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An evaluation of the perceived organizational culture and innovative climate of a Department of Defense community of organizations

Craig Whittinghill

AN EVALUATION OF THE PERCEIVED ORGANIZATIONAL CULTURE AND INNOVATIVE CLIMATE OF A DEPARTMENT OF DEFENSE COMMUNITY OF ORGANIZATIONS

by

CRAIG WHITTINGHILL

A DISSERTATION

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Submitted by Craig Whittinghill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Industrial and Systems Engineering, with a concentration in Engineering Management, and accepted on behalf of the Faculty of the School of Graduate Studies by the dissertation committee.

We, the undersigned members of the Graduate Faculty of the University of Alabama in Huntsville, certify that we have advised and/or supervised the candidate on the work described in the dissertation. We further certify that we have reviewed the dissertation manuscript and approve it in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Industrial and Systems Engineering.

_______________ 3/17/2011 Committee Chair / Co-Dissertation Advisor
(Date)

_______________ 3/17/2011 Co-Dissertation Advisor

_______________ 3-17-11

_______________ 3-17-11

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_______________ 3/17/11 Department Chair

_______________ 03/27/11 College Dean

_______________ 4/22/11 Graduate Dean

ABSTRACT

The School of Graduate Studies

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Name of Candidate Craig Whittinghill

Title An Evaluation of the Perceived Organizational Culture and Innovative Climate of a Department of Defense Community of Organizations

The Department of Defense, a hierarchically structured organization, performs a myriad of missions and tasks. To be better prepared to meet the challenges associated with these missions and tasks, senior military leaders are stating the need to be agile, adaptive, and innovative. Organic organizational cultures and innovative climates, which the literature indicates are inextricably linked, could help improve performance by empowering members to better interact with their environment, communicate and act rapidly, and innovate.

The research literature recommends that further empirical investigation be conducted to better understand the relationship between organizational culture and organizational innovation. Little empirical evidence exists that describes this relationship. Public organizations have not been studied as much as private organizations in this regard, and this type of academic study has not occurred within one of the largest public organizations in the United States, the Department of Defense. The Department of Defense, and its largest component, the Military Services, have a famously hierarchical and mechanistic structure and culture. Conducting such an investigation within the

Department of Defense could benefit its current transformation efforts to become more agile, adaptive, and innovative.

Achievements obtained by conducting this research include development of a new valid and reliable survey, development of a regression model quantifying the relationship between a perceived organizational culture and innovative climate (i.e., perceived innovative climate is predicted by perceived organizational culture), development of a structural equation model which explores the relationship between perceived organizational culture and innovative climate, and evidence that organizations can perceive themselves as innovative/organic while existing in a hierarchical/mechanistic structure. Taken together, these achievements offer public organizations and perhaps private organizations a tool and process that could be used to better understand organizational culture and climate as a first step in an effort to better align with their environment. This in turn could improve effectiveness and foster innovative thinking in an inexpensive, non-material manner. The main findings of this research, though, are that perceived organic organizational cultures foster perceived innovative climates and that providing resources (time, funding, and manpower) for innovation positively influences an organization's perceived innovative climate.

Abstract Approval: Committee Chair / Advisor ______________________

Co-Advisor ______________________

Department Chair ______________________

Graduate Dean ______________________

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INTRODUCTION

A. Background

The Department of Defense, a hierarchically structured organization, performs a myriad of missions and tasks. To be better prepared to meet the challenges associated with these missions and tasks, senior military leaders are stating the need to be agile, adaptive, and innovative. Organic organizational cultures and innovative climates, which the literature indicates are inextricably linked, could help improve performance by empowering members to better interact with their environment, communicate and act rapidly, and innovate.

The literature recommends that further empirical investigation be conducted to better understand the relationship between organizational culture and organizational innovation. Little empirical evidence exists that describes this relationship. Public organizations have not been studied as much as private organizations in this regard, and this type of academic study has not occurred within one of the largest public organizations in the United States, the Department of Defense. The Department of Defense, and its largest component, the Military Services, have a famously hierarchical and mechanistic structure and culture. Conducting such an investigation within the Department of Defense could benefit its current transformation efforts to become more agile, adaptive, and innovative.

This research, then, is based on organizational structure and culture theory. The two interact creating organizations that can either innovate well, implement innovations well, or both depending on the combination of culture and structure type (Gresov 1984; Prakash and Gupta 2008). Gresov (1984) wrote that analyzing and modifying cultural patterns to improve innovation holds great promise. Such an approach holds financial, manpower, and technological resources constant while retaining strengths and ameliorating weaknesses. This research has taken this premise and the premise that organic organizational cultures and innovative climates are linked and gathered data to determine if there is evidence to support these premises by exploring a small community within the larger Department of Defense.

B. Need for an Innovative Climate in the Department of Defense

The Department of Defense, and in particular the military, often finds itself operating in an environment of uncertainty. An organic organizational design improves performance in environments of high task uncertainty and low or high levels of organizational horizontal dependence (i.e., the need for communication across an organization or external to the organization to accomplish tasks) (Gresov 1989). If organizational design (and hence culture) does not fit with the demands of the work environment, performance suffers (Gresov 1989). Further, public organizations are required to meet numerous goals necessitating innovation across a broad range of innovation types (administrative, technical, etc.) to ensure achievement of sometimes conflicting objectives (Walker 2007). Innovativeness enables organizations to develop

new products, operating practices (or processes), managerial tactics, and business strategies (Prakash and Gupta 2008) in order to remain relevant in ever-changing environments (Obenchain 2002). Being able to interpret its environment and act accordingly (bound by laws and the chain of command), frees the Department of Defense to innovate while at the same time maintain a command structure that enables broad implementation of successful innovations. To better illustrate the utility of this concept, a brief examination of a military mission area is offered.

Humanitarian Assistance / Disaster Relief (HA/DR) missions, part of the Homeland Defense and Civil Support mission area listed in the Quadrennial Roles and Missions Review Report of January 2009 (U.S. Department of Defense 2009), require innovative thinking to solve problems in uncertain, rapidly changing environments. These missions have recently been growing in importance and frequency within the Department of Defense, and the lessons learned from prior missions help demonstrate the need for innovative and organic cultures within a hierarchical organizational structure like the Department of Defense.

