Examining the Relationship between Communities of Practice and Climate of Innovation in the U.S. Federal Government Environment

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ABSTRACT

A recurrent justification for knowledge management initiatives in the U.S. federal government workplace is the assertion that knowledge sharing groups, such as communities of practice, positively impact their members and benefit the organization by fostering a work environment that results in innovation. However, limited quantitative research existed to support the claims. The purpose of this research was to discover evidence for and explain the relationships between two of the dimensions of communities of practice (i.e., participation and connectivity) and a climate of innovation (e.g., vision, participative safety, task orientation, and support for innovation). This study provided empirical support for the relationship between participation and climate of innovation, as well as the relationship between connectivity and climate of innovation. Given the current economic and security challenges such as the global recession, homeland protection, and industry bailouts, the need for innovative products and services is paramount. Incorporating the results of this study and placing an emphasis on building or solidifying relationships, members of knowledge sharing groups within and across the federal government environment may better develop and implement strategies to address the current stresses and work toward stabilizing the worldwide situation.

Perceptions were collected from 384 community of practice members within the U.S. federal government environment about participation, connectivity, and the community's climate of innovation. Items from three existing instruments, Communities Assessment Tool (Verburg & Andriessen, 2006), Sense of Community Index (Chipeur & Pretty, 1999; Peterson, Speer, & Hughey, 2006), and Team Climate Inventory (Kivimäki & Ellovainio, 1999), were consolidated into one online questionnaire. Once the data were collected from the respondents, they were checked for completeness, reorganized and relabeled as necessary, and then transported to SAS JMP, version 7. The reliabilities in this study were comparable to previously published reliabilities. Demographic data indicated that the respondents tended to see themselves as experts, were active within their community, and relied on virtual contact with community members, although they had the opportunity to meet face-to-face in the past. After a review of

the correlations, a parsimonious model containing four variables (i.e., climate of innovation, perceived benefits of participation, nature of participation, and connectivity) was generated. In response to the research questions, multiple regression was conducted. The results showed that participation variables accounted for 22% to 26% of the variance in climate of innovation, with *support for innovation* being the best explained and *vision* following close behind with the second largest percentage of its variance explained. The connectivity variables explained 18% to 29% of the additional variance, with *participative safety* responsible for the largest percentages of the variance and *vision* having the second largest percentage. Together, the four participation variables explained about one quarter of the variance in each of the climate of innovation criteria. Adding the four connectivity variables explained more than an additional quarter of the variance for *vision* and *participatory safety*. Given the results, two themes emerged: The first was the importance of connectivity within communities of practice and in relation to a community's climate of innovation. The second was the refinement of the contemporary definition of participation within communities of practice. The findings signify that social approaches to knowledge management, such as communities of practice, may contribute to a climate conducive to innovation. Suggestions for future research and implications for practitioners are discussed.

DEDICATION

For my mentor, Dr. Annette K. Sturdevant,
who first encouraged me to pursue this journey.

For my father, Marvin H. Chindgren,
who would have been very proud that I arrived at this destination.

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CHAPTER I
INTRODUCTION

Members of the U.S. federal government environment, including civilian agencies and military organizations as well as industry and research centers that support the government, are considering knowledge management strategies that can best support mission accomplishment and develop its workforce. The knowledge management strategies are in response to several challenges. First, government initiatives are increasingly complex. For example, the National Aeronautics and Space Administration is responsible for large, unique, expensive, high-risk projects that have long durations and require integrating advances in science and technology. Key knowledge and expertise often exists outside NASA, with other U.S. agencies, industry, universities, and international partners (Chindgren, 2008). In addition, similar to private industry, the government is facing continuously changing regulatory, product, and service requirements; shifting strategies and priorities; and evolving best practices. For instance, since September 11, 2001, the U.S. Department of Treasury has increased its investigations of national banks for money laundering intended to support global terrorism (J. Wagner, personal communication, December 1, 2007). Finally, the government is losing employees and generally, when people leave an agency, they take a wealth of knowledge about their jobs with them. A General Accounting Office (2001) report indicated that a substantial portion of the federal workforce would become eligible to retire or will retire over the next five to 10 years, and as a result, the U.S. government is now struggling to prepare less experienced employees who are in the pipeline to move into positions being relinquished. Lack of adequate training and a tendency to maintain the status quo further impact and impede the success of knowledge sharing. Knowledge management – the integrated, systematic approach to creating, capturing, codifying, applying, and sharing the "brainpower," or knowledge, throughout the organization – attempts to secure and replenish the learning experiences, as well as the work products, of the individuals who comprise an organization.

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A consistent theme in knowledge management entails capturing and sharing codified knowledge and reusable work products, often through information and communication technologies (ICT). As Cross, Parker, Prusak, and Borgatti (2001) remarked, activities such as "knowledge repositories" hold pragmatic benefits as they bridge boundaries of time and space and "allow for potential reuse of tools or work products employed successfully in other areas of the organization" (p. 101). They also provide a means of preserving organizational memory when employee turnover occurs. Frequently used knowledge management activities for leveraging knowledge that is internal and external to an organization include creating an intranet, building a knowledge repository, implementing groupware to support collaboration, mapping sources of internal expertise, creating networks of knowledge workers, and establishing new occupational roles such as a chief knowledge officer (Galliers, 2004, 2006; Olonoff, 2009; Ruggles, 1998; Tiwana, 2002).

Such initiatives, however, often undervalue crucial tacit knowledge held by employees and the groups and communities that help create new knowledge and dynamically solve problems (Cross, et al., 2001; Love, Fong & Irani, 2005). Increasingly, a key issue for knowledge management is fostering human interaction that enables the exchange of knowledge that contributes to organizational innovation. Observing, listening, practicing, questioning, debating, and collaborating have all become part of a prosperous knowledge sharing environment. In this knowledge-based, global economy, Chalofsky (1996) articulated the need for learning based on team and collective performance, as well as cooperation and collaboration. He also stated that employees should be encouraged to learn based on the discovery of possibilities, not based on one right answer. He recognized the value of learning based on intuition, relationships, and context. Preskill and Torres (1999, p. 14) elaborated that, with this shift, "learning is intentional and contextual, and it involves developing systems and structures that not only allow but also encourage organization members to learn and grow together – to develop communities of practice."

Communities of practice are now a popular knowledge management practice within and across organizations, emphasizing the social aspects of knowledge creation, sharing, and application. The added value of a community of practice comes when knowledge is applied for a

specific purpose such as to improve, change, or develop specific tasks (McDermott, 1999). Innovation – or the intentional application of ideas – within organizations is a desired outcome and is frequently cited as a primary purpose for knowledge management activities. However, innovation can be a complex and uncertain process due to its dynamism and episodic nature at the initial phase of creativity or invention. It may also be disruptive and highly political at the diffusion and implementation phase (Newell, Robertson, Scarbrough & Swan, 2006). Innovation is also difficult to measure because of, among other reasons, the time involved tracking it and the need to control for external influences or mediating factors. However, there is evidence to suggest that innovation often originates from a group and is subsequently developed by that group into routinized practice within organizations (West & Farr, 1990; King & Anderson, 1995). Therefore, it is assumed that a precursor to innovation is the climate of innovation, which may be examined through a group's internal environment or social climate in relation to innovation. A group's or community's climate of innovation would then serve as a reasonable proxy for innovation. Given this assumption, the following sections introduce the constructs of communities of practice and climate of innovation that serve as the foundation for this research.

Communities of Practice

A community of practice is a group of professionals who interact with each other within an organization, across organizational units, or even organizational boundaries have a common interest or field of application in certain work-related topics and share their knowledge on a regular basis (Andriessen, 2005; Lave & Wenger, 1991; Saint-Onge & Wallace, 2003; Wenger, 1998; Wenger, McDermott, & Snyder, 2002). This definition reflects key characteristics of communities of practice identified by researchers and practitioners in the last quarter century. (1) These units can exist within a specific organization or across an industry. (2) A community of practice is a knowledge sharing forum for practitioners of a discipline or topic, or those interested in addressing a specific concern. (3) Members have a shared purpose or common goal and are often internally motivated, as opposed to having some external driver. (4) Members value all kinds of knowledge (including, for instance, hunches as well as demonstrable scientific knowledge) that transpires within a community. (5) A community of practice is a joint enterprise that has its own identity, which is continually renegotiated by its members, and individuals

become members through shared practices and involvement in common activities (e.g., storytelling). (6) Typically, relationships develop and trust is generated over time. (7) Generally, communities of practice have a long-term orientation on knowledge creation and knowledge sharing. (8) The community structure provides broad access to peers and experts who share experiences and innovative ideas and is not constrained by the conventions of traditional hierarchical structures.

Their objective is for members to learn and support one another in order to create, capture, spread, retain, and apply knowledge relevant to the organization. As a result, communities of practice have emerged as a key instrument for collaboration and knowledge sharing across conventional organizational boundaries. Traditionally, communities formed to share ideas and insights as well as to solve problems and explore changes to their discipline or practice area (Lave & Wenger, 1991; Brown & Duguid, 1991). These communities were not obvious in the organizational structure, and organizations did very little to encourage, nurture, or sponsor them. In contrast, according to a recent study sponsored by the Knowledge and Innovation Network (KIN) at the Warwick Business School (2006), "in the last half decade organizations seem to be paying increasing attention to the role communities can plan in helping to drive organizational performance" (p. 3). Organizational leaders are gradually advocating the formation of communities, aligning communities with formal organizational objectives, and supporting communities with resources and training. This is because there is increasing evidence suggesting that organizations, work groups, and individual practitioners benefit from participation in communities of practice (Allen, 2003; Ardichvilli, Page, & Wentling, 2003; Malone, 2002; Swan, Scarbrough, & Robertson, 2002; Lesser & Everest, 2001; Zboralski & Gemünden, 2006). Two key dimensions of communities of practice are participation in the community by the members and the connectivity or relationships among the members of the community. Both dimensions and their relationship with climate of innovation are explored in this study.

Climate of Innovation

Communities of practice may have a climate of innovation that could indicate their potential contribution to organizational innovation (Amin & Roberts, 2008; Hildreth & Kimble, 2004). Innovation is described as the "intentional introduction and application within a role, group, or

organization of ideas, processes, products, or procedures new to the relevant unit of adoption, designed to significantly benefit role performance, the group, the organization, or the wider society" (West & Farr, 1990, p. 16).

Innovation is fostered by a combination of both personal qualities (e.g., cognitive style of individuals, openness to experience, and intrinsic motivation) and work environment (e.g., commitment to ambitious goals, freedom and autonomy regarding how tasks will be performed, encouragement of ideas, time to generate new ideas, permission for risk taking, and the opportunity to make errors) (Tesluk, Farr, & Klein, 1997; West & Richards, 1999). Organizations may cultivate an atmosphere in which innovation is fostered. West and Richards (1999) reported that the combination of a supportive and challenging environment has been found to sustain high levels of creativity in work groups. This type of environment is social and nonthreatening, characterized by clear objectives, autonomy in accomplishing work, the encouragement of ideas, recognition and rewards for creative work, and a shared sense of quality (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Tesluk, et al., 1997; West, 1990). In essence, there is a need for a climate conducive to innovation. The climate of an organization is based on the shared perceptions of how "the manner of working together" has evolved (Anderson & West, 1994, p. 3). The combination of a supportive climate and communities of practice within an organization would presumably lead to greater organizational effectiveness, including innovation.

PROBLEM STATEMENT

As stated earlier, a community of practice is a knowledge sharing group made up of professionals from across an organization, and sometimes outside it, who have a common interest in a certain work-related topic and share knowledge on a regular basis. First, this "regular basis" requires that active participation is needed in a community of practice. Participation may be represented by a variety of variables, but the four of interest are: (1) perceived benefits for participation, (2) nature of participation, (3) amount or level of participation, and (4) primary mode of participation. Second, inherent in the definition of community of practice is the importance of relationships, or the connectivity, among the members. Connectivity reflects a sense of community among the members and entails a feeling

of belonging and identification, opportunity for influence, integration and fulfillment of individual and community needs, and a shared emotional connection (McMillan & Chavis, 1986).

Also, as introduced in the previous section, a climate is the shared perception of the environment that evolves as members of a group work together. The climate of innovation reflects the extent to which the intentional introduction and application within a group would create or adopt ideas, processes, products, or procedures to significantly benefit role performance, the group, the organization, or the wider society. Factors such as shared vision, participative safety, support for innovation, and task orientation have been identified as important in fostering a climate conducive to innovation (Anderson & West, 1998; West, 1990).

A recurrent justification for knowledge management initiatives in the U.S. federal government workplace is the assertion that knowledge sharing groups, such as communities of practice, positively impact its members and benefit the organization by fostering a work environment that results in innovation (Barquin, 2008; Carlson & Wilmot, 2006; Liebowitz, 2004). Although practitioners frequently assert a favorable effect of communities of practice in the workplace, limited empirical research exists to support the claims. The characteristics of an innovative climate may exist in communities of practice, but exploratory research is needed to document this relationship.

There is an emergent need to understand the relationship between communities of practice and the climate of innovation, which is a precursor of innovation (Anderson & West, 1998; Hunter, Bedell, & Mumford, 2007; Mathisen & Einarsen, 2004). If a positive relationship does exist between communities of practice and innovation, there should be a relationship between levels of participation and connectivity that exists in such communities and factors that fosters a climate of innovation. Research that examines these relationships may contribute empirical support to the social approaches of knowledge management and the requisite knowledge sharing groups (e.g., communities of practice, social networks), as well as provide evidence for the relationship between knowledge management and innovation.

PURPOSE OF THE STUDY

The purpose of this research was to discover evidence for and explain the relationships between sets of variables representing two dimensions of communities of practice (i.e., participation and connectivity) and a climate of innovation (e.g., vision, participative safety, task orientation, and support for innovation). To this end, perceptions were collected from community members about participation, connectivity, and the community's climate of innovation. The relationship was explored within the U.S. federal government environment. This population was primarily selected because there was limited empirical research examining knowledge management and its impact within the government setting, although federal government funding and policies have resulted in innovative products and services across society.

SIGNIFICANCE OF THE STUDY

This research contributed to the growing body of literature on communities of practice and climate of innovation by offering descriptive research results. In addition, the research contributed quantitative results to the broader field and daily practice of knowledge management. Past literature heavily reflected constructs and empirical support for knowledge management and innovation, focusing on ICT activities such as defining, collecting, codifying, and disseminating data (Davenport, 1992; Sproul, 1992). Some of the problems with ICT-driven knowledge management include the difficulty for users to access the system, thereby discouraging use; the burdensome and even limited ability to capture, share, and apply localized knowledge for individuals when their normal workload was increasing; and, an unreasonably heavy reliance on experts that created bottlenecks and could not keep up with the rapid pace of the workplace.

In part due to a growing recognition that some of the knowledge management "solutions" frequently offered by vendors providing ICT services did not sufficiently meet the needs of the workplace, there has been a growth in knowledge sharing groups. As a result, there is more research today examining social approaches to knowledge management, such as communities of practice, social networking, and collaboration (Andriessen, 2005; Allee, 2000; Cross, et al., 2001; Galliers, 2004, 2006; Saint-Onge & Wallace, 2003). This research contributed to the evolving discussion.

Although there are a variety of channels and forms of communities of practice, many differ quite substantially from the original concept of "communities of practice" offered by Lave and Wenger (1991) and Brown and Duguid (1991). For example, Lave and Wenger (1991) considered a community of practice to be a group of individuals who were informally united in action and in the meaning that action had for them and their 'practice;' they were not part of a formal or official structure. However, in today's workplace, some organizations are formalizing the communities and providing resources to help sustain member participation. Although communities of practice are an increasingly popular knowledge sharing and learning mechanism in organizations, there is limited research that empirically defines the characteristics of communities of practice within organizations. This study provided evidence of two dimensions of communities of practice, participation and connectivity.

Currently, practitioners are mainly responsible for reporting on the phenomenon. A review of the literature yields numerous examples with anecdotes, case studies, or "lessons learned," largely dominated by observations and interviews as the primary methods of investigation. Although the anecdotes, case studies, and "lessons learned" provide an illustration of what a community of practice is, including the goals of its members and their participation as well as the community activities, this quantitative research helped explain the relationship between and among variables and resulted in empirically defined characteristics of communities of practice in the U.S. government environment. Furthermore, with increased conceptual clarity, practitioners may more readily support and facilitate the development and contributions of communities of practice in the workplace.

Finally, knowledge management research has focused on the profit-driven, commercial sector and not the public-sector, service-driven U.S. federal government workplace. In this study, communities of practice and climate of innovation within the U.S. federal government environment, including federal agencies and the contractors and research centers that support them, were examined. Some may suggest that the "government" and "innovation" are incompatible. Although U.S. industry is known for its innovation in, for example, earlier technological revolutions such as computer chips, telecommunications, and the Internet, the U.S. government is not. Historically, however, the U.S. government has funded the majority of basic research done in the U.S., and although research spending has been declining for the last 20 years, research and development support of life, physical, and environmental sciences;

engineering, mathematics and computer sciences; and social sciences continue to lead to innovative solutions (Russell, 2005). Today, supportive government policies and guidance have resulted in products and services that have significantly benefited organizations and even the wider society.

