Hirsch, 1979; Levin & Cross, 2004; Schultz-Jones, 2007). The name generation technique allowed participants to freely identify their contacts or alters, rather than using a pre-defined list (Cross & Parker, 2004; Marsden, 2005). The questionnaire instrument was adapted with permission from Cross and Parker's (2004, p. 147) assessment model derived from their numerous studies (R. Cross, personal communication, July 21, 2008; A. Parker, personal communication, June 30, 2008).

Validity and Reliability

Empirical research is founded on designs that use measures that reflect what is intended to be measured or valid, and provide consistent or reliable measures over time (Singleton & Straits, 2005). Yet, these two aspects pose some challenges within the social network framework. Review of several social network questionnaire instruments revealed several similarities with respect to question wording, yet numerous subtle and important contextual differences that were problematic with respect to validity and reliability. Carpentier and Ducharme (2007) identified that this complexity stemmed from the fact that "social network construct ... cannot be established definitively, as it

comprise[d] a certain measure of subjectivity” (p. 105), a view supported by Marsden (1990). Marsden (2005) reiterated the lack of validity “criterion data” (p. 14), yet noted that the test-retest approach could be used to measure reliability (p. 15). Wasserman and Faust (1994, pp. 57-58) echoed these views, and added that name generator questionnaires have face validity, with little construct validity. They further noted that additional reliability approaches included contrasting results from alternative question wording and rating or ranking choices.

Further analysis and review of the relevant research suggested that instrument validity was predicated on contextual influences, question construction, terminology clarity, and network issues (Bass & Stein, 1997; Carpentier & Ducharme, 2007; Cross et al., 2002; Hatala, 2006; Levin & Cross, 2004; Marsden, 2005). For example, name generators appeared to be more reliable and provided a stable core of network members over a lengthy period (Carpentier & Ducharme, 2007, p. 105; Kogovsek & Ferligoj, 2004, p. 519) and were less reliable when personal or intimate relationship questions were asked (Bass & Stein, 1997; Bien, Marbach, & Meyer, 1991; Campbell & Lee, 1991). The study questionnaire instrument included context specific questions, a technique used by several researchers (Adkins, 2008; Birk, 2005; Schultz-Jones, 2007) and roster lists, a technique used to collect data on weak ties (Granovetter, 1973; Hirsch, 1979; Zwijze-Koning & de Jong, 2007). Specific time periods, question preambles that established contextual clarity, and multipoint scales were used to enhance reliability (Carpentier & Ducharme, 2007; Ferligoj & Hlebec, 1999). Cross and Parker’s (2004, pp. 147-149) research identified three core topic areas that explored relationships to surface

information sharing practices, network rigidity, and levels of network support. From these core topics, Cross and Parker (2004) developed a sample social network analysis questionnaire (pp. 147-152) that was slightly modified for the ministry context. As a result, my study's questionnaire design incorporated the validity and reliability aspects from Cross and Parker's (2004) research. Table 3 contains a summary of the rationale for questions used in the questionnaire.

Table 3

Relational Aspects

Relational Aspect	Component ¹	Rationale	Evidence
Access	Physical proximity (e.g., where is the person located in relation to you?) Work address (e.g., where does this person work?) Organizational location (e.g., what is the person's position in the ministry's hierarchy)	Indicates if the relationship is <i>close</i> (i.e., within the business unit), within the organization, or external Questionnaire questions: ² <ul style="list-style-type: none"> • Demographics (D1 through D7) • Relationship (Q1, Q2, and Q4) 	Allen et al., (2007) Cross & Parker (2004) Cross et al. (2001)
Engagement	Identification of isolated individuals or dense network provide opportunities to adjust or enhance ministry practices that enhance knowledge transfer	Questionnaire questions: ² <ul style="list-style-type: none"> • Network (Q1, Q2, and Q3) 	Cross & Parker (2004) Cross et al., (2001)
Wellbeing	Length of relationship (e.g., how long have you known this person?)	New relationships may pose weaker ties and initially be less trusted for sharing complex knowledge. Questionnaire questions: ² <ul style="list-style-type: none"> • Relationship (Q3) 	Cross & Parker (2004) Cross et al., (2001)

Note.

¹ Questions adapted with permission of R. Cross and A. Parker (2004). *The hidden power of social networks: Understanding how work really gets done in organizations*. Boston: Harvard Business School Press.

² Appendix A contains the questionnaire instrument. Appendix A contains the mapping of the original questionnaire to the questionnaire instrument.

For demographic questions, a participant's gender, and age range were collected to determine if there were similarities or differences with respect to information sharing practices. For the relationship and network questions, numeric response scales, with values ranging from 0 through 5, were used. Agreement/disagreement response categories used wording similar to that used in the annual government workforce engagement questionnaire, as this wording was familiar to participants. Alternative wording that may reduce double-barreled responses was considered, yet discarded as such alternative wording may be unfamiliar to participants and thereby increase overall confusion (Singleton & Straits, 2005). Corroborating evidence from archived documents, such as newsletters and communiqués, were used to provide insights on emerging themes, an approach espoused by both Creswell (2007) and Merriam (1988).

Data Collection

Case study data were collected from multiple sources: a questionnaire, interviews, and document reviews. Use of multiple sources was a crucial aspect of triangulation activities needed for enhancing the study's credibility and utility (Creswell, 2007; Stake, 1995). Although several social network theorists had identified the use of the snowball

data collection technique, this approach was infeasible as it would not identify isolated individuals and there were numerous resource and time constraint challenges (Hanneman & Riddle, 2005, Chapter 1, Sampling Ties section; Wasserman & Faust, 1994). To study the relationship, individuals or egos and their contacts or alters would be used (Hanneman & Riddle, 2005, Chapter 1, Ego-centric Networks section; Wasserman & Faust, 1994).

The social network analysis questionnaire consisted of structured, limited response or closed questions that facilitated the visual mapping on an individual's informal relationship network (Appendix A). A key aspect of social network analysis was identifying individuals within the relevant organizational unit(s) to be studied, a technique that was consistent with previous research (Adkins, 2008; Birk, 2005; Allen, et al., 2007; Bien et al., 1991; Cross & Parker, 2004; Cross et al., 2006; Hatala, 2006; Schultz-Jones, 2007). Although the literature identified that an online questionnaire was the preferred social network data collection mechanism, alternative instruments, such as spreadsheets, could be used (Cross & Parker, 2004). Spreadsheets were chosen to address potential privacy concerns in ensuring that the collected data remained within Canada, as per the government's *Freedom of Information and Protection of Privacy Act* requirements. Other research approaches, such as conducting the research through the government's research branch, and local private sector research services were considered yet discarded because of cost and privacy concerns, which could negatively affect response rates.

The finalized questionnaire consisted of four worksheets to provide instructional guidance and collection of demographic and social network and relationship information. The questionnaire contained an instructions worksheet that outlined the study's privacy and confidentiality protections, and instructions regarding the completion of the worksheets. Collected demographic information was used to analyze differences in the informational network practices between new and long-service managers. The demographic information consisted of the participant's name, length of service (in years), managerial leadership stream category, branch, physical office address, gender, and age range (Appendix A). Collected relationship information identified the physical proximity, location, length of time known, and positional role of named individuals whom the participant perceived as important information providers.

Each relationship question provided the participant with a 5-item Likert scale, with values from 1 through 5. For example, in the relationship section, Question 1, Response Value 1 was associated with close proximity, such as same floor, same building whereas Response Value 5 was associated with distant proximity, such as locations outside of BC. Although the same 5-item Likert scale was used throughout the Relationship questions, the values corresponded to different aspects of the relationship. For example, in the relationship section, Question 1, Response Value 3 corresponded to different building whereas in the same section, Question 2, Response Value 3 corresponded to *outside the division, within the ministry*. Participants were asked to name up to 20 individuals within their informal relationship network. For each identified individual, he or she was asked if their knowledge sharing activities occurred within close

physical proximity or across a broader, dispersed geographic location (Adkins, 2008; Birk, 2005; Carpentier & Ducharme, 2007; Ipe, 2003; Pratt, 2006; Scalzo, 2006).

Participants were asked how long they had known the identified individual, information that was used in analyzing the strength of the relationship or tie strength. Tie strength questions were included based on previous research evidence by Allen et al. (2007) and Granovetter (1982) that indicated tie strength was crucial for sharing complex or less complex or simple knowledge.

In contrast, the network questions collected information regarding characteristics associated with the participant's relationship with managers in his or her division. Participants were asked to identify if they sought work related guidance from specifically named individuals within their division. This information will assist SHR managers in identifying and adjusting organizational workload strategies if an individual appears to be isolated or acting as key divisional information sharing conduit (Hatala, 2006). Similar to the relationship questions, the network relationship questions used a Likert scale using numerical values ranging from 0 through 5, with zero or a blank entry denoting that the participant did not know the listed name. This approach to data collection and questionnaire construction was similar to approaches used by several researchers (Adkins, 2008; Birk, 2005; Cross & Parker, 2004; Hatala & Fleming, 2007; Schultz-Jones, 2007). Collected data were not analyzed using traditional statistical techniques, as results may cluster around the norm. Instead, results were validated through discussion with the SHR managerial team, a process previously validated by several theorists (Adkins, 2008; Birk, 2005; Carpentier & Ducharme, 2007). The government's e-mail

network was used to distribute the invitation, consent, and questionnaire to selected participants. Follow-up reminders were e-mailed to participants on the 4th and 8th days of the study period, with one final follow-up reminder distributed one day after the questionnaire period ended. Questionnaire data were coded using a mixture of alphabetic and numeric characters, including codes for missing, blank, or incomplete data (Appendix B).

Based on previous research (Birk, 2005), general semi-structured interview questions were used to probe the characteristics of informal relationship networks (Appendix G). I used procedures and interview protocols that minimized bias sources, such as from personality or expectations, from affecting the research processes (Creswell, 2007). Discussions with SHR managers reaffirmed the individual interview participant selection list to ensure that all participants were government employees. As most participants were within the same geographic location, the majority of the interview sessions were conducted in-person however, participant time constraints and other considerations required telephone interviews or shorter interview sessions. Interview sessions were from 15 to 60 minutes in length and audio recorded with consent. Supplemental written notes were recorded if audio recordings were not permitted or there were technical issues (Creswell, 2007; Merriam, 1988; Stake, 1995; Yin, 2003). Once transcribed, the interviewee was contacted to verify that their information had been transcribed as accurately as possible. Code categories were constructed prior to the thematic analysis based on word frequencies and iterative code and quotation reviews. As qualitative analysis was iterative, new code categories were added throughout the

analysis process. Analysis ceased when no new information emerged. Further details regarding the data collection processes are outlined in Appendix H. Personally identifiable data were collected according to BC's *Freedom of Information and Protection of Privacy Act* (FOIPPA; 1996), Section 35 that allows the data to be disclosed for research or statistical purposes.

To protect individual confidentiality, individuals were assigned numeric identifiers and managerial leadership streams were color coded (Appendix B). Archived documents, such as newsletters and communiqués, were collected to support triangulation. Participant names were randomly translated to numerical study identifiers that ranged from 1 to 9999. A random number was used as the starting seed for assigning participants to reduce the likelihood of participants from deducing the identity of certain individuals, for example, assuming that the assistant deputy minister ought to be logically assigned identifier 0001. Participant supplied names were sequentially assigned study identifiers (ids) from 10,000 to segregate these ids from participant study ids. The presence of a relationship, whether singular or mutual, was indicated by the ordinal variable 1, whereas the absence was indicated by the ordinal variable 0, as per standard social network analysis coding conventions used by several theorists (Adkins, 2008; Birk, 2005; Cross & Parker, 2004; Schultz-Jones, 2007). Researcher notes, journal entries, and reflective logs were used in the analysis process, key aspects of the case study process as identified by both Creswell (2007) and Stake (1995). Collectively, these documents and researcher notes comprised this study's case study framework.

Ethical Considerations

Protecting participants from harm is a crucial aspect of any research that involves human subjects, a perspective that was strongly advocated by all of the reviewed theorists (Creswell, 2007; Denzin & Lincoln, 2005; Lincoln & Guba, 1985; Merriam, 1988; Singleton & Straits, 2005; Stake, 1995; Yin, 2003). A key aspect of collecting data through a social network analysis questionnaire is the need for all selected individuals to participate to construct a map of the existing relationship networks (Adkins, 2008; Birk, 2005; Borgatti & Molina, 2003; Schultz-Jones, 2007). Incomplete participation would result in inaccurate maps that could be misinterpreted, resulting in decisions that might be detrimental to the organization (Borgatti & Molina, 2003). Although incomplete, Hanneman and Riddle (2005) noted that the resultant network maps may be beneficial in suggesting trends.

Network maps may reveal individuals who appear to be isolated from the existing organizational relationship or hierarchical structures or identify central conduits that are at different levels, which may be problematic. Thus, reported information contained pseudonyms and/or was aggregated for small sample cell sizes to protect participants from perceived or actual harm, a common approach used by numerous theorists (Adkins, 2008; Allen et al., 2007; Birk, 2005; Cross & Parker, 2004; Schultz-Jones, 2007; Snowden, 2005b). The resultant findings will be used by a variety of audiences, including ministry SHR planners and management, participants, and other divisional managers. The intended approach and lessons learned will be useful to other government human resource personnel as well as scholars.

More subtly and importantly, participants may identify individuals who are not within the organization or “who may not wish to be named” (Borgatti & Molina, 2003, p. 339). This aspect raises lack of consent issues and potential ethical issues if individuals identify others that may be involved in illegal or unethical activities (Borgatti & Molina, 2003). As Borgatti and Molina (2003, p. 343) argued, the participant could choose who to identify in their network based on their perceptions of relevancy. With respect to possible lack of consent, Borgatti and Molina (2003, p. 343) suggested that the consent letters ought to be mailed to participants before the questionnaire was sent, so that only individuals who had consented to participate were included on the questionnaire. Within this organizational context, I believed that there was minimal risk to nonwork related individuals or actors, as it was expected that participant named actors were similar in character to that of the participant.

As I am a middle manager that has ministry information security officer (MISO) responsibilities, this role may pose perceptions of bias and possible coercion for some participants. For example, the MISO has role responsibilities that include reviewing and acting as one of several signatories of privacy impact assessments for all ministry projects, projects that may be sponsored by the participant. Although possible, yet very unlikely, the MISO may be involved in information security investigations that may include the participant. Mitigation strategies that would be used in these circumstances include discussions with SHR and/or my immediate management and executive. Questionnaire and interview candidates were asked to volunteer and provide consent prior to the questionnaire and interview. All collected data were securely protected,

including use of encryption/strong passwords and storage in secured cabinets, and accessible only to myself. Given the legislative restrictions, my Dissertation Committee Chair would not be able to view raw data outside Canada. Possible mitigation strategies that were considered were to provide aggregate data, have authorized Walden University Canadian resident faculty provide assistance, seek authorized advice from ministry doctoral staff and/or seek assistance from the government's research service.

Role of the Researcher

The research project was led by the individual actions of the researcher, who is the ministry's MISO. As I am a manager within the study sample, my role includes active participation in the questionnaire component. Although I had no prospective participants directly report to me, several of these individuals were within my immediate workgroup and branch. Many aspects of my MISO role, such as sensitivity, tact, privacy, and information security, provided me with essential skills that were needed within the study. Despite these noted potential biases and concerns, I did not believe that my workplace role would subtly influence prospective individuals into participating in the project. As my position is a middle manager, my role would not establish a power relationship with most of the participants, who would be senior to me. My previous research experiences, value systems, and professional ethical codes in conjunction with due diligence research practices were collectively used to mitigate potential biases and circumstances that some participants might perceive as coercive. With respect to the data analysis, interpretation, and summarization components, I sought peer reviews of my analysis process with social network analysts, such as those available locally through

Simon Fraser University, and/or through the International Network for Social Network Analysis (INSNA, <http://www.insna.org/>).

Research notes, logs, and reflective journals were used throughout the research process, as reflection was a key aspect of researcher/participant knowledge generation, a perspective suggested by both Creswell (2007) and Stake (1995). Meticulous notes regarding documentation, field notes, and analytical process changes were used in establishing an evidence chain that supported my decisions, assumptions, and study findings (Lincoln & Guba, 1985; Merriam, 1988; Yin, 2003). I ensured that SHR management and/or the participating divisional executives were aware of the previously identified ethical considerations and potential future issues with social networking analysis. For example, Borgatti and Molina (2003, p. 346) were concerned that organizations that misused the results from social networking analysis could negatively affect future applications of the tool, as employees would collude and only provide responses that the organization wanted to hear. Collectively, the inclusion of these considerations into the research design and subsequent study report were used to protect participants while surfacing new knowledge for the division and ministry.

Data Analysis

Within social network analysis, the unit of observation or analysis could consist of (a) one or more relations; (b) multiple levels of study, such as individuals, pairs of individuals or dyads, a group of three individuals or triads, or the entire network; or (c) quantification of relations that may be “*directional or nondirectional*, and whether it is *dichotomous or valued*” (Wasserman & Faust, 1994, pp. 43-44). As this study was

founded on exploring the informal knowledge exchange processes between individuals, the relationship was the unit of analysis, rather than an individual (Hanneman & Riddle, 2005, Chapter 1 Social Network Data, Section Notes). Knowledge sharing was the variable of interest, otherwise known as the dependent variable whereas knowledge sharing inhibitors and enablers, otherwise known as independent variables, constituted variables that assisted in explaining knowledge sharing (Singleton & Straits, 2005). These levels of measurement were used to support the analysis process.

Collected social network analysis data were analyzed using specialized social analysis software, UCINET version 6.216 (Borgatti, Everett, & Freeman, 2002), which used NetDraw version 2.090 (Borgatti, 2002) to produce visual network relationship graphs. First, a translation table was used to translate named individuals to a numeric identifier for reporting purposes. The identifier was in the format nnnn where nnnn = 0001 to 9999, with a randomly generated starting point to reduce the likelihood that audience members could guess the participant based on numerical sequence. Excel spreadsheet data were imported to the UCINET software for matrix manipulation and statistical functions, including univariate statistics, ego network basic statistics, structural holes, cohesion, centrality, betweenness, and density (Borgatti, Everett, & Freeman, 2002; Hanneman & Riddle, 2005). These functions were used to determine the extent of an individual's self-identified informal relationships and their connections (e.g., how reachable was an individual within a branch?), an approach suggested by both Hanneman and Riddle (2005) and Wasserman and Faust (1994). Within UCINET, present relationships between two actors were coded as 1, otherwise coded as 0. Collected data

were transformed and analyzed using numerous UCINET commands, which are described in Appendix B. Internal validity equivalency in the case study was met through pattern and thematic analysis of the collected data using UCINET and Atlas.ti software, tools that were used in similar research by several theorists (Adkins, 2008; Birk, 2005; Carpentier & Ducharme, 2007; Creswell, 2007; Cross et al., 2006; Cross & Parker, 2004; Hatala, 2006; Lewins & Silver, 2007; McKether, Gluesing & Riopelle, 2009; Schultz-Jones, 2007). Details regarding the UCINET analysis were included to provide future scholars insights regarding the analysis approach used within this study, a map that was evident in the McKether et al. (2009) research, yet absent in several of the reviewed social network studies.

Relationship analysis included one or all of the following inquiry techniques: (a) network density, (b) the number of ties to/from actors or in/out degree, (c) if a node is a gatekeeper between pairs of actors (or betweenness centrality), (d) efficiency of connections or closeness centrality, (e) constraints on the ego, (f) isolates, and (g) differences by gender and/or age (Costenbader & Valente, 2003; Hanneman & Riddle, 2005; Wasserman & Faust, 1994). Gatekeepers were important aspects of an informational network as they acted as translators in information flows (Jones, 2006). Directional arrows were used in visual diagrams to indicate actors sending/receiving information, based on questionnaire responses. For example, suppose that Jane indicated that she sent Joe information, yet he did not reciprocate. The resultant graph would indicate an arrow directed *from* Jane *to* Joe, but not the reverse. A description of the analysis approaches that were used is contained in Appendix B.

Interview sessions were audio recorded and transcribed as close to verbatim as was possible. Where consent was not obtained for audio recording sessions, researcher notes were used. Audio recordings allowed me to hear pauses and changes in response delivery, which may have signaled deeper issues that would need additional probing (Denzin & Lincoln, 2005; Merriam, 1988). Documents were reviewed based on insights from discussions with SHR managers and/or interview participants. Documentation analysis included reviewing available electronic and paper documents that described current ministry/divisional knowledge sharing practices and procedures, current and archived newsletters, and communiqués for HSIMT (and its predecessor, the Knowledge Management and Technology Division) and VStats (Appendix H).

Using coding categories derived from interview and questionnaire insights, documents were analyzed for patterns, themes, and key words. Open, axial, and selective coding were used to derive themes from the interview data, as supported by Creswell (2007) and Lewins and Silver's (2007) Atlas.ti coding techniques. In open coding, the raw interview data were analyzed to develop information categories. Axial coding was used to refine the information categories from subsequent interview data, resulting in selectively coding insights that connect categories (Creswell, 2007). Categorical aggregation and pattern analysis were used to identify common themes or patterns across categories (Creswell, 2007; Stake, 1995). Matrices and visual tools, such as provided through Atlas.ti, were used to provide different textual/visual perspectives in the identification of patterns and themes. For example, based on previous research, possible initial categories could include relationship attributes, such as hierarchy, location, and

gender, with other potential categories related to knowledge type and complexity (Adkins, 2008; Birk, 2005; Casciaro & Lobo, 2005; Cross & Parker, 2004; Kleinbaum & Tushman, 2008; Morrow, 2006; Schultz-Jones, 2007). Once collected, the interview sessions were reviewed with the participant to ensure that the key elements had been accurately transcribed (Stake, 1995; Yin, 2003). Pseudonyms and/or aggregate results were used in discussing the analysis findings and subsequent reports to protect the privacy of individuals as there were few individuals at senior management levels, such as at the executive director level, and at the director level within the division (Creswell, 2007). Network maps and collected data were thematically analyzed for patterns or key words/phrases and transformed into a detailed or thick description that could be used to make sense of the transpired event(s) and generate new knowledge (Merriam, 1988). Data inconsistencies, contradictions, or unusual information were reviewed as potential pattern sources (Creswell, 2007). Use of multiple analysis methods allowed me to take a broader perspective on the overt and subtle aspects of complex knowledge transfer practices and underlying conditions, an approach supported by numerous theorists including Adkins (2008), Birk (2005), Venters and Wood (2007) and Schultz-Jones (2007). Using a combination of numerical and visual analysis approaches, several knowledge transfer patterns emerged from interview transcripts and archival documents. Further discussion of these patterns is contained in chapter 4.

Written Report

The final report combined graphical social network maps, interview results, and documentation findings into a comprehensive narrative, an approach that was aligned

with previous case study research and social analysis reporting techniques (Cross et al., 2006; Creswell, 2007; Hatala, 2006; Stake, 1995). Pseudonyms and/or aggregate information were used to protect the privacy of participants. In collaboration with SHR, I will provide participating divisional managers with specific results. Analysis results will be reviewed with the ministry's SHR management team to ensure that the findings reflect the environmental context. Feedback from participants was used as part of the participant or member checking process during the drafting of the final report, an approach suggested by both Creswell (2007) and Stake (1995). Transferability was achieved through the use of detailed or thick descriptions, a technique that facilitated multiple interpretations and allowed each reviewer to transfer the study's findings to their environment (Lincoln & Guba, 1985; Merriam, 1988). Unusual findings and discrepancies were identified and discussed, as they were critical in understanding the underlying nature of the knowledge transfer processes being used (Creswell, 2007; Stake, 1995). I included a peer review of the social network process using external resources to provide an external and independent assessment of my methodology and analysis processes, an approach espoused by Stake (1995) and used in other social network studies by Birk (2005) and Schultz-Jones (2007). Reviews from the study's sponsor, participants, and peer reviewers ensured that the study approach and findings were accurate and relevant.

After the research is accepted by the ministry and Walden University, all written materials and/or electronic media that contain personally identifiable information will be securely shredded and/or erased according to government's information technology asset

disposal practices. Within the ministry, I will distribute the report through the ministry's internal website or through focused divisional/branch communication tools, such as the HSIMT Employee Engagement Committee. The report will also be distributed electronically throughout government on the government's research network, and/or in-person to relevant stakeholders, including the Public Service Agency, corporate research group, or communities of practice.

Research Questions

As stated in the chapter 1 problem statement, the Ministry of Health Services will experience significant loss of operational knowledge from an aging managerial workforce, increased staff turnover, and difficulties in recruitment. There is also a gap regarding the effectiveness of these practices. To understand the informal knowledge transfer practices, I sought answers to the following questions:

1. What are the characteristics of an effective knowledge sharing network?
2. How similar or dissimilar are the knowledge sharing practices being used by senior executive and managers?
3. What are the perceived knowledge sharing enablers or inhibitors within the study context?

A mixed-methods case study approach facilitates an iterative approach in answering these questions. In-depth inquiry allows myself and participants to co-discover insights, which facilitates the generation of new knowledge and meaning. Table 4 maps the questionnaire instrument questions to each research question, whereas Table 5 maps the interview questions to each research question. Where possible, incomplete or

missing information was corroborated or supplied from other verifiable ministry sources, such as the government's internal e-mail address list and/or with SHR staff.

Table 4

Map Research Questions to the Questionnaire

Questionnaire Questions D: Demographic R: Relationship N: Network	Research Questions (RQs)		
	Knowledge sharing characteristics (RQ1) ¹	Similarities or Differences In Knowledge Sharing Practices (RQ2) ²	Perceived Knowledge Sharing Enablers or Inhibitors (RQ3) ³
D1. Name (first, last)	√	√	
D2. Length of service in government (in years)			√
D3. Managerial leadership stream			√
D4. Branch (e.g., DARS, Corporate Registries)			√
D5. Office address			√
D6. Gender			√
D7. Age range		√	√
R1. What is each individual's physical proximity to you?		√	√
R2. Please indicate where each individual works.	√		√
R3. How long have you known the individual?	√		√
R4. Please indicate each individual's positional role relative to your own.	√	√	√
N1. How often did you receive information from the named individual?	√	√	√
N2. How often did you give work-related information to the named individual? ⁵	√	√	√
N3. I would be more effective in my work if I could communicate with this individual more.	√	√	√

Note.

¹ RQ1: What are the characteristics of an effective knowledge sharing network?

² RQ2: How similar or dissimilar are the knowledge sharing practices being used by senior executive and managers?

³ RQ3: What are the perceived knowledge sharing enablers or inhibitors within the study context?

⁴ N1: Suppose you needed information to help you resolve a complex work-related problem. Within the last three (3) months, how often did you receive information from the named individual that would assist you on a work-related problem? See Appendix A for details.

⁵ N2: Within the last three (3) months, how often did you give work-related information to the named individual? See Appendix A for details.

Table 5

Map Research Questions to the Interview and Collected Documents

Interview Questions (I) or Archival Documents (A)	Research Questions (RQs)		
	Knowledge sharing characteristics (RQ1) ¹	Similarities or Differences In Knowledge Sharing Practices (RQ2) ²	Perceived Knowledge Sharing Enablers or Inhibitors (RQ3) ³
I1. What types of information would you share in the workplace?	√	√	
I2. In what contexts or situations would you share this information?	√	√	
I3. Do you use any particular terms or phrases when sharing knowledge with different individuals?	√	√	√
I4. In your view, what do you see as the key barriers to successful knowledge sharing?	√	√	√

(table continues)

Research Questions (RQs)			
Interview Questions (I) or Archival Documents (A)	Knowledge sharing characteristics (RQ1) ¹	Similarities or Differences In Knowledge Sharing Practices (RQ2) ²	Perceived Knowledge Sharing Enablers or Inhibitors (RQ3) ³
I5. What changes, if any, would you make to your knowledge transfer practices to ensure that this complex knowledge could be transferred?			√
I6. Reflecting on your overall approach regarding knowledge transfer, what has been most effective for you in sharing knowledge? Why was this effective?	√	√	√
A. Collected archived documents (e.g., newsletters)	√	√	

Note.

¹ RQ1: What are the characteristics of an effective knowledge sharing network?

² RQ2: How similar or dissimilar are the knowledge sharing practices being used by s senior executive and managers?

³ RQ3: What are the perceived knowledge sharing enablers or inhibitors within the study context?

Summary and Comments

The study plan provided a practical, yet flexible research approach regarding knowledge sharing practices within a public sector context. The purpose of this study was to provide a point in time perspective into informal knowledge sharing practices within the HSIMT Ministry of Health Services division. This study also provided a flexible tool and lessons learned that could be used by other ministries and public and private sector organizations for similar inquiries. Chapter 4 will provide a description of how the methodology was implemented and analysis findings.

Chapter 4: Data Analysis and Findings

Introduction

The previous chapter contained an overview of the methodology used to study the ministry's informal social networks within a bounded context. This chapter contains a description of the phased data analysis approach and analysis findings. The data analysis component includes a description of the preliminary study phase, data collection, and analysis activities. Collectively, these three phases were conducted over several months, starting in February 2009 and concluding in September 2009 (Figure 5).

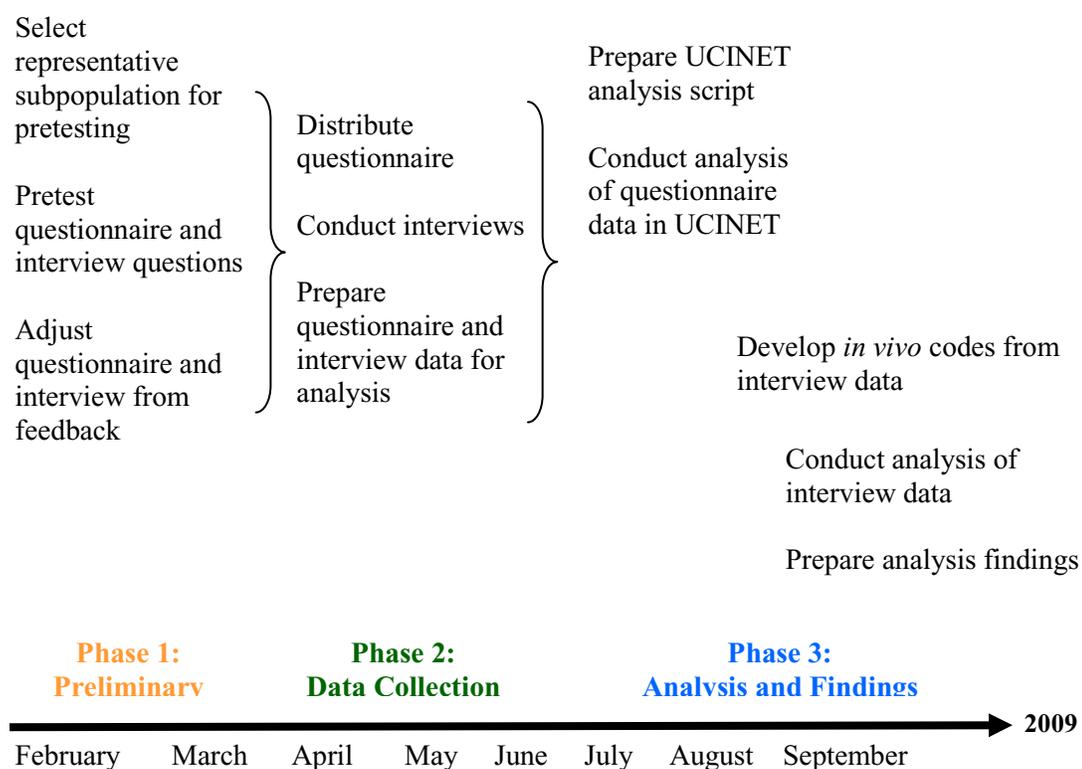


Figure 5. Analysis phase overview.

Data Analysis

Preliminary Study Phase

Of the three phases, the *Preliminary Study* phase was the shortest in duration and was used to field test the study materials to ensure that prospective participants understood the proposed questionnaire and interview questions. Field testing of questionnaires and interview questions was initiated through the assistant deputy minister (ADM) e-mailing the study announcement to 41 of the division's managerial population on February 23, 2009. Managers were selected based on a February 2009 review of the internal government e-mail address list for individuals who included *manager*, *director*, or *executive* in their listed position title. Selected individuals were confirmed to be excluded via e-mail discussions with SHR management.

From this research population, I preselected six individuals as candidates for field testing, with eight subsequent individuals as backup selections. Individuals were selected across the strategic, business, and applied leadership streams for the divisional branches of Corporate and Management Operations, Business Management Operations, eHealth Privacy, Security and Legislation Office, and Vital Statistics. I self-tested the field testing invitation (Appendix E) three times to ensure that the invitation's wording was grammatically correct and the text was logically consistent with the attachment sequence. Attachments consisted of a study consent form (Appendix E), questionnaire (Appendix A), interview questions (Appendix G), and a feedback form (Appendix E).

On February 24, 2009, the field testing invitation, consent forms, and materials were distributed to the preselected individuals using the government's e-mail system.

Participants were given 7 business days to review the materials. Initially, the review period was for 3 days but was extended to accommodate heavy divisional workload schedules. Two participants were unavailable during the time period, so replacement candidates were selected from the backup list. Where possible, a backup candidate was selected that had the same positional role as the individual that was unavailable. One reminder was distributed March 1, 2009. At the end of the review period, three participants consented to participate and provided feedback through e-mail, the feedback form, completion of the questionnaire, and/or discussions with myself. The e-mail and electronic documents were strongly encrypted (using Advanced Encryption Standard, AES 256-bit) and stored in a Winzip file for secure transport to my home for analysis. Feedback analysis was delayed until late March, as I attended the international conference for social network analysts in San Diego, California.

Questionnaire and interview feedback were consolidated into separate tables or matrices for further analysis (Appendix B). For the questionnaire analysis, matrix rows listed four feedback categories, one for overall or miscellaneous comments and rows for each of the questionnaire's worksheets. Three matrix columns were used to indicate researcher reflections, notes, the questionnaire's item used in the testing, and proposed changes to the questionnaire's item. Different font colors were used for the contents of the latter two columns to provide visual and contextual feedback, so I could determine if any additional data collection instrument wording adjustments were required. Similarly, for the interview feedback analysis, matrix rows listed seven feedback categories, one for overall or miscellaneous comments and six rows, one for each interview question. Two

matrix columns were used to indicate researcher reflections and notes and proposed changes to the interview format or question, the latter often in a different font color. As most of the feedback was related to lack of clarity for a few terms in the interview questions (e.g., what does manager refer to?), I significantly revised the interview questions to enhance readability and understanding.

In late March 2009, the study instrument revisions were discussed with SHR management, which resulted in further minor instrument revisions. For example, question order was adjusted so that the first two questions asked participants to consider if they had received information *from* and sent information *to* the listed divisional manager. Response categories for these first two questions were adjusted to accommodate broader response values (e.g., *seldom* or *frequently*) that could be used by participants to indicate an occasional response. Interview question wording was adjusted to provide specific examples that were relevant to the workplace context. The final version of the study announcement and consent form were adjusted for distribution from the ADM instead of SHR management to enhance the visibility and importance of the study within the division. Concurrent with my discussions with SHR, I learned that a mandatory government workforce questionnaire was to be distributed on April 6, 2009.

Data Collection

To avoid potential confusion or delays in responding to the study questionnaire, I distributed the revised questionnaire and consent form on March 23, 2009 to 41 divisional managers using the government's e-mail system. Participants were given until end of day April 6, 2009 or 10 business days to complete the questionnaire. Participants

could complete the questionnaire within 20 minutes and return the completed results using the government's e-mail system. Completed consent forms were returned using the same e-mail system or printed and delivered in-person or through the government's internal house mail system. In a few instances, after clarifying discussions with myself, some participants resubmitted a portion of their questionnaire results. On the 4th, 8th, and 11th days of the study, individual e-mail reminder prompts for questionnaire completion were distributed to participants who had not responded. Throughout the questionnaire completion period, I logged the receipt of submitted questionnaires and encrypted the results for secure transport and handling. Although all divisional managers were invited to participate in the questionnaire and interview study phases, not all chose to participate in one or both phases.

Concurrent with this time period, relevant divisional archival documents that were not confidential were obtained to support the interview data analysis. Materials dated September 2008 through February 2009 were included in the document search. Numerous individuals were contacted within the division, including communications, executive, branch, and administrative staff in the document search. Common documents, such as divisional newsletters, were readily available to all divisional staff using the ministry's Microsoft SharePoint document sharing site. Few other documents were available, as obtaining them would have been too labor intensive for key divisional resources and/or too costly, such as obtaining materials from electronic backup sources. Instead, I was able to obtain 21 electronic documents that consisted of a few e-mails, divisional meeting summaries and six newsletters. At the conclusion of the data

collection phase, the data were cleaned and prepared for analysis using specialized social network analysis and qualitative analysis tools.