While this is a mission of growing importance, it does not diminish the Department of Defense's primary responsibility. Vice Admiral Adam Robinson, U.S. Navy Surgeon General, stated "while we still train our forces to fight and win our nation's wars alongside our allies, we have adopted a serious focus on humanitarian assistance and disaster response to help those in need…" (Navy Medicine Responds to Haiti Earthquake Disaster 2010, p. 1). Competing goals definitely exist within the Department of Defense, necessitating innovations in areas besides HA/DR. For brevity,

though, an examination of one recent example of an HA/DR mission will demonstrate the military's need, broadly, for innovation.

Hurricane Katrina and the subsequent levee breaks in New Orleans presented responders with a catastrophe that was overwhelming. Local, state, and federal responders found it difficult to understand and interpret the environment, and this was compounded by a lack of communication and information sharing. Initiative largely was not taken, and the response effort was slow (Gecowets and Marquis 2008). There were, however, examples of innovative actions taken by all levels of responders. The National Guard showed many examples of units taking initiative. Lieutenant Colonel Tim Powell, a National Guard spokesman, stated guardsmen were doing "'whatever we can to help the citizens of Mississippi' (Miles 2005 p. 1)." Orders issued to guard units echo this sentiment. The Oklahoma Army National Guard was ordered to "conduct relief support operations (evacuations, recoveries, supply movement) for Hurricane Katrina in conjunction with the Louisiana State Emergency Response Authority ISO (in support of) the federally declared natural disaster caused by Hurricane Katrina" (Oklahoma Army National Guard 2005, p. 2). It was not told how to conduct these operations, but it was given commander's intent and expected to interpret the environment to best meet that intent. Further, the Rhode Island National Guard at times felt it was not effectively utilized, so it went looking for missions to aid the city of New Orleans and local law enforcement (Gabriele 2005).

The National Guard did not exclusively take the initiative and implement innovative solutions, though. The USS IWO JIMA was part of the federal response, and she and her crew acted innovatively to meet the many demands placed upon her. For

example, the IWO JIMA was a Presidential support platform, a command and control center, a power plant, a water production plant, a rescue coordination center, an air field, a hospital, a public affairs and information bureau, a religious support center, a hotel, a restaurant, and a regional intelligence center (Whittinghill 2006). To meet demands, the crew was granted the autonomy to interpret and respond to an uncertain environment and meet the needs of the city of New Orleans. Innovations abounded, especially since these missions were new and not in the routine training program.

These examples show that when the Department of Defense is asked to innovate, it indeed does innovate. The need for an innovative climate is apparent, but does this climate exist throughout the Department of Defense or does it only exist in tactical units faced with turbulent, uncertain environments? Are there means available that can be utilized to begin answering this question? The value of self-assessing organizational culture and climate is that it can better prepare organizations to interact with their environments, but the endeavor is complex and not easily accomplished, though, especially when attempting to measure organizational culture and innovative climate due to the immaturity of this field of study.

C. Research Objectives

The objectives of this research are 1) to determine if there is evidence of a relationship between perceived organizational culture and perceived innovative climate in a public organization, 2) to discover a model of the relationships between innovation affiliated attributes that contribute to a climate of innovation in a public organization and

3) to develop a tool that public organizations can use to simultaneously assess their perceived degree of organizational culture and innovative climate. There is some empirical evidence that supports organizational culture's link to an innovative climate, but further study is needed, particularly to better understand this relationship in public organizations.

D. The Study

Understanding the Department of Defense's organizational culture and innovative climate, both key elements to success and effectiveness, would offer great value and utility to leadership. However, development of a methodology to explore organizational effectiveness by investigating the relationship between organizational culture and innovative climate within the Department of Defense has not occurred. To conduct this research, a Navy community, whose organizations have a common goal, was evaluated to determine the organizational culture and innovative climate it contained. Before the full study was undertaken, though, a pilot study was executed that built confidence that the approach being taken for the full study was appropriate.

E. Research Significance

This research contributes to the literature by exploring the relationship that perceived organizational culture shares with perceived innovative climate in a large public organization. A cursory review of the literature revealed that little empirical

evidence exists that demonstrates this relationship, less exists with respect to public organizations, and none exists for any portion of the Department of Defense. The literature recommends that this type of research is needed to better understand this relationship.

Further, this research has the potential of improving organizational and mission effectiveness by improving an organization's innovativeness and interaction with its environment through organizational culture manipulation (Gresov 1984; Gresov 1989; Denison 1990; Sawner 2000; Obenchain 2002; Jones 2004; Robbins and Judge 2009). Coping with uncertain and/or rapidly changing circumstances, processing information quickly, and making better decisions is incumbent on having the appropriate culture in place that encourages quick action, communication, and innovation.

An organization can apply this research to evaluate whether cultural attributes should be modified to improve mission effectiveness. This research provides an inexpensive, non-material approach that can be used to better understand organizational culture as a first step in an effort to foster innovative thinking and improve organizational effectiveness, outcomes the Department of Defense is keenly interested in.

F. Summary

Within a community of organizations in the Department of Defense, organizational culture and innovative climate data was gathered and evaluated to determine the relationships between these cultural phenomenon and the relationships between the attributes that contribute to these cultural phenomenon. An organization can

potentially use this information to evaluate whether cultural attributes should be modified to improve mission effectiveness. This research will provide an inexpensive, non-material approach that can be applied in an effort to foster innovative thinking and improve organizational effectiveness.

CHAPTER II

LITERATURE REVIEW

A. Introduction

This chapter reviews the existing research on organizational culture and innovation. A review of the literature reveals that little empirical evidence exists demonstrating the relationship between organizational culture and organizational innovation, and even less evidence exists with respect to public organizations. No research published in peer reviewed journals exists for any portion of the typically mechanistic and hierarchical Department of Defense, which could benefit greatly from better understanding its culture and climate since its senior leadership is calling for greater innovation. The literature recommends, then, that further empirical investigation be conducted to better understand this relationship. To provide an overview of the literature, five sections are provided. The first three sections offer a discussion of organizational culture and innovation, Department of Defense culture, and its recent shift. The last two sections address measuring organizational culture and innovative climate and exploring the relationship they share.

B. Organizational Culture and Innovation

Webster's Ninth New Collegiate Dictionary (1990, p. 314) defines culture as "the customary beliefs, social forms, and material traits of a racial, religious, or social group."