DELIMITATIONS OF THE STUDY

The main purpose of this research was to investigate a relationship between certain characteristics of communities of practice and the climate of innovation within the communities. It was not the intention to evaluate strategies to promote building or facilitating communities of practice. In addition, techniques for fostering innovation in the workplace were not included in this study nor were definitions of innovative products or services and their measures.

CHAPTER II
LITERATURE REVIEW

Although communities of practice have become popular ways of developing, organizing, and sharing knowledge in organizations, there is limited empirical research about key characteristics and their effects. In this chapter, the literature on participation of the members within a community of practice and the connectivity of the members will be examined. In addition, the literature on the climate of innovation within communities of practice will be reviewed, with emphasis placed on four factors that may serve as precursors to innovation.

Characteristics of Communities of Practice

Participation

Participation entails four variables of interest: *perceived benefits of participation, the nature of participation, the amount or level of participation,* and *the primary mode of participation.* The literature for each characteristic is discussed below.

Perceived Benefits of Participation

The various needs for knowledge sharing in organizations has resulted in the growth of a wide variety of channels and forms of communities of practice, many of which differ quite substantially from the original concept of "communities of practice" offered by Lave and Wenger (1991). They envisioned a model of apprenticeship, based on socialization-related learning. Learning activities include the adoption of knowledge that is shared by peers and subject-matter experts, as well as the discovery or creation of new knowledge (Argyris & Schön, 1996; Zboralski & Gemünden, 2006).

The literature continues to provide evidence that individuals participate in communities of practice for learning purposes, but, in addition, other outcomes may be important. Many community members report that they participate to network and develop contacts, search for solutions to problems or challenges they are addressing, build and sustain camaraderie with peers, share 'lessons learned' or generate a best practice within their community (Chindgren & Hoffman, 2006; Verburg & Andrissen, 2006).

Recent empirical research has identified three discernable types, or levels, of benefits that arise from organizationally supported communities (Millen & Fontaine, 2003). The *perceived benefits of participation* entail anticipated benefits at the individual, community, and organizational levels. Individual members of a community of practice generally participate because they believe that it is in their interest to participate; they may have something to gain, learn, or benefit from a community (Zboralski & Gemünden, 2006). Although personal goals and individual motivation influence their perception of individual benefits, there are a variety of benefits accrued by the community members. Most notably, when asked about individual benefits, 65% of respondents to a self-report survey indicated that their participation in the community and their use of community resources increased their individual skills and know-how, and 58% felt they were more productive in their jobs (Millen, Fontaine & Muller, 2002). In addition to improved skills and personal work productivity, increased networking and the development of social capital have been cited as perceived benefits of participation (Cohen & Prusak, 2001; Lesser & Storck, 2001). As well as an increased sense of belonging and professional reputation which have a positive impact on an individual's professional development and personal job satisfaction (McDermott, 2002; Millen, et al., 2002).

Community benefits consist of those that accrue to the 'collective' community, often resulting from individual-level actions (Fontaine & Millen, 2004; Newell, Robertson, Scarbrough & Swan, 2002). These benefits are realized by interaction and collaboration. Members share similar experiences and solve problems together. The community is a source of information and, in their research, Millen, et al. (2002) discovered that 81% of respondents reported that the community resulted in greater sharing of expertise, knowledge, and resources among members. In addition, 70% of respondents indicated that collaboration had increased as a result of the community. Other benefits advance the community, such as increased or improved trust among members, consensus and problem solving, and community reputation and legitimacy.

Organizational benefits consist of gains for the larger organization and may result in strategic advantages (Zboralski & Gemünden, 2006). Since communities of practice are forums for knowledge sharing, organizational learning may occur (Brown & Duguid, 1991) and creativity may be stimulated across the organization (Storck & Hill, 2000). Millen, Fontaine, and Muller's (2002) research indicated that 57% of study respondents reported that they agreed

that the community increased operational efficiency, leading to improved cost savings. Additionally, 51% indicated that they believed that the community's resources and activities increased sales and decreased costs. Other benefits include speed-to-market of new products, customer satisfaction, new business development, decreased employee turnover, and product innovation.

Nature of Participation

The *nature of participation* within communities may be examined through the lens of "knowledge work." Since Peter Drucker (1979) coined the phrase "knowledge workers," the disciplines of economics, accounting, information systems, and management have attempted to describe "knowledge work." Today, knowledge work has been defined as a profession, a characteristic of individuals, and as an individual activity (Kelloway & Barling, 2000). For the purposes of this proposed research, knowledge work is a discretionary behavior focused on the *use of knowledge* in the workplace. Table 2.1 lists eight knowledge work activities that will be examined here.

Table 2.1 Knowledge Work Activities

1. Interacting and communicating with fellow community members
2. Advising or helping other members
3. Organizing and packaging knowledge for others or embedding it in a useful form
4. Creating new or generating better knowledge
5. Searching, accessing, or acquiring knowledge sources
6. Analyzing, processing, or evaluating knowledge
7. Solving problems and making decisions using job-relevant knowledge
8. Monitoring the field and keeping tabs on what's going on

The traditional focus of the community of practice theory is on learning as social participation. As a result, regular interaction among community members is a key characteristic. For Wenger (1998), "participation" refers:

> Not just to local events of engagement in certain activities with certain people, but to a more encompassing process of being active participants in the *practices* of social communities and constructing *identities* in relations to these communities. (p. 4)

To this end, *interacting and communicating with fellow members* are crucial knowledge work activities. Also a part of the community of practice tradition is *advising and helping other members*. In order to do this, it may be necessary for members to *organize and package knowledge for others* or embed it in a useful form such as processes, products, and services (Bird, 1994; Kelloway & Barling, 2000; Nonaka & Takeuchi, 1995).

Creation of new knowledge relevant to the community is another important knowledge work activity (Adams & Freeman, 2000; Davenport & Prusak, 1997; Kelloway & Barling, 2000). For many communities, the need to generate new and better knowledge is a reason for its members to participate. In order to do so, an appropriate culture, or sense of community, recognizes the need to provide time for members to dialogue and interact (Adams & Freeman, 2000). Furthermore, the process that communities go through in order to generate knowledge is itself often knowledge that should be captured.

Searching, accessing, or acquiring existing knowledge from relevant sources through research and learning is another knowledge work activity. This activity may entail looking for knowledge from colleagues as well as through ITC resources. This activity is facilitated by "transparency," that is, the ability to identify or view information, and the "situatedness" of access (Adams & Freeman, 2000, p. 39).

A sixth type of knowledge work is *analyzing, processing, or evaluating knowledge.* With this type of participation, the community member must understand the knowledge and reflect on its value and application to different situations. Another type of knowledge work, *problem solving and decision making*, usually requires that the members analyze, process, or evaluate the knowledge. Communities of practice are an ideal method of sharing knowledge and establishing artifacts. Frequently, contemporary organizations rely on artifacts such as documents, Web sites, and presentations published by members to maintain the memory of the knowledge and help individuals solve problems and make decisions (Ruggles, 1998).

Monitoring the field and keeping tabs on what's going on is the eighth and final knowledge work activity examined in this proposed research. Members use the community to

keep abreast of new ideas and problems. Monitoring may be ongoing or periodic, depending on the needs and interests of the members.

Amount or Level of Participation

Members of a community of practice participate at different *amounts* or *levels*. Typically, three levels are evident: core, active, and peripheral. *Core* participation defines the activities of a small group of members who reliably and enthusiastically participate in discussions in the community forum. Wenger, McDermott, and Snyder (2002) report that members who serve as core participants "take on community projects, identify topics for the community to address, and move the community along its learning agenda" and, as a result are the "heart of the community" (p. 56). Working closely and often sharing leadership with the core members is a coordinator. The coordinator is responsible for organizing events and connecting members and may be self-selected, community-nominated, or organizationally-assigned to the role (Wenger & Snyder, 2000; Wenger, et al., 2002). Other forms of leadership, such as 'thought leaders', networkers, people who document practice, and pioneers, may emerge within the communities as well. This group is usually small with only 10 to 15 percent of the community serving in these capacities (Wenger, McDermott, & Snyder, 2002).

Active members are at next level of participation within communities of practice. They do not exhibit the regularity or passion of the core members but periodically participate in the community forums (Wenger, et al., 2002). The active group is also quite small, consisting of 15 to 20 percent of the community. The third level of participation – and where most members are located – is at the *periphery*. These members rarely participate, but as Wenger, et al. (2002) discovered:

> They keep to the sidelines, watching the interaction of the core and active members. Some remain peripheral because they feel that their observations are not appropriate for the whole or carry no authority. Others do not have the time to contribute more actively. (p. 56)

Beyond these three main levels of participation, there are people who have an interest in the community, such as customers, stakeholders, vendors, contractors, and retirees. Sister communities may also be interested in their activities and discussions. Individuals from different communities may play a brokering role, which helps all communities stay connected. These

knowledge brokers take many different forms, including boundary spanners (i.e., individuals who link the community to another one), roamers (i.e., individuals who move from community to community, creating an informal network), and outposts (i.e., individuals who bring back news from other communities or organizational units) (Wenger & Snyder, 2000).

Wenger, et al. (2002) underscore that community members move through the levels of core, active, and peripheral and that this migration should be supported.

> The key to good community participation and a healthy degree of movement between levels is to design community activities that allow participants at all levels to feel like full members. Rather than force participation, successful communities 'build benches' for those on the sidelines. (p. 57)

With fluid boundaries, community members, as well as those outside the community, can become involved to heightened degrees for a period of time as their interests are addressed and then disengage when other, less relevant topics are being addressed.

Primary Mode of Participation

Two general categories of *participation modes* for communities of practice are face-to-face gatherings and virtual contact or meetings. This section describes both types and explores the assumptions that undergird them.

The original mode of community participation, face-to-face gatherings, can be traced back to ancient times. "[Communities of practice] were our first knowledge-based social structures, back when we lived in caves and gathered around the fire at night to discuss the hunt, the shape of arrowheads, strategies for cornering the prey, how to recognize certain berries, or which roots were edible" (Wenger, et al., 2002, p. 3). In ancient Rome and classical Greece, "corporations" of craftsmen, such as potters and masons, had both a business and social purpose (Wenger & Snyder, 2000, p.140). The business function entailed training apprentices and spreading innovation. The social function involved shared worship and celebrations. During the Middle Ages, "guilds" supported artisans in similar capacities (Wenger & Snyder, 2000, p. 140).

During the industrial revolution, guilds slowly lost their influence, as formal education and a new business structure grew. At the turn of the last century, sociologist Emile Durkeim traced the history of professional groups from ancient times to the twentieth century (1913). He believed that occupational groups – communities of practice – could provide much-needed social

connections, or connectivity, to strengthen the fabric of societal trust and mutual commitment, even as forces of industrialization and ensuing social disruptions endangered the historical ties that bound people together in ancestral towns (Wenger & Snyder, 2000).

In more recent years, Lave and Wenger (1991) described in their book *Situated Learning: Legitimate Peripheral Participation* an informal, continuous, and naturally occurring learning process that was typical of traditional apprenticeships and purportedly coined the phenomenon "community of practice." They illustrated that the nature of the situation impacts the learning process. They place learning squarely in the processes of "coparticipation," not in the cognitive processes of any single individual. Rather than focus on learning as the acquisition or discovery of knowledge, they situate learning in certain forms of social interaction and examine the types of social engagements and personal contact that provide the proper context for learning. Co-location and face-to-face gatherings are important aspects of this process.

However, given the global work environment, meeting in person is often expensive, time consuming and inconvenient. Distributed, virtual communities have emerged as ICT have improved, and as a result, they are now a common mode of participation (Fong & Chu, 2006). Virtual meetings entail video conferences, telephone conference calls, and e-mail via an organization's intranet or the Internet. Virtual communities can rely on a range of ICT support including codification of information or warehousing data that simply transfers information. ICT can also connect individuals and communities who are committed to a common interest, concern, or passion and have a shared understanding and degree of trust (Newell, et al., 2000).

Although ICT provides benefits such as greater access to community members, "Information technologies may support or hinder community formation, or change the dynamics of existing communities for better or worse depending on how they are employed" (van den Besselaar, Michelis, Preece & Simone, 2005, p. iv). A key challenge for all communities (i.e., those that regularly meet face-to-face, as well as virtual communities) is participation. There is an additional effort needed for participation from members of virtual communities, as Newell, et al. (2002) observed that:

> Where members of a working community of practice would see participation as part of their working day, members of online communities may need to make a conscious effort to participate actively – something which may be harder or easier depending on the quality of the electronic links. (p. 125)

Another concern, more reflective of the online environment than in person meetings, is the reluctance on the part of members to document their thinking (Ciborra & Patriotta, 1996). This is partly because community members tend to be disinclined to post personal insights and incomplete ideas in a fairly public arena.

ICT systems may complement but not replace the importance of authentic relationships and communities. This is because computer-mediated technologies, on their own, cannot encourage knowledge sharing across organizational, disciplinary, or geographical boundaries (Vandenbosch & Ginsberg, 1996). However, community practices that encourage the development of trust, commitment, and shared understandings can foster community development.

For some communities, during the early stages of community development, personal contacts and face-to-face conversation occurred before the successful launch of online or virtual communities of practice (Knowledge and Innovation Network, 2007). Then, using ICT, practitioners communicated different perspectives, exchanged stories and lessons learned, and solved problems together—all of which helped reinforce the meaning and purpose of a particular community.

Connectivity

Connectivity entails the level of interaction between members and possession of feelings of cohesion and belongingness (Andriessen, 2005). Within organizations, connectivity may be illustrated as a dimension ranging from low (e.g., simple, loose) to high (e.g., complex, tight) (Allee, 2000; Chindgren & Wiswell, 2006). For example, an interest group consists of members who generally share only an interest about a certain topic. According to Andriessen (2005), members have limited interaction and identity and, as a result, have a low level of connectivity. An intermediate level of connectivity may be illustrated by an informal network or a "brown bag lunch" gathering. These members share a common interest and the members exchange information, but they do not work together on a common action (Brown & Duguid, 1991). Lave and Wenger's (1991) concept of "legitimate peripheral participation" reflects a high level of connectivity among the members of informal communities. Legitimate peripheral participation is a process by which "newcomers" become "old timers" by performing minute yet necessary tasks that contribute to the community goals. Connectivity within communities of practice may be further explained by borrowing a construct from the field of community

psychology, the sense of community. The next two sections are intended to introduce sense of community and provide an overview of McMillan and Chavis's (1986) model of psychological sense of community, including its four key elements.

Sense of Community

In 1974, psychologist Samuel Sarason introduced the concept of "psychological sense of community" and proposed that it become the conceptual center for the psychology of community, a field concerned with the application of social science to both people and their environments (Rappaport, 1977). At that time, "community" was narrowly interpreted as the traditional residential locale (Gusfield, 1975). By 1986, however, the psychological sense of community had emerged as a central overarching value for community psychology and there was increasing attention to explore alternative locales and dimensions of community (Chavis & Pretty, 1999). Since then, psychological sense of community has been applied to a variety of communities such as planned towns (Plas & Lewis, 1996), urban barrios (Garcia, Giulani & Wiesenfield, 1999), workplaces (Catano, Pretty, Southwell, & Cole, 1993), religious communities (Miers & Fisher, 2002), and student communities (Pretty, 1990). It has also been applied to various indexes of quality of daily life, including perception of safety and security (Perkins & Taylor, 1996) and life satisfaction (Prezza & Costantini, 1998).

Today, meanings of "community" range from a small village within a specific geographical region to virtual communities where members are located throughout the world and connected through ICT. Obst and White (2007, p. 77) report, "In its broadest sense, community can simply be seen as a set of people with some kind of shared element, which can vary widely from a situation, such as living in a particular place, to some kind of interest or belief." It is "a set of social relationships that are bound together by a sense of community" (Chavis & Newbrough, 1986, p. 335).

McMillan and Chavis Model of Psychological Sense of Community. A review of the literature suggests that McMillan and Chavis's (1986) model of psychological sense of community was the first and is still the most widely accepted and influential. They relabeled this construct "sense of community," and defined it as a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members'

needs will be met through their commitment to be together. Four elements are instrumental in describing the sense of community: *Membership, influence, integration and fulfillment of needs,* and *shared emotional connection.* Although researchers describe these elements as distinct, the elements influence each other. McMillan and Chavis (1986) have suggested that these four dimensions work together dynamically to create and maintain an overall sense of community.

The McMillan and Chavis (1986) model is the primary theoretical reference for most sense of community research, although recent studies have indicated that there may be actually different dimensions than those first identified in the original model (Long & Perkins, 2003; Tartaglia, 2006). Despite the disparity among those researchers studying sense of community, there is general agreement that the construct manifests differently depending on the context. In a special issue of the *Journal of Community Psychology* dedicated to exploring sense of community, Hill (1996) reported that despite some common elements, sense of community is setting-specific. In addition, she recognized that across the literature, sense of community was perceived as both a unidimensional construct (Buckner, 1988; Davidson & Cotter, 1986) and a multidimensional construct (Perkins, Florin, Rich, Wandersman, & Chavis, 1990). This is likely due to the complex nature of sense of community and the interest in establishing a measure for a phenomenon that could be applied in multiple contexts entailing community life.