Analysis

Prior to data analysis, several processes were used to clean and transcribe the data. Preparation activities for the questionnaire data consisted of reviewing the data for completeness, recoding where necessary, and transferring to a format suitable for uploading. Audio interview data were manually transcribed into documents and reviewed by the participant for completeness prior to analysis. Archival documents did not require any preparation prior to analysis. The following sections describe the preparation and analysis activities for the questionnaire, interview, and archival materials.

Transcribing Questionnaire Data

Collected questionnaire data were transferred to separate demographic, relationship, and network spreadsheets to facilitate uploading to the UCINET social network analysis software (Borgatti, Everett, & Freeman, 2002). Participants provided responses in a column format, which needed to be transferred to a specific row and column matrix cell entry. To determine the most effective uploading approach, three to five trials were conducted using matrices and a data list for five participants, based on UCINET user discussion forum feedback. Trial results indicated that although the matrix coding approach might be more labor-intensive, it was easier to use the matrix format for visual comparison of the participant's submitted responses and the transcribed matrix. In the transcribed matrix, all study participants had a corresponding row and column or cell entry and associated randomly assigned study identifier or *study id*. Individuals who did

not respond had blank row and column entries. For the relational questions, named individuals who were provided by the participants otherwise known as non-HSIMT managers, were assigned a unique sequential study id, starting with number 10,000. The demographic spreadsheet contained a row for each participant and an attribute column that corresponded to the seven demographic questions, thus was a 41 by 7 (41 X 7) matrix. Within the individual network and relationship spreadsheets, individually named spreadsheet tabs were associated with each question, as per Brooks's (2005) method (Appendix B). The network matrices consisted of 41 rows and columns (41 X 41 matrix), whereas the relationship matrices contained an additional 239 nonstudy individuals provided by the participants (280 X 280 matrix).

Once all collected data were transferred, visual cell-by-cell comparison was conducted between the original and the transferred or *cleaned* spreadsheets to ensure that the data were transferred correctly. In the cleaned spreadsheets, responses were checked for completeness, recoded as required, and transformed to numeric codes for uploading into UCINET. For completeness, different colors were used to indicate one of the following conditions: (a) that the data were correct and no further coding changes were required, (b) that the data were correct and further changes were required, or (c) the data were incorrect. Response recoding was used for ensuring consistency across demographic data responses, such as capitalization of first and last name, branch name, location, and removal of extraneous response information (Appendix B). Missing data were coded as *m* for missing, as zero could be interpreted by UCINET as a valid relation response. For the relationship spreadsheets, no recoding activities were required. After

uploading the cleaned spreadsheets to UCINET and reviewing the initial graphs, I realized that additional demographic group codes were required. New grouped codes for years of service, branch, and office address were created in the cleaned demographic spreadsheet and uploaded to reduce the likelihood that participants could be readily identified through small cell sizes (Appendix B).

As several of the UCINET analysis tools were designed for binary data manipulation, new dichotomous adjacency matrices were generated, excluding missing data and the matrix diagonal (Appendix B). This generation process used researcher assigned cut-off parameters based on similarity of the original data values to determine whether a value of 0 or 1 would be generated. For example, for the relationship matrix Question 1, Response Values 1 and 2 were recoded as 0, as the responses were associated with the same location, with the remaining values recoded to 1 (Hanneman & Riddle, 2005, Chapter 6, Transforming Data Values section). Initially, the matrix corresponding to the Network Question 3 was not dichotomized yet was dichotomized later in the analysis process using a different cut-off value (Appendix B). The demographics matrix was excluded from the dichotomization process as cell entries were used as attributes. The implications from different cut-off values were explored using several social network measures. Analysis of these test results indicated that using lower or higher cut-off values than the chosen cut-off value would produce more variation. Concurrent with the questionnaire cleaning and transformation were the interview and archival data collection and coding processes.

Interviews

For the study population, in-depth management interviews were conducted between April 20, 2009 and June 5, 2009 regarding the type of knowledge shared, perceived knowledge sharing enablers or inhibitors, and effective knowledge sharing practices. On April 20, 2009, 23 of 41 managers were e-mailed an invitation to voluntarily participate in the hourly interview sessions. All managerial streams were represented and all but one branch were included in this initial invitation request. One branch was excluded because of known workload issues, which reduced the number of available interviewees. From this reduced candidate population, a further 6 interviewees were invited to participate when the initial invitation response rate was low. These additional candidates were selected based on representation across managerial streams, branches, and my awareness of workload pressures and likelihood of participation.

Interview sessions were between 15 to 60 minutes, and held in various offices and meeting room locations according to the interviewee's schedule. An interview script was prepared along with a one-page list of the interview questions, the latter being e-mailed to the interviewee prior to the interview session to facilitate discussion and minimize the interviewee's time burden (Appendix G). Where required, consent to participate was obtained prior to, or after the interview session. Throughout the interview, I jotted hand-written notes of key points on the interview script. Immediately after interview sessions, I recorded hand-written journal notes and observations that were associated with the session. Participant request and equipment problems meant that only two of the

interview sessions were not recorded. Instead, my field notes were used to record the session and/or conversations that occurred prior to, or immediately after the session.

Interview Coding

Audio interviews were transcribed using Express Scribe version 4.30 into a pre-set transcription format Microsoft Word document based on the interview script. Field notes were transcribed into a separate Word document that was also based on the interview script. Each line of transcribed audio material was prefixed with one of three codes: INT for the interviewer, QU for each question, and RESP. For the interviewee's responses, RESP contained a suffix that consisted of the interviewee's first name and first letter from their last name, a technique that was aligned with Lewins and Silver's (2007) qualitative analysis best practices. Different colors and special suffixes were used to distinguish audio transcripts from interview notes and field notes (Appendix I). All three types of interview documents were saved in a rich text format (.rtf) for ease of editing within Atlas.ti version 6.1 (Lewins & Silver, 2007; McKether et al., 2009). Individual transcripts were e-mailed to each participant for review along with periodic feedback reminders using the government's e-mail system. Of the 18 interviewees, 72.22% (13/18) provided feedback or stated that the transcript was acceptable. If no response was received, I assumed that the contents were acceptable. The 37 interview transcripts, interview notes, and field note comments or memos and 21 archival documents were first visually reviewed to derive codes then uploaded as individual documents that were otherwise known as *Primary Documents* in Atlas.ti terminology.

Analysis Processes

Analysis of the questionnaire data were performed for properties associated with the overall managerial network structure, for individuals, and at the relationship level, whereas interview analysis was performed iteratively. Findings from both processes were used to derive key themes for the research questions that will be described later in this chapter. Social network analysis of the division's managerial network was first conducted at a broad or group level to provide an overview of the network's structure (Figure 6).

Structural aspects, such as degree of influence and how many connections were needed to transmit knowledge or density were explored. As critical to knowledge sharing was the influence that resided with individuals and in groups of individuals. An individual's information transferal role as being a filter within and across managerial streams was explored, as were the possible constraints on this influence. With respect to relationship properties, the relationship's distance between individuals was reviewed to determine how many connections from an individual were needed to transmit knowledge between individuals. Appendix B contains the analysis test script for the network and relationship matrix analysis. The social analysis processes were peer reviewed by Simon Fraser University's Dr. Andrew Seary, whose suggested clarifications were subsequently incorporated into this chapter.

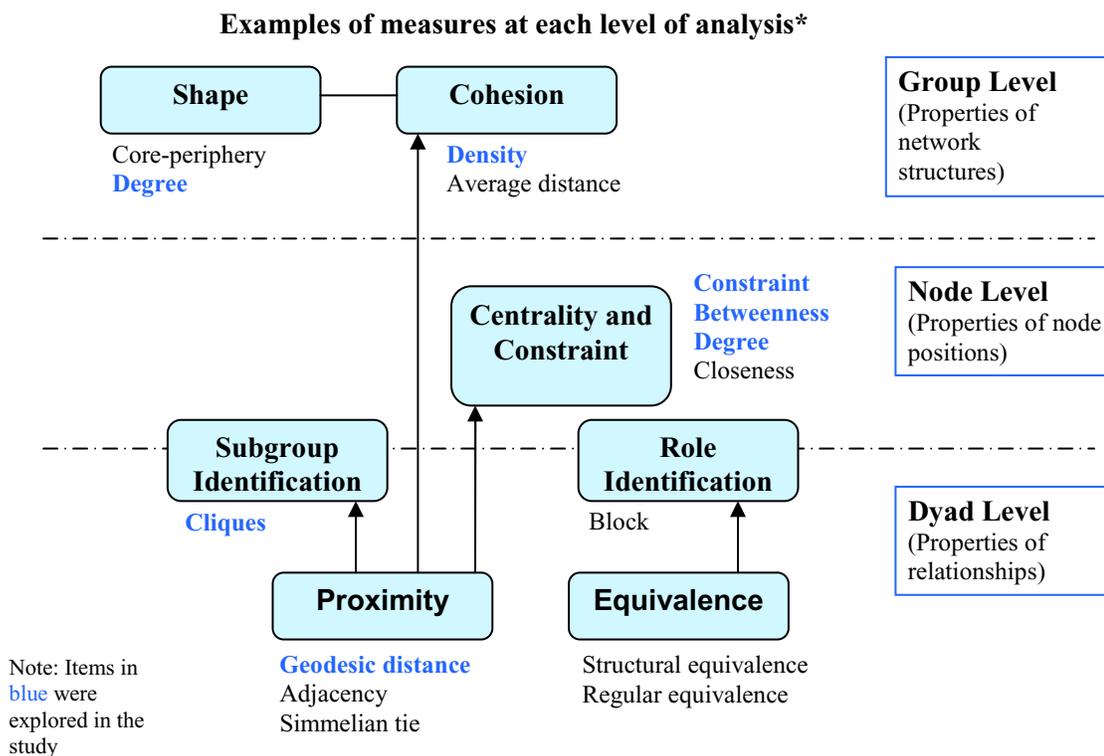


Figure 6. Social network analysis measures.

Note. From: "Introduction to Social Network Analysis" D. Halgin, J. Labianca, C.

Sterling, R. DeJordy, and M. Sytch (2009). Retrieved from

<http://linkscenter.org/slides/ItSNA2009.pdf>. Reprinted with permission of the authors.

Themes were derived from iterative reviews of participant interviews and researcher notes, an approach aligned with Stake's (1995) code categorization process. The categorization process consisted of three steps: initial coding, intensive coding, and iterative code categorization (Figure 7). The first step, *initial coding*, identified codes based on participant response or *in vivo* coding using Atlas.ti's Word Crunch analysis tool, rather than using previously developed or *a priori* code categories (McKether et al., 2009). The second step, *intensive coding*, was comprised of an intensive review of each

document using the initial coding list and categories, and adding new codes as appropriate.

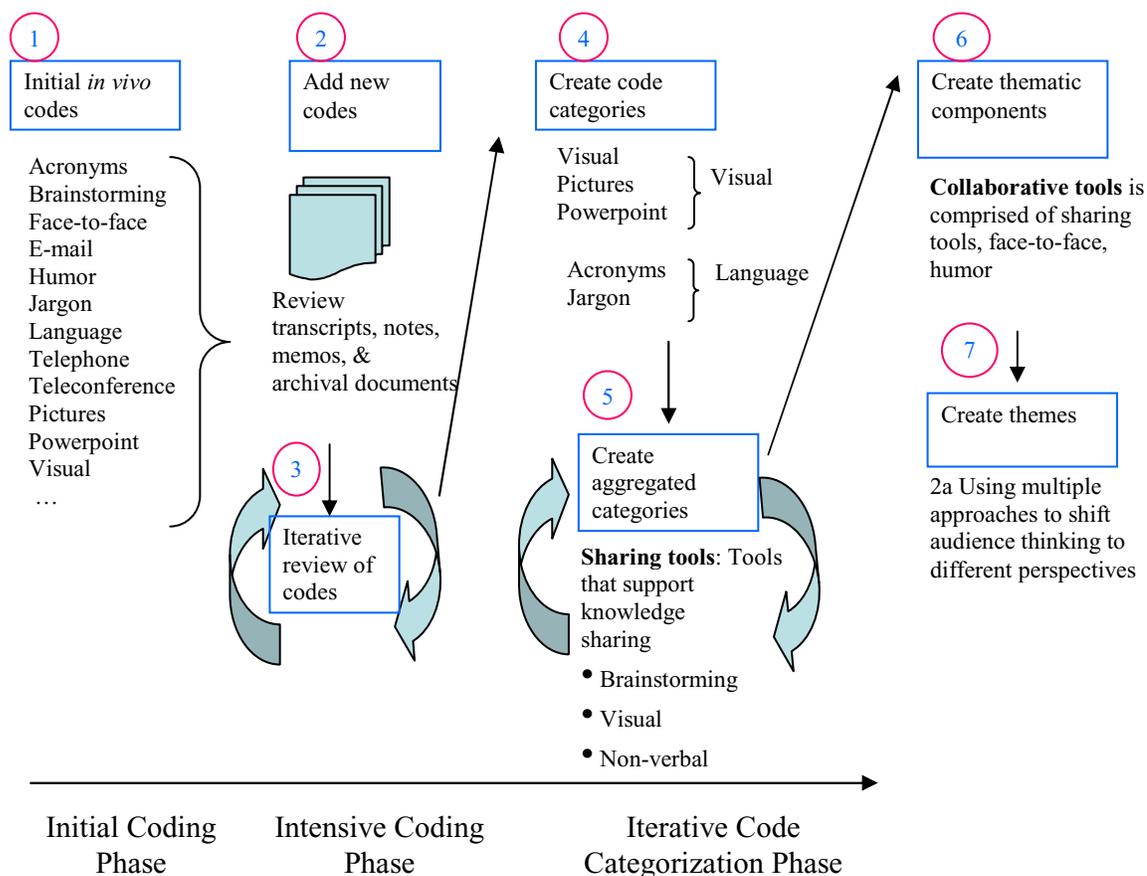


Figure 7. Code categorization phases.

Initially, over 130 codes and 695 quotations were identified for the interview and archival documents. Each quotation contained a word, phrase, or several lines of text, and was associated with one or more codes. The third step, *iterative code categorization*, was used to refine code categories and/or merge codes that appeared to be closely related, such as combining codes for *picture* and *visual* into the code *visual*. Table 6 contains an excerpt from this code categorization process, with details contained in Appendix C. Throughout the iterative code categorization process, aggregated code groupings were

created through examination of the similarities, differences, and commonalities between codes. First, code lists or hierarchies were reviewed to determine initial groupings, which were reviewed for similarities and aggregated. For example, codes for PowerPoint, picture, and visual were merged to form one code, *visual*.

Table 6

Code Categorization Analysis

Initial <i>In vivo</i> Codes (not an exhaustive list)	Additional Codes from Iterative Reviews	Aggregated Code Categories	Supported Thematic Components
Brainstorming, E-mail, Humor, Meeting, Technical, Visual	Face-to-face, Filtering, Jargon, Metaphors, Tools, Written	Tools that support knowledge transfer (e.g., brainstorming, body language, PowerPoint) – visual, verbal, nonverbal, written	Collaborative Tools
Practices	Stories	Sharing practice (e.g., coffee talks, knowledge broker, stories)	

Code lists were listed as spreadsheet columns then visually reviewed for common patterns. Two to four coding review cycles reduced the number of unique codes to 70. Code themes or families were created from these codes to represent key knowledge sharing themes. The final phase, *Findings*, contains a description of the analysis results for the study's research questions.

Findings

This section contains a description of the study population's demographic profile and detailed findings for the three research questions. As the response rate was less than 100%, the network portion of the study findings were incomplete and should not be interpreted as being a definitive picture of knowledge transfer within the division. These

results, however, should be interpreted as being indicative for the division's managers (Hanneman & Riddle, 2005). During October 2009, these findings were distributed to six HSIMT managers in two managerial streams to review and provide feedback. Workload issues precluded other potential reviewers from participating during the review period. Of the six individuals, only three provided feedback during the required review period. Despite the low response rate, the feedback from the reviewers was positive and included minor suggested revisions, such as terminology clarification, that were subsequently incorporated into this chapter.

Demographic Profiles

As not all managers participated in both study phases, two demographic profiles will be provided, rather than one consolidated profile. Not surprisingly, the study population reflected the division's predominately male population for the business managerial stream. For the questionnaire, of the 41 possible participants, 68.29% (28/41) participated, 4.88% (2/41) declined, and 26.83% (11/41) did not respond (Table 7).

Table 7

Demographic Summary

Demographic Question	Result
D2. Length of Service (in years) ¹	39.28% (11/28) had 10 to 19 years of service 39.28% (11/28) had 20 to 29 years of service Mean: 16.93 years
D3. Managerial Stream ¹	21/28 (75%) were in the business managerial stream
D4. Branch ¹	Results withheld
D5. Office Location ¹	1515 Blanshard St., Victoria; 1483 Douglas St., Victoria and 712 Yates St., Victoria
D6. Gender	64.28% (18/28) were male, 35.71% (10/28) were female
D7. Age Range ¹	39.28% (11/28) were 40 to 49 years of age 50.00% (14/28) were 50 to 59 years of age

Note.

¹ Grouped and/or specific results withheld to protect participants.

All branches were represented in the responses. Of those that responded, 64.29% (18/28) were male and 35.71% (10/28) were female. Of the three managerial leadership streams, 75% (21/28) of the participants were in the business leadership stream. Except for gender, results were aggregated to protect participants from possible identification. Almost 80% of the participants had over 10 years of experience within government, averaging 16.93 years of service. Approximately 90% of the participants were over 40 years of age, with at least 50% of them indicating that they were in the 50 to 59 years of age category. It was expected that participants would identify fewer than 10 individuals for the relationship portion of the questionnaire. Surprisingly, participants identified an average of 15.93 individuals, an average that included individuals within and external to the study population. Although an incomplete perspective of the division's managerial network was obtained, the collected information was valuable as relationship patterns emerged for certain individuals, collectively giving a general overview of the network's structure, as noted by Hanneman and Riddle (2005):

We can still get a pretty good picture of the "local" networks or "neighborhoods" of individuals. Such information is useful for understanding how networks affect individuals, and they also give a (incomplete) picture of the general texture of the network as a whole. (Chapter 1, Ego Networks section)

For the interview, 29 of the 41 participants were invited to participate, 62.07% (18/29) accepted the invitation, 13.79% (4/29) declined, and 24.14% (7/29) did not respond. Of those that were interviewed, 66.67% (12/18) were male and 33.33% (6/18) were female, with most participants coming from the business leadership stream (55.55% or 10/18). The next section is a summary of the key research question themes and findings.

Research Question Findings

This section contains key thematic findings for the three research questions as identified in the previous chapter. Each theme will be described within the context of its related research question. A summary of the key findings will be presented at the conclusion of each research question. Collectively, these identified themes are present throughout key sections within the knowledge sharing cycle (Figure 8).

The sender is influenced by several *sender factors*, including the existing network of relations, the knowledge to be shared and sharing rationale, behavioral and organizational filters. Behavioral filters, such as length of time one has known the recipient and level of trust influences the sender's choice of what knowledge to share. Organizational filters, such as the requirement for formal communication processes, influences the message composition and choice of message delivery method. *Sharing factors*, such as assumptions, expectations, and organizational culture, tailor the message so that it is appropriate for the recipient's context. Depending on the message, context, and recipient, the sender could choose appropriate collaborative tools, such as a *Live Meeting* session or engage in a face-to-face brainstorming session.

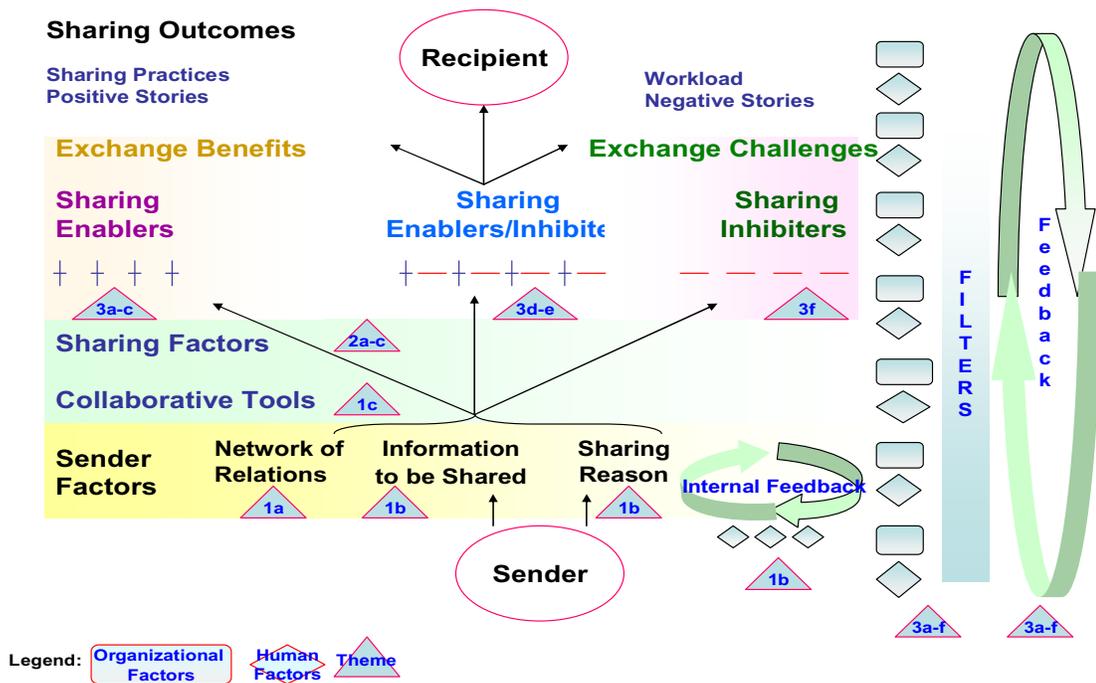


Figure 8. Knowledge sharing cycle.

Conversely, inappropriate choice of communication styles and collaborative tools could inhibit, rather than enable information sharing. For example, face-to-face communication could be an effective knowledge sharing tool, yet be less effective if only a few recipients could see each other. From this sharing cycle, positive sharing enablers, such as impromptu hallway or elevator face-to-face meetings, or information sharing barriers, such as increased workload, emerged. Table 8 contains a mapping of the knowledge sharing cycle components to the identified themes and associated research questions.

Table 8

Mapping the Knowledge Sharing Cycle to the Research Questions

Knowledge Sharing Cycle Components	Theme	Theme is associated with Research Question(s)
Sender Factors	1a Being well connected and perceived as a source for information	1. What are the characteristics of an effective knowledge sharing network? (RQ1)
	1b Building and sustaining informal networks	
Collaborative Tools and Sharing Factors	1c Using multiple communication styles, preferably face-to-face, influences message content and delivery	2. How similar or dissimilar are the knowledge sharing practices being used by senior executives and managers? (RQ2)
	2a Using multiple approaches to shift audience thinking to different perspectives	
	2b Using dense, efficient relationship networks	
Sharing Enablers, Filters, and Feedback	2c Using a diversity of knowledge sharing roles	3. What are the perceived knowledge sharing enablers or inhibitors within the study context? (RQ3)
	3a Using multiple communication styles and collaboration tools influences the message content and informal to/from formal message delivery	
	3b Flexibility, learning, and being reflective	
Sharing Enablers, Filters, and Feedback	3c Centrality and betweenness	3. What are the perceived knowledge sharing enablers or inhibitors within the study context? (RQ3)
	3d Inappropriate awareness of what information should be shared and audience requirements lead to incorrect selection of collaboration tools	
	3e Absence of trust, perceptions, and organizational culture	
	3f Organizational and human barriers, such as lack of time, lack of trust, unclear roles, and too much work	

The following sections contain a description of the key themes associated with this knowledge transfer sharing cycle. Within these sections, the following key network variables will be discussed: (a) sending information to other HSIMT managers was labeled as *Sends Information*, (b) receiving information from other HSIMT managers was labeled as *Receives Information*, (c) proximity to other HSIMT or non-HSIMT managers was labeled as *Proximity*, (d) how long the HSIMT manager had known the identified individual was labeled as *Known*, (e) indicating if more communication with the identified individual was desired was labeled as *More Communication*, (f) indicating if the HSIMT manager worked with the identified individual was labeled as *Works With*, and (g) indicating the HSIMT manager's positional role as compared to the identified individual's positional role was labeled as *Positional Role*.

Research Question 1

The first research question asked: *What are the characteristics of an effective knowledge sharing network?* Findings indicated that having a diverse, well connected, or *dense* network, building and sustaining relationships, and using multiple communication styles, particularly a face-to-face style, were essential for effective knowledge sharing.

Being Well Connected

For any information sharing network, the number of information relationships and level of interconnectivity factor into how fast or slow knowledge is shared, resulting in a sense of *being well connected*. For any network, the extent of possible connections or *ties* influences the rate of knowledge diffusion. As each individual is added to the network, the number of possible connections or *ties* that an individual can support

decreases, as he or she has a limited number of resources that can be used to support the connections (Hanneman & Riddle, 2005; Schultz-Jones, 2007). The network's size can be calculated for all possible individuals less one individual using the formula $k * k - 1$, where each k is the total number of individuals or *nodes* within the network (Hanneman & Riddle, 2005, Chapter 7, Basic Demographics section). For example, for the division's 41 managers, there were $41 * 41 - 1$ or 1,640 possible pairs of information sharing relationships or ties, much larger than what were being used.

To determine the extent of interconnectivity, the density for the managerial network was reviewed. Network influence key indicators that were explored were *density*, the number of connections between individuals or *arcs*, and densities within or between groups. Density was used to determine how fast or slow knowledge could be transferred within the network. For the division, the overall density ranged from 29.59% to 54.90%, indicating that overall, there was moderate connectivity, with 100% representing a completely connected network (Table 9). Relations that had lower overall densities, such as the *Receives Information* and *Sends Information* relations had fewer connections, which may slow knowledge flows across the network.

Closer examination of the sum of the number of arcs in the *Receives Information* or *Sends Information* relations revealed high and low information receivers and senders. Individuals who were potential information sources or more influential within the network had high arc values. Individuals who had sent many connections to others within the network had a high *out-degree* and high arc values, whereas if they received many connections, they had a high *in-degree* and high arc values (Hatala & Fleming,

2007; Hanneman & Riddle, 2005, Chapter 7, Basic Demographics section; Schultz-Jones, 2007).

Table 9

Overall Density

Relation (Binary data)	Density	Density as a Percentage of Existing Ties (100% is a completely interconnected network)	
<i>Receives Information</i>	0.2959	29.59%	Low – fewer connections
<i>Sends Information</i>	0.3160	31.60%	
<i>Proximity</i>	0.5490	54.90%	High – more possible connections
<i>Works With</i>	0.4480	44.80%	
<i>Known</i>	0.5210	52.10%	
<i>Positional Role</i>	0.4640	46.40%	

Conversely, individuals who were potentially isolated from the rest of the network received or sent few connections to/from others thus had low in/out-degree values and low arc values. Individuals 8446 and 6528 appeared to be potential influential information receivers or senders, as they had the highest in-degree and out-degree values (Table 10).

Table 10

Measure of Influence

Relation	Individual (Node)	Average No. of Connections (Mean)	Sum of Connections To/From Others (Arcs)	Notes
<i>Receives</i>	8446	0.560	14	Highest mean – receives from 0.56 or 56% of others
<i>Information</i> [In-degree] ¹	6528	0.524	11	
	2204	0.067	1	
	8131	0.056	1	Low mean – receives from 0.067 or 6.70% of others
<i>Sends</i>	8446	0.636	21	High sender of information
<i>Information</i> [Out-degree] ¹	6528	0.618	21	
	9431	0.462	18	
	1909	0.333	1	Low sender of information

Note.

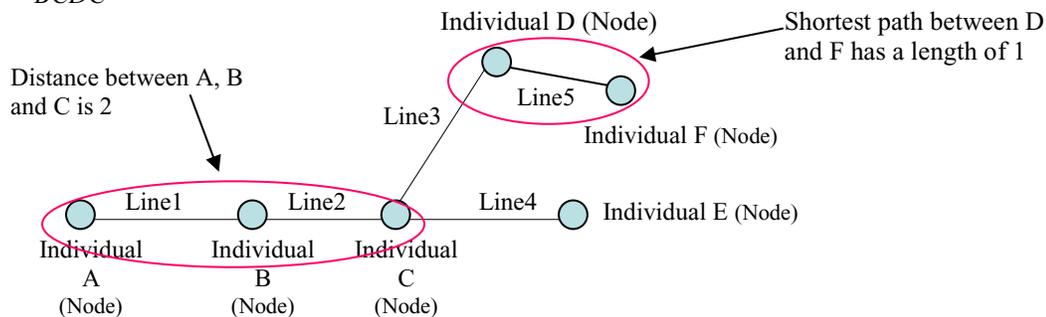
¹ Reflects participants rather than all possible participants to protect participant identities.

For example, Individual 8446 had 0.560 or 56% for receiving information from others, and had the highest percentage (63.60%) for sending information to others. Although the mean values for Individual 6528 were not as high as for Individual 8446, Individual 6528 had the same number of arcs (21) for receiving information as Individual 8446. As interestingly, both individuals were in the same managerial stream. Only Individual 1909 had the fewest arcs (1) when sending information to others, a possible indication of being less influential or isolated. In contrast, Individuals 2204 and 8131 were from different managerial streams had the lowest arc values (1) when receiving information from others. To explore the characteristics of ties between individuals, an analysis of the unique number of individuals and the ties between them or *paths* was explored (Figure 9).

An individual that had few paths to connect to another individual was more influential as fewer steps were involved in the connection. The most efficient path was one that had a length of one, otherwise known as a *geodesic* distance or *geodesic* (Hanneman & Riddle, 2005, Chapter 7, Distance section; Wasserman & Faust, 1994, pp. 106-107). In contrast, the more steps that were required and thus higher geodesic distance values, the less influential the individual, as other individuals were required to reach the intended target individual.

A **Walk** W is a “sequence of adjacent nodes”¹

W is Individual B Line2 Individual C Line3 Individual D Line3 Individual C or
 $W = BCDC$



A **Path** is a walk where “all nodes and all lines are distinct”¹

The **shortest** path between representative nodes is a **geodesic** (e.g., between Individuals A and B there is 1 line, so the geodesic is 1)

“The **distance** between two nodes is the length of any shortest path between them”¹
 (e.g., between Individuals A and C, the distance is 2 as there are 2 lines)

¹ *Social Network Analysis: Methods and Applications* (Wasserman & Faust, 1994, pp. 106-107), UK: Cambridge University Press.

Figure 9. Walks, paths, and geodesic distances.

In the review of geodesic distances, calculations for missing individuals reflected the greatest possible geodesic distances, as the divisional network was incomplete. As a result, many of the geodesic distances were greater than 10, which was unusual for a small network. For the *Receives Information* or *Sends Information* relations, most of the direct connections were less than four, which meant that less than four individuals were needed to transfer information from one point to another (Table 11).

Yet a few individual pairings needed more than 10 steps to reach an individual, an indication of less influence. For example, the individual pair 9965 and 6948 needed 14 steps to connect with each other, whereas the individual pair 8012 and 9287 needed only one step, the most efficient possible within a network. Interestingly, with respect to

receiving information, 13 pairs needed more than 10 steps to connect with each other, whereas for sending information, only 7 pairs needed more than 10 steps, the latter a possible indication of individuals being more connected.

Table 11

Shortest Distance Between Individuals (Geodesic Distance)

Relation	Individual (Node) Pairings	Most Direct Path ¹
<i>Receives Information</i>	9965 and 6948	14 steps (highest value, less efficient)
	9965 and 4434	13 steps
	6528 and 2065, 3461 and 1769, 3461 and 7156, 8131 and 1769, 8131 and 7156, 1559 and 7156, 1559 and 7156, 2885 and 1769, 2885 and 7156	10 steps. Note that two or more of these pairings were in the same managerial stream
	8012 and 9287	1: fewest steps (i.e., efficient)
	6948 and 5601	12 steps (highest value)
<i>Sends Information</i>	6948 and 9965	10 steps
	1769 and 512	2 steps (i.e., efficient)

Note.

¹ Most direct path between individual pairs is known as the geodesic distance.

Although the reviewed geodesic distances were insightful, this analysis did not account for the human factor in that an individual may choose to send information using alternative paths. For example, if an individual only had one path to another, the overall connectivity was weak as there were no alternative paths that could be used. In contrast, an individual with many paths had a higher chance of ensuring that the information was transferred (Hanneman & Riddle, 2005, Chapter 7, Flow section). Alternative paths were explored for the *Receives Information* and *Sends Information* relations, including missing individuals. For the *Receives Information* relation, path length values ranged from 7 through 64, with high values indicating the availability of many alternative paths to a

recipient (Table 12). Four individual pairings across two managerial groups had the highest value of 64 paths and had a missing individual in common (Table 12).

Table 12

Alternative Connection Paths to Support Information Flow

Relation (Binary data)	Alternative Path Value Range	Notes
<i>Receives Information</i>	0 – 64	4 pairings for two managerial streams had the highest number of alternative paths (64), thus very well connected 13 pairs had more than 60 alternative paths, 14 pairs had more than 21 alternative paths, thus well connected
<i>Sends Information</i>	1 – 14	8 pairings had more than 12 alternative paths (i.e., inefficient) 4 pairings had 17.07% of alternative paths to others in the network (i.e., alternative path values of 1, 2 or 3), thus, few choices
<i>Proximity</i>	1 – 15	7 pairings with a missing individual had more than 10 alternative paths. Note that Individuals 9287 and 5601 had a path length of 4 Most pairings had 1 or 2 paths, yet 13 pairs had a path length of 3, thus, not many alternative choices

Overall, 13 pairs of individuals had more than 60 alternative paths to support information distribution. The higher the number of alternative paths, the more options the individual had in using other individuals as information sharing conduits.

Interestingly, there were two groups of individuals with more than 21 alternative paths.

One group with 5 individuals was in the same managerial stream, whereas the other

slightly larger group of 9 individuals was in all managerial streams. For the *Sends*

Information relation, the alternative path values were much lower and had values that

ranged from 1 through 14. The highest three values (i.e., 12 through 14) each contained

pairings with the same missing individual. Four individuals appeared to have few alternative path choices, as they only reported between 1 to 3 alternative paths with 17.07% of the 41 individuals. For the *Proximity* relation, most of the alternative path values ranged between 0 and 2, with 14 individuals having path values of 3, with Individuals 9287 and 5601 having path values of 4. Thus, individuals in the *Proximity* and *Sends Information* relation had fewer alternative path choices or were less connected overall than individuals in the *Receives Information* relation. Given these tendencies, the *Sends Information*, *Receives Information*, *Proximity*, *Known*, and *Positional Role* relations were explored to determine if densities were similar or differed within or between groups. Density values ranged from 0.000 or no within group connections to 1.000 or all individuals being connected (Table 13).

Table 13

Density Within Groups by Managerial Stream

Relation	Within Strategic Stream ¹	Within Business Stream ¹	Within Applied Stream	Notes on Scores Between Streams (e.g., Applied and Strategic)
<i>Receives Information</i>	0.778 or 23 of 30 possible ties	0.248 or 84 of 342 possible ties	0.000	Between applied and strategic streams (0.500, highest value)
<i>Sends Information</i>	0.815 or 24 of 30 possible ties	0.242 or 83 of 342 possible ties	0.000	Between business and strategic streams (0.583, highest value)
<i>Proximity</i>	0.615 or 28 of 30 possible ties	0.343 or 118 of 342 possible ties	0.000	Between strategic and applied streams (1.000, highest), strategic and non-HSIMT managers (0.763), and strategic and nonparticipating HSIMT managers (0.583)

(table continues)

Relation	Within Strategic Stream ¹	Within Business Stream ¹	Within Applied Stream	Notes on Scores Between Streams (e.g., Applied and Strategic)
<i>Works With</i>	0.000	0.000	0.000	Between strategic and external stream (0.797, highest value), business and non-HSIMT managers (0.657), and applied and non-HSIMT managers (0.567)
<i>Known</i>	0.462 or 14 of 30 possible ties	0.600 or 20 of 342 possible ties	0.000	Between strategic and applied (1.000, highest value), and between business and nonparticipating HSIMT managers (0.639)
<i>Positional Role</i>	0.077 or 2 of 30 possible ties	0.114 or 39 of 342 possible ties	0.000	Between strategic and applied (1.000, highest value), and between strategic and business streams (0.727)

Note.

¹ Number of possible ties within managerial stream is based on the number of individuals within the managerial stream n and the formula: $n * (n-1)$. For the strategic managerial stream, $n=13$, thus the number of possible ties is $13 * (13-1) = 13 * 12 = 342$. For the business managerial stream, $n=6$, thus 30 possible ties, and for the applied managerial stream, $n = 3$, thus 6 possible ties. Individual within stream tie calculations is the density * possible ties. Thus, for the *Receives Information* relation, density = 0.778 and the number of possible ties is 30, thus $0.778 * 30 = 23.34$ or 23 possible ties out of 30.