Culture is additionally defined as "socially transmitted behavior patterns, beliefs, and institutions that shape a community or population" (Meilinger 2007, p. 80). These definitions describe culture at a macro level, but they also apply to organizational culture.

An organization's culture is considered to be an important factor affecting organizational success or failure (Sawner 2000). According to the literature (Denison 1990; Beach 1993; Jones 2004) organizational culture is comprised of shared values, norms, artifacts, principles, and beliefs that shape members' behaviors and responses to their surrounding environment. Organizational culture is an extremely important piece of an organization's composition that has profound effects on the organization from every day decisions to strategic vision. If an organization's culture and strategy are aligned, it has an advantage over an organization that is not likewise aligned, resulting in increased levels of productivity, efficiency, customer service, and creativity (Reigle 2003).

Fastabend and Simpson (2004) indicate that organizational culture is an organization's collective state of mind and is therefore, not surprisingly, difficult to describe. Sawner (2000) states that organizational culture is complicated and perplexing, and it bewilders researchers as they tediously try to comprehend it. An example of how difficult it can be to understand culture involves trying to distinguish between an organization's culture and its climate.

Culture and climate are closely related. Climate describes organizational expectations for behavior and outcomes. People respond to these expectations by shaping their behavior in order to achieve positive results like self-satisfaction and self-pride (Scott and Bruce 1994). Both culture and climate are associated with behaviors

(Denison 1990), culture being the shared values and norms that shape behaviors and climate representing organizational expectations that shape behavior.

Further, climate has been referred to as the manifestation of culture (Patterson et al. 2005), and, interestingly, climate measures have been used to evaluate culture. "Goodman and Svyantek (1999), for example, used the Organizational Climate Questionnaire (OCQ) to operationally define dimensions of organizational culture … Hence the problems of conceptual and definitional overlap" (Patterson et al. 2005, p. 380). Culture, on the other hand, has been described as a determinant of climate (Sarros, Cooper, and Santora 2008). Further, Denison (1996) concluded that research efforts investigating culture and climate should view differences between culture and climate as differences of interpretation and not phenomenon. He also concluded that culture and climate are a common phenomenon and that each describe organizational social context. These conclusions imply that culture and climate research should be integrative and not mutually exclusive, utilizing each others' theoretical foundations for further research efforts (Denison 1996). Therefore, because of their close relationship, this dissertation evaluates organizational culture and innovative climate.

1. Organic and Mechanistic Organizational Culture

An organization's culture is the most important driver of innovation (Yu 2007). Organizational culture can affect numerous factors that will produce either success or failure of innovative efforts. Ensuring the proper culture is in place, then, is important to the innovative process (Oden 1997).

Organizational culture in this dissertation is described as organic or mechanistic, terms used to describe two ends of a continuum regarding how an organization interacts with its environment. These continuum extremes (either being overwhelmingly mechanistic or organic) are best described by Burns and Stalker (1966) as organizational systems. Before describing these systems, though, it is worth noting that organizational structure greatly influences and is integral to an organization's culture. Gresov (1984) suggests that structure and culture are related since both organize members' relations, and each influences the other. Therefore, it is difficult not to mention organizational structure when discussing organizational culture.

A mechanistic system is described as one that approaches problems and tasks by utilizing methods and duties that are strictly defined via instructions and orders issued by superiors (which follow a vertical path down to the subordinate). Also, information flows up to superiors, which enables them to maintain their command hierarchy (Burns and Stalker 1966). Further, mechanistic systems are characterized as controlled, formalized, and standardized (Reigle 2003). They develop efficient manufacturing processes, standardized products designed for ease of manufacture, and low cost distribution systems (Lamore 2009).

An organic system, on the other end of the continuum, adapts to unstable conditions and change. It is characterized by individuals performing their tasks outside of a clearly defined hierarchy, and these individuals consider their understanding of the overall workload of the organization while accomplishing these tasks. Methods and duties are continually redefined based on lateral and vertical interaction amongst different

ranks in the workforce. Control of information flow no longer rests with superiors (Burns and Stalker 1966).

Further, high task uncertainty and horizontal dependence jointly encourage development of organic structures. The demand to process more information because of high task uncertainty and horizontal dependence leads an organization to utilize an organic system's ability to avoid information saturation (Gresov 1989). Also, an organic organization can operate flexibly and adapt quickly to a rapidly changing environment (Jones 2004). Organic cultural values also encourage creativity and innovation (Jones 2004; Lamore 2009).

2. Innovation

Innovation is regarded as a key organizational attribute for success. The U.S. Department of Commerce (2008, p. i) defines innovation as "the design, invention, development and/or implementation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm." Public organizations, however, are not chartered to produce financial returns, but are chartered to serve the public and provide value for their constituents. Another definition describes an innovation as a new product, service, process technology, organizational structure, or a new plan or program for organizational members (Damanpour 1991). Both definitions include the idea that an innovation is something new, whether it is a product, a process, or organizational construct.

Innovation, like organic and mechanistic culture, also exists along a continuum, from incremental to radical. Incremental innovations improve a product or process but do not typically make sweeping changes. Radical innovation occupies the other end of the continuum and could bring change to an entire industry (McLaughlin, Bessant, and Smart 2005). However, this dissertation is agnostic with regard to innovation magnitude. The primary focus is the recognition that an organization perceives itself as innovative and capable of innovating, no matter what the type or level of innovation.

3. Innovative Climate

An innovative culture expects innovation, has the infrastructure needed to foster innovation, and promotes an environment of innovation implementation (Dobni 2008). An organization's culture can encourage innovative behavior by creating member belief that innovation is an organizational value and norm (Hartmann 2006). The Asociacion Espanola de Contabilidad (AECA) refers to an innovative culture as thinking and behaving that develops values and attitudes that support ideas that improve organizational function and efficiency even though the changes these ideas may introduce conflict with conventional behavior (Kenny and Reedy 2006). An innovative culture is also a determinant of an innovative climate (Sarros, Cooper, and Santora 2008), the term chosen to reflect this phenomenon in this dissertation. Further, group innovativeness can be attributed to vision and support for innovation (i.e., innovation is valued and viewed as beneficial) (Ashkanasy, Widerom, and Peterson 2000). But besides an organization

generally supporting innovation, what other organizational attributes contribute to an innovative climate?