Despite the continuing debate over defining sense of community, the discipline of community psychology has embraced the McMillan and Chavis (1986) model with the four components. These four key elements are described here.

Membership

Membership refers to the feeling of belonging and identification, of being a part of a community. Membership in a community entails a variety of attributes, such as security, sense of belonging, personal investment, shared symbol system, and boundaries (Chipuer & Pretty, 1999; McMillan & Chavis, 1986). Security or "emotional safety" is a community member's willingness to reveal how one feels. Sense of belonging and identification involves one's "fit in the group" (McMillan & Chavis, 1986, p. 10), a feeling of acceptance within the community and personal investment to that community. Also important to members is a shared symbol system, such as language, dress, or ritual, as these symbols reaffirm community boundaries. Boundaries indicate who belongs and who does not. In some communities, "outsiders" may be held in lower regard. McMillan and

Chavis (1986) acknowledge that "boundaries" are the most troublesome feature of the "membership" portion of the definition because communities may isolate, reject, and punish a deviant in the group. They point out that, "While much sympathetic interest in and research on the deviant have been generated, group members' legitimate needs for boundaries to protect their intimate social connections have often been overlooked" (p. 9). McMillan (1996, p. 315) later included the "spirit of community" as another aspect of membership that can evolve from authentic friendships within a community.

Influence

Influence describes "the reciprocal relationship of the individual and the community in terms of their ability to affect change in the other" (Chipuer & Pretty, 1999, p. 646). McMillan and Chavis (1986) explain that members of a group must feel empowered to have influence over what a group does while, at the same time, group cohesiveness depends upon the group having some influence over its members. They comment:

> People who acknowledge that others' needs, values, and opinions matter to them are often the most influential group members, while those who always push to influence, try to dominate others, and ignore the wishes and opinions of others are often the least powerful members. (p. 11)

Later, McMillan (1996, p. 319) described the role of power and influence within a community in a single sentence: "This process [of bidirectional influence] occurs all at the same time because order, authority, and justice create the atmosphere for the exchange of power." McMillan increasingly underscored the importance of trust between members as a key aspect of influence within a community.

Integration and Fulfillment of Needs

Integration and fulfillment of needs assume that for a community to maintain a positive sense of togetherness, the individual-group association must be rewarding in terms of needs, goals, and values for the members (Obst & White, 2007). "Individuals … get their needs met through cooperative behavior within the community, thereby reinforcing the individuals' appropriate community behavior" (Chipuer & Pretty, 1999, p. 464). For McMillan and Chavis (1996), this dimension includes those required for survival, as well as that which is desired and valued.

Integration and fulfillment of needs largely entail reinforcement of aspects of community membership such as status, competence, and shared vision.

Shared Emotional Connection

Shared emotional connection "seems to be the definitive element for true community" (McMillan & Chavis, 1986, p. 14) and refers to the bonds developed over time through positive interaction with community members (Obst & White, 2007). Generally, a shared history provides stories and folklore that help to bond community members with each other, and although not necessary to have shared history together, "members must identify with it" (McMillan & Chavis, 1986, p. 14, p. 13). McMillan and Chavis (1986) identify seven attributes of shared emotional connection. These features are (1) The more personal interaction there is increases the likelihood that members will become close. (2) Quality of that interaction fosters shared emotional connection. (3) Ambiguous interaction and unresolved tasks inhibit community cohesiveness. (4) Events within or external to the community may facilitate a community bond. (5) Members who have invested in the community feel the community is more important. (6) Members who have been recognized or rewarded in the community feel more attracted to that community, and if humiliated feel less attraction. (7) There is a spiritual bond, essence, or psyche that persists in communities that is unique.

Climate of Innovation

Continuous renewal and adaptation by the U.S. government is required to serve the public. As a result, a key factor to long-term organizational success is innovation in products and services. Factors such as personal qualities and work environment influence innovation within organizations (Amabile, 1996; Scott & Bruce, 1994; West & Richards, 1999). As reported by Hunter, Bedell, and Mumford (2007, p. 69), "*Creativity*, the generation of new ideas, and *innovation*, the translation of these ideas into useful new products, are commonly held to arise as a function of an interaction between the person and the situation."

The literature reflecting personal qualities offers many types of individual differences related to the creativity of employees, including cognitive style (Martinsen & Kaufmann, 1999), expertise (Ericsson & Charness, 1994), and intrinsic motivation (Amabile, 1996). The literature referencing the work environment or group atmosphere in which innovation is fostered entails

studies examining collaborations (Abra, 1994), leadership (Amabile, Schatzel, Moneta, & Kramer, 2004), and organizational structure (Cardinal & Hatfield, 2001).

West and Richards (1999) reported that the combination of a supportive and challenging work environment has been found to sustain high levels of creativity in groups. This type of environment is social and nonthreatening, characterized by clear objectives, autonomy in accomplishing work, the encouragement of ideas, recognition and rewards for creative work, and a shared sense of quality (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Tesluk, et al., 1997; West, 1990). A climate that is conducive to innovation may be examined through a group's internal environment or social climate in relation to innovation.

The following sections will define innovation and climate, and then describe the characteristics of a climate of innovation at the group-level within organizations. Four factors that have been identified as crucial to workplace climate of innovation will also be discussed.

Innovation

Innovation is widely claimed to have beneficial influences on the effectiveness and performance of organizations (Amabile, 1988; Carlson & Wilmot, 2006; Kanter, 1988). The growing body of literature has examined personal factors, contextual factors, and their interactions that facilitate or inhibit individual and group innovation. Despite a range of descriptions of innovation, a widely-accepted definition is:

> The intentional introduction and application within a role, group, or organization of ideas, processes, products, or procedures new to the relevant unit of adoption, designed to significantly benefit role performance, the group, the organization, or the wider society. (West & Farr, 1990, p. 16)

West and Farr's definition (1990) is not limited to technological innovation but allows for innovation in management and organizational processes, products, or procedures. In addition, the definition reflects an application component with intentional attempts to derive benefits from change. Benefits may include administrative efficiency, staff well-being, personal growth, increased satisfaction, improved group cohesiveness, as well as productivity and economic benefits (West & Anderson, 1996). Yet, innovation may be disruptive to the workplace. For example, the application of innovative processes is unpredictable and controversial, and it may result in costs instead of benefits to individuals and groups (Kanter, 1988). Potential costs

include, but are not limited to, failure, unclear objectives, lowered cohesion, and group ineffectiveness (Janssen, van de Vliert, & West, 2004).

Climate

An established precursor to innovation is the climate of the group or organization in which the innovation may occur. Although a review of the literature provides many definitions (Rousseau, 1988), the climate of an organization will be described in this research as the shared perceptions of how "the manner of working together" has evolved (Anderson & West, 1994, p. 3). It is commonly reflected in individuals' "perceptions of, or beliefs about, environmental attributes shaping expectations about outcomes, contingencies, requirements, and interactions in the work environment" (Hunter, Bedell, & Mumford, 2007, p. 70). Unlike culture, which refers to a system of shared meaning held by members and reflects the organizational 'way of doing things' through values, attitudes, and behavioral norms (Schein, 1985), climate reflects individual or group-level localized experience.

Climate is "a domain reference phenomenon, in which multiple variables, or dimensions, act to shape performance in the domain under consideration" (Hunter, et al., 2007, p. 70). Climate studies examine individuals' perceptions of, or experience in, their work environment with respect to a variety of dimensions such as leadership support, positive peer group, autonomy, and risk taking (Mathisen & Einarsen, 2004). There are two approaches that are generally advocated: the cognitive schema approach and the shared perceptions approach. The cognitive schema conceptualizes climate as individuals' constructive representations or cognitive schema of their work environments, and it has been made operational mainly through attempts to uncover individuals' sense-making of their work environment (Anderson & West, 1998; Ashforth, 1985; James & Sells, 1981). The shared perception approach reflects the common opinion of the 'way things are around here.' It entails "the shared perception of organizational policies, practices, and procedures" (Reichers & Schneider, 1990, p. 22). Both the cognitive approach and the shared perceptions approach of defining climate are compatible with one another and are not mutually exclusive.

Researchers' attempts to implement the shared perceptions approach have been challenged because of the difficulty in reaching consensus over minimum levels of agreement sufficient to indicate that perceptions are truly shared among work groups or organizational

members (James, Joyce & Slocum, 1988; Joyce & Slocum, 1982; Patterson, West, & Payne, 1992). However, given the increasing focus on shared perceptions in the literature, and following the evidence provided by a particularly insightful study conducted by Anderson and West (1998), this research applied the concept of shared perceptions to the group level of analysis to develop a measure of climate within a community of practice.

Group climate within an organization. Traditionally, studies about climate have focused on the organization as the level of analysis, evaluating organizations as a whole. A potential dilemma with using an organizational level of analysis is that there may be considerably more variation in perceptions (e.g., across departments, divisions, project teams, and communities of practice) (Anderson & West, 1998). In addition, there is less likelihood of social interaction leading to shared meanings, a contributing factor for innovation (Payne, 1990).

However, there is evidence to suggest that innovation often originates from a work group, and is subsequently developed by that work group, into routinized practice within organizations (King & Anderson, 1995; West & Farr, 1990). "The foundation of all innovation is creative ideas, and it is individuals or groups who generate, promote, discuss, modify, and ultimately realize ideas" (Janssen, van de Vliert, & West, 2004, p. 129). Examples include an engineering team that modifies processes to reduce costs and a community of practice that informally serves as an expertise locator for its members working on product design. Researchers and practitioners indicate that a work group may be used to access the climate for innovation (Anderson & West, 1998; Hosking & Anderson, 1992; Payne, 1990; Rao, 2009; Welch & Welch, 2008; West, 1990).

For their seminal work examining group climate within organizations, Anderson and West (1998) use the term "work group" to represent a "proximal work group," which is operationalized as "… either a permanent or semi-permanent team to which individuals are assigned, who they identify with, and whom they interact with regularly in order to perform work-related tasks" (Anderson & West, 1998, p. 236). Emphasis is placed on the group within which daily tasks or activities at work are carried out. The group represents the "primary medium through which shared climates will evolve through active social construction and become embedded into the fabric of the organization" (Anderson & West, 1998, p. 237).

Anderson and West (1998, p. 237) report that having "sharedness" occur requires several considerations. First, group members interact at work, at least on an infrequent basis. Second,

there exists some common goal or attainable outcome that predisposes individuals toward collective action. Lastly, there is sufficient task interdependence such that individuals need to develop shared understandings and expected patterns of behavior. Anderson and West (1998) clarify that having these three conditions do not necessarily result in a shared climate, but they are important contributors.

Four Factors of Workplace Climate of Innovation

There are numerous models of climate addressing a variety of dimensions such as requirements for new product development (Thamhain, 2003), organizational learning theory (Lapieere & Girous, 2003), and intrinsic motivation (Amabile & Conti, 1999). However, West and his colleagues (Anderson & West, 1994, 1998; Bain, Mann, & Pirola-Merlo, 2001; Burningham & West, 1995) have been largely responsible for examining climate of innovation within a workplace group, in particular, a team. They reviewed the literature to uncover a consistent pattern of climate factors found across studies associated with team innovation (1990, 1996, 1998). Using a theory of team interactions to develop their model of group climate of innovation, West (1990) hypothesized that the four major factors of climate are predictive of innovativeness. The four factors are vision, participative safety, task orientation, and support for innovation (Anderson & West, 1996).

Although West and his colleagues were <u>not</u> exploring a community of practice, the two groups share some similarities that make the factors relevant. For example, they may both provide a cross-functional platform for members who share an interest in a specific topic or practice and have common objectives or goals; interpersonal relationships may foster knowledge sharing; and members contribute to communal resources over time.

A description of Anderson and West's (1996) four factors of climate of innovation follows.

Vision

West (1990, p. 310) writes that "the vision is an idea of a valued outcome which represents a higher-order goal and a motivating force at work." Work groups need clearly defined objectives that are relatively attainable in order to be innovative. A vision provides focus and a direction and is composed of four parts: clarity, visionary nature, attainability, and sharedness.

Clarity entails the degree to which the vision is readily understandable by the group members. Visionary nature refers to the extent to which the vision has a valued outcome to the members and, as a result, engenders a commitment to the vision. Attainability entails objectives that may "stretch" or challenge the members, but are motivating and are accomplishable. Sharedness depicts the extent to which all members accept the vision.

Participative Safety

"Participativeness and safety are characterized as a single psychological construct in which the contingencies are such that involvement in decision making is motivated and reinforced while occurring in an environment which is perceived as interpersonally non-threatening" (West, 1990, p. 311). Participative safety refers to group members actively contributing to creating a non-threatening, trusting, and supportive group environment. Anderson and West (1998, p. 240) later clarified that "the more people participate in decision making through having influence, interacting, and sharing information, the more likely they are to invest in the outcomes of those decisions and to offer ideas for new and improved ways of working."

Task Orientation

"Task orientation describes a commitment to excellence in task performance coupled with a climate which supports the adoption of improvements to established policies, procedures, and methods" (Anderson & West, 1998, p. 240). Early in his research, West (1990, p. 313) described it "in relation to shared vision or outcomes, characterized by evaluations, modification, control systems, and critical appraisals." Examples of task orientation within work groups include evaluation systems for monitoring and modifying performance, intra-team advice and knowledge sharing, clear outcome criteria, and constructive criticism (Anderson & West, 1998).

Support for Innovation

Support for innovation refers to the "expectation, approval, and practical support of attempts to introduce new and improved ways of doing things in the work environment" (West, 1990, p. 38). West (1990) distinguishes between articulate support and enacted support within an organization. Articulated support is documented support often evident in policy statements. Enacted support is

active support for innovation by providing necessary resources or visible senior leadership support.

CHAPTER III
METHOD

The purpose of this research was to discover evidence for and explain the relationships between sets of variables representing the two dimensions of communities of practice (i.e., participation and connectivity) and a set of variables representing climate of innovation. To this end, perceptions were collected with an online questionnaire from community members about participation, connectivity, and the community's climate of innovation. The relationship was explored within the U.S. federal government environment. This chapter outlines the research questions, instruments, procedures, participants, and analyses used in this study.

RESEARCH QUESTIONS

Considering the four key factors representing a climate of innovation separately (i.e., *vision, participative safety, task orientation,* and *support for innovation*), how much of the variation in each factor was explainable by the participation and connectivity dimensions of a climate of innovation? Specifically, the following questions were addressed for each key factor:

1. What proportion of each climate of innovation factor was explained by the set of participation variables:
    a. perceived benefits for participation,
    b. the nature of participation,
    c. the amount or level of participation, and
    d. the primary mode of participation?
2. What proportion of each climate of innovation factor was explained by the set of connectivity variables:
    a. membership,
    b. influence,
    c. integration and fulfillment, and
    d. shared emotional connection

    over and above that which was explained by the participation variables?

INSTRUMENTS

Given the research questions, perceptions were collected from community of practice members about participation, connectivity, and the community's climate of innovation. I collected both descriptive and behavioral information from the respondents. Descriptive information included demographic information as well as participation characteristics, such as *perceived benefits, nature of participation, amount/level of participation,* and *primary mode of participation.* Behavioral information included connectivity information such as the sense of community that the members experience. In addition, respondents were asked their perspective of the community's climate of innovation, focusing on the four key elements of *vision, participative safety, task orientation,* and *support for innovation*.

To examine these variables, I used items from three existing instruments: Communities Assessment Tool (Verburg & Andriessen, 2006); Sense of Community Index (Chipeur & Pretty, 1999; Peterson, Speer, & Hughey, 2006); and Team Climate Inventory (Kivimäki & Ellovanio, 1999). The instrumentation is discussed below.

Measures of Participation

Participation in communities of practice may be represented by a variety of variables, but the four categorical variables of interest were: *(1) the perceived benefits for participation, (2) the nature of participation, (3) the amount or level of participation,* and *(4) the primary mode of participation.* The second variable listed, *nature of participation,* was developed following a review of the literature and vetted by knowledge management practitioners. Eight knowledge activities (e.g., interacting and communicating with fellow community members, advising or helping others, organizing and packaging knowledge for others) with Likert response scales were offered for respondents to denote the extent to which they perform the activities. Three of the remaining four variables were examined with the use of an existing instrument, the Community Assessment Toolkit.

Community Assessment Toolkit. Verburg and Andriessen (2006) developed the Community Assessment Toolkit (CAT) as a method for the assessment of communities of practice. They drew heavily from current theories on communities of practice and group

dynamics and offered the tool for both scientific research and practical assessments of communities. The CAT comprises three parts: (1) an online questionnaire for members, consisting of mainly closed items; (2) an open-ended questionnaire for the community coordinator, which may be used in a telephone or face-to-face interview; and (3) a checklist of open questions for use with a high level, key informant of the organization that the community is a part of. The checklist provides information about the organizational knowledge management strategy and relevant structures, processes, and tools (Verburg & Andriessen, 2006). It is only the first part, an online questionnaire for members consisting of mainly closed items, that was used for this study to measure participation.