For the *Receives Information* and *Sends Information* relations, densities within a managerial stream were higher than densities between the streams, an indication of more connections to support information flows. For example, for the *Receives Information* relation, a density of 0.778 for 13 individuals within the stream resulted in 23 of 30

possible connections, an indication that individuals within the stream were well connected. Curiously, the density within the applied managerial stream was zero for all of the reviewed streams, an indication that individuals in this stream did not connect with each other. Notably, the densities between some of the managerial streams were higher than those within the managerial streams for a few of the examined relations. For example, for the *Proximity* relation, the density values between the strategic and applied stream (1.000) and the strategic stream and non-HSIMT managers (0.763) was higher than the within group densities, an indication that the connections between the streams was stronger than within the specific streams. The human behaviors and practices that may support these within and between managerial stream findings were explored through in-person or telephone interviews with selected divisional managers. To protect individuals from possible identification, participant quotations have been excerpted and replacement words inserted within square brackets.

Building and Sustaining Informal Networks

From the interviews, several managers expressed the importance of building and sustaining relationship networks. A key aspect of building a relationship network was having a *reason* to establish a connection, such as seeking peer advice, needing to confirm or give information, or learning more about the other person's role. In particular, seeking peer advice was identified as an important component of a manager's knowledge sharing network by 38.88% (7/18) of managers in all three managerial streams:

Experience to share opinions, [or] gut feelings about terms ... or what we think is a good idea without having available to us clearly defined facts. Individual 8012

When you are dealing with peers, you are probably at your most informal.

Individual 8446

[Seek] details to understand and subsequently seek advice. Individual 8761

For other managers, using informal contexts, such as coffee meetings, were used to build and establish relationship networks:

I had to actively go out and seek and set up, you know an hour of coffee session just to chat about what that person did and what we needed to connect on and what I saw as my role in helping them be successful and vice versa. Individual 9287

These examples illustrated that a *trust* element was required as a key part of building and sustaining relationships. Within a trusted relationship, several managers voiced that sharing all appropriate information was an important aspect to maintain commitment and linkages to other shared networks:

Everything that needs to be discussed [is shared]. Individual 3461

It's important to use bridges like intermediaries. If you share all common friends, common coworkers that have to work together in a unit, even if you are not in the same work unit, but logically you are part of the same team or you are working on the same project, you can rely, if you have a good relationship, with those other people. Individual 8084

Having periodic face-to-face, because those kinds of interactions build trust.

Individual 7726

Using Multiple Communication Styles

A common thread throughout the building and sustaining relationship comments was the need for *face-to-face* engagement. Almost one-third of the interviewed managers 27.77% (5/18) within two managerial streams expressed the importance of face-to-face engagement in relationships, especially if the information was complex or hard to share. A key aspect of face-to-face engagement was the immediacy of feedback available to the sender through multiple communication styles, such as visual, verbal, and nonverbal gestures and body language:

Hard-to-share knowledge or information is better done in a face-to-face meeting.

Individual 1276

To build relationships, to exchange ideas or knowledge sharing is best in person as can build trust and more commitment, more obligation when you see [their] eyes, [it is] more humanizing. Individual 9358

In-person - spontaneous interaction and feedback. Individual 2784

Feedback loop built-in to the process, and the more personal it can be, the better.

Individual 5601

Much is said through body language and expressions. Individual 2885

At least three managers voiced the importance of impromptu face-to-face engagements in hallways or being able to stop by another manager's office without a formal appointment:

Share information informally and this can include elevator conversations, hallway conversations, or just popping into someone's office [being] aware of body language and facial expressions. It gives you a better understanding of whether or not the information that you are giving to that individual is actually understood in the way you intended it to be understood. Individual 6528

At least two managers indicated that knowing the context and intended recipient helped frame the message and how it was delivered consistently to the intended recipient. Prior to framing messages, one manager indicated that he or she reflected on the intended message recipient's context and possible outcomes or organizational impacts. Managers within all three managerial streams indicated that they used a clear written style and concise messaging, often using bullets, to frame messages so that the intended recipient could understand the message without a face-to-face interaction. At least two managers indicated that regular team meetings were effective tools for sharing branch activity information. One manager stated that using various engagement practices within meetings was effective for ensuring that the message was interpreted as intended:

For example, at the end of the meetings about the type of information, if there's action items coming from it, have each of the people reiterate what they think their actions are coming out of the meeting or what messages or information that

they have taken out of [the meeting] that [aligns] what you felt your key messages were. Individual 9431

With respect to sustaining relationships, consistency of messaging and taking the time to discuss and hear concerns was cited as an effective approach for sustaining relationships: “I took [them] through the [problem], explained what the [problem] was and I [would] get a far better reception, even though it takes time out of my day” (Individual 3461).

Summary of Findings for Research Question 1

Within the managerial network, short connectivity distances, few constraints, and high densities enabled knowledge to be shared more effectively. Managers who used a variety of communication styles, preferably face-to-face, were more effective in sharing complex knowledge. Through careful framing of message content and choice of message delivery tools, these managers were able to meaningfully engage and sustain connections with their audience. Yet, these results did not indicate if these practices and knowledge sharing characteristics were common across all streams, or concentrated in one or two managerial streams. To explore this aspect, the next section contains a description of the results from examining the similarities or dissimilarities of knowledge sharing practices across the managerial streams.

Research Question 2

The second research question asked: *How similar or dissimilar are the knowledge sharing practices being used by senior executives and managers?* Findings indicated that a few managers used multiple approaches to shift audience thinking to new perspective

(theme 2a) and/or had more efficient sharing networks (theme 2b). Within these different approaches, these managers effectively used a variety of roles, such as liaison, and as a consultant, to share knowledge (theme 2c).

Using Multiple Approaches to Shift Thinking

Exploration of previous themes revealed subtle differences between managerial streams with respect to using multiple knowledge sharing approaches. All three managerial streams identified that information sharing for strategic management required a focused, concise message:

What are the 3 or 4, no more than 3 or 4 highlights, of what we are or why we are communicating [or] what we want accomplished and the time frames that are involved. Individual 7726

Balancing brevity and comprehensiveness. Individual 8446

Balance - make picture simpler or complex - with [the] message ... [To executive] what decision [do] you want made? [excerpted]. To peers [excerpted] "This is how I am thinking - do you agree with this analysis?" Individual 8761

One manager further indicated that shifting the message to a concise format with minimal details enabled the knowledge to be discussed at a "different level" (Individual 9287). Whereas when sharing detailed knowledge with peers, managers often used jargon, terms or metaphors that the sender knew would be understood and would be meaningful to the recipient. At least 33.33% (6/18) of the participants in at least two managerial streams echoed the following comment: "I adjust the vocabulary to the

audience so that when I am working with people within the branch here who understand what the acronyms that we use on a daily basis” (Individual 6528). Being able to adapt and use multiple collaboration methods to consistently deliver messages and receive feedback was identified across all three managerial streams as an important aspect of information sharing exchanges:

Two-way, it probably ends up being the most effective, because the by-product of that imparts some ideas or information that they might otherwise have not been aware of or overlooked or not really understood or thought that they understood, but until they have been asked to have some [input] and actually participate, it’s not apparent that they have understood. Individual 1276

Nonverbal cues and the nonverbal exchange sometimes will make or break the communication that you are relating. Individual 8446

[It is] important to remain flexible. Individual 8084

The value of combining verbal, concise messages and visual methods, including pictures and body language, to convey a complex message was identified as being valuable from two managers in different managerial streams, as identified by the following managers:

[Use] pictures and bullet points with key messages and using language [to convey the complex message in a form]. Individual 8761

Much is said through body language and expressions. Individual 2885

Another manager provided a different, yet insightful perspective on the use of acronyms as “words that are concepts to shorten a conversation” (Individual 1769). Yet at least two managers in the same managerial stream noted that jargon or acronyms could be a potential source for miscommunication and a potential knowledge sharing barrier. As an alternative to using jargon, two managers in different managerial streams indicated that they used humor and metaphors to engage and sustain a meaningful relationship. For example, Manager 8012 illustrated how he or she used the metaphor “roads, bridges, and highways” to explain complex network and system connections to individuals not familiar with specific divisional terminologies and concepts. Another manager in a different managerial stream similarly used humor and language that evoked meaningful, visual images for the intended recipient. In his or her view this approach was used to “emphasize points and or to try to give people some visual reference point, they think it through” (Individual 8446). Two other managers in the same managerial stream suggested that effective use of language, such as through debate, or combined with pictures were effective knowledge sharing mechanisms.

An important precursor to choosing the appropriate language and message delivery mechanisms was in framing the message so that it would be meaningful for the recipient. Individual 8012 noted that by framing the message so that the recipient’s priorities were incorporated increased the level of openness and willingness to engage and resolve issues: “When we start this conversation and if I touch their priorities, they are a lot more receptive to dealing to my issues, rather than me going to them with my priorities” (Individual 8012). Inherent in these examples was the use of active listening

in combination with feedback processes. Collectively, this combination ensured that the recipient understood the message and that this message was meaningfully incorporated into his or her own frame of reference. For three managers in different managerial streams, a written record of actions was used to support face-to-face dialogue:

Communications will begin with an e-mail note or sometimes a phone call, and as that escalates as more details and things start to become evident in the e-mails then, to me, my natural instinct is to say, ok, I now have to have a face-to-face.

Individual 4434

[For] face-to-face communications, [excerpted] and I follow-up with a written confirmation of what is to be communicated. Individual 7726

Implicit in the previous examples was the use of an open, trusted context that enabled different perspectives to be voiced and discussed. Managers in two different managerial streams indicated that having a trusted, open environment that allowed participants to engage and find a different perspective were effective in supporting knowledge sharing:

Let people [put] ideas on the table and find ways to make it ... more positive.

Individual 9287

The best way to deal with [people] is to bring all the [people] in the same room to talk openly and honestly. Individual 8012

I would encourage somebody [excerpted] feeling comfortable to come to me informally and [excerpted] say “Here’s where I am heading” or “Here’s my thinking” or “Here’s some ideas that I have” to transfer that [excerpted] information to me and for me to provide some context or some initial response to that for some knowledge or information I might have that they wouldn’t have which would help them to work it through. Individual 8446

Interestingly, three individuals in different managerial streams identified a more profound understanding of the higher value and future benefits that could accrue from established relationships:

Incidental teaching, we are doing knowledge transfer but at the same time we are doing knowledge imparting as well [You need to] recognize the great value of those people around you. Individual 1769

[You] provide some input or value-add. Individual 1276

Openness, share as much information as possible and sharing ... opinions and using your background and your knowledge to put it all in context, is what really differentiates just a normal information flow with a *valuable* information flow.

[emphasis added] Individual 8084

Inherent within these comments were indications that some managers assumed different knowledge sharing roles based on whether the relationship was within or external to the division. An overall review of densities within and external to a group, such as a managerial stream, were reviewed using the external/internal index or *E-I*

index. The E-I index surfaced network tendencies that indicated if there were more internal or *homophily* relationships as compared to external or *heterophily* relationships (De Jordy & Halgin, 2009). Hanneman and Riddle (2005, Chapter 8, Group External and Group Internal Ties section) state that the E-I index is calculated as “the number of ties of group members to outsiders, subtracts the number of ties to other group members, and divides by the total number of ties.” This calculation is paraphrased and translated into the following formula:

$$\text{External-Internal index} = \frac{\text{number of relations external to the group} - \text{number of relations to other individuals in the group}}{\text{total number of relations}}$$

Note that these calculations only assumed that a tie was present between two individuals and did not account for which individual was the source of the tie. Incorporating density and group sizes into the E-I calculations, the resultant index had a value that ranged between -1.000, the minimum possible number of internal relations, and 1.000, the maximum possible number of external relations. The index was calculated for the overall divisional network that was grouped by managerial stream. For the *Receives Information* relation grouped by managerial stream, detailed E-I calculations are contained in Appendix B and summarized in this section. The number of overall external connections or ties was 0.230 or 23%, slightly higher than the number of internal relations of 0.210 or 21%, that resulted in an E-I index of 0.388 (Table 14). Comparison of the external and internal tie values implied that there were slightly more external connections than internal.

Table 14

External-Internal Relationship Tendencies

Relation	By Grouping	Internal Ties	External Ties	Calculated E-I Index	Notes
<i>Receives Information</i>	Managerial Stream	0.210	0.230*	0.388	More external ties
	Age Category	0.196	0.234*	0.519	More external ties
	Grouped Location	0.283*	0.205	0.421	More internal ties
<i>Sends Information</i>	Managerial Stream	0.273*	0.273*	0.348	No difference
	Age Category	0.289*	0.267	0.420	More internal ties
	Grouped Location	0.369*	0.245	0.384	More internal ties
Permutation Test ¹					
Relation	By Grouping	Re-Scaled E-I Index	Sampling Variability	Recalculated E-I	Notes
<i>Receives Information</i>	Managerial Stream	0.388	0.075	0.332	0.388 within the range of sampling variability (0.332 +/- 0.075 = 0.257 and 0.407)
	Age Category	0.519	0.059	0.148	Recalculated E-I is subject to sampling variability (Result A)
	Grouped Location	0.421	0.060	0.981	Same as for Result A
<i>Sends Information</i>	Managerial Stream	0.348	0.066	0.524	Same as for Result A
	Age Category	0.420	0.053	0.757	Same as for Result A
	Grouped Location	0.262	0.053	0.998	Same as for Result A

Note.

* Highest value for the external or internal density.

¹ Permutation test allowed comparison of the observed values with expected, to determine if the calculated E-I index occurred through sampling error (standard deviation) or by random chance. Refer to Appendix B for further details.

To account for differences in group size and densities, the E-I index was recalculated 5,000 times to determine if the calculated value of 0.388 could be different if the connections were randomly distributed. The permutation results indicated that in a random distribution, the recalculated E-I index of 0.332 that could vary by chance by 0.075, a variability factor known as the standard deviation or sampling variability. This meant that the observed E-I value 0.388 could be expected to occur in a range between the $0.332 - 0.075$ and $0.332 + 0.075$ or between 0.257 and 0.407.

To explore if there were any differences or similarities by age and by location, the E-I index for the *Receives Information* relation was recalculated by age range and by grouped location and used the same number of permutations. The E-I index results for the age ranges were similar to those from the managerial stream, with respect to having slightly more external ties of 0.234 or 23.4% in comparison to the number of internal ties of 0.196 or 19.60%. In contrast, for the grouped location, there were 28.30% or 0.283 internal ties versus 20.50% or 0.205 external. For both the age and grouped locations calculations, the observed E-I indices were within their respective range of expected E-I values that could occur based on sampling variability. This set of calculations for managerial leadership stream or managerial stream, age, and grouped location, including permutation calculations were repeated for the *Sends Information* relation. Interestingly, for the sending information relation by managerial stream, there were no differences in

the number of external and internal ties of 0.273 or 27.30%. Thus the E-I index provided an interesting perspective regarding differences for more external or internal connections based on managerial stream, age range, and by grouped location.

Differences and similarities between managerial attributes, such as years of service and managerial stream, were explored through visual graphs that grouped individuals by their attributes. Figure 10 illustrates the *Receives Information* relation that clusters individuals based on their years of service.

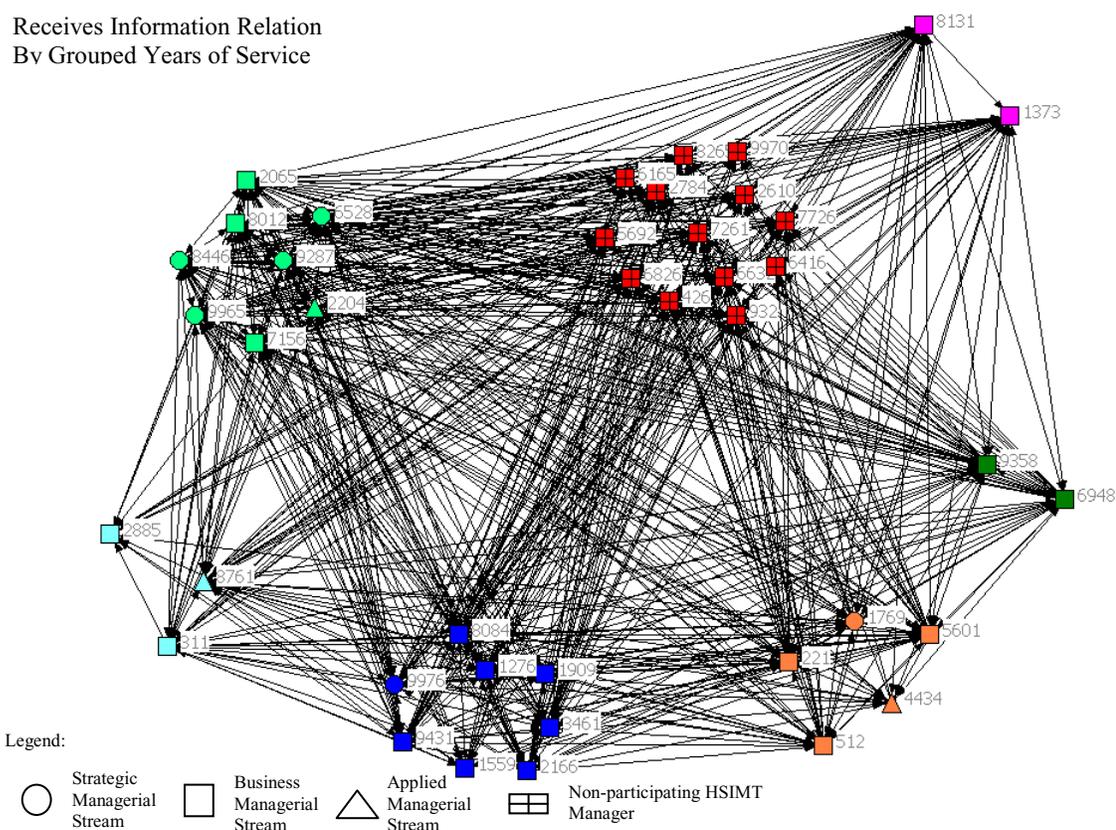


Figure 10. Receives information relation grouped by years of service.

Graphical symbols and colors represent the three managerial streams and nonparticipating HSIMT managers. Analysis included colorization based on the grouped years of service values and symbols based on the managerial stream. To protect

participant identities, graphical identification of the years of service values was suppressed. Except for the nonparticipating HSIMT managers, Figure 10 illustrates six distinct clusters of individuals. Individuals 8131 and 1373, and 9358 and 6948 formed two clusters that had the same grouped years of service value and same managerial stream. Except for the nonparticipating HSIMT managers, the remaining clusters had two or more managerial streams.

This analysis process was repeated for the *Sends Information* relation, with similar results except that the clusters for Individuals 8131, 1373, 9358, and 6948 were closer to each other (Appendix I). For the *Proximity* relation, one group of individuals (311, 9358, 3761, 1373, 8131, and 2885) had three different years of service values across two managerial streams (Figure 11).

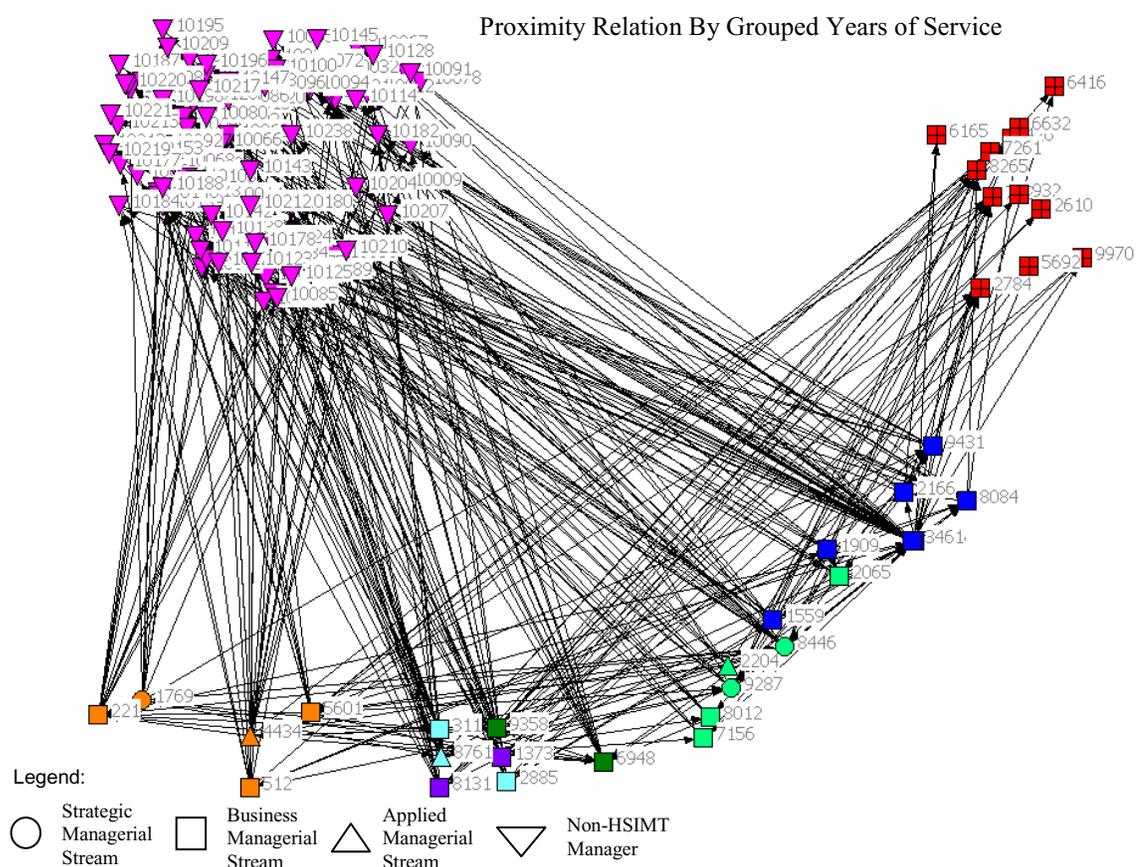


Figure 11. Proximity relation grouped by years of service.

One group had the same years of service value and was in the same managerial group (i.e., Individuals 9431, 2166, 8084, and 3461). Note that nonparticipating HSIMIT managers and non-HSIMIT managers were in separate clusters as clustering information was not available. Clustering analysis for the *Works With* relation revealed that one group of individuals (i.e., Individuals 9976, 6528, 8012, through to 8084 and 9965 or light blue and green colored symbols) appeared to work in different locations (Figure 12).

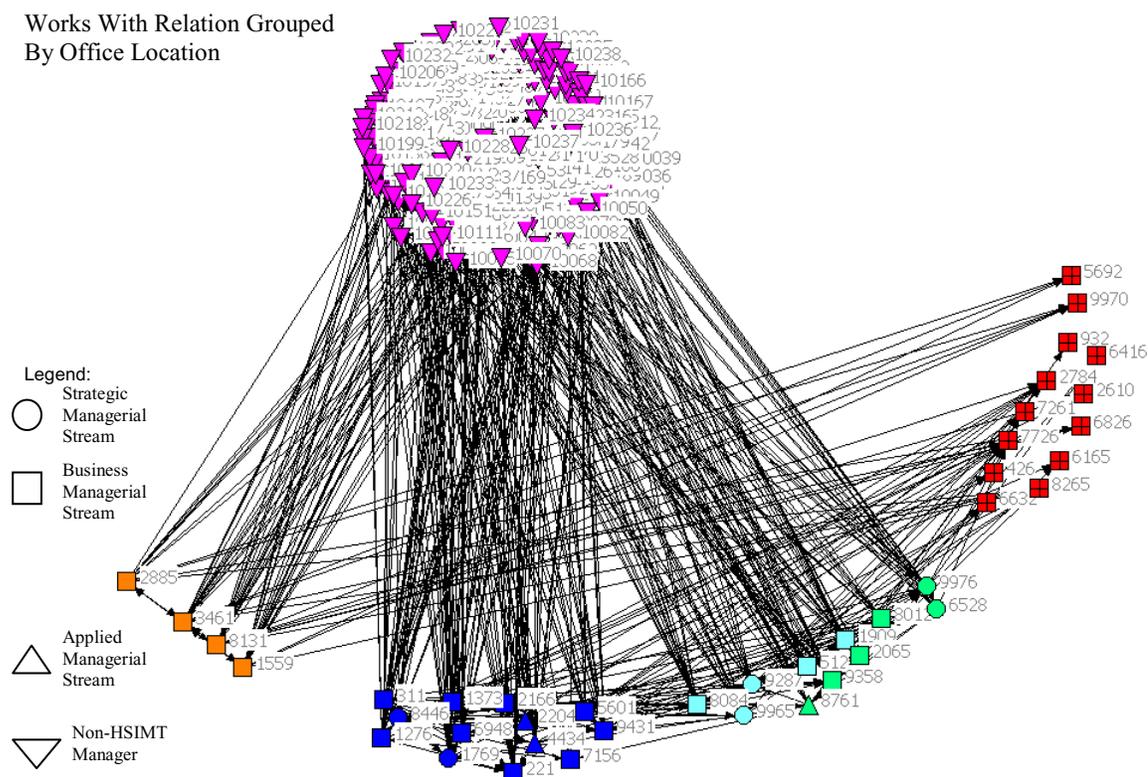


Figure 12. Works with relation grouped by office location.

With respect to the analysis for the *Known* relation, one group of individuals (e.g., the group of Individuals 1276, 1769, through to 5601 and 311 or blue colored symbols) had known each other for the same time period, were at the same grouped location and in all three managerial streams (Figure 13).

Table 15

Strength of Tie Pairings

Relation	Individual (Node) Pairings	Relationship Strength ¹	Additional Details ²
<i>Receives Information</i>	8084 and 1 person	3.000*	Highest value – strong relationship
<i>Sends Information</i>	9965 was paired with 31 other individuals 2065 was paired with 18 other individuals 8012 was paired with 7 other individuals 6528 was paired with 2 other individuals	3.000*	Individuals 9965, 2065, 8012, and 6528 were paired with each other All four individuals were in two of the three managerial streams All but one of the 18 individuals associated with Individual 2065 were also associated with Individual 9965

Note.

* Highest values (from 0.000 to 3.000).

¹ The higher the values for the strength of the relationship pairing, the stronger the relationship.

² The specific pairings have been omitted to protect individual identities.

This result indicated that the *Sends Information* relation contained stronger relationships than the *Receives Information* relation. A stronger relationship value of 3.000 was indicated for Individuals 2065, 9965, 8012, and 6528, that were in two of the three managerial streams. Interestingly, Individual 9665 had the largest number of strong relationship pairings (31), then Individual 2065 (18), Individual 8012 (7), and finally Individual 6528 (2). Comparisons of individuals within these pairings revealed that each of the four individuals was also paired with each other, a potential indicator of influential

individuals. As a point of interest, all but one of the 18 individuals associated with Individual 2065 were also associated with Individual 9965.

An evaluation of the relationship strength revealed that certain managers *may* be more influential or central in sharing knowledge. Centrality was explored through analysis of an individual's or *ego*'s role, such as a broker or liaison between different managerial streams, and possible constraints on his or her influence from other individuals. To understand how efficient an individual was in using his or her secondary contacts to reach others, reach efficiency was calculated as the number of disconnected pairings in the ego's network divided by the number of relationship pairs (Hanneman & Riddle, 2005, Chapter 9, Ego Network Density section). Reach efficiency or *ReachE* could range from an inefficient network (i.e., a ReachE of 0.00) to an efficient network (i.e., a ReachE of 100.00).

An individual's propensity to act as an information broker was calculated based on the individual's network size, number of relationship pairings, and density and then normalized for comparison, with scores ranging from zero to 1.00 (Hanneman & Riddle, 2005, Chapter 9, Ego Network Density section). A zero value indicated minimal brokerage was exercised, whereas a value of 1.00 indicated high levels of brokerage. In viewing the normalized reach efficiency scores for individuals in the *Proximity, Works With, Known, and Positional Role* relations, high ReachE scores, such as for Individuals 9358 and 9207 and 1276, indicated that each individual used many secondary contacts to connect with others (Table 16).

Table 16

Ego Network Overview

Relation (Binary data)	Individual (Ego)	Percent of Possible Ties Present (Density)	Efficiency to Reach Others (ReachE ¹)	Propensity to Act as a Broker (nBroker ²)	Notes
<i>Proximity</i>	9358	2.40	89.02	0.49	Largest ego network (17.00) and highest efficiency (89.02), yet only acted as a broker 0.49 or 49% of the time Highest propensity to act as a broker (0.50 or 50% of the time)
	8084	0.00	74.19	0.50*	
	9287	5.42	89.02	0.47	
	9976	7.14	79.56	0.46	
	8761	3.33	73.77	0.48	
<i>Works With</i>	512	0.00	100.00	0.50*	
	1769	0.00	100.00	0.50*	
	221	0.00	100.00	0.50*	
	9358	0.00	78.95	0.50*	
	4434	0.00	66.67	0.50*	
<i>Known</i>	3461	1.31	7.43	0.49	
	6528	4.49	77.78	0.48	
	311	16.67	70.11	0.42	
<i>Positional Role</i>	3461	0.33	81.25	0.50*	
	1276	0.00	94.74	0.50*	

Note.

* Highest propensity to act as a broker.

¹ Reach efficiency (ReachE) scores are based on how many individuals are within two-steps of the ego divided by the size of the ego's network (Hanneman & Riddle, 2005, Chapter 9, Ego Network Density section).

² Normalized Broker (nBroker) is calculated as the number of pairs of individuals within an individual's ego network that are not directly connected divided by the number of pairs (Hanneman & Riddle, 2005, Chapter 9, Ego Network Density section).

For the *Proximity*, *Works With*, *Known*, and *Positional Role* relations, the highest normalized brokerage scores were 0.50. For the *Proximity* relation, all three managerial streams were represented by individuals who had the largest ego networks. In contrast, only two managerial streams were associated with individuals who had the largest ego networks in the *Works With* relation. Interestingly, for the *Works With* relation, there were no connections or directed ties between individuals within each of the ego networks, yet two managerial streams had the highest reach efficiency scores of 100.00. For the *Known* relation, Individual 6528 had a less dense network than Individual 311, yet both had similar reach efficiency cores.

Brokers and Liaisons: Role Diversity in Knowledge Sharing

Although the ego network analysis provided insights regarding who might be potential knowledge brokers, these insights did not include effects that may constrain or enhance an ego's influence. Constrained brokerage was defined by Gould and Fernandez (as cited in Hanneman & Riddle, 2005, Chapter 9, Brokerage section) as a means to determine how an ego's relations could constrain his or her brokerage influence. In contrast, an ego's influence could be enhanced if his or her connections had few alternative connections between groups, a concept otherwise known as *structural holes* that was proposed by Burt (1992). Brokerage is needed when individuals are not directly connected and need a common individual to enable knowledge sharing between groups.

Five types of constrained brokerage roles were examined for the receiving and sending information relations and the proximity relations: (a) coordinator, (b) gatekeeper, (c) representative, (d) consultant, and (e) liaison (Table 17).

Table 17

What Types of Brokerage Roles Were Used?

Relation ¹ (Binary data)	Individual (Node)	Coordinator ²	Gatekeeper ²	Representative ²	Consultant ²	Liaison ²	Manager Stream ³
<i>Receives Information</i>	8446	9	29	48	39	56	Stream A
	6528	1	20	20	23	43	
	221	37	19	38	1	11	Stream B
<i>Sends Information</i>	9431	28	16	60	3	15	
	9431	20	23	41	25	23	Stream B
	8446	3	37	19	43	77	Stream A
<i>Proximity</i>	6528	18	27	26	8	26	
	9976	2	4	21	0	24	Stream A
	9287	0	6	11	1	35	
	9358	0	2	13	1	27	Stream B
	8761	0	0	0	8	30	Stream C

Note.

¹ Un-normalized or raw scores from the binary data. Brokerage calculations assumed that each relation had a weighting factor of 1.0, versus being based on the number of relations attached to the ego (Hanneman & Riddle, 2005, Chapter 9, Brokerage section). Low brokerage values indicated less role functionality as a broker, whereas higher values, such as greater than 30.00, indicated higher brokerage functionality.

² Brokerage roles:

<i>Coordinator</i> : information sender, broker, and receiver are in the <i>same</i> group	Group A $\xrightarrow{\text{sends to}}$ Broker in Group A $\xrightarrow{\text{sends to}}$ Group A
<i>Gatekeeper</i> : the information sender is in a different group than the broker	Group B $\xrightarrow{\text{sends to}}$ Broker in Group A $\xrightarrow{\text{sends to}}$ Group A

(table continues)

<i>Representative</i> : the information receiver is in a different group than the broker	Group A $\xrightarrow{\text{sends to}}$ Broker in Group A $\xrightarrow{\text{sends to}}$ Group B
<i>Consultant</i> : the broker is in a different group than the information sender and receiver	Group B $\xrightarrow{\text{sends to}}$ Broker in Group A $\xrightarrow{\text{sends to}}$ Group B
<i>Liaison</i> : the information sender, broker, and receiver are in different groups	Group B $\xrightarrow{\text{sends to}}$ Broker in Group A $\xrightarrow{\text{sends to}}$ Group C

³ Specific managerial streams have been de-identified to protect the identity of participants.

Of the five roles, the coordinator brokerage role was the only role where the broker and information sender and receivers were in the same group. For these constrained brokerage calculations, all relations had the same weighting factor of 1.00, rather than using a proportional factor, as only an exploration of the ego's brokerage network, rather than group relations, was required. Brokerage values near zero indicated low brokerage role functionality, whereas higher values, such as those greater than 30, indicated higher levels of brokerage role functionality. In the *Receives Information* relation, Individuals 8446 and 6528 had high scores for four of the brokerage roles, except for the coordinator role.

In contrast, Individuals 221 and 9431 had high brokerage scores in the coordinator and representative roles, and low scores in the consultant role between groups. In the *Sends Information* relation, Individual 9431 had a high representative role score for sending information from the same group to other groups, and lower yet similar scores for the remaining roles. In contrast, Individual 8446 had very high brokerage scores as a liaison between disparate groups. In the *Proximity* relation, two individuals in the same managerial stream had high liaison scores in contrast to Individuals 9358 and

8761 who were in different managerial streams. As interestingly, for Individuals 9976, 9287, 9358, and 8761 in the *Proximity* relation, there was at least one brokerage role that they did not perform. One manager summarized the importance of divisional knowledge brokers as being filters as well as bridges between different managerial streams:

Knowledge broker between the detail of the organization, the filter to keep enough knowledge of it, so that you are able to kind of keep your head above water, but then be that filtering system that takes that kind of more detailed knowledge, packages it into things that are digestible and understandable, be the kind of knowledge broker upward, that you can provide it in bite-sized or clear enough chunks that the senior executive decision makers can get what they need and not be mired in the detail to be able to make the kind of harder decisions that they have to make. Individual 8446

A contrasting view of brokerage influence was explored by reviewing how many of the broker's relations had alternative sources that they could use instead of using the broker. The absence of such alternative relations indicated a hole within the network structure, otherwise known as a *structural hole*, which could be exploited to the broker's advantage (Burt, 1992). For example, if ego A had connections with persons or *alters* B and C, and B and C did not connect with each other, ego A was in a more influential brokerage role. Instead, if persons B and C were mutually connected, ego A's influence was weaker over persons B and C, as the latter individuals or alters had alternative connections (Burt, 1992; Hanneman & Riddle, 2005, Chapter 9, Structural Holes section). Structural hole calculations were performed on binary relations, as only the

existence, rather than extent, of a relation was required. For these calculations, network *efficiency* was based on the ego having the fewest number of redundant alter connections, whereas network *effectiveness* was where the ego was more efficient in using resources to support his or her relationships (Hanneman & Riddle, 2005, Chapter 9, Structural Holes section). Although all managerial streams were present in the calculations, only two managerial streams were represented in Table 18 to protect participant identities.

Table 18

Relationship Constraints and Alternative Connections (Structural Holes)

Relation (Binary data)	Individual (Node)	Size of Ego's Network (Degree)	Effective Size of Ego's Network (Effective Size) ²	Percent of NonRedundant Ties (Network Efficiency) ³	Extent to Which Others Constrain Ego (Ego Constraint) ⁴	Extent to Which One Person is the Constraint (Hierarchy) ⁵
<i>Receives Information</i> ¹	8446	23.000	16.571	0.720 (72%)	0.176	0.106
	9431	22.000	16.950	0.770	0.178	0.135
	6528	19.000	12.741	0.671	0.204 (high)	0.076 (low)
	221	19.000	13.339	0.702	0.203	0.085
<i>Sends Information</i> ¹	8446	27.000	18.986	0.703	0.146	0.083
	9431	26.000	18.726	0.720	0.167	0.141
	1373	20.000	14.762	0.738	0.198 (high)	0.162 (high)
<i>Proximity</i>	9287	18.000	16.075	0.893	0.184	0.248
	9976	18.000	15.632	0.868	0.243 (high)	0.381 (high)
	9358	18.000	17.250	0.958	0.102	0.151
<i>Works With</i>	512	13.000	13.000	1.000	0.077 (low)	0.000 (low)
	1769	13.000	13.000	1.000	0.077	0.000
	221	13.000	13.000	1.000	0.077	0.000

(table continues)

Relation (Binary data)	Individual (Node)	Size of Ego's Network (Degree)	Effective Size of Ego's Network (Effective Size) ²	Percent of NonRedundant Ties (Network Efficiency) ³	Extent to Which Others Constrain Ego (Ego Constraint) ⁴	Extent to Which One Person is the Constraint (Hierarchy) ⁵
<i>Known</i>	221	19.000	18.553	0.976	0.079	0.066
	3461	19.000	18.000	0.947	0.109	0.170
	6948	19.000	17.136	0.902	0.155	(high) 0.196
<i>Positional Role</i>	3461	18.000	17.889	0.994	0.063 (low)	0.017 (low)

Note.