Innovative organizations encourage experimentation and reward success and novel attempts even if they fail (i.e., recognizing that failure can occur when trying something new). Punishing failure discourages risk taking and subsequently innovation, motivating people to innovate only when there are no penalties for such behavior (Robbins and Judge 2009). Participating without fear of failure, then, contributes to innovativeness (Ashkanasy, Widerom, and Peterson 2000).

Resources are also a component that contributes to innovation (Neely 2004). Slack resources, in particular, nurtures innovation because an abundance of resources enables purchasing innovations from outside the organization, bearing costs associated with incorporating innovations, and absorbing failures and mistakes (Robbins and Judge 2009). Slack allows organizations to better maneuver in response to changes in the environment by developing new strategies or developing new products or processes (Ruiz-Moreno, Garcia-Morales, and Llorens-Montes 2008). However, although slack resources can contribute to innovation, resource constraints have been observed to seldom be a significant impediment to innovation (Roxborough 2000).

Organizational communication is an attribute that contributes to innovation. Innovative organizations utilize inter-unit communication by using mechanisms such as committees and task forces, for example, which facilitate inter-departmental interaction (Robbins and Judge 2009). Roxborough (2000) found through reviewing literature about 20th century military innovations that organizational autonomy and organizational

mission were also important contributors to innovation. Akgun, Keskin, and Byrne (2009) found that management efforts to instill hope, encourage enthusiasm, and infuse joy in an organization, especially when environmental uncertainty is high and little else is understood, are also important contributors.

Besides these observations of and insights into organizational attributes which contribute to innovation, there is also some empirical evidence that supports culture's link to innovation. In their research of Taiwanese firms, Chang and Lee (2007) found a positive correlation between organizational culture and organizational innovation. Firms with innovative and supportive cultures (i.e., as previously established, climates) were better able to innovate than those firms which did not have such cultures (i.e., climates). Sarros, Cooper, and Santora (2008) surveyed Australian managers to determine if a competitive, performance-oriented culture is positively correlated to a climate of organizational innovation. Their results showed a strong positive relationship between the two, and further noted the interrelationship between the concepts of culture and climate (climate was measured by adequacy of resources and support for innovation).

However, despite these definitions, insights, observations, and evaluations, the U.S. Department of Commerce (2008) has stated that very little is known about drivers, impediments, and enablers of innovation. Recognizing this shortfall, it is clear that further study is needed, particularly the effect an organization's organic or mechanistic culture has on innovation.

4. Literature Linking Organic Organizational Culture and Innovative Climate

The literature widely regards an organic culture to be a driver of innovation. Organizations with organic systems have little vertical differentiation, formalization, or centralization and therefore these organizations encourage flexibility, adaptation, and cross-fertilization which in turn facilitate the opportunity for adoption of innovations (Robbins and Judge 2009). Organic systems encourage participation in decision-making at all levels within an organization, and this has been found, empirically, to have a positive and significant relationship with perceived innovation (Prakash and Gupta 2008). Meta-analysis conducted by Damanpour (1991) found positive correlations between innovation and a number of organic system attributes, which included specialization, functional differentiation, managerial attitude toward change, slack resources, and external and internal communication. Organic approaches are also suited to developing organizational innovations that meet customer needs, primarily due to member interaction with the environment where problems occur (Walker 2007).

There is a consensus in the literature that a mechanistic system inhibits innovation. For example, a high degree of external control, characteristic of public organizations, discourages managers from delegating authority and subsequently increases bureaucratic control (to levels typically higher than private organizations) which in turn inhibits innovativeness. The previously mentioned meta-analysis performed by Damanpour (1991) found a negative correlation between centralization and innovation. However, is it universally true that only organic cultures foster innovation and mechanistic cultures never do? Williams (2009, p. 61) stated that "to function properly, a strong culture of innovation requires a strong bureaucracy." So, are there

times when a mechanistic, hierarchical, bureaucratic system facilitates innovation? Can organizations have attributes of both organic and mechanistic systems that better develop and apply innovations than either can by themselves? A growing body of literature regarding this seemingly dichotomous relationship warrants review.

5. Organizational Culture and Structure

Despite an organizational structure's influence on and seemingly inseparable tie to organizational culture, it is possible for an organizational culture and structure to exist with a seemingly dichotomous, relationship. This blend of opposite culture and structure can be advantageous to organizations, depending upon the type of environment in which they operate. This is particularly true of organic cultures operating within mechanistic structures. For example, units or departments may have their own organic cultures, but the overall mechanistic structure of the organization outside the unit or department may have a formalized chain of command. An organic organizational design improves performance in environments of high task uncertainty and low or high levels of organizational horizontal dependence (demanding external communication), so units or departments may need to be organic according to their environment. Gresov (1989) has indicated that if organizational design (and hence culture) does not fit with the demands of the work environment, performance suffers.

Organic and mechanistic system types illustrate a polarity instead of a dichotomy. Intermediate states exist between extremes of the continuum, and organizations can oscillate up and down the continuum as an environment oscillates from one of stability to

one of uncertainty. Organizations can operate with a management system which incorporates both organic and mechanistic systems (Burns and Stalker 1966; Damanpour 1991). So, for the example given above, organic cultures that exist within a hierarchical organizational structure improve performance and enable development of innovations while taking advantage of quick organization-wide dissemination and implementation of those innovations.

Organizational culture and structure interact with each other creating organizations that either innovate well, implement innovations well, or both depending on the combination of culture and structure type. "Organizations with diverse and differentiated task structures initiate more innovations, and those with formalized and centralized structures implement more innovations" (Damanpour 1991, p. 562). An organic culture imbedded in a bureaucratic or hierarchical structure can respond to an uncertain environment (Gresov 1984; Gresov 1989). This type of organization can innovate while receiving guidance and authority via a well-defined chain of command through which innovations can be widely implemented throughout the organization (Gresov 1984).