First, the *perceived benefits for participation* are addressed by the CAT section that asks, "How important are the following goals for you personally as a member of the community?" and lists 13 reasons. Using a five-point Likert scale, respondents denoted the degree of importance for each of the reasons. These responses were combined to produce an overall perceived benefits scale score.

Second, the *amount or level of participation* is ascertained by an item from the CAT and a literature review. With the CAT, respondents were asked open-ended questions such as, "How actively do you participate in the community?" and. "On average, how many hours do you spend on the community per month?" A review of the literature indicated that there were typically three categories (i.e., core, active, or peripheral) and, therefore, these categories with brief descriptions were included in my questionnaire. Respondents were asked to select the category that described their typical amount or level of participation in their community.

Finally, the item for *primary mode of participation* was also examined using the CAT question addressing this variable. With the CAT, respondents were asked, "Does your community have the following types of meetings?" Face-to-face meetings and virtual meetings were both provided as choices. With my questionnaire, respondents were provided the option of identifying face-to-face meetings as their primary mode of participation or virtual meetings. If they selected virtual meetings, then choices (e.g., telephone calls, video conference, intranet) were provided to further delineate the main mode of virtual meetings.

CAT is the first published instrument for assessing communities of practice intended to serve as a tool for both the researcher and the practitioner. However, the limited psychometric information provided by the authors was a concern. I requested additional information from the

researchers through e-mail correspondence prior to collecting data. Their response was that the psychometric information was proprietary and, as a result, "we are not eager to reveal the nature of our developed scales as this is part of our intellectual capital" (R. Verburg, personal communication, March 8, 2007).

I then attempted to locate other published research that used or referenced the CAT to examine the psychometrics. With the assistance of a Virginia Tech librarian, I searched several databases looking for articles that cited the original Verburg and Andriessen (2006) questionnaire. Search engineers and databases that were reviewed included ABI Inform, Infotrac, Factiva, WorldCat, and Dissertation Abstracts. No results appeared for the CAT or the Verburg and Andriessen (2006) article where the instrument was originally published.

Because of the lack of psychometric information, I identified three reasons that justified using it. First, there were no other instruments available, and the items addressed in the CAT were important and relevant to my research. Second, the CAT was a published questionnaire in a peer-reviewed journal, was heavily based on community of practice related theory and reasonably grounded in the literature. Finally, at the time of delineating this research study, the CAT was a recently-published instrument, and the developers, as well as other researchers, may need more time to review, test, and publish findings on the CAT. My research may help to illuminate the questionnaire's usefulness.

Measures of Connectivity

The importance of relationships, or connectivity, among the community of practice members is largely absent in quantitative research. The term connectivity has been chosen to describe the sense of community among the members and entails *a feeling of belonging and identification, opportunity for influence, integration and fulfillment of individual and community needs,* and *a shared emotional connection* (McMillan & Chavis, 1986).

McMillan and Chavis's (1986) model of psychological sense of community is defined as a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together. Four elements are instrumental in describing the sense of community: *(1) membership, (2) influence, (3) integration and fulfillment of needs,* and *(4) shared emotional connection.* Although researchers describe these elements as distinct, the elements influence each other.

McMillan & Chavis (1986) have suggested that these four dimensions work together dynamically to create and maintain an overall sense of community.

Sense of Community Index. The Sense of Community Index (SCI) was developed by Chavis, et al. (1986) as an instrument to assess the McMillan and Chavis (1986) sense of community model. The SCI uses four subscales to reflect the four elements in the model: *(1) membership, (2) influence, (3) integration and fulfillment of needs,* and *(4) shared emotional connection*.

Though widely used, the model and the SCI have been subject to critique and revision (Peterson, et al., 2006). Although the McMillan and Chavis (1986) model remains the primary theoretical reference for most sense of community research, recent studies have indicated that there may be actually only three, not four, dimensional scales, and they may vary from the original model (Long & Perkins, 2003; Tartaglia, 2006). For example, Long and Perkins (2003) developed revised measures reflecting new structures – social connections, mutual concerns, and community values. Despite these recent studies, other researchers have reaffirmed the original model by reexamining it for ways to improve the fit indices (Brodsky, 1996; Plas & Lewis, 1996). Obst and White (2004, p. 703) argue that "the concept of the four dimensions should not be summarily dismissed in favor of new non-theoretical factor structures, as there is a substantial body of research that indicates the validity and usefulness of the four-dimensional theory." For this reason, I used the four dimensional scales.

Table 3.1 lists researchers/authors of the SCI with the four dimensions, the subscales, response format, number of items, and subscales reliabilities, as well as overall reliabilities. This study used the 12 items identified by Chipeur and Pretty (1999) and Peterson, et al. (2006) to collect data about connectivity. Their total reliabilities were acceptable and ranged from moderate to high.

Table 3.1 Sense of Community Researchers/Authors, Subscales, Response Format, Number of Items, and Reliabilities

Authors/Researchers	Subscales	Response Format	Number of Items	Subscale Reliabilities	Total Reliability
Chavis, Hogge, McMillan & Wandersman (1986)	Membership Influence Integration and fulfillment of needs Shared emotional connection	5-point scale	17 6 9 7	Not available	.97
Chipuer & Pretty (1999)	Membership Influence Integration and fulfillment (reinforcement) of needs Emotional connection	True/False and 3-point scale	3 3 3 3	.40 to .72 .16 to .43 .24 to .51 .07 to .38	.64 to .69
Obst & White (2004)	Membership Influence Needs fulfillment Emotional connection	7-point scale	2 3 3 2	.75 to .78 .71 to .76 .75 to .80 .70 to .76	.80 to .84
Peterson, Speer & Hughey (2006)	Membership Influence Needs fulfillment Emotional connection	4-point scale and 5-point scale	3 3 3 3	.54 to .63 .42 to .43 .55 to .56 .54 to .62	.78 to .82

Measures of Climate of Innovation

A climate that is conducive to innovation may be examined through a group's internal environment or social climate in relation to innovation. Using a theory of team interactions to develop a model of group climate of innovation, West (1990) hypothesized that the four major factors of climate are predictive of innovativeness. The four factors are *(1) vision, (2) participative safety, (3) task orientation, and (4) support for innovation* (Anderson & West, 1994; 1996).

Team Climate Inventory. West's four factor model of work group innovation (1990; 1996) led to the development of the Team Climate Inventory (TCI), a tool designed to measure climate of innovation. The primary aim of the TCI was to provide a team development tool that would facilitate innovation-related initiatives in the workplace (Anderson & West, 1994). Although West and his colleagues were not examining a community of practice, the two groups (i.e., teams and communities) have some similar characteristics that make the factors relevant.

West's (1990; 1996) model hypothesized four major climate factors to be predictive of the innovativeness of a group. For each factor, subscales (i.e., vision, participative safety, task orientation, and support for innovation) have been assembled (Anderson & West, 1996). According to Mathisen and Einarsen (2004, p. 131), the majority of the items were generated specifically for the TCI, although some items were selected from other questionnaires related to the four-factor model (e.g., 15 items from the Tjosvold, Wedley, & Field, 1986, scale of constructive controversy). The original version of TCI consisted of 61 items but a short form of 14 items is now available (Anderson & West, 1994; Kivimäki & Ellovainio, 1999). This short version was developed by extracting items from the original version that correlated highly with their own scale while showing a low correlation with other scales (Mathisen & Einarsen, 2004). The TCI short form has been translated into several languages, including Swedish (Agrell & Gustafson, 1994), Finnish (Kivimäki, Kuk, Elovainio, Thompson, Kalliomäki-Levanto & Heikkilä (1997), and Italian (Ragazzoni, Baiardi, Zotti, Anderson, & West, 2002).

Confirmatory factor analyses have led to enhancements of the short version. Since 2000, the TCI has been applied to a variety of groups in different industries around the world including, but not limited to, Finnish health care (Kivimäki, et al., 1997); United Kingdom (UK) stroke care facilities (Gibbon, Watkins, Barer, Waters, Davies, Lightbody, & Leathley, 2002);

Norwegian public sectors, such as oil and gas and private sector entities like the postal organization (Mathisen, Einarsen, Jørstad & Brønnick, 2004); and Swedish air traffic control teams (Arvidsson, Johansson, Ek, Akelsson, 2003). Although the TCI has been psychometrically tested in these sample populations and results for internal homogeneity tests (i.e., Cronbach's alpha) consistently suggest that the reliability of the instrument is acceptable (see Table 3.2), construct validity studies of the TCI have produced mixed results. For instance, exploratory factor analysis revealed a five-factor result in the UK sample (Anderson & West, 1998). Yet a Swedish sample revealed a four-factor result (Agrell & Gustafsen, 1994). Factor analyses with Finnish studies indicated that a five-factor model was the best in one sample, and both a four- and five-factor model were acceptable in the other (Kivimäki, et al., 1997). Confirmatory factor analysis on the UK and Finnish studies indicated that the five-factor solution with the interaction frequency factor had the best fit (Anderson & West, 1998; Kivimäki, et al., 1997). The studies indicated that the original theoretical four-factor model of the TCI is supported although there is evidence that a fifth factor should be added.

Table 3.2 contains the TCI subscales (i.e., *vision, participative safety, task orientation,* and *support for innovation*) and the corresponding number of items and reliabilities, which were acceptable and high. Also cited are the researchers/authors who conducted the studies and the response scale used. For this study, the TCI Short Version developed by Kivimäki and Elovainio (1999) was used.

Table 3.2 Team Climate Inventory Subscales, Number of Items, and Reliabilities

Subscales	Number of Items					Reliability Range
	(1)	(2)	(3)	(4)	(5)	
Vision	11	11	12	4	11	.84 to .94
Participative safety	12	12, 8	24	4	12	.85 to .93
Task orientation	7	7	17	3	7	.85 to .95
Support for innovation	8	8	8	3	8	.79 to .95
Response Scale Used	--	--	5 and 7 point scales	5 point scale	5 point scale	

(1) West & Anderson (1996)
(2) Kivimäki, Kuk, Elovainio, Thompson, Kalliomäki-Levanto & Heikkilä (1997)
(3) Anderson & West (1998)
(4) Kivimäki & Elovainio (1999)
(5) Mathisen, Einarsen, Jørstad, & Brønnick (2004)

To examine the variables of participation, connectivity, and climate of innovation, this study used items from these aforementioned instruments – Communities Assessment Tool (Verburg & Andriessen, 2006), Sense of Community Index (Chipeur & Pretty, 1999; Peterson, et al., 2006), and Team Climate Inventory Short Version (Kivimäki & Elovainio, 1999). The following procedures section describes the process of structuring and administering my questionnaire.

PROCEDURES

The method selected for gathering data to understand the relationship between communities of practice and climate of innovation was a sample survey using an online questionnaire. The procedures for this study included structuring the questionnaire and administering the questionnaire. Each procedure is described below. My commitment to the Virginia Tech Institutional Review Board for Research Involving Human Subjects is also stated.

Structuring the Questionnaire

The steps for structuring the questionnaire were to first define the content of the questionnaire and then structure the questionnaire items to address that content.

Defining the Content of the Questionnaire

An important step in conducting survey research is defining the content of the questionnaire (Belli, 2003; Fink & Koseoff, 1985). For this study, I conducted a literature review of both scholarly journals and practitioner publications and organized the domains from which items for the questionnaire were eventually used. At this stage of the research, I identified three domains of variables. These domains were: (a) participation, (b) connectivity, and (c) climate of innovation.

Structuring Questionnaire Items

Given the purpose of the research, I used items from three existing instruments: CAT, to partially address the domain of participation (Verburg & Andriessen, 2006); SCI, to examine the connectivity domain (Chipeur & Pretty, 1999; Peterson, et al., 2006); and TCI, to explore the domain of climate of innovation (Kivimäki & Ellovainio, 1999). I modified the items in order to more appropriately describe the phenomenon that I was studying. For example, the SCI uses the term "[neighborhood] block," and I replaced it with "community" in my questionnaire. Additionally, an open-ended question was included at the end of the questionnaire inviting respondents to provide additional comments about their participation within the community, the relationships within the community, or the climate of innovation.

Administering the Questionnaire

With permission provided by organizational representatives, research participants received an e-mail invitation containing a link to the questionnaire on a commercial Web-based product. Respondents were solicited to self-report information about themselves and their communities. In the e-mail cover letter there was a statement indicating that participation was voluntary. By clicking on the URL to connect to the instrument, the respondent was giving tacit agreement to participate in the survey. The questionnaire took about 15 to 20 minutes to complete. With the online survey process, only anonymous responses were collected.

An invitation to respond to the questionnaire is in Appendix A. The link remained open and available for several weeks. At the end of the first week, if the response rate was below 50%, I re-invited community members to participate and extended the time to complete the questionnaire. The questionnaire is provided in Appendix B. It contains five demographic questions and approximately 50 items that mostly require a 5-point Likert scale.

Online Questionnaire

An online questionnaire, using the commercial Web-based product called SurveyMonkey, was distributed to research participants. I selected this tool for several reasons: first, SurveyMonkey was the leading survey tool on the Internet, according to Alexa (Alexa.com, 2007). Alexa obtains its traffic data, including reach, page views and rank information, from a global panel of web users. The panel is used as a statistical sample of Internet usage to extrapolate overall traffic patterns and Web-usage information. Furthermore, more than 80% of the Fortune 100 companies are currently using SurveyMonkey, largely due to its ease of use for both researcher and participant (SurveryMonkey, 2008). Second, SurveyMonkey maintains privacy. The data collected in this proposed study was anonymous, via the collection mechanism used by SurveyMonkey that strips all identifying information from the online responses. The service provides multiple layers of security to ensure that account information and data remains private and secure. The data collected resides behind the latest firewall and intrusion prevention technology.

Institutional Review Board for Research

I was committed to protecting the rights of and ensuring the safety of human subjects participating in this research. This commitment was guided by federal regulations and was vested in the Virginia Tech Institutional Review Board for Research Involving Human Subjects (IRB) which operates under a Federalwide Assurance (FWA) on file with the Office for Human Research Protection (OHRP) within the U.S. Department of Health and Human Services (DHHS). I completed the *Training in Human Subjects Protection* provided by Virginia Tech in December 2007 and sought and received IRB approval in February 2008, prior to conducting the study. The IRB Exempt Approval Letter for Research is located in Appendix C.

PARTICIPANTS

The target population for this study was the U.S. federal government environment, including civil servants and military personnel, as well as federally funded researchers, industry contractors, and vendors that support the government. The government was selected for several reasons. First, examining the relationship between *communities of practice* and the *climate of innovation* would provide insight into a public-service population that was increasingly reliant on knowledge management strategies and tools. Additionally, U.S. federal government funding and policies have resulted in innovative products and services across society. However, there was limited empirical research examining knowledge management and its impact, such as innovation, within the government workforce. This study could contribute to the understanding of innovation within the public arena.

Furthermore, in contrast to the private sector, which is motivated by profit, the government's dictate is to better serve and protect its citizens. To facilitate this mission, the U.S. federal government spending on knowledge management is expected to reach $1.3 billion by fiscal year 2010, according to the Federal Management MarketView report released by INPUT (2005). The spending is largely in response to critical challenges such as combating the threat of terrorism, overcoming siloed and bureaucratic organizational structures, reacting to information lapses highlighted by Hurricane Katrina, and responding to an aging work force (Barquin, 2003; Liebowitz, 2004; Neilson & McCrea, 2002; U.S. Office of Personnel Management, 2006).

Given this expenditure, exploring the relationship between knowledge management activities (e.g., communities of practice) and innovation (i.e., climate of innovation) would assist public sector scholars and government officials in making informed decisions about investing in knowledge management. Finally, the research was conducted within the Washington, D.C., metropolitan area, conveniently located near the headquarters of many of the participating civilian agencies, military organizations, federally funded research centers, and contracting organizations. The proximity allowed for better access to community liaisons who in many cases coordinated their community efforts from organizational headquarters.

Population Engagement

Communities were chosen to participate using three criteria: (a) the communities were active and not in a start-up phase, (b) communities represented a myriad of professions and existed within a variety of federal organizations, and (c) communities were interested and available to participate in the study.

Community liaisons were approached about the research and offered individual community results for their community's participation in this study. Community liaisons then distributed the invitation with a link to an online questionnaire to community members. The questionnaire was accessible 24 hours a day in order to accommodate the respondents in different time zones across the globe. I maintained close contact with the liaisons and monitored the participation rate using the Web-based survey tool, SurveyMonkey. Most community liaisons sent reminder notices to their members to complete the questionnaire and the online questionnaire was available for several weeks.

The targeted sample size was between 120 and 180 respondents, reflecting individual perceptions from a variety of communities of practice within the U.S. federal government environment. I arrived at this range because there were 12 variables in my study (8 independent variables and 4 dependent variables) and conservatively applied the 'rule of thumb' that there should be at least 10 to 15 observations for every variable (Cohen & Cohen, 1975; Howell, 1997). This rule, which typically applies to number of subjects per independent variable in regression analyses, would require 96 to 120 participants. But, because less than 100 participants seemed too small a number for valid results and it was anticipated that all 12 variables would be

included in a canonical correlation analysis, the goal was to attain at least 120 and, hopefully, 180 participants. The final participant count was 384, more than double the target.