¹ To protect the identities of nonparticipants, relational results reflect individuals who participated, rather than all possible divisional managers.

² An ego's network may contain redundant ties that may constrain the ego's influence. Calculation of the ego's network without these redundancies provides a more accurate representation of the network size.

³ Within the efficient network, the percentage of nonredundant ties indicates the level of efficiency. Higher efficiency percentages, such as greater than 70%, indicate that the network is more efficient for sharing information.

⁴ High values for ego constraint indicate that the ego's influence is constrained, as individuals within the network are connected with each other.

⁵ Hierarchy indicates the extent to which the ego constraint is concentrated in one person. High values indicate that one person in the ego's network is the potential constraint source.

For the *Receives Information* and *Sends Information* relations, Individuals 8446 and 9431 had effective networks as their percentage scores were greater than 0.70 or 70%. Interestingly, in the *Receives Information* relation, Individual 221 had a smaller effective network (13.339), yet had a high level of efficiency of 0.702 or 70.20%. For the *Sends Information* relation, Individual 1373 had a smaller effective network yet, was more efficient. As interesting were the high network efficiencies that were over 0.85 or 85% for several individuals, such as Individuals 9287, 9976, and 9358, which indicated that these individuals efficiently used resources to sustain their networks.

Although networks may be efficient and effective, an ego's influence may be constrained if one or more individuals in the network were connected with each other. High constraint values, such as for Individual 6528 in the *Receives Information* relation (0.204), and Individual 1373 (0.198) in the *Sends Information* relation indicated that their influence was constrained by their neighbors or alters. Interestingly, Individual 6528 was less constrained by any one individual, as indicated by the low hierarchical or hierarchy constraint value (0.076). In contrast, in the *Proximity* relation, Individual 9976 had a high hierarchical constraint of 0.381, which indicated that the constraints were from one individual, rather than many individuals. As interestingly, in the *Works With* relation, individuals, such as 512 or 1769, did not appear to be constrained by any individual, as the hierarchy constraint was 0.00. From this analysis, several individuals who appeared to be central within the network were more closely reviewed.

Initially, the specific networks or *ego networks* were reviewed for Individuals 8446, 6528, 8012, 9431, and 9965 (Figures 14 through 16). Of these individuals,

Individual 6528 (Figure 14) appeared to have the densest network for his or her neighbors that could reach Individual 6528 in one step as compared to less dense neighborhoods for another individual, such as 9965 (Figure 14). Although the one step networks for Individuals 6528 and 9965 appeared to be similar, Individual 9965 had four additional individuals (1559, 9970, 5692, and 2885) as information sources. Network similarity for Individuals 6528 and 9965 extended to them being in same managerial stream.

Appendix I contains the visual ego networks for Individuals 8012, 8446, and 9431. Comparison of the ego networks for these six individuals at distances of two through six steps away from the ego provided interesting contrasts. For example, as the number of steps away from the ego increased, there were fewer individuals in the ego's network.

The most visual changes occurred between one and two steps from the ego. For example, Individual 6528 had 9 neighbors in his or her two step network, as compared to 7 neighbors for the other reviewed networks (Figure 15). Interestingly, one neighbor, 1559, appeared in all five of the reviewed two step networks.

Two Steps To or From Ego 6528

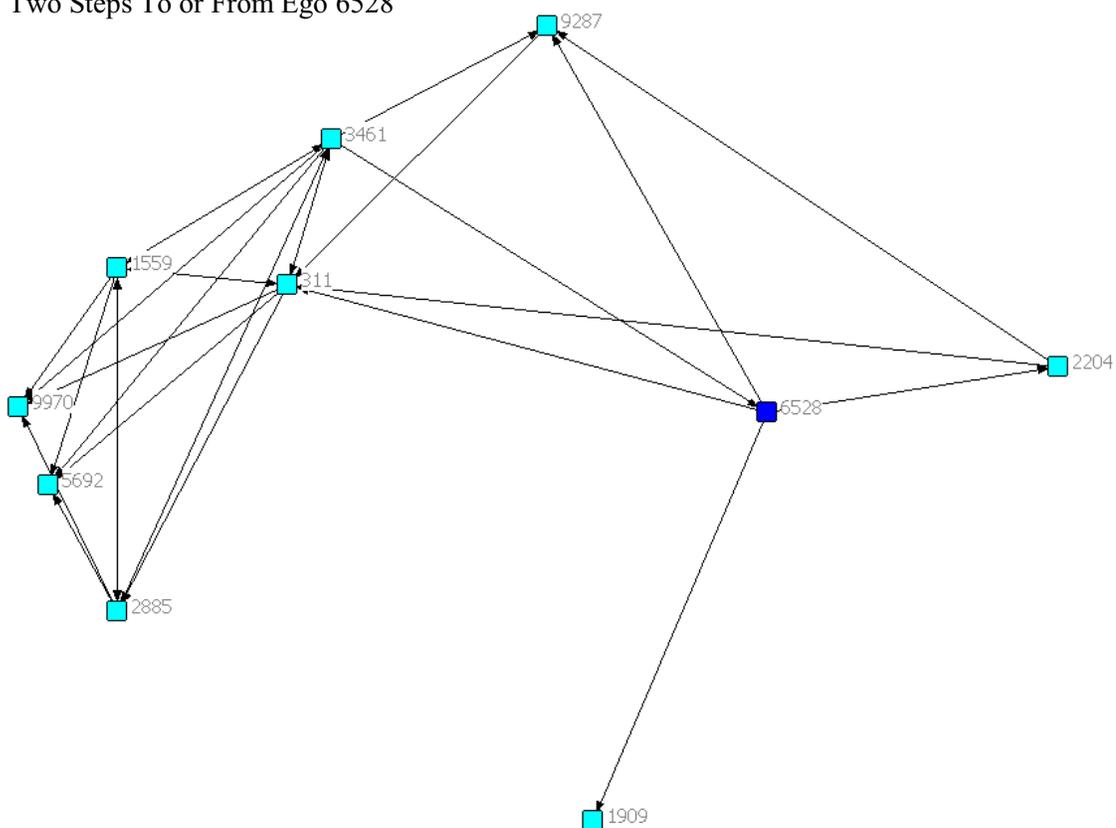


Figure 15. Two step ego network for individual 6528.

Two step networks for Individuals 9431 and 9965 (Figure 16) were identical with respect to the number of neighbors. Both the individuals and neighbors were in different managerial streams and different locations. Interestingly, six Individuals 4434, 1909, 9287, 3461, 311, and 2885 (Appendix I) appeared in 80% of the reviewed two step networks, suggesting a high degree of commonality.

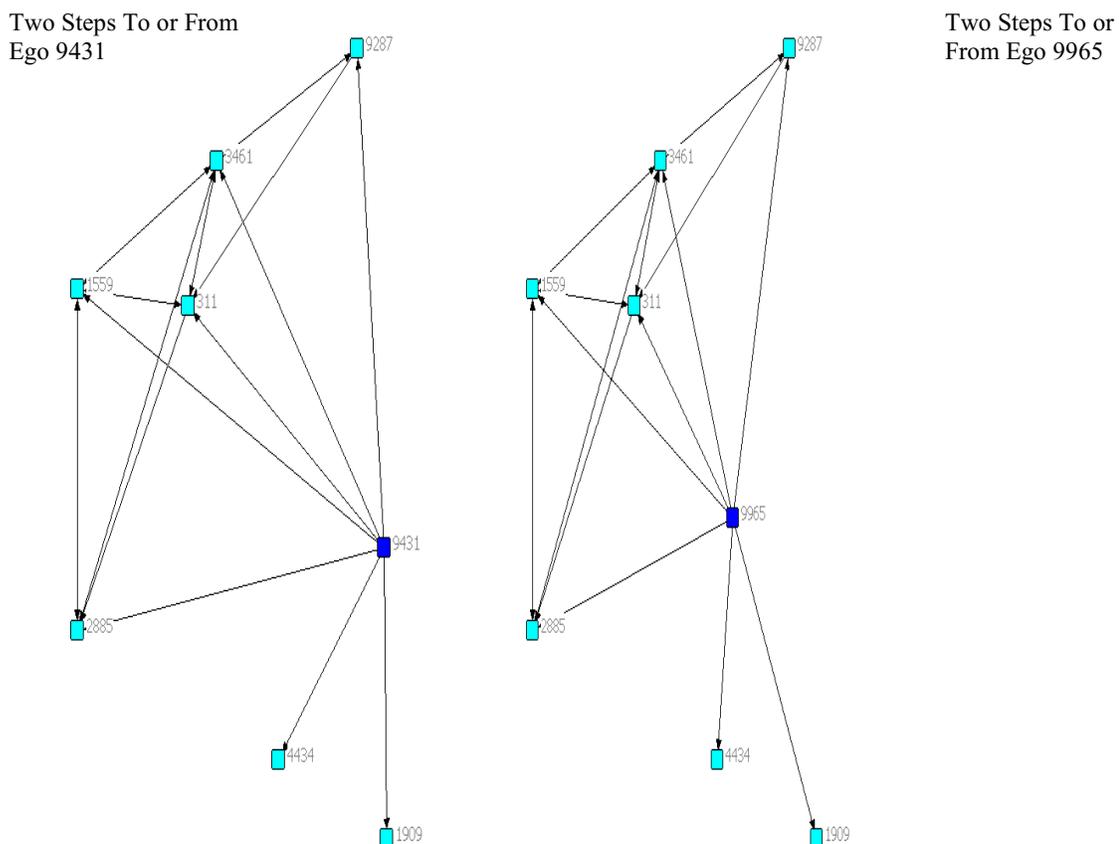


Figure 16. Two step ego networks for individuals 9431 and 9965.

Selecting individuals (egos) and their networks for the *Receives Information* and *Sends Information* Relations provided interesting insights (Table 19).

Table 19

Information Sharing By Managerial Stream and Years of Service

<i>Receives Information Relation</i>	<i>Sends Information Relation</i>	No. of Individuals ¹	Managerial Stream(s) ²	Years of Service
90.00 to 100.00%	90.00 to 100.00%	6	A, B, C	10 to 25 years
		1	B	Less than 10 years
		1	B	Greater than 25 years
80.00 to 89.99%	80.00 to 89.99%	2	B	10 to 25 years
		2	B	Greater than 25 years

(table continues)

<i>Receives Information Relation</i>	<i>Sends Information Relation</i>	No. of Individuals ¹	Managerial Stream(s) ²	Years of Service
90.00 to 100.00%	80.00 to 89.99%	1	A	10 to 25 years
80.00 to 89.99%	90.00 to 100.00%	1	A	Greater than 25 years
		1	B	Less than 10 years
90.00 to 100.00%	50.00 to 59.99%	1	B	10 to 25 years
		1	B	Less than 10 years
0.00 to 39.99%	0.00 to 39.99%	2	B	10 to 25 years

Note.

¹ Not all individuals identified.

² Managerial stream name withheld to protect participant identities.

A small number of individuals (14.63% or 6/41) in all managerial streams appeared to be high senders and receivers (i.e., 90.00 to 100.00%) of information to all others in the network. These six individuals had moderate government experience between 10 and 25 years. Interestingly, two additional individuals in the same managerial stream were also high senders and receivers of information, yet one had less than 10 years of government service, whereas the other one had more than 25 years of service. A smaller group of individuals in the same managerial stream received or sent information to slightly fewer individuals (i.e., 80.00 to 89.99%). Both of these individuals had been in government from 10 to 25 years. In contrast, two individuals in the same stream appeared to receive or send to few individuals (i.e., 0.00 to 39.99%). Between these extremes, several individuals appeared to favor being a sender or receiver of information. For example, two individuals in the same managerial stream were high information receivers (i.e., 90.00 to 100.00%) yet were low in sending information to

others (i.e., 50.00 to 59.99%). Both individuals had a low to moderate experience in government (i.e., from less than 10 years to between 10 and 25 years of experience).

The previously discussed ego networks were examined to determine if certain individuals connected with more HSIMT managers or other non-HSIMT managers, which could include HSIMT or ministry staff, friends, family, or colleagues. Two groups of individuals (groups A and B) had the same or more external linkages with non-HSIMT managers than they did with other HSIMT managers (Table 20).

Table 20

Information Sharing to HSIMT Managers and Non-HSIMT Managers

Group	No. of Individuals ¹	No. of Non-HSIMT Managers (Externals)	No. of Other HSIMT Managers	Notes ²
A	5	13 to 16	4 to 8	Managerial stream B 1 individual has less than 10 years of service
B	6	10 to 12	6 to 10	Managerial streams A, B, and C 2 individuals have the same number of non-HSIMT and HSIMT managers 2 individuals had less than 10 years of service
C	8	Less than 5 to 9	Less than 7 to 16	Managerial streams A and B

Note.

¹ Not all individuals identified.

² Managerial stream name withheld to protect participant identities.

Interestingly, individuals in group A who were in the same managerial stream, had very few connections (i.e., 4 to 8) with other HSIMT managers, yet had the highest number of connections with non-HSIMT managers (i.e., 13 to 16). Three individuals in group B had the same number of connections to HSIMT and non-HSIMT managers, whereas two individuals in group C had fewer than 7 connections with HSIMT and non-HSIMT managers.

Summary of Findings for Research Question 2

Managers who used multiple communication styles and tools and a variety of knowledge sharing had higher centrality and network density scores. Through having efficient connections with others with few constraints also supported the notion that these individuals were central to divisional knowledge sharing. Not surprisingly, several managers in all managerial streams recognized the efficiency of using face-to-face communication to share complex knowledge. Initially, many of these communication approaches appeared beneficial, yet it was not clear if there were contexts where these approaches could be potential knowledge sharing barriers, an exploration conducted as part of the third research question.

Research Question 3

The third research question asked: *What are the perceived knowledge sharing enablers or inhibitors within the study context?* Findings indicated that face-to-face knowledge sharing, using diverse communication styles with appropriate terminology were effective knowledge sharing practices. Yet, influences, such as proximity, level of trust, or inappropriate use of terminology could collectively support or inhibit knowledge

sharing. More subtly, organizational structures, such as a lack of role clarity or clearly defined responsibilities could lead to over reliance on collaborative tools and consequently information overload. For some managers, this abundance of information in combination with too many activities was cited as key knowledge sharing barriers. Detailed findings for the identified themes (3a through f) and knowledge sharing enablers, enablers or inhibitors, and inhibitors are contained in this section.

Knowledge Sharing Enablers – Face-to-face, Flexibility, and Openness

Across all three managerial streams, using multiple communication styles, collaboration tools, and having effective feedback mechanisms were perceived to be critical for effective knowledge sharing. One-third (33.33% or 6/18) of interviewed participants identified that face-to-face communication was the preferred communication style. As important was the requirement for immediacy of feedback through visual, verbal, and nonverbal mechanisms, such as body language or gestures. Although several managers indicated the importance of gestures as a feedback mechanism, one manager indicated that this same mechanism was used by his or her staff to initiate knowledge exchanges: “My staff notice when I am having a bad day and I am not communicating” (Individual 9287). Feedback immediacy enabled the message sender to determine if his or her choice of words, message construction, and delivery mechanisms were conveying a meaningful message to the recipient. Being able to recognize and adapt these communication choices based on audience need was critical in sharing knowledge:

So I have to remind myself on a regular basis that communicating verbally is excellent for some, and communicating by e-mail is perfect for others. Individual 7726

... information transfer and knowledge transfer has to be sensitive to the audience, and the context and be sensitive to the multiplicity of communication that is happening. Individual 8446

Always must be cognizant of audience and use clear, simple language so that there are no misunderstandings. Individual 9358

Choice of when to use a particular communication style differed between managers. For one manager, e-mail was an effective mechanism for initiating the engagement process that escalated from a textual one-way exchange through to a verbal exchange and then face-to-face engagement as knowledge complexity increased. Whereas for another manager, a one-way exchange, such as through e-mail, often followed a face-to-face engagement. Yet in both examples, face-to-face was identified as a key exchange component. For other managers, appropriate choice of communication styles included the careful selection of linguistic tools. Using humor, metaphors, stories, or techniques that resulted in meaningful visual and verbal imagery were cited by several managers as being effective sharing mechanisms:

You know there's no [excerpted] stupid idea ... let's just put things out on the table and then sometimes its useful to kind of use a humorous example or use some kind of an example that all of a sudden somebody goes "Ahhh yeah! That

makes sense to me!” and then I find that the little bit of time that you might invest in that will actually make you focus better, because people get on the same page.

Individual 8446

... Evolving language, sometimes you will just come up with something, you will be talking with somebody, and the two of you will just think “Oh my gosh that means X!” Discuss something and that “X” becomes a phrase that you have heard me talk about “I’m a simple country nurse.” ... what I meant by that was very simply “Everything that I [do] should be done to help a nurse who is isolated [and] caring for a patient in a very different setting”. Individual 1769

For example, one would be the ENG [eHealth Network Gateway], while those of us that know ... and it is the network with which all of our health systems will talk over and communicate with, that part they get, but when I am talking to external people, what I’ll say is “These are the roads, bridges and highways which will transport all of our information.” And then the laypeople get that. Individual 8012

If face-to-face communication could not be used, verbal exchange accompanied by visual and/or textual materials was the next most preferred communication style. One manager, Individual 9358 stated that the “phone environment is next best thing to [being] in-person.” Single function communication styles, such as only using e-mail or divisional newsletters, were identified as one-way exchange mechanisms that were not

effective for sharing detailed or complex knowledge. Flexibility and being open to learn or adapt one's communication approach was identified as a critical knowledge sharing factor. Approximately one-third (27.77% or 5/18) of the interviewed managers indicated that they could envision themselves in the recipient's role prior to development of their knowledge sharing strategy:

You try to put yourself in their shoes and what are the needs what are the specific information pieces that they would need to make a decision or to confirm direction. Individual 8446

I really try to draw on the aspects of what would I feel like if I didn't know.
Individual 7726

So you just have to ensure that it aligns with the level of discussion you are having ... try not to get into too many details [excerpted] ... you take the conversation to a different level. Individual 9287

Information is only information if it is in context ... leverage it ... into knowledge ... a sequence of wisdom that you are trying to find possibilities of what you have.
Individual 1769

One manager aptly stated that he or she approached each exchange as an opportunity to fully listen to the recipient without prejudgment: "Every interaction [is] as [if it were the] first with [that] person and listen fully" (Individual 1769). Flexibility with respect to the engagement process was deemed to be an important factor in knowledge

sharing. Having the opportunity for hallway or drop-in office sessions was found to be valuable for approximately one-third (27.78% or 5/18) of the interviewed managers. The value of this impromptu exchange was aptly identified by several managers, who had comments similar to the following: “[You can] share information informally and this can include elevator conversations, hallway conversations, or just popping into someone’s office” (Individual 6528).

The informal coffee talk meetings with the divisional executive and/or ministry executive were identified as effective engagement practices by 27.78% (5/18) of the participants. Most of the archival newsletters (80% or 4/6) reiterated the use of coffee talk sessions as an informal way to connect with divisional management and staff. More formal exchange opportunities, such as through branch or unit meetings, were identified by at least three managers in different managerial streams as being effective sharing practices:

Every manager should have fairly frequent one-on-one [meetings] as well as [excerpted] something specific that they want that person to get an update on [or] how things are going, status reports, or other types of [items]. Individual 9431

At least three managers in two managerial streams voiced that effective meeting facilitation practices were important factors for sustaining the exchange process. For example, designing meeting materials to be clearly understood and distributing these materials in a timely manner prior to the meeting were critical engagement factors. Sustaining the engagement process during the meeting was accomplished by the

facilitator who ensured that all participants had opportunities to meaningfully participate in the exchange process:

Knowledge transfer is much more effective if you are actually well-prepared and have your information that you want to get across laid out efficiently, short as possible, [and] emphasizing the key messages that you want to get feedback on [and] acknowledge when they have been received and understood. Individual 9431

The importance of effective meetings and the ramifications from inefficient sessions were identified in one divisional newsletter. Approximately one-quarter (22.22% or 4/18) of the interviewed managers stated that the success of the knowledge sharing exchange was being able to present clear, concise messages using the right language for the intended audience:

Always must be cognizant of audience and use clear, simple language so that there are no misunderstandings. Individual 9358

I have adapted the style of the written communication and I adapt the style to the audience that it is going to. Individual 6528

Centrality and Betweenness as Enablers

Woven throughout participant comments regarding effective exchange practices was the notion of an individual's location or centrality within the network structure. Centrality consists of three key measures: (a) degree, (b) closeness, and (c) betweenness. Individuals who tend to be more influential usually have more connections or a higher

degree within the network (Hanneman & Riddle, 2005, Chapter 10, Centrality and Power section). High values of sending information or *out-degree* indicate that the individual was more influential within the network as compared with the optimal location in a perfect or *star* shaped network structure (Figure 17). For the identified relations, only centrality and betweenness were explored, as the relations were not symmetric. Values ranged from zero to 21.000, depending on the specific relation. Note that some results were suppressed to protect the identity of individuals.

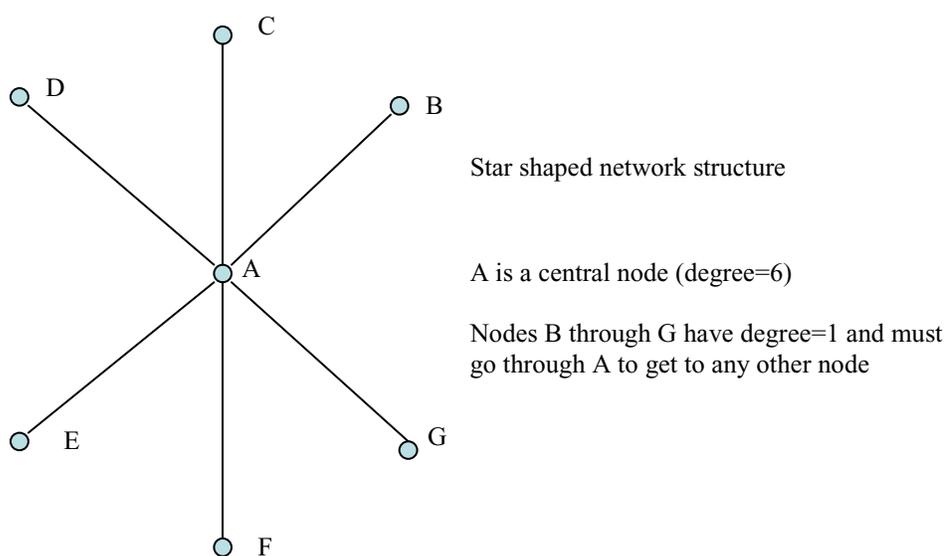


Figure 17. Optimal star network structure.

For the *Receives Information* and *Sends Information* relations, individual 8446 appeared to be central within the relation, as he or she had the highest number of connections for in-degree (21.000) and out-degree (14.000; Table 21). For the *Receives Information*, *Sends Information*, and *Proximity* relations, individuals who had the highest out-degrees were in the same managerial stream, whereas for the *Works With* relation, individuals in two managerial streams had the highest out-degrees. Curiously, there were

more individuals in all four relations that had out-degrees greater than 10.000 than for receiving information, an indication that there were more influential information sources than information receivers.

Table 21

Who Appears To Be Central? (Centrality)

Relation ¹ (Binary data)	For Individual(s) Sending Information (Out-degree) ²	For Individual(s) Receiving Information (In- degree) ²	Notes
<i>Receives Information</i>	8446 and 9431: 21.000 (highest)	8446: 14.000 (highest)	No. of individuals with values greater than 10.000: 10 (out-degree), 8 (in-degree)
<i>Sends Information</i>	8446 and 6528: 21.000 (highest)	8446: 14.000 (highest) 9431: 11.000 1276: 10.000	No. of individuals with values greater than 10.000: 11 (out-degree), 8 (in-degree)
<i>Proximity</i>	9358 and 8084: 17.000 (highest)	8446 and 8265: 5.000 (highest)	No. of individuals with values greater than 10.000: 13 (out-degree), 1 (in-degree)
<i>Works With</i>	221, 512 and 1769: 13.000 (highest)	0.00	No. of individuals with values greater than 10.000: 10 (out-degree), 0 (in-degree)
<i>Known</i>	3461: 18.000 (highest) 6948: 16.000	6528: 8.000 (highest) 6948: 6.000	No. of individuals with values greater than 10.000: 11 (out-degree), 0 (in-degree)
<i>Positional Role</i>	3461: 18.000 (highest) 1276: 15.000	6948: 5.000 (highest) 8761: 3.000	No. of individuals with values greater than 10.000: 6 (out-degree); 0 (in-degree) – most were 1.000 or 2.000; 1 with 5.000

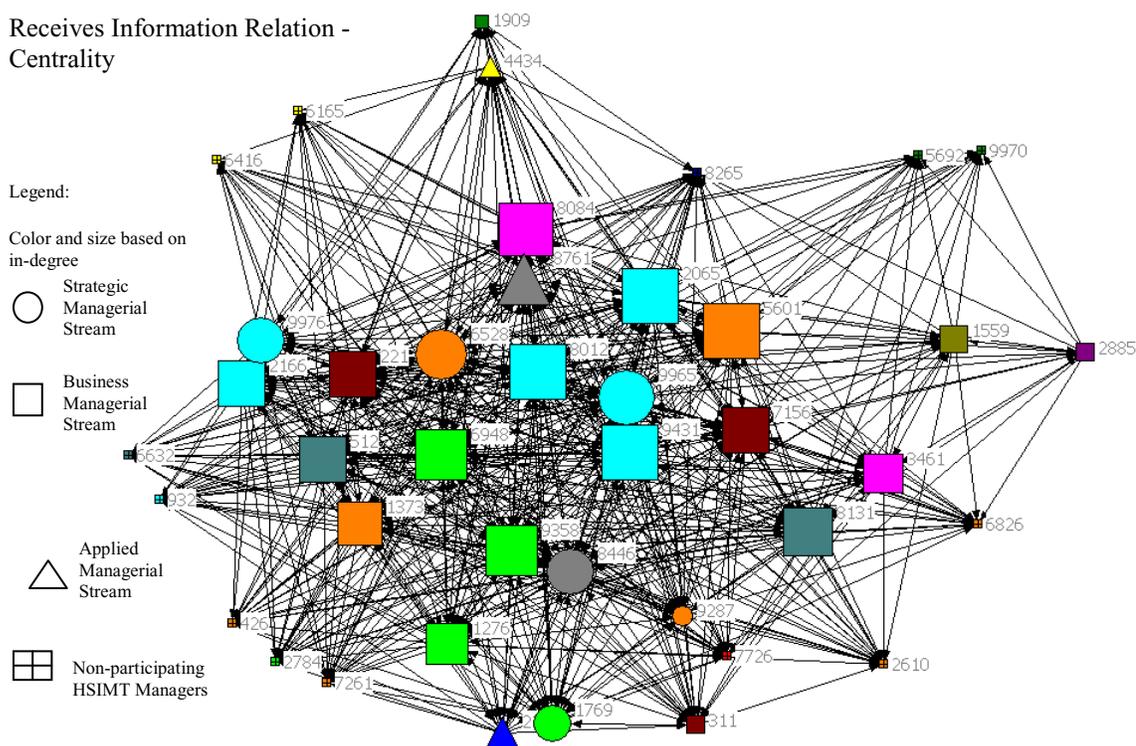
Note.

¹ Binary data and results were for individuals who participated. For each relation, in-out degree values ranged from 0.000 to the stated highest stated value.

² High sending information (out-degree) indicates individuals who are potentially influential information sources. High receivers of information (in-degree) indicate individuals who are potentially knowledgeable across a broad topic area.

Visual review of the centrality measures for the *Receives Information* and *Sends Information* relations supports these findings. For example, Figure 18 indicates that Individuals 8446 and 8265 appeared to be high receivers of information. Similar colors for individuals, such as grey for Individuals 8446 and 8761, indicate similar in-degree values. For the *Sends Information* relation, Individuals 8446, 6528, and 9431 appeared to be central (Figure 18). Interestingly, for both of these relations, Individuals 221 and 512 appeared to receive different numbers of connections (as noted by the dark red and teal colors in Figure 18's *Receives Information* relation) yet send similar numbers of connections (as noted by both individuals having the same gray color in Figure 18's *Sends Information* relation).

Receives Information Relation -
Centrality



Sends Information Relation -
Centrality

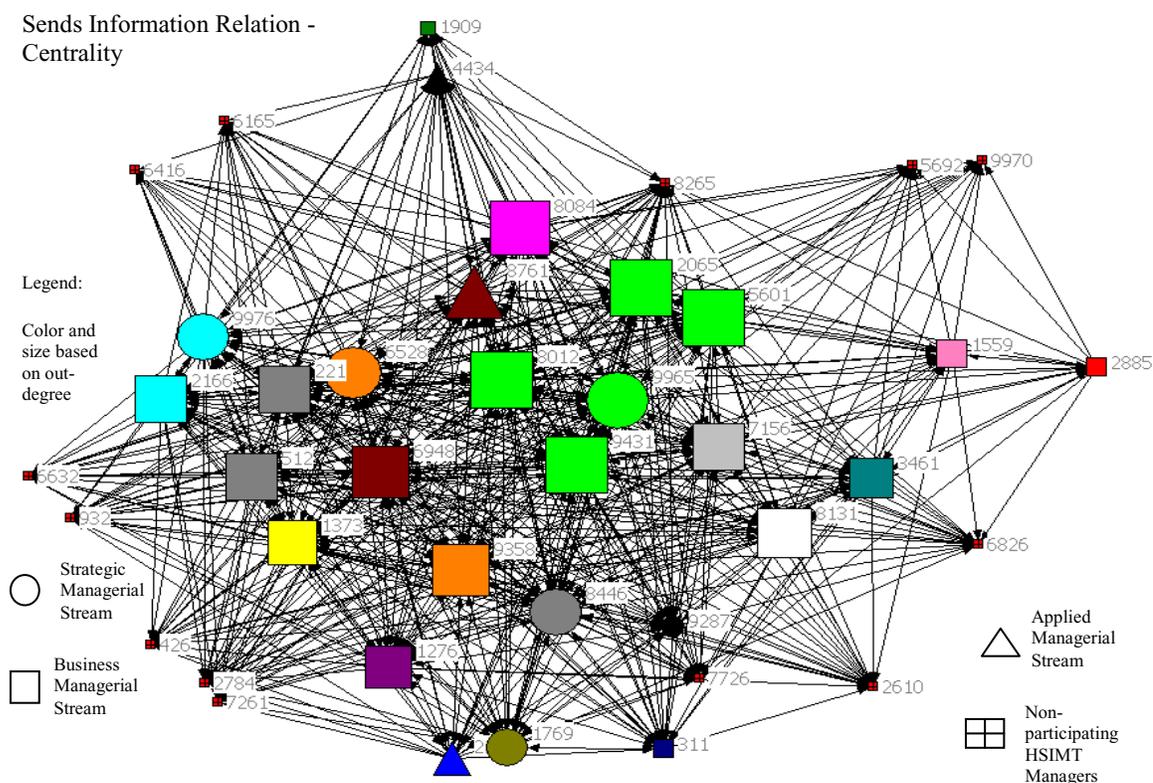


Figure 18. Receives and sends information relations – central individuals.

Although reviewing in- and out-degree provided insights regarding individuals who might be central, centrality was also influenced by one's neighbors. Analysis of the possible influence from neighboring connections was conducted through the Bonacich power index that used positive and negative weighting factors of ± 0.5 (Hanneman & Riddle, 2005, Chapter 10, Degree Centrality section). For the Bonacich power analysis using the 0.5 weighting factor, the index's absolute value indicated that the ego's influence was less affected by his or her neighbors, thus the ego was more influential or powerful. A negative weighting factor of -0.5 was applied to neighboring connections that were well connected with other individuals, and positive weights applied to neighboring connections that had weaker connections with others. Interestingly, some individuals remained influential with their neighbors, whereas other influential sources became weaker as a result of having stronger neighbors (Table 22).

Table 22

Strength Based on Connectedness to Neighbors

Relation	Having the Right (Strong) Connections with Others ¹	Weaker Influence as Stronger Neighbors ²	Stronger Influence as Weaker Neighbors ²	Notes
<i>Receives Information</i>	Individuals 2166 (highest), 3461, 9431, 5601	Individual 9431 (highest), 6948	Individual 5601: (highest), 2166, 9476	Individual 9431 is weaker, whereas 5601 is stronger
<i>Sends Information</i>	Individual 3461 (highest), 2885, 4434, 8446	Individual 9287 (highest), 311, 221, 1769	Individual 8446 (highest), 6948, 9976, 1373, 4434	Individual 8446 is now a stronger influence

(table continues)

Relation	Having the Right (Strong) Connections with Others ¹	Weaker Influence as Stronger Neighbors ²	Stronger Influence as Weaker Neighbors ²	Notes
<i>Proximity</i>	Individual 9358 (highest), 4434, 6948, 8761, 1769, 1909	Individual 8761 (highest)	Individual 9358 (highest), 4434, 1909, 9287, 1769	Individual 9358 remains as a strong influence
<i>Works With</i>	Individuals 512, 1769, 221 (highest)	6 Individuals (highest), 7 individuals, 2204, 7156, 2885	Individuals 512, 1769, 221 (highest), 9358, 1909	Individuals 512, 1769, and 221 are strong influences
<i>Known</i>	Individual 8761 (highest), 311, 1769, 3461, 6528, 2885, 8131	Individual 1769 (highest), 9358, 9287	Individual 221 (highest), 3461, 512, 1373, 8761, 8131	Individual 8761 remains a strong influence
<i>Positional Role</i>	Individual 9287 (highest), 3461, 8446, 9965, 6528, 1769, 1276	Individual 9287 (highest)	Individual 1276 (highest), 3451, 8131, 1909	Individual 9287 has a weaker influence

Note.

¹ Results using a positive weighting indicated individuals who had strong connections, thus these individuals appeared to be more influential.

² Results using a negative weighting indicated individuals who may have had a weaker influence as they had stronger neighbors. Details are contained in Appendix B.

For example, Individuals 2166 and 9431 became less influential as they had stronger neighbors (Hanneman & Riddle, 2005, Chapter 10, Degree Centrality section). For the *Sends Information* relation, all three managerial streams were represented with respect to strong connections with others. Whereas, when positive and negative weights were used, only two managerial streams were represented for individuals who had a weaker influence. Notably, some individuals who were initially less influential, such as

Individuals 1276 and 1909 in the *Proximity* relation, became more influential as they had weaker neighbors.

Similar connectedness and weak/strong influence patterns emerged for the *Proximity*, *Works With*, *Known*, and *Positional Role* relations. For example, Individuals 9431, 8446, and 9358 remained as strong, influential sources within the network, as they had neighbors that were less influential. As a result, the neighbors were more dependent on the individual for influence within the network. Reviewing how many individuals were reachable from a specific individual could also reveal the extent of an individual's centrality (Table 23).

Table 23

How Many Steps Does It Take To Reach Others? (Reach Centrality)

Relation (Binary data)	Proportion of individuals reachable by the individual in a distance of m steps	Proportion of individuals who can <i>reach</i> another individual in m steps
<i>Receives Information</i>	0.52 (52%) can be reached by Individual 9431 in 1 step	0.65 (65%) can reach Individual 8265 and 1 other person in 2 steps
	0.45 (45%) can be reached by Individuals 6528, 221 in 1 step	0.60 (60%) can reach Individual 8446 in 2 steps
	All individuals can be reached by Individual 3461 in 3 steps	
<i>Sends Information</i>	0.45 (45%) can be reached by Individual 9431 in 1 step	0.38 (38%) can reach Individual 6165 in 1 step
	All individuals can be reached by Individuals 2885, 1559, 8131, 3461 in 4 steps	0.70 (70%) can reach Individuals 6165 and 9970 in 2 steps

(table continues)

Relation (Binary data)	Proportion of individuals reachable by the individual in a distance of m steps	Proportion of individuals who can <i>reach</i> another individual in m steps
<i>Proximity</i>	0.41 (41%) can be reached by Individuals 9965 and 6528 in 5 steps	0.74 (74%) for 1 suppressed individual can reach others in 1 step, rest is near zero (e.g., 0.05, 0.06, 0.01)
<i>Works With</i>	Most were near zero (e.g., 0.05, 0.06, 0.01), thus less than 10%	Most were near zero (e.g., 0.05, 0.06, 0.01), thus less than 10%
<i>Known</i>	0.34 (34%) can be reached by Individual 8084 in 2 steps 0.38 (38%) can be reached by Individual 1373 in 6 steps (highest value for the remainder of matrix)	Most were near zero (e.g., 0.05, 0.06, 0.01), thus less than 10%
<i>Positional Role</i>	0.16 (16%) can be reached by Individual 9287 in 2 steps 0.19 (19%) can be reached by Individual 9287 in 3 steps (highest value in rest of matrix)	Most were near zero (e.g., 0.01, 0.03), thus less than 10%

For the *Sends Information* and *Receives Information* relations, Individual 9431 was more centrally positioned to reach most or 52% of all other individuals in one step and 45% when sending information. Yet Individuals 3461 and 2885 could reach all of their connections in three or more steps. Interestingly, for the *Proximity*, *Works With*, *Known*, and *Positional Role* relations, two or more steps were required to reach other individuals. Interestingly, over 60% of managers could reach Individuals 8265, 8446, 6165, and 9970 in two steps, an indication that these individuals were easier to reach, and thus more central.