This idea that organic organizational culture and hierarchical structure can exist simultaneously, even symbiotically, within one organization supports the notion that an innovative climate might require a bureaucracy (Williams 2009). Thompson (1965) suggested this overall concept is best conveyed by project teams being isolated from the larger, bureaucratic organization so that they could develop and incorporate innovations that could then be implemented by the larger, hierarchical organization. This cultural heterogeneity lessens the rigidities inherent in a highly centralized and formalized

bureaucracy, and, as is demonstrated here, organizational culture and structure, both used to organize relations between members of an organization, can be used in the design of an organization to adjust for the shortcomings of each other (Gresov 1984). Further, Prakash and Gupta (2008, p. 56) supported this point by stating "structure is the most significant factor which can be modified to impact innovations inside an organization."

So far, this review has focused on the literature's contention that organic systems are better innovators than mechanistic systems. The literature also largely states that mechanistic systems inhibit innovation, such as when Beyer and Trice (1978) observed that higher degrees of formality and centralization provided greater hindrance to innovation implementation (Tsai, Chuang, and Hsieh 2009). However, there is a growing body of knowledge that states that mechanistic systems are suited for implementing or even developing particular innovations. For example, organic systems may be conducive to developing technical innovation at the initiation stage while a mechanistic system is suited to implementing an administrative innovation (Damanpour 1988). Another example is that hierarchical and formal organizational structures are associated with marketization innovations (improvements to procurement of and payment for services) (Walker 2007). Further, as stated by Daft (1989) and reiterated by Chen and Chen (2008), hierarchical organizations with mechanistic organizational cultures are suited for the development of managerial (administrative) innovations.

New research has revealed that what was once thought to inhibit innovation can actually foster it. For example, formalization and centralization were thought to inhibit innovation. Prakash and Gupta (2008) have corroborated that there is a significant negative relationship between perceived innovation and centralization, but their research

has also shown a significant positive correlation between formalization and perceived innovation. They concluded that formalization defines roles through established organizational standards, reduces role conflict, and leads to employee commitment. This relationship, though, appears conditional, and further research is needed to better understand it.

Another surprising result from the research of Miller and Friesen (1982) indicates that what may drive innovation in a conservative (non-entrepreneurial) organization (such as a large public organization) does not drive innovation in an entrepreneurial organization. For example, horizontal differentiation, a common attribute of an organic organization, is significantly correlated with innovation in a conservative organization but not in an entrepreneurial organization which depends on the personality and goals of executives and not organizational structure. Further, entrepreneurial organizations demonstrate a high correlation between centralization and innovation, again most likely attributable to executives at the top of the organization exerting control, thus being free to innovate and not being encumbered by risk-averse dissenters.

Miller and Friesen (1982) also found that conservative organizations had a weak correlation between integrative mechanisms and innovation. Integrative mechanisms foster collaboration across groups of specialists within an organization. This collaboration generates new ideas. Collaboration, then, fosters innovation. However, the weak correlation between integration and innovation in conservative organizations indicates that having integrative mechanisms within their structure is not an important factor for innovation. This may be so because conservative firms, whether they have adequate integrative mechanisms in place or not, may wait too long and are then forced to

innovate. Because conservative organizations do not innovate until pressured, perhaps integrative mechanisms are a better predictor of innovation effectiveness rather than quantity. One last finding of Miller and Friesen (1982) to mention that affects innovation is a corps of professionals (such as scientists and engineers). A corps of professionals within an organization capable and motivated to develop new ideas for products and processes is positively correlated to innovativeness.

Blending organic and mechanistic system attributes in response to environmental influences to foster innovation is a complicated endeavor. It is clear that the conventional wisdom that organic culture fosters innovation while mechanistic culture inhibits innovation is not entirely accurate. The Department of Defense (the focus of this research) is famously mechanistic and hierarchical, but it has a legacy of independent thinking and initiative. An analysis of its culture is pertinent for this review and will provide background on its history and development before moving on to its ongoing transformation.

C. Department of Defense Culture

The culture of the U.S. Department of Defense is shaped primarily, but not exclusively by, U.S. military culture. Uniformed military personnel are found at every Department of Defense organization, but not every military command or organization has Department of Defense civilians. However, each command and organization is influenced by decisions made by Department of Defense civilians, most notably the Secretary of Defense. The Department of Defense culture is so greatly influenced by

military culture that they are considered synonymous. The two cannot be separated. Each individual Military Service, command, organization, and office will have its own distinct culture, but they are heavily influenced by parent commands and organizations and ultimately the overall culture of the military and its overseer, the Department of Defense. In order to discuss Department of Defense culture, a review of military culture is required.

U.S. military culture has been shaped since 1775 when the Continental Army was formed. It has a famously mechanistic chain of command and stresses the importance of values such as self-sacrifice and discipline that are essential to success in military engagements. However, military culture is not static and is susceptible to changing societal attitudes, government policies, and technological change (Ulmer, Collins, and Jacobs 2000). Senior Department of Defense officials, both civilian and military, shape its culture by continually communicating desired cultural shifts and vision.

The military is steeped in tradition, customs, and practices that identify and describe its uncommon profession of war (Terriff 2006). Military culture is made up of attitudes, values, goals, beliefs, and behaviors rooted in these traditions, customs, and practices. Its culture influences how the military comprehends the environment and changes to meet challenges, both current and future (Siegl 2008). And although military culture does change, it does so slowly, particularly in peacetime (Murray and Millett 1996).

The United States secured its independence through conflict, and this has had a significant influence on its military's culture. Early Americans were not very militaristic

as compared to the disciplined European armies. As observed by one of George Washington's military aids, General William von Steuben, who assisted in the training of the Continental Army, Americans wanted to know why orders were being given and would not simply abide by them. American military personnel were unusually independent. This attribute has endured to be a lasting cultural trait (Meilinger 2007). The Military Services also have enduring cultural traits that have been formed from their unique perspectives on warfare and operations.

The Services have their own cultures, and each is distinct. Carl Builder observed that the Army, for example, has viewed itself as an obedient servant of the American people, remaining loyal and dependable over the years. The Air Force, the youngest of the Services, sees itself as technically oriented and progressive. The Naval Services (Navy and Marine Corps) have a tradition of independence due to long periods of autonomous operations (before long haul communications came along) while at sea. This bred a spirit of initiative (Meilinger 2007).