ANALYSES

After structuring the questionnaire and administering it to the respondents in the U.S. federal government environment, the next step was to collect and analyze the data. The data collected from the online questionnaire were exported from SurveyMonkey into an Excel spreadsheet and then into JMP, version 7, for analysis. Data were checked for completeness and descriptive statistical analyses, including frequencies and percentages for the demographic information. Reliability estimates for scales and subscales were calculated and compared to previously published reliabilities and then scale means were computed. Means and standard deviations were determined for each scale. Table 3.3 displays the four criterion variables, eight predictor variables, and five demographic variables examined in this study.

Table 3.3 Criterion, Predictor, and Demographic Variables

	# of Items	Reliability
Criterion Variables		
Climate of Innovation Factors (TCI Short Version)		
a. Vision	4	.84, .86
b. Participative safety	4	.85
c. Task orientation	3	.85, .86
d. Support for innovation	3	.79, .82
Predictor Variables		
Participation Factors (CAT)		
a. Perceived benefits	13	Not available
b. Nature of participation	8	Not available
c. Amount or level of participation	1 categorical	
d. Primary mode of participation	1 categorical	
Connectivity Factors (SCI)		
a. Feeling of belonging/identification (membership)	3	.40 to .78
b. Opportunity for influence	3	.16 to .76
c. Integration/fulfillment of individual and community needs	3	.24 to .80
d. Shared emotional connection	3	.07 to .76
Demographic Variables		
Employment	a. Government b. Military c. Industry d. Academia e. I am not currently employed. f. Other: _____	
Workplace environment	a. Government b. Military c. Industry d. Academia e. I am not currently employed. f. Other: _____	
Level of expertise	a. Novice b. Advanced beginner c. Competent d. Proficient e. Expert	
Time in current job	_____ years _____months	
Time in community	_____ years _____months	

Conducting Regression

To learn more about the relationship between several independent or predictor variables and a dependent or criterion variable, multiple regression was used. I was interested in discovering evidence for and explaining the relationships between two sets of predictor variables (i.e., participation and connectivity) and four criterion variables (i.e., *vision, participative safety, task orientation,* and *support for innovation*). Four hierarchical regression analyses were used, one for each criterion. The four participation variables were entered together in the first step to determine variance explained by participation, and four connectivity variables were entered in the second step to determine variance explained by connectivity beyond what is explained by participation. Two of the participation variables were categorical and needed to be dummy coded to allow for their inclusion in the regression analyses.

Canonical correlation (CCA) was an additional procedure that I planned to use. However, once the data were collected and the results of the intercorrelations were reviewed, it was apparent that CCA would not provide additional insight into the relationships between sets of variables representing two dimensions of communities of practice (i.e., participation and connectivity) and the set of variables representing climate of innovation.

CHAPTER IV
FINDINGS

This chapter provides a description of the respondents and the relationships between and among the predictor variables (i.e., participation and connectivity) and the criterion variable (i.e., climate of innovation). A parsimonious model with four key factors is offered as well as a response to each of the research questions outlined in Chapter III. The SAS JMP statistical package, version 7, was used for all analyses. Appropriate data presentation and discussion of the findings are also included in this chapter.

Respondent Profile

A total of 384 individuals representing the U.S. federal government environment participated in the study. They came from six organizations including civilian government and military, as well as industry, academia, and research centers that support the federal government. From these organizations, 12 communities participated in the research study. Non-attribution was promised to each community and, therefore, the specific communities that participated are not cited here. It can be reported, however, that these communities represented transportation and logistics specialists, intelligence analysts, strategic thinkers, human computer researchers, technology security, leadership, acquisition specialists, F-16 officers, finance managers, and ordinance experts.

It is important to note that within the federal government environment it is common to have an assemblage of civilian government, military, industry, academia, and research centers all participating within a single community regardless of the host organization or workplace location. For instance, one of the armed forces-sponsored communities had 83 community members participate in this study. The members represented military, civilian government and industry. For this reason participants were asked to identify the organization they were employed by, as well as their workplace location. In this sample, 85% worked in their employer's organization while 15% worked outside their employer's organization.

Table 4.1[1] indicates that the military and civilian government provided the largest respondent base for this research. More specifically, the employer for nearly half of 327 respondents was the military (47%), and the workplace was a military location for more than half (52%) the 331 respondents. The civilian government was the employer of a little less than one-third of the respondents (28%) and was the workplace location for just over one-third (32%).

Table 4.1 Respondents' Employer and Workplace Environment

Organizations	**Employer (N = 327)**		**Workplace (N = 331)**	
	N	%	N	%
a) Government (civilian)	92	28%	106	32%
b) Military	153	47%	171	52%
c) Industry	69	21%	43	13%
d) Federally Funded Research and Development Centers (FFRDC)	12	4%	7	2%
e) Other	1	0%	4	1.2%

Table 4.2 displays the respondents' self-reported expertise levels, categorized into one of five groups: novice, advanced beginner, competent, proficient, or expert. Of the 330 respondents' reporting, nearly one-half (47%) saw themselves as an "expert" in their field, followed by one-third (34%) who perceived themselves as "proficient", and 14% who perceived themselves to be "competent." Small percentages of respondents reported that their expertise level was "advanced beginner" (4%) or "novice" (1%).

[1] A total of 384 respondents participated in this study. However, some data are missing because questions were unanswered. As a result, the sample size (N) varies for each question and is denoted in the tables.

Table 4.2 Expertise Levels of Respondents (N = 330)

Expertise level	N	%
a.) Novice	4	1%
b.) Advanced beginner	14	4%
c.) Competent	46	14%
d.) Proficient	112	34%
e.) Expert	154	47%

The mean for the participants' tenure in their current job was 8.6 years (N = 241, SD 7.7) with the tenure ranging from less than one year to more than 35 years. The distribution was positively skewed with the 25th, 50th, and 75th quartiles being 2.6, 6.8, and 12.7 years, respectively. The mean tenure as a community member was 3.2 years (N = 160, SD 3.9), with ranges from "newly joined" to 25½ years. Community tenure also had a positively skewed distribution with quartiles of 1 year, 2 years, and 3.7 years, respectively.

Table 4.3 illustrates a fairly direct relationship with self-reported expertise level for both average job tenure and community tenure. In both cases, novices averaged less than one year in their job and a half a year within their community. Experts averaged 11 years in their job and four years in their community of practice.

Table 4.3 The Mean of Job Tenure and Community Tenure by Expertise Level

Expertise level	Job Tenure (N = 241)	Community Tenure (N = 160)
a) Novice	.8	.5
b) Advanced beginner	1.5	.6
c) Competent	3.6	1.5
d) Proficient	8.4	3.3
e) Expert	11.1	4

Criterion and Predictor Variables

Once the data were gathered from the respondents in SurveyMonkey, they were downloaded to an Excel spreadsheet. Using the spreadsheet, data were checked for completeness and reorganized and relabeled as necessary. The data were then transported to SAS JMP, version 7. Dummy coding was used for two of the predictor variables: *participation level* because it encompassed three categories, core, active, and peripheral; and, *participation mode* because it had two groups, face-to-face interaction and virtual contact.

Before exploring the relationships between the two dimensions of communities of practice (i.e., participation and connectivity) and a set of variables representing a climate of innovation, preliminary analyses were undertaken for the criterion and predictor variables. The reliabilities in this study were comparable to previously published reliabilities, as was described in Table 3.3, located in Chapter III. Means and standard deviations were also determined for each scale. The reliabilities (Cronbach alphas), means (M), and standard deviations (SD) for the criterion and predictor variables in this study are presented in Table 4.4.

Criterion Variables: Climate of Innovation Factors

As discussed in Chapter III, I used an existing instrument, Team Climate of Innovation Short Version, to examine the criterion variables. The Likert response scales for two of the four climate of innovation subscales, *vision* and *task orientation*, were recoded in order for them to be consistent with the other two climate of innovation subscales (i.e., *participative safety* and *support for innovation*) and so high scores on each scale would indicate a positive attitude on that climate factor. This facilitated interpretation and comparison of the means for each subscale.

As shown in Table 4.4, subscale means ranged from 3.5 to 3.8 (SD .68 to .81) with an overall mean of 3.7 (SD .65) on a Likert scale using 1 = strongly disagree/not at all to 5 = strongly agree/completely agree. These values showed that there was a fairly strong consensus among respondents that these factors were present in their communities. Notably, the subscales' means were clustered closely together, which may indicate that the respondents' saw these aspects in the same positive light.

Table 4.4 Reliabilities, Means, and Standard Deviations for Criterion and Predictor Variables

Variables	# of items	alpha	M	SD
Criterion Variables				
Climate of Innovation Factors				
a) Vision	4	.88	3.79	.73
b) Support for innovation	3	.88	3.70	.75
c) Task orientation	3	.86	3.54	.81
d) Participative safety	4	.83	3.81	.68
Total Climate of Innovation	14	.94	3.73	.65
Predictor Variables				
Participation Factors				
a) Perceived benefits	12	.88	2.71	.72
b) Nature of participation	8	.91	2.58	.94
c) Amount/ level of participation	1	Single, categorical item		
d) Primary mode of participation	1	Single, categorical item		
Connectivity Factors				
e) Feeling of belonging/ identification (membership)	3	.68	3.44	.78
f) Shared emotional connection	3	.59	3.89	.63
g) Integration/fulfillment of individual and community needs	3	.50	3.90	.62
h) Opportunity for influence	3	.25	3.46	.59
Total Connectivity	12	.83	3.68	.54

The highest mean was for *participative safety* at 3.8 (SD .68). As discussed in Chapter II, earlier researchers examining the climate of innovation phenomenon believed that *participative safety* entailed members actively contributing to creating a non-threatening, trusting, and supportive group environment. The respondents tended to agree with items such as "we have a 'we are together' attitude" and "community members keep each other informed about work-related issues in the community." Because communities of practice often provide a safe harbor to discuss issues and challenges, it is plausible that *participative safety* is a necessary foundation in building an innovative environment.

Although the mean for *task orientation* (3.5, SD .81) was also quite high and close in score to the other climate of innovation subscales scores, it was the lowest mean score. This variable described a commitment to excellence in task performance coupled with a climate that supports the adoption of improvements to established policies, procedures, and methods. To

assess participants' perceptions, the questionnaire used three questions, such as, "Does the community critically appraise potential weaknesses in what it is doing in order to achieve the best possible outcomes?" The questions alluded to some responsibility for action on the part of the members. However, as discussed in greater detail in the following section, community members were generally interested in "staying up to date on a topic" and not task-related responsibilities.

Predictor Variables: Participation Factors

Unlike the climate of innovation factors, the participation measures for *perceived benefits, nature of participation, amount/level of participation,* and *primary mode of participation,* did not come from one sole instrument. As outlined in Chapter III, the items for *nature of participation* were developed for this study following an extensive literature review and then vetted by knowledge management experts. The remaining three variables, *perceived benefits, amount/level of participation,* and *primary mode of participation* used items from an existing instrument, the Community Assessment Toolkit.

As illustrated in Table 4.4, *perceived benefits of participation* and *nature of participation* had high reliabilities (.88, .91 respectively). Table 4.5 reports the median and mode for *perceived benefits for participating* within communities of practice. Respondents reported that "staying up to date in the topic of the community" was the most important, followed closely by "saving time in finding all kinds of information" and "receiving ideas from others on how to solve concrete problems in my work." Of least importance was "having nice meetings, fun and non-work- related activities" and "acquiring projects or customers." These findings indicated that the true value of community membership is efficient access to knowledge for addressing current issues and problems. These findings are in sync with earlier research that has shown that individual members of a community of practice generally participate because they believe that it is in their interest to participate.

Table 4.5 Perceived Benefits of Participation[a]

Perceived Benefits	N	Median	Mode
a) Staying up to date in the topic of the community	381	4	4
b) Saving time in finding all kinds of information	378	3.5	4
c) Hearing about new knowledge and experiences from other community members	383	3	4
d) Developing standards, methods, and best practices	381	3	4
e) Receiving ideas from others on how to solve concrete problems in my work	380	3	4
f) Making useful contacts/networking	381	3	4
g) Improving the level of expertise of the members	383	3	4
h) Developing together new ideas for the community	384	3	3
i) Helping newcomers in the community	381	3	3
j) Making the organization more attractive for customers	380	2	3
k) Advancing my career	382	2	3
l) Acquiring new projects or customers	382	2	1
m) Having nice meetings, fun and non-work-related activities	381	1	0

[a] Response options ranged from 0 = not important to 4 = very important.

As illustrated by the medians and modes in Table 4.6, respondents reported that their *nature of participation* most often entailed "searching, accessing, or acquiring knowledge from relevant sources" with "monitoring the field" following close behind. "Interacting and communicating with fellow community members" and "organizing and packaging knowledge for others" were the least important types of participation. Given the previously discussed *perceived benefits of participation,* such as staying up to date on the community topic and finding information expeditiously, the respondents focused on ways that they could best do so. Of lesser

importance regarding both the *perceived benefits of participation* and *nature of participation* is the social aspect of communities that entails building an affiliation, and interacting with and helping others. As referenced in Chapter II, previous research indicated that camaraderie and togetherness were components of communities of practice; however, it appears that for these respondents, these aspects of community participation were of lesser importance.

Table 4. 6 Nature of Participation [a]

Nature of Participation	N	Median	Mode
a) Searching, accessing or acquiring knowledge from relevant sources	361	3	4
b) Monitoring the field and keeping tabs on what's going on	361	3	4
c) Advising or helping other members	359	3	3
d) Analyzing, processing, or evaluating knowledge	360	3	3
e) Creating new or generating better knowledge	359	3	3
f) Solving problems and making useful decisions using job-relevant knowledge	360	3	3
g) Interacting and communicating with fellow community members	360	2	3
h) Organizing and packaging knowledge for others or embedding it in a useful form	361	2	3

[a] Response options ranged from 0 = not at all to 4 = a lot.

The frequencies for *amount/level of participation* and *mode of participation* variables are displayed in Table 4.7. One-half of the 359 respondents (50%) saw themselves as "active members" in their community with one-third of the respondents (33%) reporting their level of participation as "peripheral" to the community. Although earlier studies suggested that most members are located on the periphery, the respondents in this study appear to be more actively involved. This may be for a variety of reasons such as peripheral members were not aware of or interested in the study, did not have time to contribute because they were actively participating in

other communities, or believed that their observations were not helpful because they were not core or active members.

Less than one-fifth of the respondents (17%) believed they were "core members" of their community. This distribution for core members reinforces earlier findings suggesting that there is always a smaller group who serve as the "heart of the community" (Wenger, McDermott, & Snyder, 2002, p. 56). With this study, a member of the core group for all 12 communities was instrumental in facilitating data collection and expressed interest in the research results.

In addition, Table 4.7 illustrates that "face-to-face gatherings" were the primary mode for community participation for only 29% of the 360 respondents, whereas almost three-quarters (71%) of the respondents reported that "virtual contact" was largely how they interacted with fellow community members. For the 249 respondents who primarily participated virtually, 72% have had previous face-to-face interaction with community members but approximately one-quarter of the respondents (28%) had not. This proportion of face-to-face interaction during some point of community membership appears to be rather high, especially given that community members are often dispersed to different locations. As will be discussed later in this chapter, the *participation mode* did not correlate with other participation variables; however, the opportunity to meet in-person may have influenced the respondents in ways that were not evident in this study.

The intranet or Internet is the primary vehicle for participation for three-quarters of the participants (74%) followed by telephone or conference calls (20%). Only 5% of respondents reported using video conference or online meeting capabilities. The three respondents who identified using "other" participation modes reported that they used (a) "telephone plus [software] to see each other's computer screens," (b) "webinars," and (c) "IM with members I know."

Table 4.7 Amount/Level and Primary Mode of Participation

	N	%
Amount/Level of participation (N = 359)		
a) Core member	61	17%
b) Active member	181	50%
c) Peripheral member	117	33%
Mode of Participation (N = 360)		
a) Face-to-face gatherings	105	29%
b) Virtual contact:	255	71%
Telephone calls or conference calls	50	20%
Video conferences or online meetings	12	5%
Intranet or Internet	189	74%
Other	3	1%
Previous Face-to-Face Interaction for Participants whose Primary Mode is Virtual Contact (N = 249)		
a) Yes	179	72%
b) No	70	28%

Predictor Variables: Connectivity Factors

To assess connectivity (i.e., the level of interaction between members and feelings of cohesion and belongingness) the Sense of Community Index (SCI), was adapted for this study. As described in Chapter III, a Likert scale ranging from 1 = strongly disagree to 5 = strongly agree was used with the items. Table 4.4 reports the subscale means ranging from 3.4 to 3.9 (SD .59 to .78), with the overall mean for connectivity at 3.7 (SD .54). This indicates that the respondents tended to agree that connectivity existed within their communities. Like the means for the climate of innovation variables, the subscales' means were clustered closely together which may again show that the respondents positively interpreted these factors similarly for their community.