Betweenness was another measure used to determine if information flows must be distributed through a specific individual (Freeman, 1979; Freeman, Borgatti, & White, 1991). The more that others must use a specific *go between* individual for knowledge

sharing, the stronger the influence that this individual had within the network (Hanneman & Riddle, 2005, Chapter 10, Betweenness section). Overall network centralization scores were less than 20%, an indication that there were few powerful or central individuals (Table 24).

Table 24

Who Appears To Be More Powerful?

Relation (Binary data)	Individual (Node) ¹	Appeared to Be Central (nBetweenness)	Notes
<i>Receives Information</i>	8446* 9431*	12.276 (highest) 8.465	10.91% centralized network (low)
<i>Sends information</i>	8446* 6528* 9431*	13.948 (highest) 7.506 7.477	12.86% centralized network (low)
<i>Proximity</i>	8761	0.896 (highest)	0.88% centralized network overall (low)
<i>Proximity</i>	9287 6528*	0.806 0.783	Individual 9431 had the 6 th highest centralized (betweenness) score
<i>Works With</i>	All zeros		
<i>Known</i>	6948 6528* 1769	0.777 (highest) 0.548 0.532	0.77% centralized network overall (low)
<i>Known</i>	8084 8446*	0.452 0.318	
<i>Positional Role</i>	6948	0.068	0.07% centralized network overall (low)

Note.

¹ Individuals who appeared to be more powerful based on their normalized betweenness (nBetweenness) score, using Freeman's node betweenness calculations (Hanneman & Riddle, 2005, Chapter 10, Betweenness section) were indicated with an asterisk (e.g., Individual 6528*).

From the analysis results, Individuals 8446, 6528, and 9431 appeared to be more powerful, based on their high normalized betweenness scores for each relation and across the relations. For example, Individual 8446 had the highest normalized betweenness scores for the *Receives Information* and *Sends Information* relations and the fifth highest for the known relation. As interestingly, there were no positive scores for the *Works With* relation. To provide a different perspective, centrality was examined at the relationship, rather than at the individual level. For the *Receives Information* relation, Individual 3461 had the highest relationship pairing score and had three of the highest five scores (Table 25).

Table 25

What Relations Appear To Be More Powerful?

Relation ¹ (Binary data)	Results For Individual (Node) Pairs
<i>Receives Information</i>	3461 to 8012 (47.971), 3461 to 8084 (28.476; highest 2 scores) – same managerial stream 8446 to 9431 (28.726), different managerial streams
<i>Sends Information</i>	5601 to 8446 (43.791, highest), different managerial streams 1276 to 6948 (37.463), 8446 (33.750) 7156 to 1276 (27.179), 8446 to 2204 (27.000), 1373 to 426 (27.000) 9358 to 6948 (25.781)
<i>Proximity</i>	8761 to 9287 (518.667, highest), different managerial streams 6948 to 8084 (495.250), 6528 to 9358 (351.458) 9358 to 6948 (302.500)
<i>Works With Known</i>	Zero values for all 6948 to 8084 (363.500, highest) 8446 to 1769 (277.000), 1769 to 6948 (206.267)
<i>Positional Role</i>	8446 to 1769 (22.000, highest)

Note.

¹ Used using Freeman's relation or edge betweenness calculations (Hanneman & Riddle, 2005, Chapter 10, Betweenness section). Some individuals were omitted to protect their identity.

In contrast, for the *Sends Information* relation, Individual 8446 had three of the highest 10 scores, yet not the highest, which was associated with the Individual 5601 to Individual 8446 pairing (43.791). It was interesting to note that that the highest scores were often associated with individuals in different managerial streams, rather than the same managerial stream. Interestingly, Individual 6948 appeared in the highest 10 scores for the *Proximity*, *Known*, and *Sends Information* relations, an indication that this person may have a relationship that was central or influential. As interestingly, there were no positive scores for the *Works With* relation. Centrality was further explored from the perspective of individuals who act as a central linkage to other portions of the network. Networks could also be disconnected if certain relationships between individuals or *bridges* were removed (Table 26).

Table 26

Who Appears To Be An Important Bridge Between Groups?

Relation (Binary data)	What parts of the network would be vulnerable if the individuals were removed?	If the link (bridge) between individuals were removed, the network structure would be disconnected
<i>Receives Information</i>	All individuals are in 1 network block versus 2 subcomponents	Individuals 8446 and 9431 – different managerial streams
<i>Sends Information</i>	2 individuals (8446, 1373) in different managerial streams	Individuals 6948, 8446, and 1 individual in different managerial streams

(table continues)

Relation (Binary data)	What parts of the network would be vulnerable if the individuals were removed?	If the link (bridge) between individuals were removed, the network structure would be disconnected
<i>Proximity</i>	9 individuals (9358, 9287, 8131, 5601, 4434, 3461, 2885, 2166, plus 1 individual) in all managerial streams	One individual and external Individual 10238
<i>Works With</i>	10 individuals (same as for the <i>Known</i> relation) plus Individuals 9976, 9965, 9431, 9358, 4434, 2166, 2065, 1909, 1769, 1559, 1373, 1276, 512, 311, 221 and 1 individual in all managerial streams	Individuals 4434 and 6948 – different managerial streams Next most important was a group of external Individuals: 10005, 10011, and 1013
<i>Known</i>	22 individuals (same as in the <i>Positional Role</i> relation) plus Individuals 7156, 4434 in all managerial streams	Individuals 4434, 6948 – different managerial streams Individuals 3461 and 2885 – same managerial stream
<i>Positional Role</i>	22 individuals (same as in the <i>Known</i> relation) plus Individuals 9976, 9431, 9358, 2204 in all managerial streams	Individuals 4434 and 6948 – different managerial streams Individuals 3461 and 2885 – same managerial stream

For example, for the *Sends Information* relation, two individuals, 8446 and 1373, both in different managerial streams could weaken the network if they were removed. Interestingly, for the *Proximity*, *Works With*, *Known*, and *Positional Role* relations, there were groups of 9 or more individuals who appeared to be central linkages within the division's managerial network structure. Individuals 6948 and 8446 appeared to have central bridging relationships, as Individual 6948 appeared in four of six relations, with Individual 8446 in three relations. Notably, in the *Works With* and *Proximity* relations, a non-HSIMT manager otherwise known as an external Individual 10328 appeared to be an

important relationship bridge within the network, as were a group of external Individuals 10005, 10011, and 1013.

Examining the presence of groups of individuals and which individuals commonly appeared within these groups provided another perspective regarding an individual's centrality. Individuals who may be influential in a network are often found in groupings of three or more individuals, otherwise known as *cliques*. Groups of three individuals were examined within each of the *Receives Information* and *Sends Information* relations, *Proximity*, *Known*, and *Positional Role* relations. The highest number of cliques occurred in the *Sends Information* relations (101 cliques; Table 27).

Table 27

Are There Any Cliques?

Relation (Binary data)	Clique Details ¹
<i>Receives Information</i>	Total: 71 cliques <ul style="list-style-type: none"> • Individuals 6528 and 8446 (24/71 cliques, highest) • Individuals 9431 and 8446 (19/71 cliques) • Individuals 9776 and 8446 (17/71 cliques) • Individual 6165 appears to be isolated (no cliques)
<i>Sends Information</i>	Total: 101 cliques <ul style="list-style-type: none"> • Individuals 6948 and 8446 (32/101 cliques, highest) • Individuals 9431 and 8446 (21/101 cliques) • Individuals 8446 and 8265 (21/101 cliques) • Individual 2024 appears to be isolated (no cliques)
<i>Proximity</i> ¹	Total: 58 cliques <ul style="list-style-type: none"> • 2 cliques have Individuals 9358, 6948, 4434 and three other external individuals in common. • 2 cliques have Individuals 9287 and 8446 in common
<i>Known</i> ²	Total: 29 cliques <ul style="list-style-type: none"> • Individuals 6528, 9358, 6948, and 4434 (highest) • Individuals 6948 and 6528 are in common with other cliques²

Note.

¹ Some results were omitted to protect individuals from being identified.

In the *Receives Information* relation, Individuals 6528 and 8446 had the highest number of cliques (24), whereas Individuals 6948 and 8446 had the highest number of cliques (32) in the *Sends Information* relation. Higher levels of commonality across cliques implied that Individuals 6528, 8446, 9431, and 6948 were perceived to be central information sources or receivers. All four of these managers were in different managerial streams, thus, there was no concentration of central information sources within a managerial stream. Interestingly, two individuals, 6528 and 6948, appeared to be common across at least two cliques for the *Proximity* and *Known* relations, yet two individuals, 6165 and 2024, appeared not to be affiliated with any cliques. As interestingly, these two individuals were in different managerial streams.

The extent to which managers appeared to reciprocate knowledge sharing relationships was also examined through reciprocating tie analysis. Figure 19 illustrates several interesting insights for the *Proximity* relation grouped by location. Note that this diagram did not include individuals who did not respond, known as isolates, or only had one linkage, otherwise known as pendants.

Reciprocal Ties for the Proximity Relation By Grouped Office Location

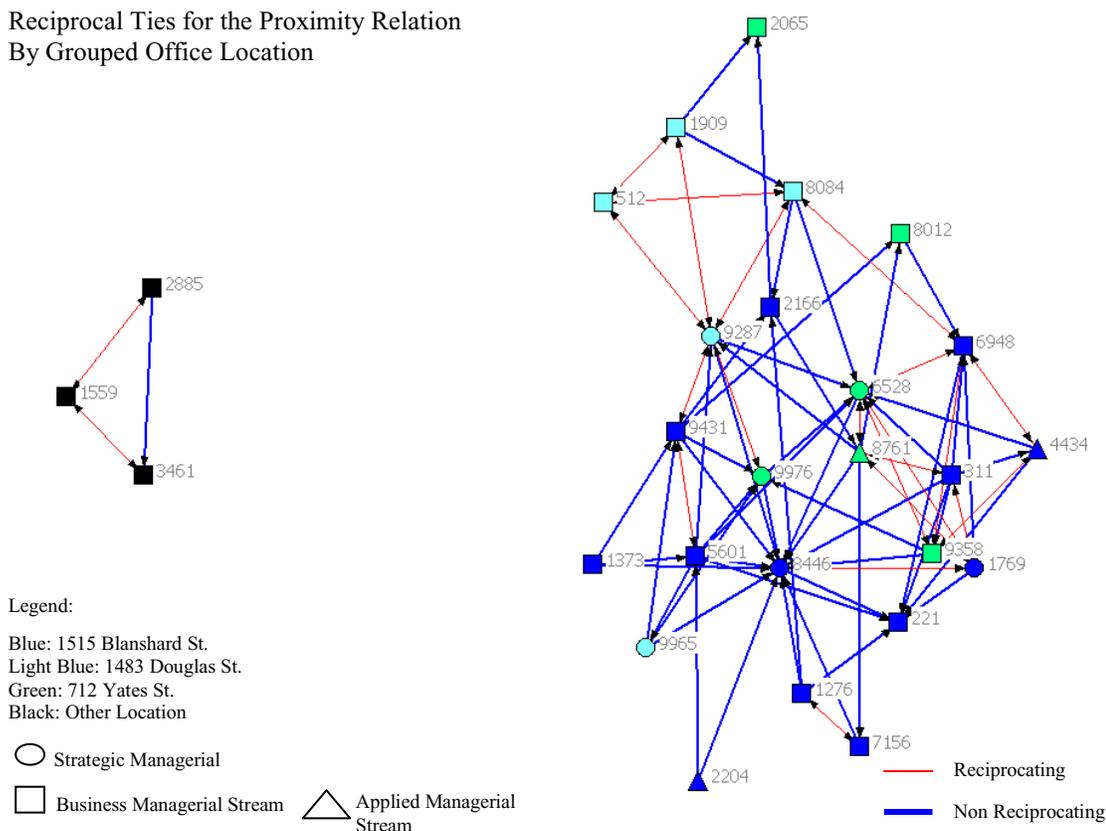


Figure 19. Reciprocating ties for the proximity relation by grouped location.

Note that one group was clearly separated from the rest as denoted by the black squares and only one instance of a non reciprocating link from Individual 2885 to Individual 3461. The other group had three distinct clusters of individuals: (a) individuals at 1483 Douglas St. (light blue symbols), (b) 712 Yates St. (green symbols), and (d) the largest group at 1515 Blanshard St. (blue symbols). Although there were a few reciprocating ties (red lines), there were more non reciprocating linkages (blue lines). As interestingly when reciprocating and non reciprocating relationships were examined for the *Known* relation by grouped location, fewer similar clusters appeared and more linkages to non-HSMT managers were revealed (Figure 20).

Reciprocating Ties for the Knows Relation
Grouped by Location

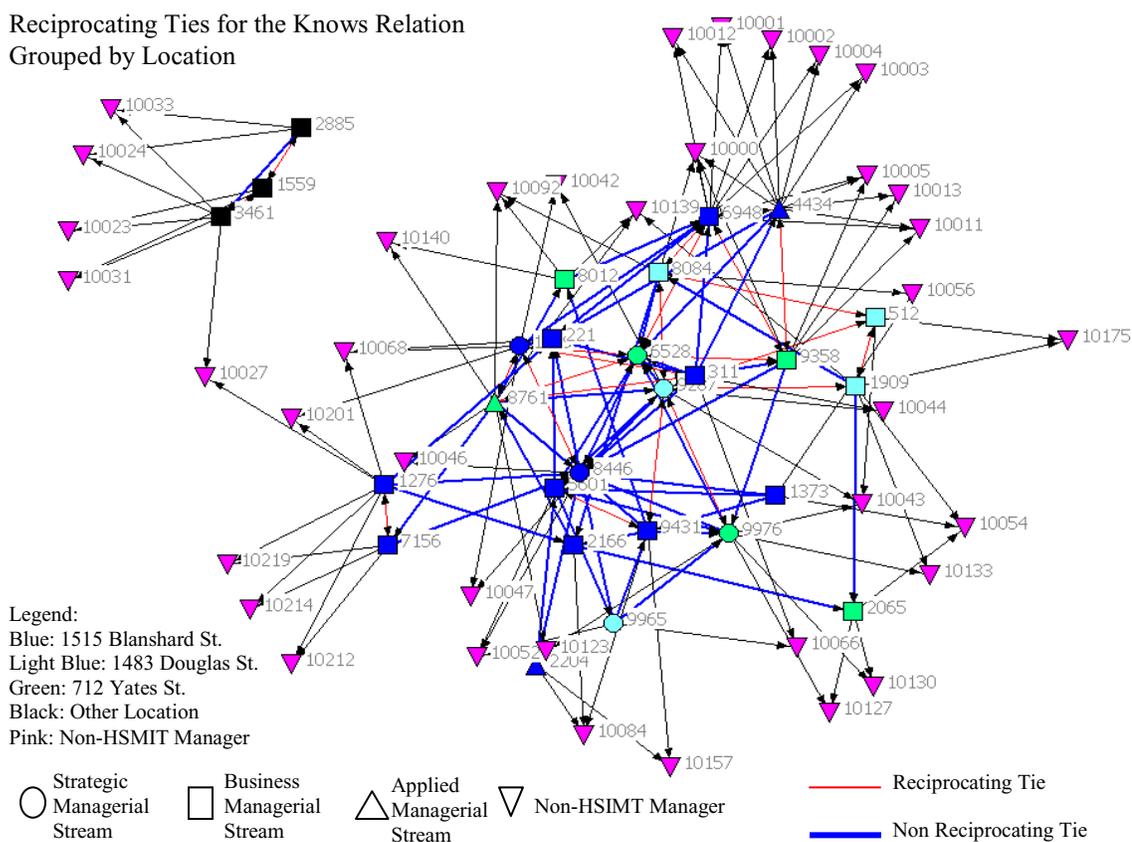


Figure 20. Reciprocating ties for the known relation by grouped location.

For example, Individuals 512 and 1909 had linkages with the same external Individual 10175. One external Individual 10027 appeared to be a common linkage for Individual 3461 and 1276 who were at different locations. There were discernable clusters at the Other Location (black symbols) and at 1515 Blanshard Street (blue symbols), yet not as clearly defined for the remaining locations. There did not appear to be many reciprocating ties between individuals at different locations (e.g., between blue and green symbols).

Divisional groups were examined to determine more tightly connected subgroups within the network using *faction* analysis, which determines who was “more tightly

For the *Proximity* relation, all factions contained four or more individuals who were non-HSIMT managers, as denoted by the inverted triangle symbol. Factions appeared to be clustered, with the largest cluster in the middle of the diagram (denoted by red symbols). Interestingly, only individuals in the strategic managerial stream appeared in the largest faction (denoted by red symbols). Increasing the faction number beyond four did not result in a significantly different graph. Increasing the number of faction groups provided interesting contrasts within the relations. For example, for the *Receives Information* relation, Figure 22 illustrated that there was a large, central faction that had all three managerial streams (denoted by red symbols).

Receives Information Relation, Faction = 3

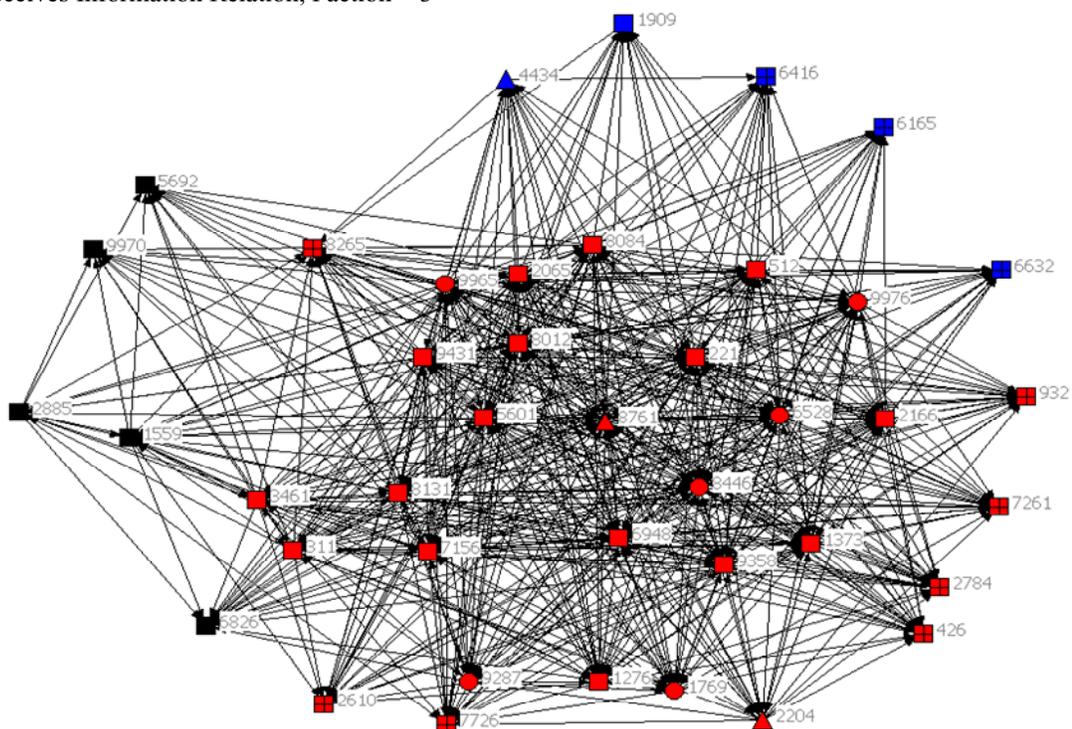


Figure 22. Receives information relation tightly connected groups (faction 3).

Interestingly, individuals who were initially connected with one group, such as Individual 8131, were more closely connected with another group as he or she switched from the red group in Figure 22 to the pink group in Figure 23.

Crossing Bridges - Knowledge Sharing Enablers or Inhibitors

Closer examination of the knowledge sharing enablers revealed that proximity, collaboration tools, organizational culture, and trust could positively or negatively affect the success of the exchange process. Although proximity of the knowledge sender and receivers was identified as being beneficial, proximity was also identified by three managers in two managerial streams as being a potential knowledge sharing barrier:

[I] may want to share a particular piece of information that you just learned with somebody but they are in a very different location, so you park it in the back of your head, and it's when I see them I'll tell them or I'll set up a meeting or I'll send them an e-mail, and it either never happens. Individual 6528

One manager further suggested that the ministry had fewer areas where informal, yet sensitive discussions could occur. Interestingly, the alternative notion of establishing a formal meeting to compensate for proximity issues was a common comment from at least three managers in all three managerial streams. At least one archival document supported the importance of proximity to effective knowledge exchange.

Another common concern was the inappropriate use of knowledge sharing tools, such as e-mail or language. E-mail was problematic for one-third (33.33% or 6/18) of interviewed managers, as e-mail only provided textual, rather than visual, verbal, and nonverbal feedback: "E-mail is that you just have no clue about their reactions"

(Individual 1373). Using language or acronyms that were not known to the intended audience was cited by one-third (33.33% or 6/18) as barriers to successful exchanges. Sharing too much, too little or sensitive knowledge inappropriately surfaced as a problem for at least two managers. Similarly, relying on one or two communication styles, such as using e-mail rather than face-to-face engagement, were perceived as exchange inhibitors by 22.20% (4/18) managers. Two managers noted that reframing complex topics to simpler constructs may inhibit, rather than support effective knowledge sharing:

I think that we mistake quantity, fancy words or something as effectively communicating the information, whereas in fact in some instances, [it has] the opposite effect. Individual 8446

We have to talk at a much higher, broader level and a simpler manner, which often defeats the goal of trying to articulate why a problem is so complex.

Individual 8012

Organizational cultural characteristics, such as having vertical information flows and a risk tolerant culture were identified by a few managers as key knowledge sharing factors. Although managers in all three streams indicated that vertical communication flows in the division were working well, a few comments indicated that some flows were less effective, and negatively affected their workload. In a few instances, some managers interpreted the flow delays as opportunities to take risks. Yet for other managers, these delays were not perceived as risk-taking opportunities, as these managers did not perceive that the division's cultural environment was risk tolerant:

[We] need to know personally that it is “ok” to take risks, [and] not be blamed.

Individual 8761

There are a few of us who feel comfortable, we just stick our necks way out and say “Ok, this is the decision and we just fire it up and say, ok, we needed to make a decision and here is the decision and do let me ... know if there are any issues.”

Individual 8012

Managers across all managerial streams identified that trust, respect, and honesty were integral components of knowledge exchange and the supporting organizational culture. Trust in the information exchange meant that both partners had confidence and respect for each other’s views. Trust in the organizational culture meant that individuals felt safe to share positive and negative information without fear of negative consequences:

Honesty factor is a big, to me, a really critical factor in communication.

Individual 7726

I think that it makes things much easier if I have either a personal or professional relationship with the people, because I know, [excerpted] usually how they are going to react, [excerpted] so being able to have that background knowledge of who you are dealing with and what their concerns will be, will greatly influence the conversation. Individual 8084

[We are] committed to working together and creating a safe environment, feeling safe to give an opinion. If you don't have that, you are not going to be successful.

Individual 9287

As we evolved over time, we would have a kind of confidence in each other, that I could depend on them for a knowledge transfer of the details in [so] far as it was needed. Individual 8446

Yet, there were a few perceptions that a lack of trust in the exchange process or within the organizational culture, acted as information filters and exchange barriers:

If you know in the past that you haven't gotten the complete set of facts, or they have given you the wrong information, or just haven't done a good job, then every time you hear from them, you are going to question it. Individual 8084

[There is also] reputation and face-saving [that is a concern]. Individual 8761

If you do not trust the person that you are sharing the information with, [excerpted] I have personally edited or reframed the information in a way, that [excerpted] "won't come back to bite me." Individual 6528

Knowledge Sharing Inhibitors

Pervasive throughout the interviews were indications that inadequate feedback mechanisms, lack of time, and organizational rules posed barriers for effective knowledge sharing. One-third (33.33% or 6/18) managers in two managerial streams indicated that lack of feedback immediacy and seeing reactions in the knowledge exchange were problematic:

You don't see the body language over the phone. Individual 1276

If you have one-[on]-one [meetings], you can ... have an audience, emphasize meanings and look in their eye and have that captive audience which isn't trying to juggle five things at the same time. Individual 9431

Lack of time, primarily from lack of face-to-face opportunities was a concern noted by several managers in two managerial streams. Having a division distributed in multiple locations posed challenges in sharing important knowledge simultaneously to all individuals. One manager voiced concerns that lack of time meant that there were few informal mentoring opportunities with senior managers. Several managers indicated that difficulties in booking formal meetings, because of a lack of face-to-face opportunities, unnecessarily complicated the information exchange:

It's almost impossible to get everybody in the same room. Individual 8012

[I am] missing the mentoring for informal exchange and learn how [executives think about strategic] scenarios and exchange, [similar to how] it [exchange] happens at the peer level - [at the peer level] knowledge is expanding horizontally, [whereas at executive, it is a vertical, narrower type of knowledge sharing.] Individual 8761

Difficulties in connecting with the recipient, either through the telephone, Blackberry, or checking calendar entries, were often cited as being major exchange barriers. For example, formal meetings often had to be arranged several weeks in advance because participant calendar meeting times were unavailable. When the formal

meeting occurred, both parties quickly resolved the issue in minutes. Closer proximity would have helped quickly resolve the issues and have reduced the additional workload and activities associated with the formal meeting. Although not as pervasive an issue as proximity or workload, was the underlying issue that surfaced regarding perceived organizational obstacles. Inflexible organizational practices, lack of past learning, and unclear organizational responsibilities were identified as potential knowledge sharing barriers by a few managers in two managerial streams. One manager noted that the physical structure of many meeting rooms posed potential exchange barriers, as the formal setting implied an adversarial rather than collaborative and open exchange environment.

Part of becoming a knowledge [sharing] organization is becoming creative and [that] failures [are tolerated]. Individual 8761

Lack of knowledge of the right people with responsibilities of the right knowledge. Individual 9358

The formal organization's rules, policies and structure ... this cannot and does not move as quickly as the environments are evolving and changing. Individual 8012

There was no comfortable room dynamic for the kind of information exchange that we had. Individual 8446

[I] believe the organizational structure [is a barrier] - too many decisions [are being made] at the top. Individual 8761

The cumulative effects from these potential exchange barriers included an over abundance of e-mails, too much information to review, and confusion over task prioritization. One manager noted that some individuals often shared e-mail for future reference, a practice that contributed to increased workload and lack of time. Yet another manager identified that he or she had an increased workload from having to review too many materials that were stored in multiple locations:

Information overload can be an issue. Individual 8084

[The] more that you ask people to contribute to, or commit to, or collaborate in, the busier they are. Individual 1276

Getting messages from different sources. Individual 4434

E-mail is [difficult] when detailed exchange is needed. Individual 9358

If you have a comprehensive SharePoint area, it once again, tends to develop so many files. Individual 5601

Summary of Findings for Research Question 3

Reflection on the closer examination of the various knowledge sharing enablers and inhibitors revealed that most of the division's managers preferred using a face-to-face approach for sharing complex knowledge. Body language, gestures, and visual imagery were important for engagement and sustaining the knowledge flows within a relationship. Individuals who used multiple communication styles and knowledge exchange roles, such as brokerage and liaison roles between groups appeared to be more influential with respect to sharing knowledge. Individuals who had few powerful neighboring

connections appeared to be more influential as central information sources within the network. As important was the presence of mutual trust and an organizational culture that supported open exchanges. Divisional activities, such as coffee talks and the ability to have impromptu informal knowledge exchanges were perceived as being important. Yet, a few organizational aspects, such as reliance on one communication style, and the overabundance of tasks and e-mail appeared to be barriers to effective knowledge sharing. The final chapter, chapter 5, will contain a summary of the study's findings, implications for social change, and recommendations for the ministry and future research.

Chapter 5: Summary, Conclusions, and Recommendations

Summary

The previous chapter contained a summary of the findings from an inquiry into the managerial knowledge sharing practices within the HSIMT division. The intent of the inquiry was to examine the characteristics of an effective knowledge sharing network, associated knowledge sharing similarities and dissimilarities, and perceived knowledge sharing enablers and inhibitors. Approximately 40 managers within the division provided details on their knowledge sharing practices through a questionnaire and/or interview sessions that were supplemented with archival document reviews. Using a mixed-methods approach, social network and iterative code categorization analyses were used to derive a map of influential knowledge sources and reveal effective and ineffective knowledge sharing practices, influences, and behaviors.

Findings indicated that most of the division's managers preferred using a face-to-face approach that was supported through body language, gestures, and linguistic cues for sharing complex knowledge. Individuals who used multiple communication styles and knowledge exchange roles, such as brokerage and liaison roles between groups appeared to be more influential with respect to sharing knowledge. Individuals who had a few powerful neighboring connections were more influential as central information sources within the division's managerial network. This chapter contains an interpretation of these findings and provides conclusions for each research question, implications for social change, and recommendations for the ministry and future research. The chapter concludes with my reflections and overall conclusions.

Conclusions

The study's demographic profile mirrored the division's primarily male managerial population that was concentrated in the business leadership managerial stream. Profile findings also depicted that approximately 90% of the division's managerial population was over 40 years of age, with an average of 16.93 years within the public service. Despite the incomplete participation from all managers, the social network results provided a glimpse into the influential knowledge sharing conduits and potential barriers within the division (Hanneman & Riddell, 2005, Chapter 1, Ego Networks section). Prevalent throughout the findings was the importance of managers being adept at interpreting feedback from multiple contexts and being able to adjust and retransmit messages in a manner that was meaningful to the intended recipient. This foundational aspect will be discussed from a different perspective for each of the research questions.

Research Question 1

The first research question asked: *What are the characteristics of an effective knowledge sharing network?* Three conclusions arose from findings for the first research question. The first conclusion is that managers must be adept at interpreting cues from their environment to effectively share complex knowledge and nurture their knowledge sharing networks. An individual's ability to build and sustain a broad relationship network and use multiple communication styles during the knowledge sharing exchange emerged as an essential knowledge sharing characteristic. Face-to-face communication was the most preferred method to share complex knowledge and engage in meaningful

dialogue. In particular, using face-to-face communications through impromptu meetings or office drop-in opportunities was the most preferred approach by almost one third of participating managers. This finding supports Ball's (2009, p. 85) divisional research findings regarding the importance of employees and managers having office drop-in sessions to build relationships and promote trust.

The second conclusion to Research Question 1 is that managers who were efficient in using their resources to connect with others appeared to be influential knowledge sources. For example, Managers 8446 and 6528 appeared to be influential knowledge sources, based on their high sending/receiving information or in- or out-degree scores to over one half of the other division's managers. Managers who were able to reach other managers in one or two steps or had many alternative choices within their network appeared to be influential knowledge sources. Most of the managers appeared to be able to connect each other within four steps, which implied a moderate level of connectivity present that would support knowledge sharing. Connecting to others within one step was most efficient for sharing knowledge. Although the findings indicated that a few specific individual pairings were separated by 10 or more steps, these results could have been influenced by the number of missing participants within the study network. Managers who had many alternative paths to share knowledge were perceived as influential knowledge sources. For example, four individuals in two managerial streams had over 64 alternative paths to others within the divisional network, a result that implied that they were well connected and influential knowledge resources.

The final conclusion to Research Question 1 is that managers within the highest managerial stream appeared to have the most effective knowledge sharing characteristics. For example, the level of connectivity within and between managerial groups indicated that interconnectivity was highest within the strategic managerial stream. This result was not surprising, as this group consisted of individuals who were in senior managerial positions within the division. Curiously, the level of connectivity within the applied managerial stream was zero, a finding that could have been influenced by the small number (i.e., fewer than 10) of participating managers or by other unknown influences. As interesting were the high values associated with intermanagerial stream connectivity and connectivity with non-HSIMT managers. Further analysis needs to be conducted to determine the rationale for these high values. That said, managers, such as 9287 and 8446, who indicated that they actively sought connections with others to help them be successful or achieve greater understanding appeared within the highest managerial stream. Implicit in these actions was being able to trust one another and having common interests or knowledge about each other appeared to be critical in sustaining the trust relationship (Ball, 2009; Chan & Liebowitz, 2006). Favored approaches in establishing trust included informal face-to-face meetings, positive past experiences, and/or having common connections with others. Trust was sustained through using a combination of visual, verbal, and nonverbal approaches in crafting and delivering meaningful messages and immediately adjusting one's communication style and delivery approach based on audience feedback. Overall, being flexible in using multiple communication styles and

using connectivity resources in an effective manner appeared to be successful knowledge sharing practices.

Research Question 2

The second research question asked: *How similar or dissimilar are the knowledge sharing practices being used by senior executives and managers?* Three conclusions emerged from findings for this research question. The first conclusion to Research Question 2 is that effective knowledge sharing managers were individuals who were able to shift their communication approach and assume different knowledge sharing roles within and between groups. Similarities in effective knowledge sharing practices were evident in the strategic and business leadership managerial streams, particularly for managers who were able to connect and nurture these connections across all managerial streams and with non-HSIMT managers. Managers who were able to shift to a variety of brokerage roles, such as representative, consultant, or liaison were able to act as knowledge brokers within and external to the division's managerial network. In particular, Individuals 8446, 9431, 9358, 9976, and particularly Individual 9965, were effective in using their network resources to connect with others. Information sharing to HSIMT and non-HSIMT managers appeared to be balanced for six individuals in the three managerial streams, yet five other managers favored connections with non-HSIMT managers. These results could have been influenced by the network's incompleteness; nevertheless, these results indicate that there is room to improve connectivity within and external to the managerial network.

The second conclusion to Research Question 2 is that managers who were perceived to be influential knowledge sources had lengthy experience within government, few powerful neighboring connections, and few redundant connections within their ego networks. For example, Managers 9431, 9287, and 9976 appeared to be influential information sources as they had few powerful neighboring connections within their network and few redundant connections. For the most part, managers who had 10 to 25 years of government service were key divisional knowledge sources. Interestingly, this pattern was tempered by the emergence of two individuals, one with less than 10 years of experience, and one with more than 25 years of experience, who were high information senders and receivers. Further inquiry into this result is needed to determine if there were mitigating factors, such as positional role or subject matter expertise that may have influenced these results. Interestingly, a few individuals had low levels of sending or receiving information, a result that could have been influenced by an incomplete network.

The final conclusion to the second research question was that managers who were adept at framing knowledge for their intended audience were most effective in sharing knowledge. Framing knowledge included the manager's ability to quickly determine audience needs, understanding what information was needed and not needed, and being able to use multiple communication styles in tailoring and delivering this information to the intended audience. In particular, crafting messages that considered the recipient's requirements and using appropriate linguistic terms, metaphors, humor, or pictures were techniques that acted as *glue* to strengthen and sustain the trust relationship. Through setting a context where the recipient perceived that he or she was safe assisted in the

creation and strengthening of a trusted relationship. For example, managers who reframed complex knowledge into concise messages using pictures and metaphors established the engagement context for the intended audience. Pictures and metaphors provided common reference points for both the information sender and receiver to begin the dialogue and develop their exchange relationship. Managers who had prior knowledge of the message recipient could use appropriate linguistic terms, such as acronyms, humor, and debate to convey complex information. As essential was the manager's ability to interpret recipient feedback through visual, verbal, and nonverbal gestures. Managers, such as Individual 8446, who visualized themselves in the recipient's role, or used face-to-face engagement combined with written follow-up appeared to be perceived as influential. Collectively, managers who had lengthy government experience, who assumed multiple knowledge sharing roles, and were able to frame messages that were meaningful for their intended audience were the most effective knowledge sources within the division.

Research Question 3

The third research question asked: *What are the perceived knowledge sharing enablers or inhibitors within the study context?* Conclusions to this research question were clustered into three knowledge sharing categories: (a) enablers, (b) enablers or inhibitors, and (c) inhibitors. The first conclusion to Research Question 3 is that key knowledge sharing enablers included in person exchange, effective use of multiple communication approaches, and proximity. Consistent throughout the interviews was the importance of face-to-face engagement as the most preferred approach in sharing and

receiving knowledge. Managers who were adept at interpreting feedback and being able to use different communication styles and delivery tools were most effective in sharing complex knowledge. Approximately 33.33% (6/18) of the interviewed managers voiced the importance of being able to receive immediate feedback through visual, verbal, and nonverbal gestures, including body language, from the exchange process. As important was the ability of managers to discern concerns with colleagues through these same feedback processes to initiate a conversation.