Despite these differences among the Services, they have many shared values. These include a strong sense of community, strong commitment to core values, and commitment to winning our nation's wars (Molz 2007). Each Service's primary focus and responsibility is combat effectiveness (Ulmer, Collins, and Jacobs 2000) and military readiness (Baker 2007). These shared values unite the Services as brothers and sisters in arms. Soldiers, Sailors, Airmen, and Marines also share other cultural attributes. Discipline is a trademark of the military, as is group solidarity (Garsombke 1988). These characteristics benefit the military because they enable individuals and units to carry out their missions under extremely adverse conditions (Murray and Millett 1996). These

cultural traits will likely not change, and this is appropriate because the military should be guided by the democratic and legalistic ideals of America's forebears (Meilinger 2007). Another cultural trait not likely to change is the military's belief in the strength of the chain of command.

The military operates in a rigidly legal manner (Meilinger 2007). It is not surprising, then, that a majority of military officers have a preference for efficiency, structure, and bureaucracy (Williams 2009). Typically, then, the military is mostly mechanistic in nature. There exists a strong chain of command, vertical communication, clear roles and responsibilities, definitive division of labor, detailed job descriptions and hierarchical rules. Communication channels in the military are hierarchical, and vertical paths of communication are enforced (Whittinghill, Brockway, and Gaffney 2007). The military is prone to using standard operating procedures and routine tasks that provide stability and reduce uncertainty (Siegl 2008). This is not to say that the military does not face changing environments and will not focus on changing mission demands. It does, but it strives to provide as much stability and reduce as much uncertainty in its response to its environment as possible (McGuinness 2006). So, it is logical that it will resist changes to how it operates, especially if change is perceived to be detrimental to core mission areas (Siegl 2008). The military is a disciplined organization and disciplined organizations do not often value new ideas or innovations (Murray and Millett 1996). So, the military is not likely to change its culture quickly, does not appear to be very organic (despite its legacy of independent thinking and initiative), and may not be very innovative (even with the possibility of hybrid organic and mechanistic cultures).

The Department of Defense is a leading developer of cutting edge technology and has fielded the most advanced military in the world, but it has self-defeating mechanisms that inhibit innovation (Erwin 2006). The highly institutionalized missions of the military and the limitations they impose tend to suppress innovation (Li and Lin 2008). This raises the question can initiative and innovation co-exist with the hierarchical, mechanistic system that defines today's U.S. military? Where does the enduring cultural trait of independent thought and initiative born during the American Revolution now reside?

Terrif (2006) wrote that an increasing amount of literature is now focusing on organizational culture's effect on military innovation and how it influences military organizational behavior. His contribution to this effort was to examine the U.S. Marine Corps and cultural influences on the development of solutions to the challenges of the 1970's. The research based on this dissertation will contribute to this growing body of knowledge as well, but before proceeding, a concept that may address where independent thought and initiative reside in today's Department of Defense must be considered. Commander's intent, or command by negation, grants subordinates the freedom to interpret their environments and act accordingly, in an organic manner.

1. Command by Negation

Command by negation (i.e., making decisions unless a senior in command directs otherwise) and the emergence of new information technologies offers tactical units a decentralized construct to prosecute their mission at their level, following commander's

intent, while still maintaining a formal chain of command. The key to command by negation is trusting unit commanders have sound judgment. Command by negation assumes the unit commander has the best information to act locally (LeGree 2004). This concept, though, assumes that the unit or organization operating out in its environment is ready or capable of making this transition from an otherwise mechanistic organizational structure.

Command by negation empowers on-scene commanders with the lowest hierarchical authority and the best information to make tactical decisions. This system encourages innovation and initiative while controls (i.e., rule of law, general guidelines, overall objectives, and the chain of command) establish parameters that help ensure the most rational decision. This concept is applicable to all Services and can be applied at the lowest levels (e.g., squads) or higher levels of command (e.g., Joint Force Commanders) (Legree 2004).

This concept demonstrates that the military has in fact adopted a hybrid culture. Organic cultures exist within the larger hierarchical, mechanistic chain of command. This construct allows commands, organizations, units, squads, etc., to take the initiative and innovate based on their interpretation of the environment. Command by negation's intent is to enable warfighters during times of conflict, but it is applicable to all organizational levels within the Department of Defense.

2. Innovation in the Department of Defense

The extent of innovation in public organizations is not well understood (Walker, Jeanes, and Rowlands 2002). The Department of Defense is no exception. However, the literature on military innovation and organizational culture's influence on it is growing (Terrif 2006). Some specific examples of how the military encourages innovation follow.

The military does have a history of encouraging an innovative climate. As mentioned earlier, from the nation's beginning and the founding of the U.S. military, "American military personnel were imbued with an unusual amount of independence and initiative … a lasting cultural trait" (Meilinger 2007, p. 81). Also mentioned, command by negation is a technique practiced in which local commanders have the freedom to conduct warfare in their specified area of responsibility until guidance from above redirects their efforts.

Another way this spirit of independence is reinforced occurs during entry level training. Many new military recruits are indoctrinated with "A Message to Garcia" (Hubbard 1982) in which they learn there is no one way to mission accomplishment and that they must find the solution on their own. In *The Armed Forces Officer*, an expectation of America's fighting forces is that "Americans are resourceful and imaginative, and the best results will always happen when they are encouraged to use their brains along with their spirit" (U.S. Department of Defense 1988, p. 77).

The military defines innovation to be something new or unusual, whether it is new equipment or a new way to apply it, a new idea, or even a new organization (McClintock 2002). The verdict seems mixed, though, on whether the military is good at innovation or

not. According to Fastabend and Simpson (2004), the U.S. Army, despite societal stereotypes, has a great record of anticipating and leading change. However, McClintock (2002) holds that the military in general, and in particular the Air Force, is not good at innovation. The military has had innovation achievements, so what made those achievements possible?

In the past the military has innovated during times of rapid technological change, limited resources, and great environmental uncertainty to prepare for the next war. In general, success was achieved when military organizations had cultures that fostered debate, identified a clear organizational task, and had autonomy to concentrate efforts on that task (Roxborough 2000). However, Williamson Murray points out that to achieve a culture that encourages debate within the military is difficult in light of its hierarchical, obedient nature (Murray and Millet 1996). This conflict is at the core of the military's difficulty to innovate (Roxborough 2000).