As exhibited in Table 4.4, the reliabilities for the connectivity subscales ranged from weak to strong (.25 to .68). A principle components factor analysis was conducted on these items because, as was discussed in Chapters II and III, previous studies with the scales showed that the four dimensions may actually work together dynamically to create one factor of connectivity within a community. Results of the factor analysis indicated that the items for connectivity represented only one dimension, not four. The reliability for the total connectivity score was .83, much more reliable than any of the subscale scores. Although the four subscales were retained for subsequent analyses, the total connectivity score was ultimately used as a single measure.

The total connectivity mean score was 3.7, indicating a strong overall sense of connection with the communities of practice. Even though the subscales did not represent separate dimensions, the separate subscale means are discussed here for completion to show the variations in the subtle aspects of connectivity, and to be consistent with prior research where the subscale scores were used. The highest mean was for *integration/fulfillment of individual and community needs* (Mean 3.9, SD .62). This subscale was described in Chapter II as the need for the member-community association to be rewarding in terms of needs, goals and values for the members. An example of an item is, "My fellow community members/colleagues and I want the same thing from this community." The *shared emotional connection* subscale followed very closely with a mean of 3.9 (SD .63). Earlier in this "Criterion and Predictor Variables" section, the climate of innovation variables were examined, and it was reported that *participative safety* had the highest mean score of the climate of innovation subscales. All three variables share a sense of trust and support and indicate that these elements were important to the respondents.

The *membership* subscale had the items that the respondents least agreed with (Mean 3.4, SD .78) and referred to the feeling of belonging and identification. Items included, "I can recognize most of the people who are members of this community," and, "I feel at home on this community." Although the respondents did rate this subscale fairly high, this comparatively lower score is in keeping with the earlier mentioned idea that building and sustaining affiliation and identification among the community members is of lesser interest to the respondents who participated in this study.

Relationships among Variables

I used multiple regression to learn about the relationship between two predictor variables (i.e., participation and connectivity) and a criterion variable (i.e., climate of innovation). The validity of multiple regression was based on certain assumptions that have been satisfied. These included the distribution of means, which were normally dispersed, and low correlations between pairs of predictor variables. In this section, a correlation matrix is provided for all criterion and predictor variables, as well as one with a consolidated connectivity variable, two participation variables, and a consolidated climate of innovation factor.

Table 4.8 contains all the intercorrelations for the predictor and criterion variables. These will be discussed separately for each set of variables. The two categorical variables were dummy coded so they could appropriately be included in the correlation and regression analysis. *Participation level*, with three categories, was transformed into two 0/1 variables, where 1 represented *core* participation in the first variable and *active* participation in the second. *Mode of participation* only included two categories, so a single dummy coded variable was used.

Table 4.8 Intercorrelations among Climate of Innovation, Participation, and Connectivity Variables (N = 287)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
Climate of Innovation													
1. Vision	1.00												
2. Participative Safety	0.71	1.00											
3. Task Orientation	0.67	0.70	1.00										
4. Support for Innovation	0.66	0.75	0.70	1.00									
Participation													
5. Perceived Benefits	0.33	0.37	0.31	0.38	1.00								
6. Nature of Participation	0.43	0.46	0.44	0.47	0.53	1.00							
7. Participation Level/Core	0.30	0.32	0.25	0.27	0.20	0.37	1.00						
8. Participation Level/Active	0.09	0.12	0.09	0.06	0.11	0.11	0.56	1.00					
9. Mode of Participation	0.02	0.06	-0.01	0.01	0.04	-0.02	0.20	0.18	1.00				
Connectivity													
10. Membership	0.50	0.53	0.49	0.47	0.31	0.37	0.47	0.25	0.26	1.00			
11. Influence	0.59	0.58	0.48	0.53	0.29	0.41	0.36	0.16	0.14	0.62	1.00		
12. Needs	0.57	0.56	0.43	0.47	0.26	0.37	0.32	0.17	0.02	0.49	0.52	1.00	
13. Shared Emotional Connection	0.61	0.60	0.48	0.50	0.29	0.37	0.42	0.21	0.10	0.59	0.61	0.57	1.00

Note. Correlations < .13 are not statistically significant

Correlations within Criterion Variables

For the criterion variables, the four climate of innovation subscales were strongly related to each other (.66 to .75), with *participative safety* and *support for innovation* having the strongest correlation (.75). This underscores the aforementioned finding that *participative safety* may be a necessary building block for a climate of innovation within a community of practice.

Correlations within Each Set of Predictor Variables

The participation variables were fairly independent of each other, with the exception of *participation benefits* and *nature of participation* (.53) and the *participation level*s (i.e., .56 for the dummy coded variables representing core and active participation), which had moderate correlations. The *primary mode of participation* had a weak relationship with the other participation variables (-.02 to .20) and may indicate that the *mode* (i.e., face-to-face interaction or virtual contact) is not related to one's community participation. However, as suggested in the earlier "Predictor Variables: Participation Factors" section, a large percentage of the study respondents had face-to-face interaction with community members, and this contact may have mitigated the relationship with other participation variables.

The connectivity subscales were fairly related with each other (.49 to .62), as depicted in Table 4.8. This would be expected based on the factor analysis of the underlying items. *Influence* had the strongest relationship with *membership* (.62) and *shared emotional connection* (.61), and, as theorized in Chapter II, this indicates that *influence*, described as the "reciprocal relationship of the member and the community," is an important aspect of connectivity.

Correlations between Two Sets of Predictor Variables

Table 4.8 illustrates that two of the connectivity variables, *membership* and *shared emotional connection*, were moderately correlated with *participation level/core* (.46, .42 respectively). These relationships suggest that if community members acted in a core capability, there was a heightened sense of bonding and security that was likely generated over time through positive interaction with fellow community members. *Influence* also had a moderate correlation with *nature of participation* (.41), implying that the reciprocal relationship of the individual and

the community is related to the type of knowledge work that is performed within the community (e.g., searching, accessing, or acquiring knowledge from relevant sources).

Correlations between Predictors and Criterion Variables

Overall, the connectivity variables were more related to climate of innovation than the participation variables. Both *perceived participation benefits* and *nature of participation* had only moderate correlations with climate of innovation subscales (.31 to .47), while the other participation variables were either weakly related or not related to the criterion. These two moderate correlations suggest that why members participate and how they participate have a relationship with the community climate that is created and maintained.

Interestingly, all four of the connectivity subscales had moderate to strong correlations to the climate of innovation subscales (.43 to .61). The strongest relationships were with *vision* and *participative safety*. To ensure that there were two separate and distinct constructs, a principle components factor analysis was conducted. Four of the fourteen climate of innovation items cross-loaded with the connectivity subscales. Two of those items were *participative safety*-related and the other two were *vision*-related. A review of the climate of innovation and connectivity theories indicated that these four items could be interpreted as similar to two of the connectivity subscales, *membership* and *needs*, thereby explaining the cross-loading.

Generating a Parsimonious Model

These results contributed to the idea of generating a more simplistic model. Because there were high intercorrelations for the climate of innovation subscale scores in Table 4.8, the subscales were consolidated into one mean score for the final model. In addition, a composite connectivity mean score was used because a factor analysis suggested one dimension for connectivity and because the four subscale scores had low reliability, while the total score was very reliable. Finally, because *perceived benefits of participation* and *nature of participation* were the only two participation variables with moderate correlations to the criteria, their mean scores were kept in the final model. The correlation matrix in Table 4.9 is a parsimonious demonstration of the relationships between sets of variables representing three dimensions of

communities of practice (i.e., two participation variables and one connectivity variable) and a set of variables representing climate of innovation.

Table 4.9 Intercorrelations among Climate of Innovation, Perceived Benefits, Nature of Participation, and Connectivity (N = 289)

	1	2	3	4
1. Climate of Innovation	1.00			
2. Perceived Benefits	0.40	1.00		
3. Nature of Participation	0.51	0.53	1.00	
4. Connectivity	0.73	0.36	0.47	1.00

As was already shown, the two participation variables, *nature of participation* and *perceived benefits of participation,* had a moderate correlation with each other (.53) signifying that the motivation for participating within communities is somewhat related to the method of participation. For example, if a member believed that a primary benefit of community membership was to stay up to date on a topic, that member might use the community to "monitor the field and keep tabs on what's going on."

Nature of participation was more related to climate of innovation (.51) than was the *perceived benefits of participation* (.40). This relationship suggests that the type of knowledge work that is performed within the community is related to the four major factors predictive of the climate of innovation: *vision, participative safety, task orientation,* and *support for innovation* (Anderson & West, 1996). To continue with the above example, if the member believed that the community's climate was conducive to innovation, the member would be more likely to use the community to monitor the field, search for knowledge, and advise or help other members.

Finally, the correlation for the consolidated mean scores of climate of innovation and connectivity was very high (.73), indicating a strong association between creating the proper environment for innovation and the importance of relationships within communities. Although

earlier research has tended not to address the importance of relationships to an innovative environment, these findings suggest that this association is worth exploring.

Variance Explained: Answering the Research Questions

The purpose of this research was to discover evidence for and explain the relationships between sets of variables representing the two dimensions of communities of practice (i.e., participation and connectivity) and a set of variables representing a climate of innovation. In response to the research questions outlined in Chapter III, Table 4.10 has the coefficients of determination and provides the variance explained for each climate of innovation factor (i.e., *vision, participative safety, support for innovation,* and *task orientation).* Appendix D contains the betas for the hierarchical regression.

Drawn from a standard least squares regression analysis, the column with R^2 Step 1 denotes the proportion of each climate of innovation factor explained by the set of four participation variables (i.e., *perceived benefits for participation, the nature of participation, the amount or level of participation,* and *the primary mode of participation).* This column indicates that the participation variables accounted for 22% to 26% of the variance in climate of innovation, with *support for innovation* being the best explained and *participative safety* following close behind with the second largest percentage of its variance explained.

Table 4.10 Variance Explained for Climate of Innovation Variables by Participation and Connectivity Variables in Four Hierarchical Regressions

Climate of Innovation	R^2 Step 1 Due to participation	ΔR^2 Due to connectivity	R^2 Step 2 Participation & connectivity
1. Vision	.23	.29	.52
2. Participative safety	.25	.27	.52
3. Support for innovation	.26	.16	.42
4. Task orientation	.22	.18	.40

The column with R^2 Step 2 displays the proportion of each climate of innovation factor explained by the set of four connectivity variables (i.e., *membership, influence, integration and fulfillment,* and *shared emotional connection),* and the four participation variables. This column reflects the second step in each hierarchical regression analysis, which included all nine predictor variables. The change in R^2 column shows the difference between the R^2 scores, indicating how much of the variance in each criterion was explained by connectivity over and above that which was explained by participation. The connectivity variables explained 18% to 29% of the additional variance, with *vision* responsible for the largest percentages of the variance and *participative safety* having the second largest percentage.

Together, the four participation variables explained about one-quarter of the variance in each of the climate of innovation criteria, with only slight differences. Adding the four connectivity variables explained more than an additional quarter of the variance for *vision* and *participatory safety* but less than 20% for the other two criteria. It should be noted, however, that even the worst result was fairly remarkable, with 40% of the variance in *task orientation* being explained by participation and connectivity variables.

Comments from Respondents

At the end of the questionnaire, respondents were invited to provide comments about their participation within the community, the relationships within the community (i.e., connectivity), and the climate of innovation within their community. Seventy-three respondents, or 19% of the 384 participants, wrote comments. Interestingly, there was a pattern in the proportion of comments based on the *level of community participation.* The self-described "core" members were the group to offer the largest percentage of comments. As displayed in Table 4.11, 30% of the 61 core members responded to the invitation to provide written comments, although they only represented 17% of the total respondents. This is not surprising as indicated by the research cited in Chapter II, core members are the most involved in the community and would most likely have some insights into participation, connectivity, and the climate of innovation within their community, and be willing to give their time to comment. Self-described "active" members were the group with the second highest percentage, with 21% of 181 active members providing written comments. Finally, 15% of 117 "peripheral" members supplied comments.

Table 4.11 Written Comments Provided by Members at Different Amounts/Levels of Participation

	Total N (359)	% of Total Respondents	N of Respondents Providing Comments (73)	% of Respondents Providing Comments
Amount/Level of participation				
a) Core member	61	17%	18	30%
b) Active member	181	50%	38	21%
c) Peripheral member	117	33%	17	15%

The comments were placed in categories, quantified, and labeled accordingly (Busch, De Maret, Flynn, Kellum, Le, Meyers, Saunders, White, & Palmquist, 2005; Trochim, 2006). Nineteen of the 73 comments, or 26%, were relevant to the research questions. All addressed participation variables – *perceived benefits of participation, nature of participation, level of participation,* and *participation mode.* Some comments reflected a combination of *participation* variables such as *perceived benefits* and *nature of participation.* There were no overt comments on connectivity or the climate of innovation.

As indicated by the quantitative results, *perceived benefits of participation* was an important aspect of this study. Respondents also provided favorable written comments indicating that their communities were largely "a great way to get the word out to the field," "a powerful tool for networking and task organizing a distributed environment," and "for one stop shopping, this is the place to go for information and ideas."

One respondent's comment was especially illuminating about communities of practice, saying, "It is an excellent way to place information out for personnel to find." The member continued, "It allows access by multiple agencies to documents that were traditionally held by one agency. This concept has streamlined the way we have done business and made it easier to pass information to all personnel in the career field." The member concluded with "recommend

that we continue to use this forum and expand its usage as necessary to continue to gain dividends from this resource."

Nature of participation was another important feature of communities, as denoted by the quantitative results of the data analysis. A handful of comments expressed concern that their community was not a collaborative forum but instead, was primarily "used by senior leaders and guiding organizations as a one way communication tool to present information about the career field." For these members, the community site had "no two way flow of information" and was not currently used as a collaboration tool; however, it was an "awesome tool" that had potential to be "effective in providing information." Regardless of how well the community capitalized on itself, most of the comments about the *nature of participation* suggested that members were satisfied with how the community was being used. For instance, "our community centers around a mailing list, which has some benefits – open exchange of ideas, place to share pointers, even lurk if one has no time to participate actively or come to the regular face-to-face meetings."

As illustrated by the previous comment, *participation mode*, whether it was face-to-face interactions or virtual contact, made an impression on several respondents. The need to accommodate a distributed workplace and consider security matters were reflected in the concerns of the respondents across the federal government environment.

Unlike *perceived benefits of participation* and *nature of participation, participation level* was not quantitatively evident. However, comments indicated that some members were concerned that only a few core members, or a "small nucleus of members," were engaged in community activities. There were several comments such as, "the greatest challenge is to break down the walls of human nature and get people to actively participate, not just attend VTCs [video teleconferences] and conferences. In most cases, you get participation only from the same group of dedicated analysts. Others are just happy to listen and go along for the ride." Other comments underscored the need of a core group to reach out to other members to encourage participation, "the way core group members related to peripheral or new members has a dramatic effect on whether they continue just lurking or actually post themselves." Some respondents expressed appreciation to the core and active members for "sustaining" the community.

While many comments focused on one specific participation factor, some comments addressed two or more aspects of participation. For example the following comment reflects both *participation level* and *nature of participation* elements:

> The community was initiated so that people across the centers doing this type of work could get to know each other and share information of mutual interest. It is not funded in any way so any participation is completely voluntary. At any given time, a few people are very active and the rest lurk on the e-mail list. It has partially fulfilled its purpose to the extent that people participate and make themselves known to others. I believe this group is one of the more successful grass-roots interest groups in terms of its longevity but I would like to see more participation.

Overwhelmingly, respondents used the opportunity to provide feedback to their community. These comments were categorized as either "community-specific feedback," which generally praised the workings and fellow members of the community, or labeled as "organizational barriers," which tended to be critical of organizational obstacles to community performance. Examples of positive community-specific feedback include:

- "The community is very close and harmonious and in accord with the work to be done. It is a very professional group with enthusiastic participation."
- "How did we ever do business without this tool?!! Best thing since the invention of plastic!"

Organization barriers are illustrated by comments such as:

- "I think the community's efforts are largely nullified by an increasingly unitary management style."
- "It is hard to innovate in DoD projects because of the way things are done with respect to contracts and contractor team structure."

Because the community-specific feedback was extraneous to the research questions outlined in Chapter III, the comments were not further analyzed (Weber, 1990). However, both the community-specific feedback and organizational barriers comments were forwarded to the appropriate community liaisons for their review and distribution to the community. Six percent of the comments regarded the survey itself or miscellaneous topics. These were categorized as "other." These comments were also returned to the community that provided them.

CHAPTER V
SUMMARY AND DISCUSSION

As an aid to the reader, the beginning of this final chapter of the dissertation restates the research problem, reviews the methods used in the study, and summarizes the research results. The major sections of this chapter discuss the findings, offer suggestions for additional research, and explore the implications for practitioners.

Summary of the Study

Restatement of the Problem

As introduced in Chapter I, there is a growing need to understand the relationship between communities of practice and the climate of innovation, which may serve as a precursor of innovation in the U.S. federal government workplace. The purpose of this research was to discover evidence for and explain the relationships between sets of variables representing two of the dimensions of communities of practice, participation and connectivity, and a climate of innovation (e.g., *vision, participative safety, task orientation,* and *support for innovation).* This study was not designed to evaluate strategies to promote, build, or facilitate communities of practice; explore techniques for fostering innovation in the workplace; or define and measure innovative products or services. However, the results may contribute to accomplishing these objectives.