Managers who used multiple communication approaches understood what information was appropriate to share, when and how to share it, and with whom, were most effective in sharing knowledge. For example, pervasive throughout the conversations with managers in the strategic managerial stream was the notion that all information that could be shared was shared with staff, a perspective that was echoed from many of the receiving managers. Being sensitive to the sharing context, recipient, and recipient's knowledge level influenced the type and extent of knowledge that was shared and how it was shared. For example, Managers 8446 and 9358 commented that using clear, simple language and being sensitive to audience needs were needed so that the transferred message was interpreted as intended. Depending on audience requirements, these managers used metaphors, pictures, or visual imagery as common reference points that prefaced and supported the complex knowledge exchange. Collectively, these combined reference points and the shared knowledge created the chaotic conditions that supported the generation of new knowledge and emergence of multiple relationships, concepts supported by both Yolles (2006) and Nonaka et al.

(1998). An important aspect of these conditions was the proximity of the individuals within the knowledge exchange network.

Consistent throughout several of the interviews was the importance of proximity as an exchange enabling mechanism. Proximity supported an exchange environment where visual gestures and verbal exchange provided the chaotic conditions that supported new knowledge generation from shared understanding. The importance of proximity as a knowledge sharing enabler was aligned with previous research (Birk, 2005). Although 27.77% (5/18) of the interviewed managers identified the importance of impromptu sessions, such as the coffee talk or office drop-in sessions, only a few managers indicated that follow-up activities, such as apprising others, might be required. Given the dynamic divisional environment and increased resourcing, workload, and decision making pressures, the benefits from such impromptu knowledge exchanges should be compared with the possible disadvantages from excluding others in the exchange. Proximity and similar chaotic conditions could support new knowledge generation through more formal meetings, such as branch or unit meetings. Regular meetings offered opportunities to share and generate new knowledge while building group communication and strengthening relationship bonds.

The second conclusion to Research Question 3 is that proximity, usage of collaboration tools, organizational culture, and trust levels could enable or inhibit knowledge sharing. Proximity appeared to be an important knowledge sharing enabler through the visual exploration of relationships. For example, more reciprocating relationships occurred between some managers and non-HSIMT managers at the same

location, rather than between managers at different locations. Some groups, such as the strategic managerial stream, appeared to be tightly connected, a result that implied a high level of commonality. Certain individuals, such as 6528, 8446, and 9431, appeared to be common to triads or groups of three individuals, an indication that these individuals were potentially influential information resources. The relationship between Individuals 8446 and 9431 appeared to be an influential bridge that enabled knowledge flows within the division. As interestingly, a group of non-HSIMT managers, Individuals 1005, 10011, and 10013, appeared to be important bridges within the division. Several individuals, 9431, 8446, and 9358 appeared to be strong information sources as they had less influential neighbors in their network. Over 60% of the managers within the division could reach Individual 8446, and Managers 8265, 6165, and 9970 within two steps, an indication that these managers were easy to reach.

Appropriate usage of collaboration tools, such as inappropriate message framing, inappropriate delivery mechanisms, or an inability to discern feedback could be knowledge sharing enablers or barriers. For example, using acronyms with audiences that were not familiar with the terms was a common complaint identified by 33.33% of the interviewed managers. Using e-mail instead of face-to-face meetings was identified as an annoyance and a knowledge sharing barrier by 22.22% (4/18) of the managers. As most of the division's knowledge is complex, at least two managers voiced concern regarding the decision making implications from trying to simplify complex knowledge. In their view, simplification could result in different decisions as the extent of complexity or subtle implications would not be present in the shared knowledge. The organizational

culture and level of trust could similarly enable or inhibit knowledge sharing. For example, although many managers in all three managerial streams indicated that the division shared as much information as possible, at least two managers voiced concerns that such sharing practices were not as prevalent. In their view, the divisional culture was risk adverse and knowledge may not be shared for fear of reprisal. These perceptions were aligned with Ball's (2009) finding regarding the negative impact on trust and organizational culture from historical ministry issues that eroded trust.

The final conclusion to the third research question was that the absence of key enablers, such as face-to-face engagement, proximity, effective use of multiple communication styles, and an inflexible organizational structure were knowledge sharing barriers. For example, lack of face-to-face exchange and an inability to see body language and nonverbal gestures was problematic for 33.33% (6/18) of the interviewed managers. Lack of opportunities to meet informally or through formal meetings were noted as frustrating barriers by several managers. One or two managers indicated that they devised elaborate communication approaches to address lack of proximity issues. For example, one manager indicated that he or she often arranged to meet their intended audience in transit between different physical locations instead of scheduling formal meetings or leaving voice mail messages.

The power of knowledge generation from impromptu conversations was aptly demonstrated between a member reviewer and myself. Manager 1769 indicated that to shift the ministry's knowledge sharing culture to embrace knowledge sharing, all employees needed to incorporate "daily, small practices to embed knowledge sharing

practices and [a] willingness to share [as part of leadership]”. He or she indicated that for example, individuals in another ministry were designated as *emeritus* in their last 6 months of public service so that others could seek their advice as key knowledge sources. He or she suggested that visible signs for particular knowledge resources, such as *Knowledge Sharing Resource - Policy* signs on doors or cubicle walls could be used as signposts to assist staff in seeking knowledge resources who are willing to exchange knowledge. Collectively, these incremental changes would gradually shift current organizational practices to embed new learning through visible methods and measures, an approach that was aligned with previous research (Argyris & Schon, 1996; Cross & Thomas, 2009; Mouritsen et al., 2004). More importantly, these incremental changes would signal that divisional and ministry executive were committed to knowledge sharing.

Lack of opportunities for some applied and business level managers to understand the needs of executive meant that it was more challenging for these applied and business level managers to frame messages and strategies for executive. For these applied and business level managers, this was perceived as lost opportunities to learn and develop skills while increasing their workload. An inflexible organizational structure and lack of an organizational learning culture were identified by a few managers as knowledge sharing barriers. The lack of organizational capacity or ability for individuals to learn from past mistakes was voiced by a few managers. An inflexible, rule bound bureaucratic structure was noted by a few managers as impeding knowledge flows and negatively impacting decision making. For these managers, an inability to meet face-to-

face and make decisions resulted in a negative spiral of attempting to schedule face-to-face meetings, further delaying decisions, and increasing information overload.

Overall, findings to the third research question indicated the presence of islands of effective knowledge sharing enablers and practices used within and across managerial streams. Although many managers voiced frustration with perceived barriers, such as lack of proximity or organizational culture, some managers were able to devise new strategies that mitigated the potential negative effects from these barriers. These islands of innovation ought to be further examined to determine how to shift the divisional and ministry's culture to be flexible, retain historical lessons learned, while continuously nurturing knowledge sharing as a way of being.

Implications for Social Change

“Beliefs ... commitment ... action ... meaning ...” – these were Nonaka and Takeuchi's (1995, p. 58) prophetic words that not only described the knowledge generation spiral, but also the essence of knowledge sharing by HSIMT managers. Although the purpose of this study was to provide a map and a description of the managerial knowledge transfer practices within HSIMT, participants revealed a rich *mélange* of knowledge sharing insights that echoed these prophetic words. For many HSIMT managers, *beliefs and commitment* were demonstrated through their willingness to openly share their insights and knowledge to support their peers, staff, and service delivery to citizens. *Action* was demonstrated through managers devising different knowledge sharing strategies, such as using humor and metaphors, to engage their audiences in the cocreation of shared understanding. *Meaning* was demonstrated through

managers skillfully crafting messages and using appropriate delivery and feedback mechanisms to ensure that shared information was received as intended.

Embedding face-to-face knowledge exchange within the division's culture through slight shifts in existing practices could over time, improve managerial and managerial/staff communication and trust. For example, divisional executive should require that all branches have regular meetings for sharing activities and lessons learned within the branch and to/from divisional executive. Required HSIMT supervisory and managerial and supervisory training courses should be adjusted to include exercises to build and strengthen managerial communication skills. Over a year, lessons learned from these courses and HSIMT managers would be incorporated into training materials that could be used by other government managers. As most of the division's managers and employees are involved in operational or strategic ministry projects, lessons learned from all projects should be captured, shared, and used as an integral part of divisional practices. Without the commitment from executive, staff or the organization's culture, there is no impetus to retain, share, and use this collective wisdom. As a result, the division risks an increasing loss of valuable knowledge and the generation of new opportunities to support the delivery of health services. The importance of being able to reuse and generate new knowledge, rather than repeat past practices will become more important as ministry knowledge loss escalates from an ageing workforce.

The study's social network analysis and interview tools provided SHR management with a flexible toolkit to explore knowledge sharing practices and surface influential knowledge sources within branches and across the ministry. With this

additional knowledge, corporate knowledge retention and recruitment strategies and practices should be adjusted to capture knowledge that is about to leave and incorporate new incoming knowledge into divisional practices. SHR and divisional management should collaborate with their peers, such as health authorities and health leadership councils, to share this study's insights to improve knowledge sharing practices for the public and broader public health sectors.

Recommendations for Action

From these findings, several key recommendations for improved divisional and ministry knowledge sharing and managerial communication emerged:

1. Strategic Human Resources and HSIMT divisional executive management should interview (a) the influential individuals to explore their knowledge sharing practices in detail as a precursor for inclusion into ministry specific managerial training courses, and (b) individuals who scored high or low number of arcs, distance values, and intermanagerial group scores to surface effective knowledge sharing practices or potential concerns.
2. Strategic Human Resources should ensure that managerial training includes training for (a) using multiple communication styles and brokerage roles, message crafting, message delivery, and interpretation approaches; and (b) embedding the learning through post training support, such as mentoring or partnering across different managerial streams and years of service. Appendix J contains recommended training topic areas.

3. Strategic Human Resources and HSIMT divisional executive should collectively promote increased intermanagerial knowledge sharing activities to increase connectivity between different managerial streams through mentoring, cross divisional project collaboration, and informal managerial discussions at quarterly divisional meetings or half day workshops. In particular, these activities should include managers from different managerial streams, different locations, and different years of service. Lessons learned would be shared within the division, ministry, and broader health sector leadership councils.
4. Strategic Human Resources should incorporate visible and measurable knowledge sharing practices within ministry organizational and employee practices. In particular, these changes should include (a) having executive state that knowledge sharing is a core ministry value; (b) using visible signs (electronic, such as a list of knowledge resources on the HSIMT SharePoint or ministry intranet sites or hardcopy) for individuals who are willing to share knowledge (Appendix J); (c) including knowledge sharing as part of an employee's and manager's 2010/2011 employee development and performance plan (EPDP) measures; (d) including knowledge sharing and lessons learned as a regular part of branch, unit, and divisional activities; and (e) including mentoring and knowledge sharing as part of preretirement activities, such as partnering individuals who are in their last 2 years of public service with younger staff.

5. Strategic Human Resources management should discuss how the combined social network analysis and interview approach could be used to surface influential employee knowledge resources (a) within a branch or across a division to support employee engagement initiatives, and (b) across the public or broader public health sector, such as with health authorities.
6. Strategic Human Resources and HSIMT divisional executive should (a) promote an organizational culture that is perceived to be open, risk tolerant, perceived to be safe to voice issues, and where knowledge sharing is valued; (b) support and promote informal networking and engagement practices, such as through the coffee talk sessions, regular branch/unit and employee engagement sessions; (c) invite employees and managers to collaborate and suggest how to introduce flexibility into organizational rules to improve feedback and support decision making in a dynamic environment; and (d) reissue the survey in 6 months to obtain a more complete perspective of knowledge sharing practices within HSIMT.
7. HSIMT divisional executive should ask the Employee Engagement Committee to solicit feedback from employees on how to improve (a) vertical and cross divisional communication, and (b) the retention, sharing, and usage of lessons learned to support divisional projects and practices.

Collectively, results from these recommendations will improve managerial communication practices, improve employee and management engagement to enhance trust, and begin to shift the ministry's culture to embrace knowledge sharing.

Recommendations for Further Study

As this study only focused on HSIMT managerial knowledge sharing practices, other potential knowledge sources, such as from employees or other ministry divisions, was not explored. Further study should be conducted in three areas: (a) commonalities, (b) reciprocating relationships, and (c) potential non-HSIMT influential sources.

Strategic Human Resources management should first explore areas of commonality that were revealed to determine the underlying factors. For example six individuals (4434, 1909, 9287, 3461, 311, and 2885, Appendix J) appeared in 80% of the reviewed two step networks, suggesting a high degree of commonality. Individuals 9431 and 9965 had the same number of neighbors, yet both were in different locations and managerial streams. Why do these individuals have the same neighbors and how similar or dissimilar are the knowledge sharing approaches used by both of these managers? Second, further inquiry into reciprocating relationships for individuals at the same location, rather than between individuals at different locations should be pursued to discern similarities and differences. Third, as the study revealed that several non-HSIMT managers appeared to be influential bridges or common connections to several HSIMT managers, these insights should be examined in further detail. Finally, HSIMT executive should consider reissuing the study to obtain a more comprehensive picture of divisional knowledge sharing resources. As the study was conducted during a time of high workload on strategic ministry projects, near fiscal year end and prior to the annual employee survey, managerial participation was very low to nonexistent for some areas, such as the Vital Statistics Agency and eHealth branch. Reissuing the study's social network questionnaire and interview

questions in 6 months would potentially avoid these additional issues that possibly factored into low response rates. As a result, HSIMT executive would be able to obtain a more complete perspective of the division's knowledge sharing practices. Insights from the results from these future study recommendations would assist Strategic Human Resources management in adjusting and improving managerial training and ministry knowledge sharing practices.

Researcher Reflections

This study took approximately 21 months from proposal development in February 2008 through analysis completion in November 2009, slightly longer than I had first envisioned. Throughout this period, Nonaka and Takeuchi's (1995, p. 58) words of "*Beliefs ... commitment ... action ... meaning ...*" acted as parallel shadows to the activities of myself, HSIMT managers, and non-HSIMT participants. For example, several HSIMT managers, the research sponsor, and non-HSIMT managers provided ongoing commitment to me and my project, through daily support or through study participation, despite hectic work schedules and pressures. Actions, including lessons learned from project activities that were successful or less than successful, contributed to self-growth and learning. Insights from management interviews generated new perspectives such that I started to adopt some of the knowledge sharing practices into my daily workplace practices. I also gained new perspectives, and personal connections from the Sunbelt social network conference and discussion group participation, activities that resulted in a more comprehensive data analysis process than was initially envisioned. New knowledge was also generated for some of the member reviewers who indicated that

they had learned new communication approaches from reviewing the draft study results. Collectively these brief encounters created a web of knowledge and incremental personal change for me and several participants.

Concluding Statement

Within HSIMT, there are areas of excellence regarding knowledge sharing, with some concerns that need further exploration to surface new practices or identify possible concerns. Incremental changes to managerial communication practices and an increased emphasis on using divisional knowledge resources could improve productivity, similar to that experienced by fictional manager Bob: *As Bob was on his way back to the office, he sees Tim, whom he has been unsuccessfully trying to arrange a meeting with to discuss pressing project issues. “Tim, do you have a minute, I’d like to quickly check with you about an issue that has come up earlier this week.” Both managers quickly conversed on the sidewalk in front of the ministry building, and after a few minutes, they parted, with Bob indicating that he would send Tim a follow-up e-mail from their conversation. As Bob continued to his office, Sandy stopped him in the hallway and asked if he was free later today to discuss a new issue that appeared to be emerging for another project. Bob consulted his BlackBerry calendar, and sighed “Sandy, I am sorry, I am booked until Friday morning, yet I have five minutes now, will that help?” Sandy and Bob continued to his office, and after a few minutes, Sandy thanked Bob for his time and left with a revised plan. Before continuing, Bob remembered that he hadn’t heard back from Sally since he left his voicemail message with her earlier in the week. He remembered that Jane was Sally’s coworker and called Jane to ask if she knew when Sally would be in.*

Jane indicated that Sally was on vacation and asked him if there was anything that she could do to help. After a brief conversation, he concluded the call and noticed that his next meeting was with his mentee, Joe, regarding a discussion on how to prepare materials for next week's executive presentation.

Using social network techniques to reveal knowledge resources enables managers to expand their personal connections so that information flows can continue using alternative communication paths. Through adjusting organizational practices, such as improving opportunities for face-to-face exchange, divisional employees form contacts and build relationships. Key information brokers and liaisons enable information to efficiently flow across the division while serving as role models for learning effective communication skills. Collectively, these incremental changes infuse new ways of thinking and acting within the ministry's organizational culture. Incremental change through exchange and knowledge generation requires both trust and an organizational environment that supports risk taking and learning from past mistakes. Using the metaphor *gardeners*, Manager 1769 aptly captured the essence of the organizational and personal benefits that can accrue and organically emerge from positive knowledge exchange and nurturing, an evolving knowledge generation perspective proposed by Por and Malloy (2000). Collectively the HSIMT managers voiced their knowledge sharing practices that sustain the division, yet knowledge remains untapped and hidden in many instances. As a result, the division and ministry are poorer, as valuable knowledge is isolated or not shared effectively. Understanding key knowledge resources and sharing

practices provides the foundation for nurturing and growing knowledge to meet divisional and ministry needs that support health care delivery in a complex environment.

The larger the island of knowledge, the longer the shoreline of wonder.

(Sockman, n.d.)

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Appendix A: Social Network Questionnaire

The study questionnaire was adapted from Cross and Parker's (2004, pp. 147-151) sample questionnaire. Table A1 identifies the original questionnaire item from the sample questionnaire. For this study, I modified the sample questionnaire item to align with the study design and context. The second column in Table A1 contains a brief description of the rationale for the modification. This modified questionnaire was reviewed with SHR and field tested. From the field testing process, slight adjustments were made to the questionnaire's format. Table A2 contains the final Excel spreadsheet questionnaire that was distributed using the government's e-mail system. Excel spreadsheets were chosen to ensure that questionnaire results were kept within the government's network environment to comply with the *Freedom of Information and Personal Protection Act* (FOIPPA). Online questionnaire tools, such as SurveyMonkey, were not used as these tools stored collected information outside of Canada, which contravened FOIPPA.

Table A1

Questionnaire Modification Details

Original Questionnaire Item	Modified/New Questionnaire Item and Rationale
Name	Name Rationale: No change – need name
Tenure in Organization (in months)	Length of service in government (in years) Rationale: Standard part of Ministry Human Resources questionnaires – need to determine if the participant is a new employee (i.e., less than 1 year) or long-service employee. It is expected that long service employees will have more diverse networks within government as compared to new employee informal networks.
Hierarchical Level	Managerial leadership stream (e.g., strategic, business or applied) Rationale: To determine the participant’s leadership stream.
Location	Office Address
Department	Branch
Primary Function	Original not used New item: Gender Rationale: To determine differences between genders New item: Age range
Name	Rationale: To determine differences between age ranges Name of Individual in your informal knowledge transfer network Rationale: Original questionnaire asked to name up to twenty people. Item moved to Relationship worksheet and Item heading clarified.

(table continues)

Original Questionnaire Item	Modified/New Questionnaire Item and Rationale
Q1. What is each person's physical proximity to you? 1: Same floor 2: Different floor 3: Different building 4: Different city 5: Different country	Q1. What is each individual's physical proximity to you? 1: Same floor, same building 2: Different floor, same building 3: Different building 4: Different city 5: Outside BC Rationale: Customized to research context.
Q2. Please indicate the organization in which each person works. 1: Within same department 2: Outside department, inside business unit 3: Outside business unit, inside organization 4: Outside organization	Q2. Please indicate the organizational level for each individual. 1: Within the same branch 2: Outside the branch, within the same division 3: Outside the division, within the ministry 4: Outside the ministry, within the Government of BC 5: Outside the BC Government Rationale: Customized to research context.
Q3. How long have you known each person? 1: Less than 1 year 2: 1-3 years 3: 3-5 years 4: 5-10 years 5: 10+ years	Q3. How long have you known the individual? 1: Less than 1 year 2: 1-3 years 3: 4-6 years 4: 7-10 years 5: More than 10 years Rationale: Customized to research context.
Q4. Please indicate each person's hierarchical level within the organization relative to your own. 1 = higher than yours 2 = equal to yours 3 = lower than yours 4 = not applicable	Q4. Please indicate each individual's hierarchical level in the ministry relative to your own. 1 = Higher than yours 2 = Equal to yours 3 = Lower than yours 4 = Not applicable 5 = Do not know the individual's hierarchical level Rationale: Customized to research context.
Sample lists 12 individuals for 3 cities: London, New York, and Chicago	Questionnaire will list the names of the target managerial population, as verified through discussions with Ministry Strategic Human Resources managers. Rationale: Customize list of names to research context.

(table continues)

Original Questionnaire Item	Modified/New Questionnaire Item and Rationale
<p>Q1. Information – Please indicate the frequency with which you typically turn to each person below for information on work-related topics.</p> <p>0: I Do Not Know This Person</p> <p>1: Never</p> <p>2: Seldom</p> <p>3: Sometimes</p> <p>4: Often</p> <p>5: Very Often</p>	<p>Q1. Suppose you needed information to help you resolve a complex work-related problem. Within the last three (3) months, how often did you contact the named individual for information on work-related problems? For each named individual, please select the most appropriate response:</p> <p>0 or Blank: I do not know this individual</p> <p>1: Never</p> <p>2: Once per week</p> <p>3: Two to three times per week</p> <p>4: Four to five times per week</p> <p>5: More than five times per week</p> <p>Rationale: Customize to research context and from social network analysis literature recommendations.</p>
<p>Q2. Awareness – I understand this person’s skills and knowledge. This does not necessarily mean that I have these skills or that I am knowledgeable in these domains, but that I understand what skills this person has and what domains they are knowledgeable in.</p> <p>0: I Do Not Know This Person</p> <p>1: Strongly Disagree</p> <p>2: Disagree</p> <p>3: Neutral</p> <p>4: Agree</p> <p>5: Strongly Agree</p>	<p>Q2. I would be more effective in my work if I could communicate with this individual more. For each named individual, please select the most appropriate response:</p> <p>0 or Blank: I do not know this person</p> <p>1: Strongly disagree</p> <p>2: Disagree</p> <p>3: Neither disagree or agree</p> <p>4: Agree</p> <p>5: Strongly agree</p> <p>Rationale: Customize to research context and from social network analysis literature recommendations.</p> <p>Original question selected and adapted from “I would be more effective in my work if I were able to communicate more with this person.”</p>

(table continues)

Original Questionnaire Item	Modified/New Questionnaire Item and Rationale
<p>Q3. Communicate More – I would be more effective in my work if I were able to communicate with this person more.</p> <p>0: I Do Not Know This Person</p> <p>1: Strongly Disagree</p> <p>2: Disagree</p> <p>3: Neutral</p> <p>4: Agree</p> <p>5: Strongly Agree</p>	<p>Q3. To whom do you typically give work-related information to? Within the last three (3) months, how often did you give the named individual work-related information? For each named individual, please select the most appropriate response:</p> <p>0 or Blank: I do not know this individual</p> <p>1: Never</p> <p>2: Once per week</p> <p>3: Two to three times per week</p> <p>4: Four to five times per week</p> <p>5: More than five times per week</p> <p>Rationale: Customize to research context and from social network analysis literature recommendations.</p> <p>Original question selected and adapted from “To whom do you typically give work-related information?”</p>

Table A2

Final Questionnaire

Social Network Analysis Questionnaire
Purpose:
<p>To support the ministry's Strategic Human Resources (SHR) corporate succession planning initiatives, the SHR Division wants to understand the extent of the many informal relationship networks that exist within the Health Sector Information Management/Information Technology (HSIMT) Division. As a result, SHR wishes to conduct a baseline analysis using social networking methodologies that will help reveal the extent of such informal networks. Gwen Lock, a doctoral candidate with Walden University (Minneapolis, Minnesota) and a manager within HSIMT, will be assisting us in conducting this baseline analysis. Data is collected according to the <i>Freedom of Information and Protection of Privacy Act (FOIPPA)</i>, Section 35.</p> <p>Your participation in this study is voluntary and non-participation will NOT affect you or your employment in any way. As complete participation is crucial to the success of the baseline analysis, many privacy and confidentiality procedures will be used to safeguard your information, steps that are summarized in the Confidentiality and Privacy section.</p> <p>This spreadsheet should take less to 20 minutes to complete.</p>
Confidentiality and Privacy:
<p>Please note that your answers are confidential. Results that identify you by name will only be known by the SHR team conducting the analysis. All individuals within the team have signed a Ministry Confidentiality Undertakings Agreement. Collected information will be secured and protected according to Ministry information security and privacy policies and standards. As this project is also being conducted as part of Gwen's doctoral studies, all research activities are being conducted in accordance with Walden University's Institutional Review Board ethical requirements and the Ministry's privacy requirements.</p> <p>All collected data will remain in Canada within custody and control of the Ministry. To protect your privacy, pseudonyms and/or aggregate information will be used in the research and/or baseline analysis reports.</p> <p>For further information on the confidentiality requirements, please contact:</p> <ul style="list-style-type: none"> • Sharon Stewart, Director Strategic Planning, SHR (250) nnn-nnnn Sharon.A.Stewart@gov.bc.ca or • Deb McGinnis, Director of Information Privacy and Records, HSIMT (nnn) nnn-nnnn or Deb.McGinnis@gov.bc.ca <p>For further information on the research aspects of this project, please contact:</p> <ul style="list-style-type: none"> • Dr. Lilburn Hoehn, (Dissertation Committee Chair) at Lilburn.Hoehn@waldenu.edu or • Dr. Leilani Endicott, Director of the Research Center at Walden University, can be contacted at 1-800-925-3368, extension 1210.
<i>(table continues)</i>

Instructions:

1. Please complete the separate [Consent](#) form so that the collected data can be used.
2. Please complete the following three spreadsheets in the following order:
 - a) Open the [Demographics](#) spreadsheet (click on the 'Demographics' tab at the bottom of the spreadsheet) and complete the seven questions that will tell us who you are. Response aggregation is used so that individual responses can not be identified in the final report.
 - b) Open the [Relationship](#) spreadsheet tab to complete the four questions that will identify the characteristics associated with your informal communication network. You can name up to 20 individuals, including co-workers, friends, and family - you are not restricted in naming individuals who are within the Ministry.
 - c) Open the [Network](#) spreadsheet tab to complete the three questions. You will be asked to indicate which divisional managers you received work-related advice from, gave work-related advice to, and wanted more communication with. Please save the completed Excel spreadsheet.
3. Please e-mail the entire Excel spreadsheet and the [Consent](#) document to Gwen.Lock@gov.bc.ca

[Thank you for your time and assistance!](#)

Your support will assist the Strategic Human Resources Division in identifying your Division's informal relationship networks that are being used. Results from this analysis will be presented at future SHR sessions and will be available in report form at the completion of the project.

(table continues)

Demographics

Purpose:

To map your informal relationship network, we need to know who you are and information regarding your role in the branch. This information will be used to develop an aggregate profile of how knowledge is informally given or received. Response aggregation is used so that individual responses can not be identified in the final report.

Instructions:

1. To the right of each question in the provided space, please indicate your response.
2. Once you have completed these questions, please complete the [Relationship](#) spreadsheet (please click on the [Relationship](#) spreadsheet tab to complete).

D1. Name (firstname, lastname): _____

D2. Length of service in government (in years): Length of service (in years)

D3. Managerial leadership stream (e.g., strategic, business, or applied leadership) (Please mark an 'X' to the left of one of the following choices):

<input type="checkbox"/>	Strategic Leadership
<input type="checkbox"/>	Business Leadership
<input type="checkbox"/>	Applied Leadership

D4. Branch (e.g., DARS, Corporate Registries): _____

D5. Office address (e.g., 1st floor 1515 Blanshard in Victoria): _____

D6. Gender: (Please mark an 'X' to the left of one of the following choices):

<input type="checkbox"/>	Male
<input type="checkbox"/>	Female

D7. Age (Please mark an 'X' to the left of the age range that is most appropriate):

<input type="checkbox"/>	Less than 20 years of age
<input type="checkbox"/>	20 to 29 years of age
<input type="checkbox"/>	30 to 39 years of age
<input type="checkbox"/>	40 to 49 years of age
<input type="checkbox"/>	50 to 59 years of age
<input type="checkbox"/>	Greater than 60 years of age

Please save this spreadsheet and complete the [Relationship](#) spreadsheet by clicking the Relationship tab

(table continues)

Informal Communication Relationship

Purpose:

The purpose of this section is to obtain information about your informal communication network.

Instructions:

1. In the leftmost column of this spreadsheet, please name up to **20** individuals who are important to you with respect to providing you with information that will assist you with your work or working on complex problems. Please type in the first name and last name of the individual in the space provided. The individual may be within your branch, division, other ministries or organizations outside of government (e.g., friends, family, consultants, etc.), including professional association affiliations. You may or may not communicate with these individuals frequently or on a regular basis.
2. In the space provided to the right of each named individual, please answer questions Q1 through Q4 using the indicated numeric response scale.
3. Once you have completed these questions for all identified individuals, please complete the **Network** spreadsheet by clicking the **Network** tab.

First name and last name of the individual (friend, family, co-worker or other individual) that is important to you and provides you with information that assists you with your work or working on complex problems.	Q1. What is each individual's physical proximity to you? 1 = Same floor, same building 2 = Different floor, same building 3 = Different building 4 = Different city 5 = Outside BC	Q2. Please indicate where each individual works. 1 = Within the same branch 2 = Outside the branch, within the same division 3 = Outside the division, within the ministry 4 = Outside the ministry, within the Government of BC 5 = Outside the BC Government	Q3. How long have you known the individual? 1 = Less than 1 year 2 = 1-3 years 3 = 4-6 years 4 = 7-10 years 5 = More than 10 years	Q4. Please indicate each individual's positional role relative to your own. 1 = Higher than yours 2 = Equal to yours 3 = Lower than yours 4 = Not applicable 5 = Do not know the individual's positional role
1.				
2.				
3.				
4.				
...				
19.				
20.				

(table continues)

Informal Communication Network

Purpose:

The purpose of this section is to obtain information about *how frequently* you use your informal communication network [within your Division](#).

Instructions:

1. The leftmost column ('Column A') identifies divisional managers. To the right of each named divisional manager in Column A, please answer questions Q1 through Q3. For your own name or if you do not know the person listed in Column A, please leave the response entry blank. Please insert a new row for a divisional manager that does not appear on the list.
2. Once you have completed these questions for all identified individuals, please [save](#) the entire spreadsheet and [e-mail](#) the completed spreadsheet and completed [Consent](#) to Gwen.Lock@gov.bc.ca.

Name of Divisional Manager	Q1. Suppose you needed information to help you resolve a complex work-related problem. Within the last three (3) months, how often did you receive information from the named individual in Column A that would assist you on a work-related problem? For each named individual, please select the most appropriate response: 0 or Blank = I do not know this individual 1 = Never 2 = Seldom 3 = Sometimes 4 = Often 5 = Very Often	Q2. Within the last three (3) months, how often did you give work-related information to the named individual in Column A? For each named individual, please select the most appropriate response: 0 or Blank = I do not know this individual 1 = Never 2 = Seldom 3 = Sometimes 4 = Often 5 = Very Often	Q3. I would be more effective in my work if I could communicate with this individual more. For each named individual in Column A, please select the most appropriate response: 0 or Blank = I do not know this person 1 = Strongly disagree 2 = Disagree 3 = Neither disagree or agree 4 = Agree 5 = Strongly agree
Person 1			
Person 2			
Person 3			
Business Management Office (BMO)			
Person 4			
...			
Person 8			

(table continues)

Corporate Management Operations (CMO)			
Person 9			
...			
Person 15			
eHealth Branch			
Person 16			
Person 17			
Person 18			
Electronic Health Record Branch			
Person 19			
Person 20			
Person 21			
eHealth, Privacy, Security and Legislation Office (eHPSLO)			
Person 22			
Person 23			
Gwen Lock			
Person 25			
Strategic Policy, Information Management and Data Stewardship			
Person 26			
...			
Person 33			
Vital Statistics Agency (Headquarters, IT Services, Support Services, Corporate Registries and Regions)			
Person 34			
...			
Person 41			

Appendix B: Questionnaire Transcribing

Figure B1 illustrates the transcribing process used for Network Questionnaire Question 1 for 8 fictitious individuals. For participant Alice, her questionnaire responses were transcribed to sociomatrix cell entries for Bob (cell row 1, column 2 or cell 1, 2), James (cell 1, 3), Sally (cell 1, 4) and Jodie (cell 1, 6). Sociomatrix rows are interpreted as *From* individual or *node*, with columns interpreted as *To* individual or node.

Q1. Suppose you needed information to help you resolve a complex work-related problem. **Within the last three (3) months, how often** did you *receive* information from the named individual in Column A that would assist you on a work-related problem? For each named individual, please select the most appropriate response:
 Blank = I do not know this individual
 1 = Never 2 = Seldom 3 = Sometimes
 4 = Often 5 = Very Often

Responses for Alice Smith

Name of Divisional Manager ('Column A')	Response
Alice Smith	
Bob Jones	5
James McCracker	3
Sally Sunshine	4
Tiffany Spring	
Jodie Applesmith	3
Tammy Ng	
Dave Green	

Responses Recorded As



From Original List 'Column A'	To Ref ID	Alice Smith	Bob Jones	James McCracker	Sally Sunshine	Tiffany Spring	Jodie Applesmith	Tammy Ng	Dave Green
From RefId		1234	1567	323	9716	8906	5193	7576	560
Alice Smith	1234		5	3	4		3		
Bob Jones	1567								
James McCracker	323								
Sally Sunshine	9716								
Tiffany Spring	8906								
Jodie Applesmith	5193								
Tammy Ng	7576								
Dave Green	560								

Figure B1. Questionnaire transcribing process.

Figure B1 illustrates that Alice contacted Bob (or *from* Alice to Bob) very often, as the sociomatrix cell entry (1, 5) contains the number 5 that corresponds to the response *very often*. Cells that are blank, such as for diagonal entries do not have meaning in this binary relationship, as it is a self-reciprocating relationship (i.e., *from* Alice to Alice). Using the sample response data from Figure B1, the data was transcribed to separate

spreadsheets for review and uploading (using the copy and paste function) into a blank UCINET spreadsheet (Table B1). Responses that were verified as correct were color coded. Missing cell entries were indicated with the letter *m*. Only cell entries that contained the study identifier, missing data, and participant responses were copied to UCINET. For example, the cells that were copied from row 4 were columns D through I. Similar columns were copied for the remaining rows 5 through 9.

Table B1

Sample Cleaned Relationship Summary Matrix

Cleaned Relationship Summary								
Q1. Important named person's proximity to Respondent								
Col A	Col B	Col C	Col D	Col E	Col F	Col G	Col H	Col I
Row 3	Pers on #	From Original List 'Column A'	To RefID	Alice Smith	Bob Jones	James McCracker	Sally Sunshine	Tiffany Spring
Row 4		From RefId		1234	1567	323	9716	8906
Row 5	1	Alice Smith	1234	m	5	3	4	m
Row 6	2	Bob Jones	1567	m	m	m	m	m
Row 7	3	James McCracker	323	m	m	m	m	m
Row 8	4	Sally Sunshine	9716	3	m	3	4	1
Row 9	5	Tiffany Spring	8906	m	m	m	m	m

Table B2 contains a description of the data cleanup activities for the relevant spreadsheet items.