One final factor that encourages innovation is the culture of the military's officer corps. Military culture has been described as the intellectual, professional, and traditional values of the officer corps, and as such it influences the officer corps' interpretation of the external environment and its response to it. This directly affects the military's ability to innovate (Murray and Millet 1996). The next section will convey how today's Department of Defense senior officer corps and civilian leadership have been interpreting the external environment and stating that the Department of Defense must transform so that it is a more agile and innovative fighting force.

D. Department of Defense Culture and Climate Shift

The Department of Defense, a hierarchically structured organization, performs a myriad of missions. These missions encompass extremely complex tasks that do not have readily evident solutions or paths forward for the Soldiers, Sailors, Airmen, Marines, and Department of Defense civilians faced with them. The former Chairman of the Joint Chiefs of Staff, General Peter Pace, USMC, (retired), called on the military to become more adaptive and agile by applying "our experience and expertise in an adaptive and creative manner, encouraging initiative, innovation, and efficiency in the execution of our responsibilities" (Pace 2006, p. 2).

The current Chairman of the Joint Chiefs of Staff, Admiral Mike Mullen (2008, p. 4) stated "new asymmetrical threats call for different kinds of warfighters … smarter, lighter, more agile … only by applying our own asymmetric advantages – our people, intellect, and technology … can we adequately defend the Nation." Further, the Deputy Chief of Naval Operations for Information Dominance, Vice Admiral David J. Dorsett (2009, p. 2), in a memorandum to his staff stated "we must embrace innovation, be willing to test and evaluate new concepts, and ultimately, resource and support game-changing technologies, processes, and information capabilities." However, transforming the military and its organizational culture and climate is a long-term process (McClintock 2002; Siegl 2008), and instituting cultural change has long-term implications, success being the most important aspect which senior leaders must understand (Snow 2006). Recognizing that transforming a culture takes more time than developing a vision for innovation, organizational culture may be the driver behind achieving long-term success (McClintock 2002).

Not surprisingly, implementing these transformational ideas requires fostering a climate of innovation within the Department of Defense, a climate that the former Secretary of Defense Donald Rumsfeld testified before Congress in 2006 is "changing from one of risk avoidance to a climate that regards achievement and innovation" (Fairbanks 2006, p. 37). Developing the proper military culture and climate, then, is as important as any other factor in carrying out current military transformation efforts (Siegl 2008). To achieve this, leadership must nurture creative, critical, and innovative thought (Siegl 2008). This includes leadership at all levels, but is particularly true for senior leadership. Leaders must reward cultural transformation and encourage innovation (Fairbanks 2006).

Senior leadership promotion of this cultural transformation even includes the Commander in Chief. President George W. Bush, in a speech at the U.S. Naval Academy in 2001, challenged officers to "risk failure, because in failure, 'we will learn and acquire the knowledge that will make successful innovation possible'" (Williams 2009, p. 59). Admiral Edmund Giambastiani (retired), while Vice Chairman of the Joint Chiefs of Staff, stated in 2005 that to move more rapidly, a culture of transformation that encourages an organization to think of what needs to happen next should be worked on constantly (Regulatory Intelligence Database 2005). General Pace (2006) also stated the military must produce a force capable of quickly and decisively defeating an enemy, requiring innovative solutions to cultural and resource challenges. These examples demonstrate the strategic guidance senior Department of Defense officials routinely communicate through speeches and interviews. This guidance to transform, though, is only the first step to implementing transformation.

Key to this implementation is the integration of technological advances and doctrinal, organizational, and tactical developments, and this integration depends on the ability of the military culture to recognize and experiment with new ideas. Fostering the development of a culture and climate that nurtures innovation and accepts continuous change will in turn help transformation efforts achieve success. Therefore, military culture, technological modernization, doctrinal development, and innovation all influence the military's ability to transform (Siegl 2008). Further, technical and military cultures which traditionally are separate must unite and share knowledge in an environment which enables them to better understand each other's mission areas so that innovative solutions will be recognized that facilitate transformation (Molz 2007). However, transforming the military's culture and climate to make it a more adaptive and innovative fighting force requires cultural self-assessment. Self-assessing organizational culture can lead to better organizational preparedness for interaction with encountered environments. This endeavor, though, is complex and not easily accomplished, especially when attempting to measure organizational culture and innovative climate due to the immaturity of this field of study.

E. Measuring Organizational Culture and Climate

Measuring an organization to determine if and to what degree it has an organic or mechanistic organizational culture and/or innovative climate can be accomplished by applying assessment tools. Further, measuring organizational culture can be accomplished through the use of surveys and questionnaires (Kraut et al. 1996;

Ashkanasy, Wilderom, and Peterson 2000). Using self-report surveys, in particular, offer respondents the opportunity to report their own perceptions of reality. Rentsch (1990) stated that behavior and attitudes are determined by perceptions of reality and not objective reality, so recording respondent perceptions instead of attempting to record reality is appropriate (Ashkanasy, Wilderom, and Peterson 2000). Utilizing survey methods, then, is the preferred means of measuring organizational culture and innovative climate within the Department of Defense. However, this type of measurement within the Department of Defense is difficult for a number of reasons.

1. Measuring Department of Defense Culture

As previously stated, culture influences values, beliefs, and behavior. These values, beliefs, and behavior, on a macro scale, influence how a society conducts military action, affecting goals, strategies, technology development, weapon development, force structures, and tactics. However, analyzing culture is a complex and difficult endeavor. Even analyzing culture on a much smaller scale, such as a single organization, is daunting since some cultural elements are impossible to quantify. Despite this, such attempts must be made. The influence of culture, in this case the culture of the Department of Defense, spans a broad spectrum of military art, ranging from strategic communications to discipline (Meilinger 2007). Further, it may be determined that changes to an organization's culture may be necessary to improve mission effectiveness and innovation. Organizational culture has a direct impact on organizational effectiveness and

performance and indicates the limits and opportunities of organizational accomplishment (Denison 1990).

It is apparent that organizational culture can have a profound effect on an organization. Measuring its culture is necessary to better understand how an organization's culture is affecting its performance. Measuring can also help an organization avoid vulnerabilities to poorly understood and unwanted evolutionary forces and change and determine if adaptation of culture is necessary to properly interact with its environment (Reigle 2003).