Review of the Method

To answer the specific research questions outlined in Chapter III, perceptions were collected from community of practice members within the U.S. federal government environment about participation, connectivity, and their community's climate of innovation. Demographic data about the members' employers, workplace environments, expertise levels, and tenure in one's job and community were also collected.

To examine the predictor variables (i.e., participation and connectivity) and the criterion variable (i.e., climate of innovation), I combined items from three existing instruments into one questionnaire: Communities Assessment Tool (CAT) (Verburg & Andriessen, 2006); Sense of Community Index (SCI) (Chipeur & Pretty, 1999; Peterson, Speer, & Hughey, 2006); and Team Climate Inventory Short Version (TCI) (Kivimäki & Ellovainio, 1999).

Once the data were gathered from the respondents, they were checked for completeness and reorganized and relabeled as necessary. The data were then transported to SAS JMP, version 7. Dummy coding was used for two of the predictor variables, *participation level* and *participation mode*. Reliability estimates for scales and subscales were calculated and were comparable to previously published reliabilities. Means and standard deviations were also determined for each scale. After a review of the correlations, a parsimonious model containing four variables was generated. In response to the research questions, multiple regression was then conducted.

Summary Highlights of the Results

Participants

A total of 384 community members representing the U.S. federal government environment participated in the study. They primarily came from civilian government and military, yet industry, academia, and research centers that support the federal government participated as well. The communities addressed a variety of issues including transportation and logistics, technology security, and leadership. They supported a range of professionals such as acquisition specialists, F-16 officers, finance managers, ordinance experts, intelligence analysts, strategic thinkers, and human computer researchers. For this sample, 85% worked in their employer's organization while 15% worked outside their employer's organization.

Nearly one-half (47%) of the 330 respondents described themselves as an "expert" in their field, followed by one-third (34%) who saw themselves as "proficient" and 14% saw themselves as "competent." Small percentages of respondents reported that their expertise level was "advanced beginner" (4%) or "novice" (1%). The mean for the participants' tenure in their current job was 8.6 years (N = 241, SD 7.7) with the tenure ranging from less than one year to more than 35 years. The mean tenure as a community member was 3.2 years (N = 160, SD 3.9), with ranges from "newly joined" to 25½ years. There was a fairly direct relationship with self-reported expertise level for both average job tenure and community tenure. In both cases, novices averaged less than one year in their job and one-half a year in their community, while experts averaged 11 years in their job and four years in their community of practice.

Criterion and Predictor Variables

Climate of Innovation. The TCI Short Version with Likert scales was used in this study. Notably, the subscales' means were clustered closely together, which may indicate that the respondents' saw these aspects in the same positive light. The highest mean was for *participative safety* at 3.8 (SD .68) on a five-point Likert scale. The lowest mean was for *task orientation* at 3.5 (SD .81). The reliabilities for the subscales were strong, ranging from .83 to .88.

Participation. To assess three of the participation variables, *perceived benefits, amount/level of participation,* and *primary mode of participation,* items were used from the CAT. The items for *nature of participation* were developed following a review of the literature. For *perceived benefits of participating* within communities of practice, respondents reported that "staying up to date in the topic of the community" was the most important. Of least importance were "having nice meetings, fun and non-work-related activities" and "acquiring projects or customers." The reliability was strong (.88).

Respondents reported that their *nature of participation* most often entailed "searching, accessing, or acquiring knowledge from relevant sources" with "monitoring the field" following close behind. "Interacting and communicating with fellow community members" and "organizing and packaging knowledge for others" were the least important types of participation. The reliability was also strong (.91).

The *amount/level of participation* data indicated that one-half of the respondents (50%) saw themselves as "active members" in their community, with one-third of the respondents (33%) reporting their level of participation as "peripheral" to the community. Less than one-fifth of the respondents (17%) believed they were "core members" of their community.

In examining the *mode of participation* variables, three-quarters (71%) of the respondents reported that virtual contact was primarily how they interacted with fellow community members. For the respondents who primarily participated virtually, 72% had previous face-to-face interaction with community members but about one-quarter of the respondents (28%) had not. The intranet or Internet were the main vehicle for participation for three-quarters of the participants (74%), followed by telephone or conference calls (20%).

Connectivity. To assess connectivity (i.e., the level of interaction between members and feelings of cohesion and belongingness), the SCI was adapted for this study. Like the means for

the climate of innovation variables, the subscales' means were clustered closely together, which may again indicate that the respondents positively interpreted these factors similarly for their community. The highest mean was for *integration/fulfillment of individual and community needs (*Mean 3.9, SD .62). The *shared emotional connection* subscale followed very closely with a mean of 3.89 (SD .63). The *membership* subscale had the items that the respondents least agreed with (Mean 3.4, SD .78) and referred to the *feeling of belonging and identification*. The reliabilities for the connectivity subscales ranged from weak to strong (.25 to .68).

Relationships among Variables

Correlations within Criterion Variables. The four climate of innovation subscales were strongly related (.66 to .75) with *participative safety* and *support for innovation* having the strongest correlation (.75).

Correlations within Predictor Variables. The participation variables were fairly independent of each other, with the exception of *participation benefits* and *nature of participation* (.53) and *participation level*s (i.e., core and active) (.56), which had moderate correlations. The *primary mode of participation* had a weak relationship with the participation variables (-.02 to .20).

The connectivity subscales were fairly related with each other (.49 to .62) with *influence* having the strongest relationship with *membership* (.62) and *shared emotional connection* (.61).

Correlations between Predictor and Criterion Variables. Two of the connectivity variables, *membership* and *shared emotional connection*, were moderately correlated with *participation levels* (.46, .42 respectively). *Influence* also had a moderate correlation with *nature of participation* (.41). Both *perceived participation benefits* and *nature of participation* had moderate correlations with *climate of innovation* subscales (.31 to .47), indicating that these two *participation* variables had the strongest relationship with the criterion, as compared with the two other participation variables. The four climate of innovation subscales and the connectivity subscales had moderate to strong correlations with each other (.43 to .61).

Generating a Parsimonious Model

The results of the correlations led to the plan for developing a more simplistic model. Because there were high intercorrelations for the climate of innovation subscale scores, a composite of the subscale mean scores was made. In addition, because a factor analysis suggested one dimension for connectivity and not four, a composite connectivity mean score was constructed. Lastly, *perceived benefits of participation* and *nature of participation* were the two participation variables with moderate correlations and, therefore, their mean scores were kept in the final model.

With this revised model, a moderate correlation remained for *nature of participation* and *perceived benefits of participation* (.53), signifying that the motivation for participating within communities is related to the method of participation. *Nature of participation* had a moderate correlation with *climate of innovation* (.51) and with *perceived benefits* (.40). Of particular interest, the correlation for the consolidated mean scores of climate of innovation and connectivity was very high (.73), indicating a strong association between creating the proper environment for innovation and the importance of relationships within communities.

Variance Explained: Answering the Research Questions

In response to the research questions outlined in Chapter III, I conducted a hierarchical regression analysis. This analysis indicated that the participation variables accounted for 22% to 26% of the variance explained for climate of innovation, with *support for innovation* and *vision* responsible for the largest percentages. The connectivity variables explained an additional 18% to 29% of the variance, with *participative safety* and *vision* responsible for the largest percentages of variance. Overall, the *vision* and *participatory safety* dimensions for climate of innovation explained more than half the variance (52% each) of the participation and connectivity variables.

Written Comments

At the end of the questionnaire, respondents were invited to provide additional comments about their participation within the community, the relationships within the community (i.e., connectivity), or the climate of innovation. Of the 73 comments provided, 26% were relevant to the research questions and addressed all four of the participation variables. There was a pattern in

the proportion of comments based on the level of participation within the community. The largest number of responses came from core members (30%), followed by active members (21%). Only 15% of peripheral members provided comments. Respondents largely used the opportunity to provide feedback to their community. Generally, these comments either praised the workings and fellow members of the community or criticized organizational barriers to community performance.

Discussion of the Results

From the results two themes emerged about communities of practice and climate of innovation within the U.S. federal government environment. The first was the importance of relationships, or connectivity, within communities of practice and in relation to a community's climate of innovation. The second was the refinement of the contemporary description of participation within communities of practice. In addition, two aspects of the respondents' demographic information were of special interest and will be highlighted.

Regarding demographic information, the respondents in this study were community members within the U.S. federal government environment. Participation was dominated by military personnel (47%), followed by civilians (28%). There are a couple factors that may have accounted for the large military participation. First, the military has been a leader in knowledge management activities such as community generation and facilitation (Dixon, Allen, Burgess, Kilner, & Schweitzer, 2005; Lubold, 2008). Their progressive community-related actions may have influenced the respondents' experience, perhaps in ways that were not directly captured by this study. Second, the military communities' liaisons were interested in the study results and asked their members to participate. Historically, when military personnel are asked to complete a task, such as a questionnaire, they do.

Additionally, there was a fairly direct relationship with self-reported expertise level for both average job tenure and community tenure. The respondents tended to describe themselves as expert (47%) with the mean tenure for experts within their job just over 11 years and membership in the community for four years. This high percentage of participation in the study by experts suggests that these members may find the community to be especially helpful in keeping up to date in their field. In addition, it may be the experts within the community who believed that the research study results would be of interest or benefit to their community and

volunteered to participate. It may also be possible that some of the members who self-described their level of expertise at the expert level perceived their skills to be stronger than they actually were.

Connectivity: The Importance of Relationships

This study empirically demonstrated that connectivity is related to nurturing and sustaining a climate of innovation. As introduced in Chapter II, connectivity was described as a sense of community among the members and entails *(1) a feeling of belonging and identification, (2) an opportunity for influence, (3) an integration and fulfillment of individual and community needs, and (4) a shared emotional connection.* The implication is that if members tend to feel positively about their colleagues, they are more likely to receive the benefits of participation and rely on their community to stay up to date on new knowledge and listen to experiences from other members. Similarly, Cross, Hangadon, Parise, and Thomas (2007) have shown that emotion, energy, and enthusiasm with another type of knowledge sharing group, a social network, are important factors in organizational productivity and innovation.

Although all four factors of connectivity existed in this study, the respondents tended to agree that they experienced *integration and fulfillment of needs* and *shared emotional connection* slightly more than an *opportunity for influence* or *a feeling of belonging*. Early sense of community theory described these elements as distinct but influencing each other. Recent studies have shown that there may be different dimensions; however, given the complexity of connectivity, researchers continue to debate which dimensions are a part of sense of community. In this study, a principal components factor analysis was conducted and showed one factor of connectivity, instead of four. Therefore, a composite connectivity score was generated and used to examine the relationship among participation, connectivity and climate of innovation. With the composite score, the importance of relationships was quantified and had an impressive 52% coefficient of determination for climate of innovation. Although connectivity within communities of practice was not quantified before this study, the empirical findings supported earlier qualitative research that report that connectivity was a feature of communities.

With the respondents reporting that their level of subject-matter expertise was at the expert level, it may be that experts, in general, value their workplace relationships. They would have likely cultivated associations over many years. Perhaps connectivity had become second

nature. The experts may not even be aware of the importance or strength of relationships as "an expert's skill has become so much a part of him that he need be no more aware of it than he is of his own body" (Dreyfus & Dreyfus, 1986, p. 30). This may be the reason that the regression analysis showed a strong relationship between connectivity and climate of innovation, but when asked to comment on participation, connectivity, and climate of innovation, respondents only remarked on participation within their communities.

In this study, respondents were asked about their primary *mode of participation*, face-to-face meetings or virtual interactions. A sense of community may result from both modes, serving as the 'glue' that holds members together within communities of practice. The 'glue' reflects the feelings of attachment and belonging that an individual has towards a community and refers to the trust and reciprocity that undergird a community. Respondents indicated that 72% of them had the opportunity in the past for face-to-face interactions and dialogue. This exposure may have helped generate or solidify a sense of community. This may be especially true because the respondents described themselves as "active" members and one would expect active community members to have – or look for – the opportunity for interactions with fellow members. Furthermore, with 3.2 years as the average tenure of community membership, it is possible that this length of time helped to expand the network of active members and solidify some relationships. Interestingly, the respondents reported that interacting and communicating with fellow members was of lesser importance to them, as compared with other benefits of community membership. Perhaps this was because, as implied earlier, it was almost 'second nature' or they had already formed close working relationships with colleagues and did not rely on the community for the interaction.

Research has begun to emerge measuring a sense of virtual community (SOVC), which takes into account the unique features of groups that primarily communicate electronically (Blanchard, 2007, 2008; Forster, 2004). Early findings suggest that virtual communities may have less pronounced feelings of *influence* than do members of face-to-face communities (Blanchard & Markus, 2004). The researchers propose that ICT may affect these feelings. Yet the same research on SOVC has reported that community members feel that they experience and observe more personal relationships than do members of face-to-face communities. Although the SOVC was not used here, similar dynamics may have been present as the findings about

influence and personal relationships (i.e., connectivity) were reported by the respondents in this study.

Participation: Focusing on Knowledge Gains

Although the quantitative results generated from a regression analysis demonstrated the strongest relationship was between connectivity and climate of innovation, and not participation and climate of innovation, the written comments provided by participants indicated that these matters were on their minds. The four factors of participation examined in this study were *perceived benefits, nature of participation, amount/level of participation,* and *primary mode of participation,* and each was reflected in the written comments.

Early in this document, a community of practice was defined as a group of professionals who interact with each other within an organization, and across organizational units or even organizational boundaries, have a common interest or field of application in certain work-related topics, and share their knowledge on a regular basis. In describing key participation characteristics, previous studies were cited purporting members shared a purpose or goal and described a community as having its own identity.

For these respondents, there was not an overt commitment to a shared purpose or identity. Instead, the respondents indicated that their communities of practice primarily served as a knowledge retrieving forum. Study participants reported that "staying up to date in the topic of the community" and "saving time in finding all kinds of information" were the most important benefits of community membership. It is apparent that although contemporary communities of practice differ from the original model of apprenticeship envisioned by Lave and Wenger (1991), knowledge sharing or learning activities continue to be the most important benefit to members.

The type or *nature of participation* that was of most value was "searching, accessing, or acquiring knowledge from relevant sources" and "monitoring the field." "Organizing and packaging knowledge for others or embedding it in a useful form" or "interacting and communicating with fellow community members" were the types of participation that were least likely to occur. These findings suggest the overarching goal that members shared was one that would serve their own best interest and reiterate conclusions from earlier research (Zboralski & Gemünden, 2006). An apparent contradiction is that although members valued the ability to

access knowledge, they were only somewhat interested in helping others locate and acquire knowledge.

Community members contribute at different *participation levels* and this study used core, active, and peripheral groups to categorize respondents' participation. According to earlier research, the majority of members were peripheral, rarely actively participating and instead watching the interactions from the "sidelines" (Wenger, McDermott, and Snyder, 2002, p. 56). In this study, 50% of 359 respondents described themselves as "active." It is possible that the active members saw the invitation whereas the members on the periphery were not aware of the questionnaire, were not interested in participating, or believed their observations were not appropriate, and therefore, did not participate.

Distributed, virtual communities have emerged as ICT has improved, and for 71% of the research participants, it is now the primary mode of community participation. However, for these respondents, 72% had the opportunity for face-to-face interactions with fellow members in the past. As suggested in Chapter IV, this exposure may have influenced the members. For instance, extensive personal contact or co-location may have solidified relationships among the members and improved communication and knowledge sharing through ICT mechanisms. Alternatively, if previous face-to-face interactions did not influence, or was minimally influential, it may be that the communities that participated in this study had been successful in creating shared cultural objects (e.g., stories) around which virtual communities coalesced (Brown & Duguid, 2000).

The Climate of Innovation

Research cited in Chapter II indicated factors such as (*1) shared vision, (2) participative safety, (3) support for innovation,* and *(4) task orientation* have been identified as important in fostering a climate conducive to innovation within work groups and were applied in this study to communities of practice. Each factor described in the literature was evident in this study. Two of the climate of innovation subscales, *participative safety* and *vision*, have an important role in the relationship with connectivity. This is illustrated by their high mean scores (3.81, SD .68 and 3.79, SD .73, respectively), the cross-loading of four of their items with connectivity items, and the strength of their R^2 in a regression analysis (27% and 29% respectively).

Potential Effect of Range Restriction

Although all members of the 12 communities participating in the study were invited to respond to the questionnaire, the members who chose to respond tended to be active within the community, described themselves as "experts," and had the opportunity in the past to meet with fellow members face-to-face (See Table 4.7). As a result, the respondents may have been more inclined toward connectivity (i.e., establishing or maintaining relationships) and therefore, there may be a potential generalizability problem.

Despite the concern of a possible range restriction problem, this study did demonstrate that the climate of innovation was related to connectivity. The degree to which it is connected requires further study. It is worthwhile to reiterate, however, that earlier qualitative studies and accepted practices of practitioners supported the idea that a relationship exists among participation, connectivity, and climate of innovation. For instance, knowledge creation and application was widely seen as a social process and having moderate to strong ties within communities of practice would likely be of value to the members (Cohen & Prusak, 2001; Cross, et al., 2001; Dixon, 2000). Furthermore, trust, commitment, shared meaning, and understandings were believed to be important aspects of communities and provided the foundation for authentic connectivity (Weick, 1990).