Table B2

Questionnaire Data Cleanup

Item (Spreadsheet Name)	Sample Raw Input	Re-coded as	Notes
Participant Name (Demographics D1)	sally Smith	Sally Smith	Capitalized first letter of first and last name
	Smiley, Alice	Alice Smiley	Removed comma and reformatted name
	anna	Anna Smith	Capitalized first letter of first name, added last name (based on internal government address list)
	Missing entry	Sunny Day	Added first and last name
Length of Service (Demographics D2)	18	No change	Valid numeric range: 00 to 99
	3.75	4	Rounded input up to integer value
Managerial Stream (Demographics D3)	Strategic Leadership Business Leadership Applied Leadership	Strategic Business Applied	Managerial stream is alphabetic
Branch (Demographics D4)	CMO Corporate Management	CMO	Consistency of data
	Missing entry	CMO	Correct branch added as per confirmation from internal government address list
Location (Demographics D5)	1515 1515 Blanshard 1515 Blanshard Street 2 rd floor 1515 Blanshard in Victoria	2 rd floor, 1515 Blanshard St., Victoria	Consistency of data

(table continues)

Item (Spreadsheet Name)	Sample Raw Input	Re-coded as	Notes
Location (Demographics D5)	Missing entry	2 rd floor, 1515 Blanshard St., Victoria	Correct address added from internal government address list
	1515 1515 Blanshard 1515 Blanshard Street 2 rd floor 1515 Blanshard in Victoria	2 rd floor, 1515 Blanshard St., Victoria	Consistency of data
Gender (Demographics D6)	M or Male	Male	Male
	F or Female	Female	Female
Age Range (Demographics D7)	Numeric age as provided	LT20	Numeric age in the range: Less than 20 years of age 20 to 29 years of age, 30 to 39 years of age, 40 to 49 years of age, 50 to 59 years of age, Greater than 60 years of age.
		20	
30			
40			
50			
Greater than 60 years of age	GT60		
Network Question 1 (NQ1)	4	No recoding required	Valid input values: Blank: I do not know this person 1: Never 2: Seldom 3: Sometimes 4: Often 5: Very often
	N/A	Missing (blanks)	For cell (i, i): Diagonal cell entry
	Almost weekly	3	For cell (i, j): Assigned 3 as 'almost weekly' is regular; Removed alpha text from cell

(table continues)

Item (Spreadsheet Name)	Sample Raw Input	Re-coded as	Notes
Network Question 2 (NQ2)	4	No recoding required	Valid input values: Blank: I do not know this person 1: Never 2: Seldom 3: Sometimes 4: Often 5: Very often
	5 in cell (i, i)	blank for cell (i, i)	Diagonal cell entry
Network Question 3 (NQ3)	4	No recoding required	Valid input values: Blank: I do not know this person 1: Strongly disagree 2: Disagree 3: Neither agree or disagree 4: Agree 5: Strongly agree
Relationship Question 1 (RQ1)	4	No recoding required	Valid input values: 1: Same floor, same building 2: Different floor, same building 3: Different building 4: Different city 5: Outside BC
Relationship Question 2 (RQ2)	3	No recoding required	Valid input values: 1: Within the same branch 2: Outside the branch, within the same division 3: Outside the division, within the ministry 4: Outside the ministry, within the Government of BC 5: Outside the BC Government

(table continues)

Item (Spreadsheet Name)	Sample Raw Input	Re-coded as	Notes
Relationship Question 3 (RQ3)	3	Numeric from 1 through 5	Valid input values: 1: Less than 1 year 2: 1-3 years 3: 4-6 years 4: 7-10 years 5: More than 10 years
Relationship Question 4 (RQ4)	4	Numeric from 1 through 5	1: Higher than yours 2: Equal to yours 3: Lower than yours 4: Not applicable 5: Do not know the individual's positional role

Table B3 contains a description of the attribute coding changes for the Demographics questions.

Table B3

Demographics Attribute Coding

For Demographics Attribute	Item Code	Recoded for UCINET
Managerial Stream (D3)	Missing entry	M ¹
	Strategic	1
	Business	2
	Applied	3
	For named individuals only ²	99
Branch (D4)	Missing entry	M ¹
	Executive	1
	CMO, PMO, BPAM	2
	BMO	3
	EHealth	4
	EHR	5
	EHPSLO, CISA	6
	SPIMDS	7
	VSTATS	8
For named individuals only ²	99	

(table continues)

For Demographics Attribute	Item Code	Recoded for UCINET
Office Address (D5)	Missing entry	M ¹
	Coding withheld as could identify participants For named individuals only ²	1 through 8 99
	Gender (D6)	M ¹
Gender (D6)	Missing entry	M ¹
	Male	1
	Female	2
	For named individuals only ²	99
Age Category (D7)	Missing entry	M ¹
	Less than 20 years of age	1
	20 to 29 years of age	2
	30 to 39 years of age	3
	40 to 49 years of age	4
	50 to 59 years of age	5
	Greater than 60 years of age	6
	For named individuals only ²	99
Grouped Branch (Group D4) (New attribute)	Missing entry	M ¹
	Executive, CMO, PMO, BPAM	1
	BMO, EHPSLO, CISA, SPIMDS	2
	EHealth, EHR	3
	SPIMDS	4
	VSTATS	5
	For named individuals only ²	99
Grouped Years of Service (Group D2) (New attribute)	Missing entry	M ¹
	0 – 10 years of service	1
	11 – 15 years of service	2
	16 – 20 years of service	3
	21 – 25 years of service	4
	26 – 30 years of service	5
	31 – 35 years of service	6
	36 – 40 years of service	7
	Greater than 41 years of service	8
For named individuals only ²	99	
Grouped Office Address (Group D5) (New attribute)	Missing entry	M ¹
	1515 Blanshard St., Victoria	1
	1483 Douglas St., Victoria	2
	712 Yates St., Victoria	3
	Other locations	4
	For named individuals only ²	99

Note.

¹ Displayed in NetDraw as 0.

² For named individuals only, Relationship Questions Q1 through Q4.

Table B4 contains the UCINET commands and transformation notes associated with the creation of binary matrices for the network and relationship matrices.

Table B4

Dichotomous Matrix Transformation

Transform to New Matrix (Transform Dichotomize)	Transformation Notes
Values greater than (GT) 2 were transformed to 1, otherwise were set to 0. Diagonal entries and missing data were unchanged. Parameters: GT 2 Diagonals=No Matrix: NQ1Receive ¹	No transformation issues. New asymmetric matrix: NQ1ReceiveGT2.
Same as for NQ1Receive transformation. Matrix: NQ2GiveTo	Same as for NQ1Receive transformation. No transformation issues. New asymmetric matrix: NQ2GiveToGT2.
Blank was transformed to Blank. Values 1 and 2 were transformed to 1; Value 3 was transformed to 2, and Values 4 and 5 were transformed to 3. Matrix: NQ3MoreComm	No transformation issues. New asymmetric matrix: NQ3MoreCommGRP
Blank was transformed to Blank. Value 1 was transformed to 0, Value 2 was transformed to 1, and Value 3 was transformed to 2. Parameters: GT 1 Diagonals=No Matrix: NQ3MoreCommGRP	No transformation issues New asymmetric matrix: NQ3MoreCommGRPGT1
Values greater than (GT) 2 were transformed to 1, otherwise were set to 0. Diagonal entries and missing data were unchanged. Parameters: GT 2 Diagonals=No Matrix: RQ1Proximity	Some Values (2, 3, 4, and 5) remained in new matrix – had to manually check and code (e.g., 2 recoded to 0; 3, 4 and 5 recoded to 1). New asymmetric matrix: RQ1ProximityGT2

(table continues)

Transform to New Matrix (Transform Dichotomize)	Transformation Notes
Same as for RQ1Proximity transformation. Matrix: RQ1Proximity	No transformation issues. New asymmetric matrix: RQ2WorksGT2
Same as for RQ1Proximity transformation. Matrix: RQ3Known	No transformation issues. New asymmetric matrix: RQ3KnownGT2
Same as for RQ1Proximity transformation. Matrix: RQ4Position	No transformation issues. New asymmetric matrix: RQ4PositionGT2

Note.

¹ For questionnaire questions:

- NQ1Receive: Network Question 1 – *Receives Information* relation.
- NQ2GivesTo: Network Question 2 – *Sends Information* relation.
- NQ3MoreComm: Network Question 3 – *More Communication* relation.
- RQ1Proximity: Relationship Question 1, including named individuals – *Proximity* relation.
- RQ2Works: Relationship Question 2, including named individuals – *Works With* relation.
- RQ3Known: Relationship Question 3, including named individuals – *Known* relation.
- RQ4Position: Relationship Question 4, including named individuals – *Positional Role* relation.

Table B5 contains the social network analysis script used for the original and binary matrices for the questionnaire relations (e.g., the *Receives Information* relation is identified as NQ1).

Table B5

UCINET Analysis Script

Function	UCINET ⁶ Command ¹	N	N	N	R	R	R	R
		Q	Q	Q	Q	Q	Q	Q
		1 ²	2 ²	3 ²	1 ²	2 ²	3 ²	4 ²
Statistics	Tools Univariate		B,	B				
			V					
	Parameters: Cols: Out-degree (sends to), Diagonal=No							
	Tools Univariate		B,	B				
			V					
	Parameters: Rows: In-degree (receives from), Diagonal=No							
Centrality	Network Centrality Degree	B,	B,	V ⁴	B,	B,	B,	B,
		V	V		V	V	V	V
	Parameters: Asymmetric, Missing values included, Diagonal not included							
	Network Centrality Alpha Centrality	B	B		B	B	B	B
	Parameters: Bonacich Power using exact combinatorial method, Beta parameters: 0.5 and -0.5							
	Network Centrality Freeman	B,	B,		B,	B,	B,	B,
	Betweenness Node Betweenness	V	V		V	V	V	V
Centrality	Network Centrality Freeman	B,	B,	V ⁵	B,	B,	B,	B,
	Betweenness Edge Centrality	V	V		V	V	V	V
	Network Centrality Reach Centrality	B	B		B	B	B	B
	Note: Ucinet recoded Xij > 0 was recoded to 1 on binary data							
Cliques	Network Subgroups Cliques	B	B		B		B	
	Network Subgroups N-cliques	B	B					
	Parameters: N=2, Min. size=3							
Cohesion	Network Cohesion Maximum Flow	B	B	B ³	B			
	Network Cohesion E-I Index	B	B					
	Parameters: Using attribute partitions: Managerial Stream (D3), Age (D7), Grouped Location (GrpD5), For 5,000 permutations with random seed as input							
	Network Cohesion Density Overall (new)	B,	B,	B ³	B,	B,	B,	B,
		V	V		B	V	B	V
	Network Cohesion Density By Groups (new)	V	V		V	V	V	V
	Parameters: Row and column Attribute Managerial stream (D3)							
	Network Cohesion No. of Geodesics	B	B		B			
	Network Cohesion Distance	V	V		V			
	Parameters: Strengths/Capacities, Nearness transformation: None							

(table continues)

Function	UCINET ⁶ Command ¹	N	N	N	R	R	R	R
		Q _{1²}	Q _{2²}	Q _{3²}	Q _{1²}	Q _{2²}	Q _{3²}	Q _{4²}
Ego Networks	Network Ego Networks G&F Brokerage Parameters: Managerial stream (D3), Unweighted method. Note: UCINET recoded D3 attribute	B	B		B	B	B	B
	Network Ego Networks Honest Broker Index Parameters: Trust	B	B					
	Network Ego Networks Structural Holes Profile Parameters: Include transpose=yes, Handle diagonal values: ignored	B, V	B, V		B, V	B, V	B, V	B, V
	Network Ego network Egonet Basic Measures Parameters: Neighbourhood type=Out neighborhood				B	B	B	B
	Data Extract Ego Net Parameters: Include focal? Yes	V	V				V	
Region	Network Region Bi-component Parameters: Dataset was symmetrized by maximum method	B	B		B	B	B	B
Subgroups	Network Subgroups Lambdaset Note: Results were symmetrized by taking the larger of x _{ij} and x _{ji}	B	B		B	B	B	B
NetDraw ⁶	Layout Circle “nodetype”	V	V	V	V	V	V	V
	Layout Ego networks Geodesic distances from 1 to 5, distances equal to/from the ego.	V	V		V	V	V	V
	Layout Graph Theoretic Spring Embedding Criteria: Layout criteria: Distance + n. r. + equal edge lengths; Starting positions: Current positions; No. of iterations: 100; Distance between components: 5; Proximities: Geodesic distances	V	V		V	V	V	
	Layout Group by attribute Categorical attribute Parameters: Node shapes based on attribute Managerial Stream (D3). Colors based on: Grouped Length of Service (Group D2), Grouped Office Address (D5)	V	V		V	V	V	
	Analysis!K-cores Parameters: Node shapes based on attribute Managerial Stream (D3). Colors based on: Gender (D7), Age (D7), Grouped Length of Service (Group D2)	V	V					
	Analysis Subgroups Factions Parameters: Factions (2,3,4,5). Node shapes based on attribute Managerial Stream (D3).	V	V		V		V	

(table continues)

Function	UCINET ⁶ Command ¹	N	N	N	R	R	R	R
		Q ₁ ²	Q ₂ ²	Q ₃ ²	Q ₁ ²	Q ₂ ²	Q ₃ ²	Q ₄ ²
NetDraw ⁶	Analysis Reciprocal Ties Parameters: Node shapes based on Managerial Stream (D3). Colors based on other attributes: Grouped Location (Grouped D5)				V	V	V	V
	Analysis Centrality ⁷ Parameters: Closeness, harmonic closeness, betweenness, eigenvectors, 2-local eigenvector, degree; directed version; infinite distances (for closeness), substitute theoretical maximum (N). Node shapes: Properties Nodes Symbols Size Attribute Bases Indegree (or Outdegree)	V	V					

Note.

¹ For questionnaire questions:

- NQ1: Network Question 1 (NQ1Receive) – *Receives Information* relation.
- NQ2: Network Question 2 (NQ2GivesTo) – *Sends Information* relation.
- NQ3: Network Question 3 (NQ3MoreComm) – *More Communications* relation.
- RQ1: Relationship Question 1 (RQ1Proximity), including named alters – *Proximity* relation.
- RQ2: Relationship Question 2 (RQ2Works), including named alters – *Works With* relation.
- RQ3: Relationship Question 3 (RQ3Known), including named alters – *Known* relation.
- RQ4: Relationship Question 4 (RQ4Position), including named alters – *Positional Role* relation.

² Tests were conducted on matrices that contained one of the following types of data:

- B: Tests were conducted on matrices that contained binary data.
- V: Tests were conducted on matrices contained original or *valued* data.

³ For NQ3MoreCommGRP GT1 is the recoded matrix with cell values: blank (missing), 0, and 1.

⁴ For NQ3MoreComm and NQ3MoreCommGRP.

⁵ For NQ3MoreCommGRP only.

⁶ UCINET version 6.216 (Borgatti, Everett, & Freeman, 2002) and NetDraw version 2.090 (Borgatti, 2002).

⁷ Optimice. (2009, June). *NetDraw Basic: A practical guide to visualizing social networks, Version 1.0.*

Tables B6 and B7 contain detailed external-internal index (E-I index) calculations and expected value calculations for the *Receives Information* and *Sends Information* relational matrices that were partitioned by managerial stream, age range category, and grouped location.

Table B6

E-I Analysis – Receives Information

Whole Network Results		Freq	Pct	Possible	Density
By Managerial Stream	Internal	112.000	0.306	534.000	0.210
	External	254.000	0.694	1106.000	0.230
	E-I	142.000	0.388	572.000	0.349
By Age Category	Internal	88.000	0.240	450.000	0.196
	External	278.000	0.760	1190.000	0.234
	E-I	190.000	0.519	740.000	0.451
By Grouped Location	Internal	106.000	0.290	374.000	0.283
	External	260.000	0.710	1266.000	0.205
	E-I	154.000	0.421	892.000	0.544

Receives Information	E-I Index	Expected value for E-I Index	Maximum Possible External ties	Maximum Possible Internal Ties	Re-scaled E-I Index
By Managerial Stream	0.388	0.349	1106	534	0.388
By Age Category	0.519	0.451	1190	450	0.519
By Grouped Location	0.421	0.544	1266	374	0.421

Permutation Test (Number of iterations=5,000)		1	2	3	4	5	6	7
		Obs	Min	Avg	Max	SD	P >= Ob	P <= Ob
By Managerial Stream	Internal	0.306	0.213	0.326	0.486	0.037	0.726	0.332
	External	0.694	0.514	0.674	0.787	0.037	0.332	0.726
	E-I	0.388	0.027	0.348	0.574	0.075	0.332	0.726
By Age Category	Internal	0.240	0.175	0.274	0.404	0.030	0.894	0.148
	External	0.760	0.596	0.726	0.825	0.030	0.148	0.894
	E-I	0.519	0.191	0.452	0.650	0.059	0.148	0.894
By Grouped Location	Internal	0.290	0.142	0.228	0.344	0.030	0.032	0.981
	External	0.710	0.656	0.772	0.858	0.030	0.981	0.032
	E-I	0.421	0.311	0.544	0.716	0.060	0.981	0.032

Note.

¹ Maximum possible E-I given density & group sizes: 1.000; minimum possible E-I given density and group sizes: -1.000.

Table B7

E-I Analysis – Sends Information

Whole Network Results		Freq	Pct	Possible	Density
By Managerial Stream	Internal	146.000	0.326	534.000	0.273
	External	302.000	0.674	1106.000	0.273
	E-I	156.000	0.348	572.000	0.349
By Age Category	Internal	130.000	0.290	450.000	0.289
	External	318.000	0.710	1190.000	0.267
	E-I	188.000	0.420	740.000	0.451
By Grouped Location	Internal	138.000	0.308	374.000	0.369
	External	310.000	0.692	1266.000	0.245
	E-I	172.000	0.384	892.000	0.544

Sends Information	E-I Index	Expected value for E-I Index	Maximum Possible External ties	Maximum Possible Internal Ties	Re-scaled E-I Index
By Managerial Stream	0.348	0.349	1106	534	0.348
By Age Category	0.420	0.451	1190	450	0.420
By Grouped Location ²	0.384	0.544	1266	374	0.262

Permutation Test (Number of iterations=5,000)		1	2	3	4	5	6	7
		Obs	Min	Avg	Max	SD	P >= Ob	P <= Ob
By Managerial Stream	Internal	0.326	0.210	0.326	0.469	0.033	0.530	0.524
	External	0.674	0.531	0.674	0.790	0.033	0.524	0.530
	E-I	0.348	0.063	0.347	0.580	0.066	0.524	0.530
By Age Category	Internal	0.290	0.179	0.274	0.371	0.026	0.301	0.757
	External	0.710	0.629	0.726	0.821	0.026	0.757	0.301
	E-I	0.420	0.259	0.452	0.643	0.053	0.757	0.301
By Grouped Location	Internal	0.308	0.138	0.228	0.326	0.027	0.003	0.998
	External	0.692	0.674	0.772	0.862	0.027	0.998	0.003
	E-I	0.384	0.348	0.544	0.723	0.053	0.998	0.003

Note.

¹ Maximum possible E-I given density and group sizes: 1.000; minimum possible E-I given density and group sizes: -1.000.

² For Grouped Location, minimum possible E-I given density and group sizes: -0.670.

Table B8 contains details on the size of the individual or ego network, overall number of directed ties, number of pairs, density, efficiency to reach others (ReachE) and the propensity to perform information brokerage activities between groups (normalized broker or nBRoker).

Table B8

Ego Network Analysis (Details)

Relation (Binary data)	Individual (Ego)	Overall No. of Ties For the Ego ¹	No. of Ties Between ²	Pairs	Percent of Possible Ties Present (Density)	ReachE ³	nBroker ⁴
<i>Proximity</i>	9358	17.00	6.00	272.00	2.40	89.02	0.49
	8084	17.00	0.00	272.00	0.00	74.19	0.50
	9287	16.00	13.00	240.00	5.42	89.02	0.47
	9976	15.00	15.00	210.00	7.14	79.56	0.46
	8761	10.00	3.00	90.00	3.33	73.77	0.48
	5601	6.00	4.00	30.00	13.33	68.52	0.43
Value range		0 – 17.00	0.00 – 15.00	0 – 272.00	0 – 13.33	0 – 100.00	0 – 0.50
<i>Works With</i>	512	13.00	0.00	156.00	0.00	100.00	0.50
	1769	13.00	0.00	156.00	0.00	100.00	0.50
	221	13.00	0.00	156.0	0.00	100.00	0.50
	9358	12.00	0.00	132.00	0.00	78.95	0.50
	4434	12.00	0.00	132.00	0.00	66.67	0.50
Value range		0 – 13.00	0.00	0 – 156.00	0.00	0 – 100.00	0 – 0.50
<i>Known</i>	3461	18.00	4.00	306.00	1.31	7.43	0.49
	6528	13.00	7.00	156.00	4.49	77.78	0.48
	311	10.00	15.00	90.00	16.67	70.11	0.42
Value range		0 – 18.00	0 – 15.00	0 – 306.00	0 – 50.00	0 – 100.00	0 – 0.50

(table continues)

Relation (Binary data)	Individual (Ego)	Overall No. of Ties For the Ego ¹	No. of Ties Between ²	Pairs	Percent of Possible Ties Present (Density)	ReachE ³	nBroker ⁴
<i>Position-</i>	3461	18.00	1.00	306.00	0.33	81.25	0.50
<i>al Role</i>	1276	15.00	0.00	210.00	0.00	94.74	0.50
Value range		0 – 18.00	0 – 2.00	0 – 306.00	0 – 4.76	0 – 100.00	0 – 0.50

Note.

¹ The overall number of ties for the ego's network.

² Number of connections or directed ties between individuals in an ego's network. High values (e.g., greater than 10.00) indicate higher levels of interconnectivity between individuals, which may potentially weaken the ego's influence.

³ Reach efficiency (ReachE) scores are based on how many individuals are within two-steps of the ego divided by the size of the ego's network (Hanneman & Riddle, 2005, Chapter 9, Ego Network Density section).

⁴ Normalized Broker is calculated as the number of pairs of individuals within an individual's ego network that are not directly connected divided by the number of pairs (Hanneman & Riddle, 2005, Chapter 9, Ego Network Density section).

Table B9 contains the Bonacich power indices for the indicated relations. Using a positive weighting factor of 0.5 was used to determine individuals who have strong connections. Using a negative -0.5 weighting factor, individuals who had strong connections may have weaker influence as they had stronger, more influential neighbors.

If the neighbors were more dependent on the individual, then the individual's influence was stronger.

Table B9

Strength Based on Connectedness to Neighbors (Details)

Relation	Having the Right (Strong) Connections with Others ¹	Weaker Influence as Stronger Neighbors ²	Stronger Influence as Weaker Neighbors ²
<i>Receives Information</i>	Individual 2166: -40.754 (highest) 3461: -38.266 9431: -32.527 5601: -25.611	Individual 9431: -57.636 (highest) 6948: -29.992	Individual 5601: 31.818 (highest) 2166: 28.702 9476: 25.930
Value range	-40.754 to 20.327	-57.636 to 31.818	
<i>Sends Information</i>	Individual 3461: -33.672 (highest) 2885: -20.329 4434: -18.745 8446: -16.905	Individual 9287: -7.546 (highest) 311: -4.922 221: -3.632 1769: -1.542	Individual 8446: 15.791 (highest) 6948: 15.686 9976: 13.348 1373: 13.074 4434: 9.264
Value range	-33.762 to 5.822	-7.546 to 8.602	
<i>Proximity</i>	Individual 9358: 46.788 (highest) 4434: 36.396 6948: 30.232 8761: -17.330 1769: -16.997 1909: -15.661	Individual 8761: -3.547 (highest)	Individual 9358: 8.912 (highest) 4434: 8.542 1909: 7.140 9287: 7.849 1769: 7.387
Value range	-17.330 to 46.788	-3.5417 to 8.542	
<i>Works With</i>	Individual 512, 1769, 221: 13.000 (highest)	6 Individuals: -0.000 (highest) 7 Individuals: 0.000; Individuals 2204, 7156, 2885: 1.000	Individual 512, 1769, 221: 13.000 (highest) 9358, 1909: 12.000
Value range	-0.000 to 13.000	-0.000 to 13.000	

(table continues)

Relation	Having the Right (Strong) Connections with Others ¹	Weaker Influence as Stronger Neighbors ²	Stronger Influence as Weaker Neighbors ²
<i>Known</i>	Individual 8761: -47.899 (highest) 311: -39.358 1769: -39.031 3461: 34.000 6528: -33.410 2885: 33.000 8131: 32.000	Individual 1769: -4.291 (highest) 9358: -3.345 9287: -2.764	Individual 221: 14.000 (highest) 3461: 14.000 512: 10.000 1373: 8.814 8761: 8.418 8131: 8.000
Value range	-47.899 to 34.000	-4.291 to 14.000	
<i>Positional Role</i>	Individual 9287: 27.250 (highest) 3461: 21.000 8446: 18.500 9965, 6528, 1769, 1276: 15.000	Individual 9287: -11.250 (highest)	Individual 1276: 15.000 (highest) 3461: 15.000 8131: 13.000 1909: 11.000
Value range	-0.000 to 27.250	-11.250 to 15.000	

Note.

¹ Positive weighting used in exact combinatorial method, Alpha=0.5. Raw scores used, use absolute value when interpreting (Hanneman & Riddle, 2005, Chapter 10, Degree Centrality section). Interpret the highest index using the absolute value of the index.

² Negative weighting used in exact combinatorial method, Alpha = -0.5.

Appendix C: Interview Coding

Analysis of the interview sessions was performed using Atlas.ti software (version 6.1) on interview transcripts, interview notes, and additional field note comments or memos obtained prior to or after the interview. Within Atlas.ti, a project or hermeneutic unit (HU) was created (SNA Proj), prior to uploading the interview and other documents. Each new primary document (PD) was given a sequential number, starting from 1, and an assigned name associated with the first 30 characters in the document name (e.g., P1: Cleaned R1234 transcript.rtf). For the other documents, materials associated with the divisional newsletter were identified through the *NewsLtr* prefix, and the remaining documents assigned a *Doc* prefix, with a sequential number (Table C1).

Table C1

Atlas.ti Key Functions Used

Function	Atlas.ti coding
Set document path for the HU	Extras Preferences General Preferences and path tab were used to set the textbank (TBPATH_ pathname) TBPATH: D:\My Documents\2009 Atlasti Data\ Results in <TBPATH>: SNA Proj.hpr6
Load documents	Documents Assign and then using the Windows browse selection, select the name of the document to upload. Interview documents were prefixed with <i>PD</i> and a sequential number, e.g., PD1, PD2, etc. Newsletter documents were prefixed with <i>NewsLtr</i> and a sequential number, NewsLtr1, NewsLtr2, etc. Other documents, such as e-mails, were prefixed with <i>Doc</i> and a sequential number, e.g., Doc1, Doc2, etc.
Preliminary analysis using Word Cruncher	Tools Word Cruncher and used the default settings for stoplist, ignoring special symbols (e.g., [}/&) and ignoring case.

Different colors were used throughout the interview documents, research notes, and memos to distinguish the document source. For example, interview notes were

colored blue and contained an –INT suffix (e.g., **RESPALICES-INT**), whereas research notes were colored purple and contained an –INT-MEMO suffix (e.g., **RESPALICES-INT-MEMO**). Prior to analysis, the RESP prefix and interviewee’s name was replaced by a prefix of R and the corresponding study id (e.g., R1234). Atlas.ti’s Word Cruncher tool was used to perform preliminary analysis regarding common words that could be used for in vivo coding. The resultant Excel spreadsheet (SNA_ProjWPDMAT.xls) counted the number of words across all documents and within each document. Common words, such as *to*, *I* or speech patterns, such as *umm*, were hidden from further analysis. Table rows were colored to differentiate participant words from those used in the interview script and highlight words that were reviewed as possible codes (Table C2).

Table C2

Atlas.ti Word Crunch Color Coding

Color	Used For	Example
Fuschia	Interview script words	Knowledge, information
Yellow	Row counts greater than 30	Able, barrier, coffee
Light green	Row counts 20 to 29	Certain, comfortable, e-mails
Light blue	Row counts 10 to 19	Employee, lack, peers
Orange	High column totals greater than 1,900 words	P1 – for further analysis

Column totals for all words within a document were reviewed to determine which documents might contain further insights into developing additional codes (Table C3).

Table C3

Atlas.ti Word Crunch Excerpt

Words	P 1	P 36	P 37	Total
'APPROVED'	0	0	0	1
KNOW	20	1	0	381
KNOWING	0	0	0	11
KNOWLEDGE	20	16	2	640
LACK	0	0	0	18
MEMBERS	0	0	0	8
MESSAGE	0	1	0	32
MESSAGES	0	1	0	19
MESSAGING	0	0	0	23
MESSY	0	0	0	1
Total:	2718	825	181	62061

Primary documents that had word totals greater than 1,900 words were further reviewed to determine if there were code combinations or phrases that might be appropriate. This approach was also used for all of the other documents. Visual review of code category hierarchies in a tree structure hierarchy supported the development of code categories (Table C4).

Table C4

Atlas.ti Coding Hierarchy Excerpt

```

assumptions <is> Root
sharing_factors_human <is part of> assumptions
perceptions <is part of> sharing_factors_human
knowledge is power <is part of> perceptions
trust <is part of> sharing_factors_human

```

For example, individual codes, such as assumptions, perceptions, and trust viewed as being associated with or part of the code assumptions revealed a human knowledge

sharing factor, that was subsequently coded as sharing_factors_human. These codes were then aggregated as columns in a matrix to examine patterns (Table C5).

Table C5

Detailed Code Categorization Excerpt

Sharing practice is assoc with	Sharing enabler	Sharing inhibitor	Overlapping enablers and inhibitors	Sharing factors	Sharing factor is workload	Sharing tools
alternate sharing	f2f	booking meetings	e-mail	asset mgmt	lack of time	brainstorming
contribute, participate	flexible communication style	info overload	info sensitivity	assumptions	many concurrent tasks	e-mail
kn broker (sender role)	knowing recipient	lack of feedback	language	brainstorm		f2f
stories	openness	lack of honesty	language-jargon	clear accountability	flexible communication styles	
	opportunity to rephrase	lack of lessons learned	language-metaphors	common interest	humor	
	recipient role	lack of respect	meetings	complex info	language	
	reciprocity	lack of responsibility	newsletter	context	meetings	

Different cell and font colors were used to determine where a specific code could be used in multiple instances. For example, language was colored red as it was identified as a possible knowledge sharing enabler or inhibitor. These coding categories were then reviewed and combined to derive the identified themes.

Appendix D: Permissions

This section contains relevant permissions to use the sample questionnaire instrument and adaptations of previous works.

From: Cross, Robert [rlc3w@comm.virginia.edu]
 Sent: Monday, July 21, 2008 3:08 AM
 To: 'gelock@shaw.ca'
 Subject: Re: Request permission to adapt questions from The Hidden Power of Social Networks (2004) in doctoral survey

Please do feel free to do so Gwen. Best of luck with the dissertation!
 Rob

----- Original Message -----

From: Gwen Lock <[edited]>
 To: robcross@virginia.edu <robcross@virginia.edu>
 Cc: lhoehn@waldenu.edu <lhoehn@waldenu.edu>
 Sent: Sun Jul 20 22:07:18 2008

Subject: Request permission to adapt questions from The Hidden Power of Social Networks (2004) in doctoral survey

Hi Dr. Cross, hope that your summer is going well. I am in the midst of finalizing my doctoral proposal that will include a social networking analysis survey to examine informal knowledge transfer relationships between managers and exec directors in my organization. I am a doctoral student at Walden University (Minneapolis), with committee chair and mentor Dr. L. Hoehn (lhoehn@waldenu.edu).

I have been reading several of your research papers on social network analysis, and in particular the book The Hidden Power of Social Networks. In particular, I am interested in adapting example questions outlined in Appendix A of the book and need your permission to adapt the questions. I have also contacted your coauthor Andrew Parker, who has given me permission (June 30, 2008).

I am more than happy to share my draft/final questions with you and/or dialogue if you wish.

With much thanks – have a great week!

Cheers!

Gwen Lock MPA, MA, CISSP
 Walden University: PhD Candidate, AMDS gwen.lock@waldenu.edu

From: Andrew Parker [anparker@stanford.edu]
 Sent: Monday, June 30, 2008 3:00 PM
 To: Gwen Lock
 Subject: Re: introduction and request permission to use sample survey in your coauthored book Hidden Power of Social Networks

Hi Gwen,

Your research sounds interesting. Feel free to use any of the questions in the book. If you have any questions while drafting your survey tool or doing the analysis just let me know.

Best,

Andrew

At 02:11 PM 6/30/2008, Gwen Lock wrote:

Hi Andrew, I have been reading several of your research papers on social network analysis, and in particular the book *The Hidden Power of Social Networks*.

I am a second year doctoral student at Walden University (Minneapolis, MN) in the School of Management, Applied Management and Decision Sciences program, focusing on leadership and organizational studies. With my information technology background (27 years as a public servant) and interest in knowledge management, I am very interested in social networking analysis.

My PhD focus is using a mixed-methods case study for mapping knowledge transfer practices between executive directors and managers in two units within my organization to support corporate succession planning. My committee chair and mentor is Dr. Lilburn Hoehn, who can be contacted at lhoehn@waldenu.edu .

I found that your book was very informative, which sparked further research into several of your papers, such as those with Cross and Borgatti (2002), Cross and Nohria (2002), Cross, Laseter, and Velasquez (2006) to name a few.

For my research, I want to use previously developed questions as much as possible (for credibility, reliability), thus want to use several of the questions/approaches that were identified in Appendix A of the *Hidden Power* book.

I am in the early stages of developing my proposal now, so would appreciate knowing any concerns that you might have with my using the materials referenced in the book. Of course, I will be providing appropriate references to any materials that I will be using and can provide you with further updates on my survey drafting process if required.

I have e-mailed Dr. Cross as well to obtain permission.

With much thanks in advance.

Cheers!

Gwen Lock MPA, MA, CISSP

Walden University: PhD Candidate, AMDS gwen.lock@waldenu.edu

Permission to use Copyrighted diagrams:

From: hirotaka.takeuchi@gmail.com on behalf of Hirotaka Takeuchi

[htakeuchi@ics.hit-u.ac.jp]

Sent: Monday, July 28, 2008 2:29 AM

To: Gwen Lock

Cc: info@ics.hit-u.ac.jp; Lilburn Hoehn

Subject: Re: request permission to reproduce your diagram on the four modes of knowledge conversion in my doctoral studies

Hello Lock-san.

Permission granted with pleasure.

Ikujiro Nonaka and Hirotaka Takeuchi

On Mon, Jul 28, 2008 at 10:22 AM, Gwen Lock <gelock@shaw.ca> wrote:

> Hello Drs. Ikujiro Nonaka and Hirotaka Takeuchi.

>

> I am a Canadian doctoral student at Walden University (Minneapolis, Minnesota, USA) and preparing my dissertation proposal to explore knowledge transfer practices between executive directors and managers in my government organization. A key part of this proposal is the literature review on knowledge.

> I would like to include your diagram of the 4 modes of knowledge conversion (Nonaka & Takeuchi, 1995, p. 62) in my proposal and subsequent dissertation.

> Thus, I would greatly appreciate your permission to include this diagram with appropriate references.

> My dissertation Chair and Mentor is Dr. Lilburn Hoehn, who can be contacted at Lilburn.hoehn@waldenu.edu if you have further questions on my proposed study.
 > Nonaka, I., & Takeuchi, H. (1995). The Knowledge-creating company: How Japanese companies create the dynamics of innovation. NY: Oxford University Press, Inc.
 >> With much thanks (Domo arigato!) and appreciation for your permission.
 >> Cheers!
 > Gwen Lock MPA, MA, CISSP
 > Walden University: PhD Candidate, AMDS gwen.lock@waldenu.edu

From: Joe Labianca [mailto:joelabianca@gmail.com]
 Sent: Tuesday, September 29, 2009 10:34 AM
 To: Gwen Lock; Lock, Gwen HLTH:EX
 Cc: dhalgin@gmail.com; dejordy@bc.edu; msytch@umich.edu; chris.sterling@uky.edu; lilburn.hoehn@waldenu.edu
 Subject: Re: Request permission to adapt a slide from your 2009 AoM presentation for my dissertation

Hi Gwen,
 We appreciate you being so diligent in requesting our permission to cite the work. We're happy to have you do so.
 Good luck with your dissertation!
 Joe, Dan, Rich, Maxim, and Chris

On Mon, Sep 28, 2009 at 11:48 PM, Gwen Lock <[edited]> wrote:
 Hi Joe, Dan, Rich, Maxim and Chris - as I am a member of INSNA and SOCNET, I received the weblink to the LINKS site and reviewed your 2009 AoM presentation. I am in the final stages of doing my dissertation that uses social network analysis and I really liked your slide (page 22) as it put all of the key pieces of sna together in an easily digestible slide (I enjoyed the rest of he presentation as well and those on the LINKS site!). Thus, I would like to adapt your slide (see attached) to use in my dissertation on Who shares? Managerial knowledge transfer practices in British Columbia's Ministry of Health Services. I am a student at Walden University (Minneapolis) and my faculty Chair is Dr. Lilburn Hoehn (lilburn.hoehn@waldenu.edu) that you may e-mail if you have any questions regarding my request. If you wish to contact me during the day, I can be reached at e-mail (gwen.lock@gov.bc.ca, I'm in Victoria British Columbia, Canada on the west coast) during the day if you have questions.
 With thanks and much appreciation.
 Cheers!
 Gwen Lock MPA, MA, CISSP
 Walden University: PhD Candidate, AMDS gwen.lock@waldenu.edu

Appendix E: Invitations, Consent, and Forms

This section contains the study pre-announcement, and invitations that were used by participants in the study and field testing review process. The study pre-announcement and invitation to participate were sent to all HSIMT managerial staff as identified through discussions with SHR managerial staff that had verified internal managerial lists. The field testing consent and feedback forms were sent to a subset of the study's managerial population to refine the questionnaire and interview questions before final distribution.

STUDY PRE-ANNOUNCEMENT

Subject: Study Announcement

To support the ministry's Strategic Human Resources (SHR) corporate succession planning initiatives, the SHR Division wants to understand the extent of the many informal relationship networks that exist within the Health Sector Information Management/Information Technology (HSIMT) Division. As a result, SHR wishes to conduct a baseline analysis of informal managerial relationship networks to assist in the understanding of effective managerial knowledge transfer practices.

I have endorsed this study as part of ongoing staff engagement initiatives.

Over the next few weeks, all HSIMT managers will receive an e-mail invitation to take part in this divisional study on informal managerial knowledge sharing practices. This study is being conducted by a researcher named Gwen Lock, who is a doctoral student at Walden University in Minneapolis, Minnesota and a manager within HSIMT.

Your participation in this study and related activities is *voluntary*. Non-participation will *not* affect you or your employment in any way. Your confidentiality will be protected according to ministry privacy and security policies and Walden University's Institutional Review Board ethical practices. Only your consent form will be faxed or e-mailed to Walden University as part of institutional requirements. All collected data will remain in Canada within custody and control of the Ministry. Only aggregated information will be used in study reports.

When you receive your invitation, I encourage you to participate, as your views and insights will form an integral part of the division's and ministry's workforce engagement and succession plans. In the interim, please contact Gwen Lock if you require further information.

Elaine McKnight
Assistant Deputy Minister
Health Sector IM/IT Division

QUESTIONNAIRE E-MAIL INVITATION

Subject: HSIMT Study Questionnaire to be completed by April 6, 2009.

On February 23, 2009, you received an e-mail from Elaine McKnight that announced a forthcoming divisional study on informal managerial knowledge sharing practices. I am conducting this research as part of my doctoral studies at Walden University in Minneapolis, Minnesota, and not as part of my managerial role within the Health Sector IM/IT (HSIMT) division. Your participation in this research study is **voluntary** and non-participation will **not** affect your employment in any way.

A key part of this study is to understand informal managerial communications that are used within the workplace. The attached Excel spreadsheet "SNA Questionnaire Final Mar 23" will be used to collect data about your informal managerial communications network.

1. Please complete the three Excel spreadsheets in the "SNA Questionnaire Final Mar 23" questionnaire. Completion of these spreadsheets should take approximately 20 minutes.
2. Please complete the attached study consent form "SNA Consent Final Mar 23", so that the collected data can be used.

Once you have completed the consent form and the questionnaire, please e-mail them to me at Gwen.Lock@gov.bc.ca no later than **4.30 pm April 6, 2009**.

Thank you very much!!

Gwen Lock
Manager, HSIMT
E-mail: Gwen.Lock@gov.bc.ca Phone: 250.952.2492

INTERVIEW E-MAIL INVITATION

Subject: Would you be interested in participating in my HSIMT divisional study - interview component?

Hi [participant], in this phase of my HSIMT study, I am interviewing management to understand their knowledge sharing practices with respect to the following three questions:

- What *type* of work-related information would you share with another manager and how would you share it? With respect to type of work-related information, this is information that can be easily shared or more challenging to share, such as having a difficult conversation with a staff member.
- What are your key workplace knowledge sharing *enablers* (including terms or phrases) and knowledge sharing *barriers*?
- What workplace knowledge sharing practices have been *most effective* for you?

First, would you like to participate (it is voluntary, so I understand if you decline).
Second, if you are interested in participating, what would be an appropriate time for you? I am tentatively booking a 1 hr timeslot, yet expect we won't need that amount of time.

Can you please let me know your thoughts? With thanks!

Gwen Lock MPA, MA, CISSP

CONSENT FORM FOR STUDY PARTICIPATION

<p>Ministry of Health Services Strategic Human Resources Planning</p> <p>Social Network Analysis (SNA) on Informal Managerial Communication Networks</p> <p>Consent</p>
--

To support the ministry's Strategic Human Resources (SHR) corporate succession planning initiatives, the SHR Division wants to understand the extent of the many informal communication networks that exist within the Health Sector Information

Management/Information Technology (HSIMT) Division. As a result, SHR wishes to conduct a baseline analysis of informal managerial communication networks to assist in the understanding of effective knowledge transfer practices. Elaine McKnight, HSIMT ADM has endorsed this study as part of her ongoing staff engagement initiatives.

You are invited to take part in this divisional study on informal managerial knowledge sharing practices and were chosen based on your managerial role within HSIMT. Please review this form and ask any questions you have before agreeing to be part of the study.

This study is being conducted by a researcher named Gwen Lock, who is a doctoral student at Walden University in Minneapolis, Minnesota. None of the participants selected report directly to Gwen, who is employed in the ministry's Health Sector IM/IT (HSIMT) Division. Data is collected according to the *Freedom of Information and Protection of Privacy Act* (FOIPPA), Section 35.

Background Information:

The purpose of this study is to assess the division's informal managerial communication networks that support effective knowledge sharing practices, a key aspect of strategic succession planning and employee engagement practices.

Procedures:

If you agree to be in this study, you will be asked to:

- Complete a brief questionnaire regarding your informal work-related knowledge sharing practices.
- Be interviewed regarding your knowledge sharing experiences within the division. The interview may last from one to two hours.
- Allow the interviewer to record the interview.

You may be asked to review or verify analysis of the data for applicability relative to your experience.

Voluntary Nature of the Study:

Your participation in this study is **voluntary**. This means that everyone will respect your decision of whether or not you want to be in the study. Non-participation will **NOT** affect you or your employment in any way. If you decide to join the study now, you can change your mind later and decline to participate. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:

All reasonable efforts will be made to keep your identity and participation confidential and dissociated from your responses unless you provide specific permission authorizing direct quotation. The questionnaire and interview processes are your opportunity to influence divisional and ministry knowledge sharing practices that supports the ministry's strategic goals in providing a sustainable and affordable publicly funded health system.

Compensation:

No compensation is being provided or implied for your participation in this study.

Confidentiality:

Any information you provide will be kept confidential. All individuals within the SHR research team have signed a Ministry Confidentiality Undertakings Agreement. Collected information will be secured and protected according to ministry's information security and privacy policies and standards. As this project is also being conducted as part of Gwen's doctoral studies, all research activities are being conducted in accordance with Walden University's Institutional Review Board ethical requirements and the ministry's privacy requirements. All collected data will remain in Canada within custody and control of the Ministry. The researcher will not use your information for any purpose outside of this research project. To protect your privacy, pseudonyms and/or aggregate information will be used in the research and/or baseline analysis reports. Thus, your name or anything else that could identify you will not be used in any of the study reports.

Contacts and Questions:

The researcher's name is Gwen Lock, who can be contacted at 250-952-2492 or gwen.lock@gov.bc.ca. The researcher's faculty advisor is Dr. Lilburn Hoehn, who may be contacted at Lilburn.hoehn@waldenu.edu. If you want to talk privately about your rights as a participant, you can contact Dr. Leilani Endicott, Director of Walden University's Research Center at 1-800-925-3368, extension 1210.

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information. I have received answers to any questions I have at this time. I am 18 years of age or older, and I consent to participate in the study.

Printed Name of

Participant

Participant's Written or

Electronic* Signature

Researcher's Written or

Electronic* Signature

Note: Within BC, the *Electronic Transaction Act* [SBC 2001] governs the use of electronic signatures.

U.S. Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their e-mail address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

CONSENT FORM FOR FIELD TESTING

**Ministry of Health Services
Strategic Human Resources Planning**

**Social Network Analysis (SNA)
on
Informal Managerial Relationship Networks**

Pilot Testing Proposed Knowledge Sharing Questions

Consent

To support the ministry's Strategic Human Resources (SHR) corporate succession planning initiatives, the SHR Division wants to understand the extent of the many informal relationship networks that exist within the Health Sector Information Management/Information Technology (HSIMT) Division. As a result, SHR wishes to conduct a baseline analysis of informal managerial relationship networks to assist in the understanding of effective managerial knowledge transfer practices. Elaine McKnight, HSIMT ADM has endorsed this study as part of her ongoing staff engagement initiatives.

As part of this study, a questionnaire and interview questions will be used to collect information on your informal managerial knowledge sharing practices. You are invited to take part in a brief evaluation of these questions prior to their distribution to HSIMT's managerial population. You were selected based on your divisional managerial role as being representative of the proposed study participation. Please review this form and ask any questions you have before agreeing to be part of the pilot testing process.

Pilot testing is part of a larger study is being conducted by a researcher named Gwen Lock, who is a doctoral student at Walden University in Minneapolis, Minnesota. None of the participants selected report directly to Gwen, who is employed in the ministry's

Health Sector IM/IT (HSIMT) Division. Data is collected according to the *Freedom of Information and Protection of Privacy Act* (FOIPPA), Section 35.

Background Information:

The purpose of the pilot testing process is to refine and evaluate the study prior to the questionnaire and interview questions being distributed throughout HSIMT. The overall research study will assess the division's informal managerial relationship networks that support effective knowledge sharing practices, a key aspect of strategic succession planning and employee engagement practices.

Procedures:

If you agree to be in this pilot testing process, you will be asked to:

- Review the questionnaire and six interview questions regarding your informal work-related knowledge sharing practices.
- Provide feedback using a form or through a brief 15 to 20 minute interview.
- For interviews, allow the interviewer to record the interview using written notes.

You may be asked to review or verify analysis of the data for applicability relative to your experience.

Voluntary Nature of the Study:

Your participation in this pilot testing process is **voluntary**. This means that everyone will respect your decision of whether or not you want to be in the pilot testing process. Non-participation will **NOT** affect you or your employment in any way. If you decide to join the pilot testing process now, you can change your mind later and decline to participate. If you feel stressed during the pilot testing process you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:

All reasonable efforts will be made to keep your identity and participation confidential and dissociated from your responses unless you provide specific permission authorizing direct quotation. The pilot testing process is your opportunity to influence the proposed questionnaire and interview questions that will be used in the divisional study.

Compensation:

No compensation is being provided or implied for your participation in this pilot testing process.

Confidentiality:

Any information you provide will be kept confidential. All individuals within the SHR research team have signed a Ministry Confidentiality Undertaking Agreement. Collected information will be secured and protected according to ministry's information security and privacy policies and standards. As this project is also being conducted as part of Gwen's doctoral studies, all research activities are being conducted in accordance with Walden University's Institutional Review Board ethical requirements and the ministry's

privacy requirements. All collected data will remain in Canada within custody and control of the Ministry. The researcher will not use your information for any purpose outside of this research project. To protect your privacy, pseudonyms and/or aggregate information will be used in the research and/or baseline analysis reports. Thus, your name or anything else that could identify you will not be used in any of the study reports.

Contacts and Questions:

The researcher's name is Gwen Lock, who can be contacted at 250-952-2492 or gwen.lock@gov.bc.ca. The researcher's faculty advisor is Dr. Lilburn Hoehn, who may be contacted at Lilburn.hoehn@waldenu.edu. If you want to talk privately about your rights as a participant, you can contact Dr. Leilani Endicott, Director of Walden University's Research Center at 1-800-925-3368, extension 1210.

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information. I have received answers to any questions I have at this time. I am 18 years of age or older, and I consent to participate in the study.

Printed Name of

Participant

Participant's Written or

Electronic* Signature

Researcher's Written or

Electronic* Signature

Note: Within BC, the *Electronic Transaction Act* [SBC 2001] governs the use of electronic signatures.

U.S. Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their e-mail address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

FEEDBACK FORMS FOR FIELD TESTING

During field testing, participants were requested to provide feedback on the readability and overall presentation format for the questionnaire (Table E1) and interview questions (Table E2).

Table E1

Questionnaire Feedback

Consolidated Feedback	Researcher Notes	Item prior to field testing	Item changes to reflect field testing
Overall/additional comments			
Instruction worksheet			
Demographics worksheet			
Relationship worksheet			
Network worksheet			

Table E2

Interview Questions Feedback

Consolidated Feedback	Researcher Notes	Item changes to reflect field testing
Overall/additional comments		
Question 1		
Question 2		
Question 3		
Question 4		
Question 5		
Question 6		

Appendix F: Sample Population Details

Table F1 contains a summary of the key managerial job titles and branch. From this summary, participants were selected for interviews.

Table F1

Sample Population Details

Division (As of December 14, 2008, from Internet Directory) ³	ADM	Exec Dir.	Dir- ector	Proj Dir	Mgr	Proj Mgr	Staff	Row Sum	Mgr Row Sum
HSIMT Division	1	6	23	2	17	2	229	280	51
HSIMT (Without VStats)	1	5	21	2	5	2	155	191	36
Executive	1	2	2		1		4	10	6
BMO ¹		1	4				21	26	5
- BMO Office		1	3				8	12	4
- BMO edrug			1				13	14	1
CMO ¹		1	6		1		31	39	9
- Office		1					3	4	1
- Arch. & Stds.			1					1	1
- BPAM			1				15	16	1
- Policy			1				3	4	1
- Procurement					1		3	4	2
- Program Eval			1				3	4	1
- Project Mgmt			1				3	4	1
- Risk Mgmt			1				1	2	1
DARS ¹			1				26	27	1
eHealth Branch		1	4	1		2	33	41	8
eHPSLO ¹			2		3		11	16	5
- Office							2	2	0
- CISA			1		2		2	5	3
- CIPR			1		1		6	8	2
- Privacy & Leg.							1	1	0
KID ¹			2	1			29	32	3

(table continues)

Division (As of December 14, 2008, from Internet Directory) ³	ADM	Exec Dir.	Dir- ector	Proj Dir	Mgr	Proj Mgr	Staff	Row Sum	Mgr Row Sum
Vital Statistics									
Agency		1	2		12		74	89	15
CEO Office		1			1		7	9	2
IT Services			1				10	11	1
Support Services (SS) ²					1		23	24	1
- Business Ops.					1		18	19	1
- Finance							5	5	0
Corporate Registries			1		1		12	14	2
Region 1 – Pr. George					1		2	4	2
Region 2 – Van. Is./Suns. Cst. ²					3		10	13	3
Region 3 & 4 – Vancouver ²					3		6	9	3
Region 5 – Kelowna					1		4	5	1

Note.

¹ CMO: Corporate Management Operations; BMO: Business Management Office;

DARS: Data Access and Research Stewardship; eHPSLO: eHealth Privacy, Security and Legislation Office; KID: Knowledge Integration and Development.

² Includes assistant managers (Supervisor adjudication and office manager not included as unclear of exclusion).

³ Branch groupings based on December 14, 2008 displayed job titles and branches from the government's Internet directory (<http://www.dir.gov.bc.ca>).

Appendix G: Interview Questions

Prior to field testing, six interview questions were proposed (Table G1) and revised for the final versions (Table G2).

Table G1

Interview Questions Used in Field Testing

The type of information often influences how one shares their knowledge with others. Information, such as what format to use when creating Briefing Notes, can be codified and easily shared. In contrast, completing a Briefing Note template is less easy, as this combines one's experiences, skills, knowledge, assumptions, and values.

1. With these concepts in mind, what types of information would you share? Why?
2. In what contexts or situations would you share this information? Why?
3. Do you use any particular terms or phrases when sharing knowledge with different individuals? For example, would you use the same terms when sharing knowledge with managers in your branch as compared to other managers in other ministry divisions?

Now let's step back a bit and look more broadly regarding possible knowledge sharing practices within your work environment.

4. In your view, what do you see as the key barriers to successful knowledge sharing?
 5. Have you had to adapt or shift your preferred knowledge transfer practices to adapt to change in your work? Why or why not?
 6. In your opinion, what has been effective for you in sharing knowledge? Why was this effective?
-

Questions 1 through 3 were used to surface complex knowledge sharing techniques, as per previous research (Davenport & Prusak, 2000; Ipe, 2003; McGill, 2006; Pratt, 2006). Question 3 was used to surface details regarding specific terms or phrases to determine if there were differences between linguistic terms used by managers and executive directors (Scalzo, 2006). Questions 4 and 5 were used to determine if organizational restructuring, shifting ministry priorities, technological change, such as increased use of Sharepoint and other collaborative technologies, or other factors posed

knowledge sharing barriers (Pratt, 2006; Scalzo, 2006). Question 6 was used to determine if managers experienced increased organizational pressures to make decisions and resolve issues with less available knowledge. Scalzo (2006) found that under certain circumstances, individuals often adapted current practices and used lesser known practices. After field testing feedback and discussions with SHR, the interview questions were revised (Table G2).

Table G2

Final Version of Interview Questions

The type of information often influences how one shares their knowledge with others. Information, such as what format to use when creating Briefing Notes, can be codified and easily shared. In contrast, deciding upon an approach to initiate a difficult conversation with a staff member is more challenging, as the approach must incorporate your past personal and professional experiences, skills, knowledge, assumptions, and values.

1. With these concepts in mind, what types of information would you share in the workplace? Why?
2. In what contexts or situations would you share this information? Why?
3. Do you use any particular terms or phrases when sharing knowledge with different individuals? For example, would you use the same terms when sharing knowledge with managers in your branch as compared to sharing the same knowledge with managers in other ministry divisions or other ministries?

Now let's step back a bit and look more broadly regarding possible knowledge sharing practices within your work environment.

4. In your view, what do you see as the key barriers to successful workplace knowledge sharing? For example, too many formal organizational rules? Difficulties in contacting other individuals or managers as they are not in the same location?
 5. Individuals often have to adapt their preferred methods of sharing hard-to-share knowledge, when their work environment changes. For example, suppose that you preferred in-person discussions when exchanging knowledge with other divisional managers. Also suppose that work environment changes made these in-person discussions difficult. What changes, if any, would you make to your knowledge transfer practices to ensure that this complex knowledge could be transferred?
 6. Reflecting on your overall approach regarding knowledge transfer with managers within the workplace, what has been most effective for you in sharing knowledge? Why was this effective?
-

Appendix H: Project Tasks

Table H1 describes the key activities in the three study phases: (a) preliminary activities, (b) implementation and analysis, and (c) distribute findings.

Table H1

Project Tasks

Phase	Detailed Description ¹
1: Preliminary	1. Conducted discussions with Director of Strategic Planning (SHR) on social networking analysis ethical issues, proposed questionnaire, interview questions, and overall approach (in-person and e-mail).
	2. Researcher started journal log.
	3. Obtained formal agreement to participate from SHR (15 minutes, in-person).
	4. Discussed and confirmed with SHR the key individuals to select for questionnaire pilot and interviews (30 minutes, in-person or e-mail).
	5. Developed invitation and consent forms (questionnaire and interview pilot, questionnaire, and interviews).
	6. Obtained and completed ministry Privacy Impact Assessment (PIA), Information Sharing Agreement (ISA), and Institutional Review Board (IRB) forms.
	7. Obtained UCINET (including NetDraw) and Atlas.ti software.
	8. Obtained audio recording equipment (purchase).
	9. Generated numerical coding transformation list for pilot and questionnaire participant names.
	10. Distributed study pre-announcement via e-mail from the Assistant Deputy Minister.
	11. Researcher distributed (via e-mail) pilot testing consent, questionnaire, interview questions, and feedback forms.
	12. Conducted pilot test of questionnaire and interview questions (3 business-days, excluding holidays; 15 to 20 minutes for each participant)

(table continues)

Phase	Detailed Description ¹
2: Implementation and Analysis	13. Received pilot testing participant feedback (in-person, e-mail or via telephone).
	14. Discussed pilot test results and feedback with SHR and adjusted approach (1 hour, in-person).
	15. Scheduled questionnaire implementation with SHR (30 minutes, in-person).
	16. Developed reminder notifications and discuss with SHR (30 minutes, in-person).
	17. Researcher distributed consent letter and questionnaire for completion over 10 business days.
	18. Researcher received signed consent forms (10 business days).
	19. Researcher begins development of final report (ongoing process).
	20. Researcher issued reminder notifications to questionnaire participants via e-mail on the 4 th , 8 th and 11 th days in the study period.
	21. Researcher advised SHR on completion progress (in-person or e-mail).
	22. Researcher developed maps using UCINET/NetDraw.
	23. Researcher discussed UCINET results with SHR (in-person or e-mail).
	24. Researcher scheduled in-person and telephone interviews with candidates and issues invitation and consent letters. Contingency plan was to conduct more telephone interviews.
	25. Researcher developed interview reminders and confirmed with SHR.
	26. Researcher issued interview reminders, including re-issuing consent letters as appropriate.
	27. Researcher obtained appropriate interview resources (paper, audio tapes) and pre-tested them to ensure that they worked as intended.
	28. Researcher conducted interviews (60 to 90 minutes, in-person or telephone).
	29. Post-interview, researcher completed their journal and reflective log.
	30. Audio cassette interviews were transcribed.
	31. Researcher entered transcription/audio into Atlas.ti.
	32. Researcher confirmed transcript contents with interviewee (e-mail distribution).
3: Distribute Findings	33. Researcher analyzed interview transcripts.
	34. Researcher conducted iterative document review and analysis process (intranet, e-mail, in-person, and telephone). Documents were analyzed for patterns/themes that emerged from interviews.

(table continues)

Phase	Detailed Description ¹
3: Distribute Findings	35. Researcher developed presentation materials (using pseudonyms) for SHR and participants.
	36. Researcher discussed presentation (content and logistics) with SHR.
	37. Researcher obtained approval of presentation format with SHR.
	38. Researcher scheduled presentation meetings with SHR and participants (including room booking, etc.).
	39. Researcher (with SHR present as project sponsor) presented materials to participants.
	40. Researcher/SHR discussed post-presentation feedback (e.g., adjustments in presentation format, etc.).
	41. Researcher finalizes draft report (including assumptions, biases, reflections, etc.).
	42. Researcher/SHR discussed final report.
	43. Researcher distributed final draft report to participants to review within 10 business days.
	44. Researcher collected participant feedback and adjusts report (or not) as appropriate.
	45. Researcher issued final report to SHR for recommending approval by Ministry of Health Services SHR and HSIMT ADM.

Note.

¹ Ministry of Health Services (MOHS), Victoria location. Vital Statistics (VStats) is primarily located in Victoria yet may be in other geographic locations.

Key project tools included the accurate recording of questionnaire and interview activities. Table H2 illustrates the sample questionnaire log used to track the invitation to participate, reminders, and participate responses. Table H3 illustrates the sample interview log used to record events regarding the interview process. Color coding was used in the questionnaire and interview logs to indicate key activities.

Table H2

Sample Questionnaire Log

	HSIMT	Position	Study Ref-ID	Sent SNA Invitation	Reminder #1 Day 4	Reminder #2 Day 8	Final Reminder Day #11	Feedback and consent Received
1.	Alice Smith	Mgr - Business	1234	Mar 23 2009	Mar 29	Apr 2		April 2 - received feedback and consent
2.	Bob Jones	Mgr - Strategic	1567	Mar 23 2009	Mar 29	Apr 2		April 3 – received feedback and consent
3.	James McCracker	Mgr - Business	323	Mar 23 2009	Mar 29	Apr 2	April 7	No response

Table H3

Sample Interview Log

	HSIMT	Position	Study Ref-ID	Proposed Interviewee ?	Notes
1.	Alice Smith	Mgr - Business	1234	x	Feedback received May 12 Cleaned transcript with study id sent May 5 Interview scheduled May 1 Consent received April 26 Email invitation sent Apr 26
2.	Bob Jones	Mgr - Strategic	1567	x	Email invitation sent Apr 26
3.	James McCracker	Mgr - Business	323	Backup selection	

Appendix I: Visual Networks

This section contains visual networks for selected individuals who appeared to be central within the division's managerial network. One step ego networks are networks where an individual's or ego's neighbors are one step to or from the ego, an indication of how close one is to the ego.

One Step To or From Ego 8012

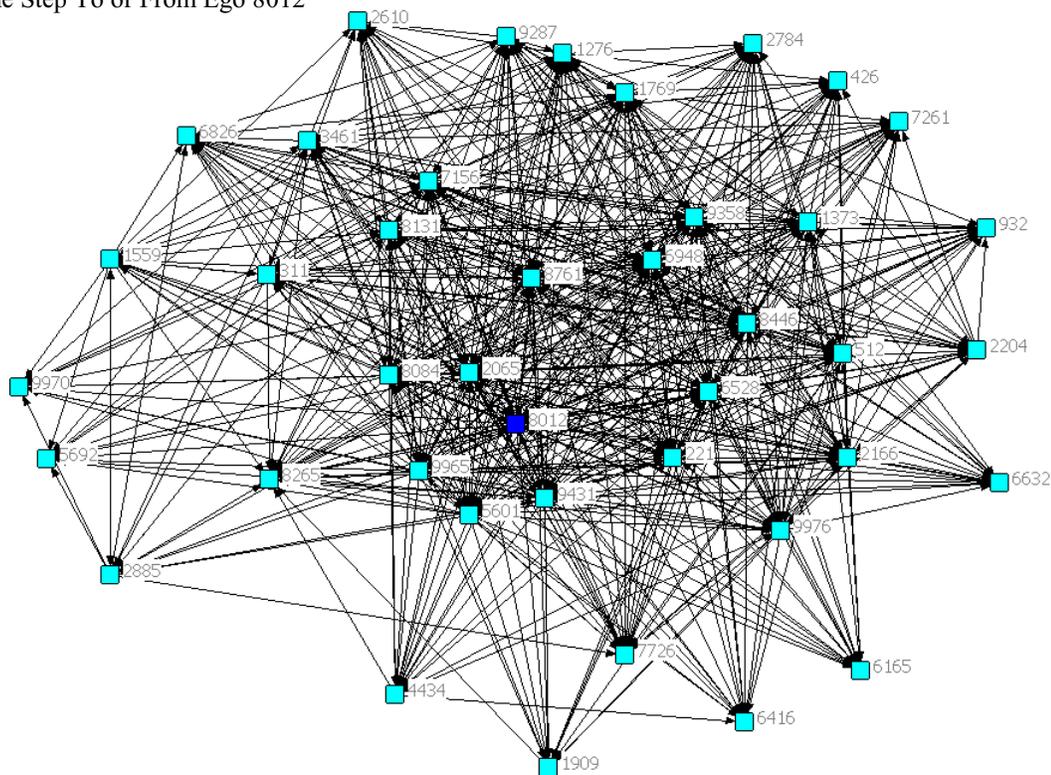
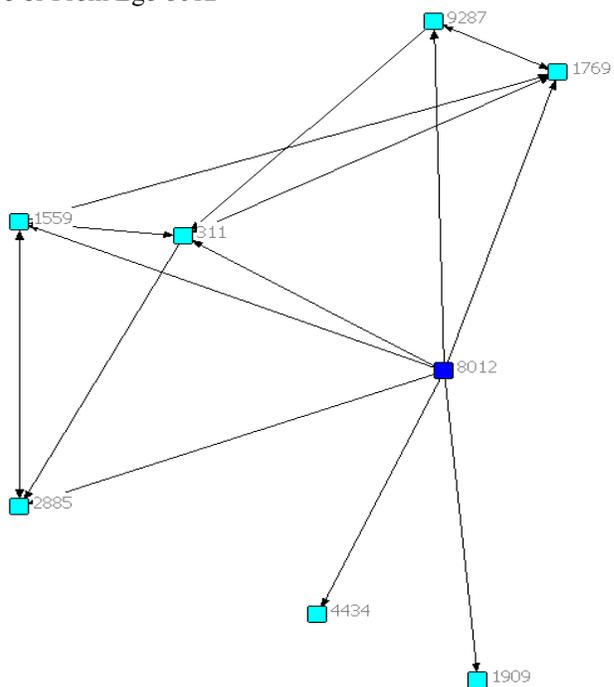


Figure 11. One step ego network for individual 8012.

Two Steps To or From Ego 8012



Two Steps To or From Ego 8446

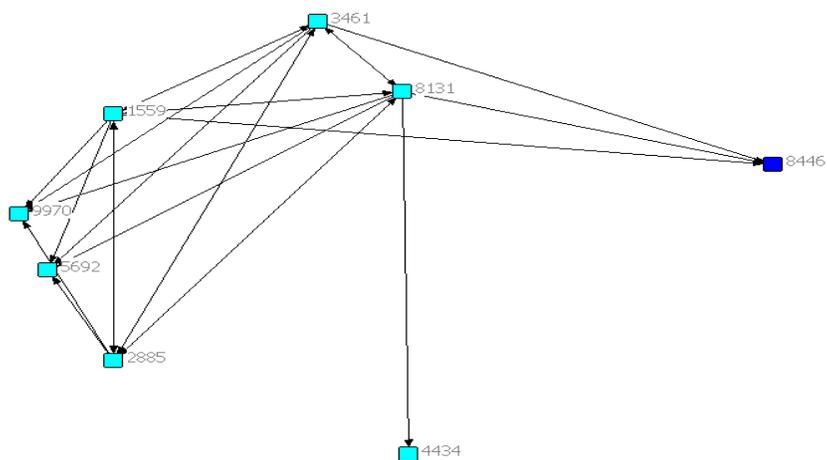


Figure I3. Two step ego networks for individuals 8012 and 8446.

Two Steps To or From Ego 9965

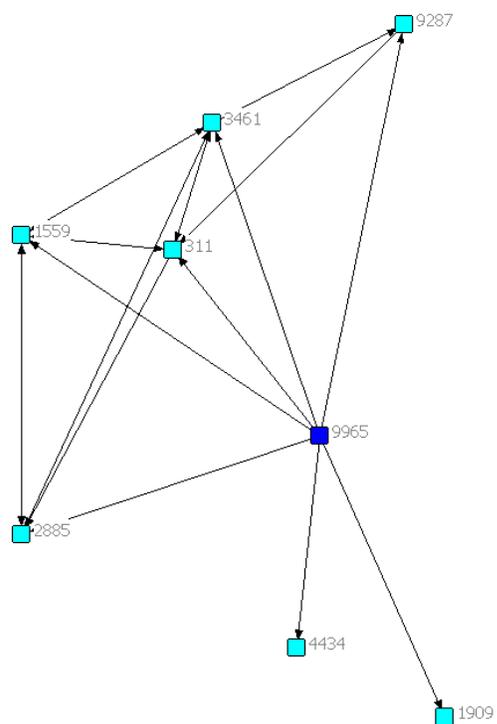


Figure I4. Two step ego network for individual 9965.

Appendix J: Recommended Knowledge Sharing Measures

To increase connectivity between different managerial streams and improve managerial knowledge sharing practices, the ministry's managerial training curriculum should include the following elements (Table J1).

Table J1

Managerial Curriculum Knowledge Sharing Elements

Element	Curriculum Goal(s)	Rationale
Active listening	To improve active listening skills.	To enhance self-awareness and listening skills that are needed to frame and deliver meaningful messages.
	To enhance one's self-awareness skills by recognizing one's biases and <i>fight or flight</i> triggers and responses.	To enhance one's ability and capacity to be flexible in different knowledge sharing contexts.
	To understand one's feedback and filtering processes.	To value the contributions from the recipient.
Brokerage roles (coordinator, gatekeeper, representative, consultant, and liaison)	To use each role in different knowledge sharing contexts (branch, division, ministry, broader government and health sector).	To understand the strength and challenges of each role with respect to knowledge sharing.

(table continues)

Element	Curriculum Goal(s)	Rationale
Visual, verbal, and nonverbal communication approaches	To use different communalization approaches in different contexts.	To enhance one's abilities and capacities for using diverse communication styles and behavioral and/or technical tools to share knowledge.
	To understand when to use humor, jargon, debate, metaphors and concise language.	
	To understand what technological tools, such as e-mail, instant messaging, <i>Live Meeting</i> , and presentations, are effective for what knowledge sharing contexts.	
Effective meeting practices	To improve one's skills in conducting effective meetings.	To improve managerial skills in preparing and conducting formal and informal meetings.
	To understand how to prepare materials for in-person and meeting contexts where some participants are not physically present.	
	To understand how to conduct meetings to ensure that each person participates and knows what their role(s) are.	
	To understand the immediate and longer term benefits and disadvantages from impromptu informal meetings (including when to call five minute meetings to discuss urgent issues).	
Effective knowledge sharing practices	To increase one's experience in generating new knowledge sharing practices within and across different groups.	To improve managerial skills that enable knowledge sharing between individuals who have different areas of expertise (e.g., new to government, from different divisional branch, or lengthy government service).

To ensure that the knowledge sharing elements are embedded within the manager's learning experiences, there should be pre- and post learning sessions. Post learning sessions, such as monthly sessions over a 6 month period, provide the manager time to practice the learned skills and obtain feedback from peers. Over time, the divisional and ministry's organizational culture will include these elements within ministry business practices.

Visible signage to indicate individuals who are willing to act as knowledge resources should be could be established as visible signs for cubicles or offices and in an electronic list, such as on the ministry's intranet site. Knowledge sharing categories could be for core ministry functions, such as analyst, and include specialty areas, such as audit or physician services (Table J2). As knowledge sharing would be part of an individual's employee performance plan, quarterly updates on knowledge sharing expertise areas could be forwarded through branch management to divisional communications staff for updating electronic lists. List updates would be sent to staff through intranet website alerts, divisional newsletters, or from branch meeting updates.

Table J2

Voluntary Knowledge Sharing Signage Categories

Element	Element Description
Administrative	For knowledge regarding key ministry administrative processes, such as briefing note drafting and submission, and corporate correspondence tracking systems (CLIFF)
Policy	For financial, health, and electronic (eHealth) policy knowledge
Legislative	For knowledge regarding the legislative drafting and submission process

(table continues)

Element	Element Description
Data Access	For knowledge regarding the drafting or interpretations of research agreements or information sharing agreements
Business Analyst	For operational business support services to program areas, including translating program area requirements into information system requirements
Specialist – Audit	For financial, medical services plan billing audit, and information security audit knowledge areas
Specialist – [Program Area Name]	For knowledge of a particular program area, such as physician services, information security, or eHealth

Curriculum Vitae

Gwendolyn Elizabeth Lock

Work: 250.952.2492 E-mail: gelock@shaw.ca Victoria, BC., V8N 5Y6

Education

Ph.D Candidate Walden University	Minneapolis, MN
Expected graduation in March 2010 in Management, specialty Leadership and Organizational Change	
Master of Arts in Leadership and Training, Royal Roads University	2002
Master of Public Administration, University of Victoria	1996
B.Sc., Majoring in Computer Science, University of Victoria	1981
Provincial Instructor's Diploma, Vancouver Community College	2006
Diploma of Public Sector Management, University of Victoria	1990
Certified Information Systems Security Professional (CISSP, (ISC) ²)	2006

Recent Research

Leadership Development Learning Module comprised of leadership theories, current research on leadership development programs. The research application analyzed the Ministry of Health's 2007 Employee Engagement and 2007 Trust Audit findings with respect to effective leadership characteristics and organizational enabling tools.

Organizational Change Learning Module focused on organizational culture theories and current research regarding organizational implications from change agents, such as information, relationships, structures, processes, and technologies. The research application analyzed the Ministry of Health, Knowledge Management and Technology Division's organizational learning practices with respect to the identified change agents.

Publications

Career Development International Journal (Emerald Publishing, UK): <i>IT Careers in British Columbia</i>	2003
Change Delivered (Royal Roads University): <i>E-Leadership in a Digital World</i>	2002

Professional Experience

As the Ministry Information Security Officer, providing all aspects of information security advice and expertise, including conducting investigations and security reviews, developing policies, policy development, and providing security awareness to the Ministry of Health Services and strategic ministry projects.	April 2005 to Present
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Professional Experience

Providing project management advice and guidance in the Ministry of Children and Family Development's Contacted Services branch, including co-leading the ministry implementation of the government's enterprise procurement management system (iProcurement).	March 2004 – April 2005
As Royal Roads University associate faculty, teaching adult learning theories to graduate students (average class size 13 to 18) in an online community through coaching/mentoring, facilitating and providing constructive feedback and assessment.	2002 – 2006
Providing graduate thesis supervision, effective feedback, editorial guidance, and critical thinking to Royal Roads University learners.	2004 - 2006
Co-authoring or leading the writing of Royal Roads University problem-based learning case studies that involved complex organizational issues. Activities were conducted within constricted time frames and included teamwork, project management expertise, coordination, and participation of integrated graduate learning seminars.	2001 – 2006
As University of Phoenix (Vancouver) faculty teaching computer fundamentals to business students (average class size 7 to 9) in classroom and online environments, activities that included developing lesson plans, revising teaching materials, providing constructive feedback and assessment.	2005
As a senior policy analyst in corporate government technology policy, providing expertise and guidance in the research, development, and implementation of complex technology policies.	2000 – April 2005
Various programmer analyst to increasingly more responsible and complex technological analyst positions in several ministries, including development of database technology standards for Ministry of Health Human Resources system, security policy frameworks and security incident response for government (Ministry of Management Services).	1981 - 2000

Professional Associations, Certifications, and Awards
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Certified Information Systems Security Professional (CISSP)	September 2009, 2006
Completed Project Management Professional Certification (PMP)	1997
Member: Information Systems Audit Control Association (ISACA), International Network for Social Network Analysis (INSNA), and (ISC) ² Information Systems Security Professionals	
Awards: Public Service Award (2000); BC Systems: Outstanding teamwork (1989) and individual contributions (1987, 1985)	