Suggestions for Additional Research

The correlations from this study suggested no relationship between *participation mode* and the other participation variables, with the exception of a weak relationship with *participation level*. They also indicated no relationship with climate of innovation and a weak relationship with the connectivity variables. However, with 72% of the respondents reporting that they had the opportunity to meet with fellow members in the past, this exposure may have nullified the distinction between face-to-face contact and virtual interaction. Further research is needed to clarify the influence of the *participation mode* within a community of practice and on a climate of innovation.

In addition, because the majority of the respondents in this study relied on virtual interaction as their *primary mode of community participation*, supplementary research could compare and contrast the results from this study using the Sense of Community Index with the results from studies using the Sense of Virtual Community questionnaire. In particular, it may

be valuable to explore why the opportunity for *influence* appeared to be less likely to occur, yet members tended to report that they observed and experienced more connectivity when online.

The majority of respondents in this study described themselves as experts and further research could validate the findings as well as dissect nuanced differences in how the novice, advanced beginner, competent, and proficient members participate in their communities. In addition, a content analysis on the written comments provided by core, active, and peripheral members may offer further insights into expectations, goals, and needs of the different *levels of participation*.

Two of the climate of innovation subscales, *participative safety* and *vision*, had a prominent role in the relationship with connectivity. *Participative safety* with its non-threatening, trusting, and supportive group environment is clearly a feature of connectivity. *Vision* with its composition of clarity, visionary nature, attainability, and sharedness is a part of building a sense of community; however, the respondents in this study did not report a shared purpose and this apparent contradiction warrants further examination. There may be a distinction between a specific purpose (e.g., create a new payroll form) and a more generalized shared sense of goal and purpose (e.g., improve battlefield decision making.)

In this study, the respondents tended to be self-described experts, active within the community, and had the opportunity to meet face-to-face in the past. As discussed earlier, these factors may have influenced their sense of connectivity and contributed to a potential generalizability problem of the research results. Therefore, another study perhaps largely replicating this one is needed to determine if the respondents are typical of the federal government environment population or are exceptional in this regard and more inclined towards connectivity.

Finally, the reason for this research was to discover evidence for and explain the relationship between sets of variables representing two dimensions of communities of practice and a set of variables representing a climate of innovation. The results from this study produced a parsimonious model containing *perceived benefits of participation, nature of participation, connectivity,* and *the climate of innovation.* Supplementary research is needed to verify the factors, and then begin to explore additional aspects that may need to be included. For example, this research examined two key features of communities of practice (i.e., participation and

connectivity) and their correlations, without any consideration of causality. Additional research may illuminate any mediating or mitigating factors to fostering a climate of innovation.

Implications for Practitioners

As introduced in Chapters I and II, knowledge is situated within a social context and the creation, sharing, and application of it depends on the context in which it is employed. Unlike data or information, knowledge is embedded in practice, and it is reconstructed in each new situation. Therefore, "while knowledge can be actively shared or constructed, through the interaction between people or groups, it cannot be passively transferred" (Newel, et al., 2002, p. 103). With this understanding and these research results, practitioners can better organize, support, and facilitate communities of practice.

Nearly a decade ago, Wenger and Synder (2000) provided some general advice that still offers value today. Practitioners (e.g., community liaisons and members) as well as organizational leadership and knowledge management/ organizational learning or human resource development professionals can undertake a variety of activities, such as: hosting public events that engage the community, including formal meetings or problem solving sessions; establishing internal community leadership roles, such as the coordinator who facilitates the community process, as well as members who serve to document practices, act as thought leaders, and network with other communities and knowledge sharing groups; brokering relationships or providing ICT resources to facilitate introductions to and connections between different groups; participating in learning projects, such as tool development; developing artifacts, such as stories, documents, and Web sites that support and communicate specific community goals.

Additionally, with the findings from this research, practitioners can offer more customized solutions. Specifically, practitioners should reassess precisely how members are using the community. For example, communities frequently rely on members to organize and package knowledge for others or embed it in a useful form. However, these findings show that members are less inclined to do this, preferring to search or acquire knowledge from relevant sources for themselves. The result could be a community that has members searching for knowledge that no one is posting or sharing. This would quickly lead to an ineffective community. It would be more useful to dedicate individuals to serve in the role of facilitating

conversation, shared work, or demonstration and if needed, collecting, organizing, and distributing knowledge.

Furthermore, the respondents in this study believed that the most important benefits of participation were the ability to stay up to date in the topic of the community and saving time in finding all kinds of information. If these respondents are representative of other community members across the federal government environment, practitioners must focus on offering value with the latest news and efficient access to information, instead of spending time and resources to help members with career progression or gain new projects or customers. This research suggests that these activities are of little to moderate importance for community members.

Creating forums for formal dialogue and relaxed conversations and even humor continue to be needed, as are opportunities for collaboration around a shared idea or goal. ICT can help distributed members communicate and establish a sense of community, but this study quantitatively demonstrated the importance of relationships and underscored the need to consider social aspects when fostering knowledge sharing, which may be more challenging via technology. In addition to fostering productivity within communities, there is the potential of positively affecting multiple communities. If "innovation occurs at the boundaries between mind sets, not within the provincial territory of one knowledge and skills base" (Leonard-Barton, 1995, p. 64), then relationships between communities are important. The findings of this research may be applied to those relationships. For instance, explicitly establishing a shared vision between groups to develop a new product might increase the likelihood of success.

In addition to empirical contributions of this study, there may be practical downstream applications for communities of practice and other knowledge sharing groups. For example, the questionnaire used for assessing characteristics of a community of practice may also serve as an instrument for practitioners to gain insight into and to establish a baseline of community of practice perspectives within organizations. Research will also contribute to a better understanding of the dynamics of communities of practice, which will help knowledge management and human resource development or organizational learning professionals identify or develop programs to foster tacit knowledge sharing throughout a community of practice and encourage an environment where employees can create and innovate. Additionally, this research may shed light on other barriers to knowledge sharing, such as an unhealthy organizational culture, management roadblocks, or insufficient ICT systems. With barriers identified,

organizations can explore options to improve knowledge sharing that will result in improved organizational performance across the U.S. federal government environment. Such an environment will likely enable employees to launch a new product, implement a new system, or improve service to customers.

Finally, although these research findings may contribute to a prescription for generating an environment conducive to innovation, practitioners are cautioned to consider their community's unique goals and needs. This study examined participation, connectivity, and climate of innovation using the individual member's perspective as the unit of analysis (N = 384). If the examination was at the group level, the 12 communities of practice that participated in this study may have differences that would need to be considered by practitioners. For example, as indicated by the written comments, some of the communities in this study served mainly to distribute information whereas others offered a collaboration platform. This simple distinction in perspective underscores the need for practitioners to customize these research findings to best support their community.

Concluding Thoughts

While researchers and practitioners recognize that a relationship exists between knowledge management and innovation, most of the communities of practice investigations have resulted in untested conceptual and theoretical models. For the most part, the research has been largely anecdotal evidence, reflected by case studies from practitioners focusing on "industry best practices." Fortunately, there is now an emergence of empirical research on knowledge sharing groups, including communities of practice.

This study provided empirical support for the association between communities of practice and a climate of innovation. Notably, the importance of relationships, as captured by the connectivity construct, along with participation, was quantified for a climate of innovation with a coefficient of determination at 52%. These findings indicate social approaches of knowledge management, including knowledge sharing groups such as community of practice, may contribute to a climate conducive to innovation. Although the focus of this study was on communities of practice, it is likely that other knowledge sharing groups (e.g., social networks), and even those who use knowledge sharing tools (e.g., blogs, wikis), could apply these findings by recognizing the association between connectivity and climate of innovation.

Post script

This research was completed at the onset of worldwide economic and security challenges. Currently in the U.S. there is as a recession, drug cartel crime is threatening the southern border, and government bailouts of the automobile, banking and insurance industries are increasing the nation's deficit spending. Furthermore, the interdependencies of the world economy have caused or exacerbated tensions among countries. There is continued insecurity in the Middle East and security threats are on the rise from North Korea. To respond to these challenges, the U.S. federal government environment clearly needs innovative solutions. It may be appropriate to incorporate the results of this study into government responses. With emphasis on building or solidifying relationships, members of knowledge sharing groups within and across the federal government environment may better develop and implement strategies to address the current stresses and stabilize the worldwide situation.

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APPENDIX A

Invitation to Participate in the Questionnaire

Dear ____Community Member:

You have been selected to participate in this survey about *communities of practice* and *climate of innovation* within the U.S federal government environment because of your membership in the ____community. The ____agency/company has approved the distribution of this questionnaire in order to assess community opinions.

Please take 15 minutes to complete the questionnaire associated with a research study that examine your perceptions of participation in the ____community, relationships within the community, and the climate of innovation in your community. Your participation in this study is valued and will help expand the research base on knowledge management and innovation.

Completion of this online questionnaire is voluntary. There are no right or wrong answers. In addition, the online questionnaire process collects only anonymous responses and no individual will be identified. Furthermore, responses will be aggregated, so no individual set of answers will be evident.

Thank you, in advance, for your assistance in this data collection. By clicking on the link below you are consenting to participate in this study and accepting that the information will be electronically supplied to the researchers to document your participation.

Please respond to this by ____If you have any questions, comments or concerns, please feel free to contact us. Additionally, if you would like a summary of the study when it is complete, please contact us via email.

CLICK THE FOLLOWING URL TO BEGIN THE SURVEY or copy and paste the URL into your browser.

http://www.surveymonkey.com/.....

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Please note: If you do not wish to receive further emails from us, please click the link below, and you will be automatically removed from our mailing list.
http://www.surveymonkey.com/.....

APPENDIX B

Questionnaire

1. How important are the following goals for you personally as a member of the community? That means, what are for you personally the most important reasons for participating in this community?

   Rate each one on a scale from 0 = not important to 4 = very important:

   a. Hearing about new knowledge and experiences from other community members
   b. Developing together new ideas for the community
   c. Having nice meetings, fun and non-work-related activities
   d. Developing standards, methods and best practices
   e. Making useful contacts/networking
   f. Acquiring projects or customers
   g. Improving the level of expertise of the members
   h. Staying up to date in the topic of the community
   i. Making the organization more attractive for customers
   j. Saving time in finding all kinds of information
   k. Advancing my career
   l. Helping newcomers in the community
   m. Receiving ideas from others how to solve concrete problems in my work

2. For each of the following, please indicate the extent to which you do each of the following activities with your community of practice?

   Rate each one on a scale from 0 = not at all to 4 = a lot.

   a. Searching, accessing or acquiring knowledge from relevant sources
   b. Advising or helping other members
   c. Analyzing, processing, or evaluating knowledge
   d. Interacting and communicating with fellow community members
   e. Creating new or generating better knowledge
   f. Organizing and packaging knowledge for others or embedding it in a useful form
   g. Solving problems and making decisions using job-relevant knowledge
   h. Monitoring the field and keeping tabs on what's going on

3. What amount or level of participation in your community best describes your involvement? Please select one.
   a. Core member -- your participation is at the "heart of the community"
   b. Active member -- you periodically participate in the community forums

c. Peripheral member -- you have an interest in the community but rarely participate, have an interest in only one facet of the community, or are a visitor from another community or team

4. What is your primary mode of participation in the community?
   a. Face-to-face meetings
   b. Virtual meetings

If the respondents chose virtual meetings, then they were forwarded to question #5.
If the respondents selected face-to-face meetings, then they were forwarded to question #7 to continue.

5. What is your main mode of participating in virtual meetings?
   a. Telephone calls or conference calls
   b. Video conferences or online meetings
   c. Intranet or Internet (including e-mails and listservs)
   d. Other:_____

6. Although you primarily participate in virtual meetings, have you had the opportunity to meet face-to-face with community members in the past?

   a. Yes
   b. No

7. To what extent do you agree with each of the following statements: Please respond on a scale from 1 = strongly disagree to 5 = strongly agree.

   a. I think my community is a good place for me to belong.
   b. People in this community do not share the same values.
   c. My fellow community members/colleagues and I want the same thing from this community.
   d. I can recognize most of the people who are members of the community.
   e. I feel at home on this community.
   f. Very few of the community members know me.
   g. I care about what the community members think of my actions.
   h. I have no influence over what this community is like.
   i. If there is a problem on this community, the members get it solved.
   j. It is very important to me to participate in this community.
   k. People in this community generally do not get along with one another.
   l. I expect to be a member of this community for a long time.

8. To what extent do you agree with each of the following statements: Please respond on a scale from 1 = strongly disagree to 5 = strongly agree.

    a. We have a "we are together" attitude.
    b. Community members keep each other informed about work-related issues in the community.
    c. Community members feel understood and accepted by each other.
    d. There are real attempts to share information throughout the community.
    e. People in this community are always searching for fresh, new ways of looking at problems.
    f. In this community we take the time needed to develop new ideas.
    g. People in the community cooperate in order to help develop and apply new ideas.

9. How would you answer each of the following questions? Please respond on a scale from 0 = not at all to 4 = completely.

    a. Are community members prepared to question the basis of what the community is doing?
    b. Does the community critically appraise potential weaknesses in what it is doing in order to achieve the best possible outcome?
    c. Do members of the community build on each other's ideas in order to achieve the best possible outcome?
    d. How far are you in agreement with the community's objectives?
    e. To what extent do you think your community's objectives are clearly understood by other members of the team?
    f. To what extent to you think your community's objectives can actually be achieved?
    g. How worthwhile do you think these objectives are to the organization?

10. Finally, the following demographic questions are needed to describe the basic characteristics of the respondents, as a group. Only aggregate data and no individual responses will be reported.

    A. Who are you employed by? That is, where does your paycheck come from? Please select one.
        a. Government (civilian)
        b. Military
        c. Industry
        d. Academia
        e. I am retired.
        f. I am not currently employed.
        g. Other: _____

B. In what workplace environment do you spend **most** of your time? Please select one.
   a. Government (civilian)
   b. Military
   c. Industry
   d. Academia
   e. I am retired.
   f. I am not currently employed.
   g. Other: _____

C. Which of the following labels best describes the level of expertise that you have in your field? Please select one.
   a. Novice
   b. Advanced beginner
   c. Competent
   d. Proficient
   e. Expert

D. How long have you been in your current job?
   _____ years _____months

E. How long have you participated in this community?
   _____ years _____months

In closing, if you have additional comments about your participation within the community, the relationships within the community, or the climate of innovation, please share them here.

APPENDIX C

Institutional Review Board Exempt Approval Letter for Research

VirginiaTech

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24061
540/231-4991 Fax 540/231-0959
e-mail moored@vt.edu
www.irb.vt.edu

FWA00000572(expires 1/20/2010)
IRB # is IRB00000667

DATE: February 28, 2008

MEMORANDUM

TO: Gabriella M. Belli
Tina Chindgren

FROM: David M. Moore

SUBJECT: **IRB Exempt Approval:** "Examining the Relationship Between Communities of Practice and Climate of Innovation in the U.S Government Environment" , IRB # 08-110

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status. Approval is granted effective as of February 28, 2008.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in previously approved human subject research activities to the IRB, including changes to your study forms, procedures and investigators, regardless of how minor. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.

2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File
Department Reviewer:Angela J. Huebner

Invent the Future

APPENDIX D

Hierarchical Regression of Climate of Innovation on Participation and Connectivity Variables

1) Vision	Beta Step 1	Beta Step 2	2) Participative Safety	Beta Step 1	Beta Step 2
Participation Variables			Participation Variables		
Perceived Benefits	.16	.06	Perceived Benefits	.17	.07
Nature of Participation	.27	.10	Nature of Participation	.28	.14
Participation Level/Core	.22	.00	Participation Level/Core	.22	-.01
Participation Level/Active	-.07	-.06	Participation Level/Active	-.03	-.03
Mode of Participation	-.01	.04	Mode of Participation	-.02	.02
Connectivity Variables			Connectivity Variables		
Membership		.06	Membership		.11
Influence		.24	Influence		.20
Needs		.22	Needs		.20
Shared Emotional Connection		.26	Shared Emotional Connection		.24
R^2	.23	.52	R^2	.25	.52
ΔR^2	.23	.27	ΔR^2	.25	.27
3) Support for Innovation	**Beta Step 1**	**Beta Step 2**	**4) Task Orientation**	**Beta Step 1**	**Beta Step 2**
Participation Variables			Participation Variables		
Perceived Benefits	.18	.10	Perceived Benefits	.13	.04
Nature of Participation	.32	.20	Nature of Participation	.33	.20
Participation Level/Core	.19	.01	Participation Level/Core	.15	-.05
Participation Level/Active	-.09	-.08	Participation Level/Active	-.03	-.02
Mode of Participation	.02	.06	Mode of Participation	.04	.10
Connectivity Variables			Connectivity Variables		
Membership		.12	Membership		.23
Influence		.20	Influence		.13
Needs		.12	Needs		.11
Shared Emotional Connection		.14	Shared Emotional Connection		.16
R^2	.26	.42	R^2	.22	.40
ΔR^2	.26	.16	ΔR^2	.22	.18