Application of culture measurement tools to determine if an organization's culture is suited for particular tasks within its environment and if it is aligned with strategic guidance can be an effective means of ensuring organizational effectiveness. Understanding the Department of Defense's organizational culture and innovative climate, both key elements to success and effectiveness, would offer great value and utility to leadership. However, development of a methodology to explore organizational effectiveness by investigating the relationship between organizational culture and innovative climate within the Department of Defense has not occurred.

Further, the analysis that organic systems are best suited to operate in uncertain and complex environments has been predominantly derived from studies of private, not public, organizations (Walker 2007). Public organizations could greatly benefit from assessing their culture in an effort to improve performance by matching their culture with their environment, but little research has been done in this area. Little research has been

conducted on measuring organic and mechanistic organizational culture and innovative climate, as well.

2. Measuring Innovative Climate

Understanding whether an organization perceives it has an organic or mechanistic organizational culture can help that organization understand if it can operate flexibly and adapt quickly to a rapidly changing environment (Jones 2004). This understanding, per the literature, will aid in an organization's evaluation of whether it is supportive of an innovative climate.

Innovation measurement, however, is a difficult, complex, and imprecise exercise that is in its infancy (Neely 2004; U.S. Department of Commerce 2008; Prakash and Gupta 2008), and, with regard to public organizations, there has been little research on innovation's impact on performance in the nonprofit sector (Carmen and Jose 2008). Further, no measure of innovation has been considered comprehensive (Prakash and Gupta 2008). Instruments such as the Organisational Innovativeness Construct (Wang and Ahmed 2004), the Value Innovation Potential Assessment Tool (Aiman-Smith, Goodrick, Roberts and Scinta 2005), the Team Climate Inventor (Anderson and West 1998), the Generalized Innovation Culture Construct (Dobni 2008), and the Climate for Innovation Measure (Scott and Bruce 1994), are available for review and consideration for use in this research. An evaluation of these instruments and others is provided in Chapter IV.

Due to innovation's collaborative nature, tolerance of subjective measures is necessary. Improving measures that quantify innovation dimensions, though, may rely on improving these qualitative, subjective measures. To improve innovation measurement, the U.S. Department of Commerce recently called on government, business, and academia to conduct research to better understand innovation (U.S. Department of Commerce 2008). A vital part of this research effort that must be conducted is exploring the link between innovative climate and organizational culture.

F. Relationship of Perceived Organizational Culture and Innovative Climate

Little research has explored the relationship between organizational culture and innovation, but speculation is abundant (Obenchain 2002; Sarros, Cooper, and Santora 2008). There is limited understanding or agreement in the literature regarding the influence of organizational culture on creativity and innovation (Obenchain 2002; Kenny and Reedy 2006). Despite the identification of drivers of innovation, to include organizational culture and environment, correlation of these drivers and innovations is not understood or plausibly demonstrated empirically (Kenny and Reedy 2006; U.S. Department of Commerce, 2008).

One study to note (Obenchain 2002) examined innovative behavior in not-for-profit private and public academic institutions. This study found a statistically significant relationship between dominant culture type and frequency of organizational innovation. Organizational innovation was attributed to organizational culture type, and the organization type that produced more frequent innovations was adhocracy (described as

adaptable and innovative). Limitations of this study included selection of respondents (a vast majority of responses came from a key position holder in that organization) and measurement of innovation frequency (measured by estimations of respondents). Despite these limitations, Obenchain (2002) found interesting results that should be explored by further research.

There still remains a paucity of empirical evidence that defines the relationship between organizational culture and organizational innovation. Empirical research in this area has focused on organizational demographics and structural characteristics in the past, but explanations of variances in organizational innovation have been inconclusive (Obenchain and Johnson 2004). Further research is called for in this area. Such research could reveal antecedents of organizational culture that influence innovation and subsequently aid in the development of innovative climates (Sarros, Cooper, and Santora 2008). Also, the U.S. Department of Commerce (2008) is calling on universities to develop research programs in innovation management and accounting to help develop and mature best practices. This is an area of research awaiting more empirical evidence to contribute to the definition of the relationship between organizational culture and innovation.

G. Literature Review Summary

The literature recommends that further empirical investigation be conducted to better understand the relationship between organizational culture and organizational

innovation. Twenty-seven attributes that contribute to innovativeness were listed throughout this chapter. These attributes are

1. Debate
2. Slack Resources
3. Corps of Professionals
4. Flexibility
5. Organizational Mission
6. Managerial Trust
7. Infuse Joy
8. Formalization
9. Organizational Communication
10. Adequacy of Resources
11. Organizational Task
12. Cross-Fertilization
13. Specialization
14. Autonomy
15. Support for Innovation
16. Adaptation

17. Vision

18. Functional Differentiation

19. Encourage Participation in Decision Making

20. Managerial Attitude Toward Change

21. Instill Hope

22. Failure Tolerated

23. Encourage Enthusiasm

24. Organizational Autonomy

25. External and Internal Communication

26. Horizontal Differentiation

27. Collaboration

Further, organizational culture was described as organic or mechanistic, degrees of which exist on a continuum between extremes. Combinations of these culture types and their coinciding structures are possible and offer specific advantages in particular environments. Innovation and innovative climate were also defined to provide background and context for further discussion.

Little empirical evidence exists that describes the organizational culture and innovation relationship. Public organizations in this area have not been studied as much as private organizations and the literature review revealed it has never occurred within

one of the largest public organizations in the United States, the Department of Defense. To perform this type of research, an understanding of the feasibility and difficulties associated with organizational culture and innovative climate measurement is needed. Conducting such research within the Department of Defense could benefit its current transformation efforts to become more agile, adaptive, and innovative. The Department of Defense, and its largest component, the Military Services, have a famously hierarchical and mechanistic structure and culture, but its senior leaders are calling for changes to that culture to enable more innovation. An examination, then, of its culture and strategic communications calling for this transformation, is presented.

Chapter III

RESEARCH STATEMENT

A. Research Concept

Organizational culture can be categorized as organic or mechanistic, terms used to describe two ends of a continuum regarding how an organization interacts with its environment (Burns and Stalker 1966). The literature widely regards an organic culture to be a driver of innovation and a mechanistic culture to be an inhibitor of innovation (Byer and Trice 1978; Damanpour 1991; Walker 2007; Prakash and Gupta 2008; Robbins and Judge 2009; Tsai, Chuang, and Hsieh 2009). However, can organizations have both organic and mechanistic cultural and structural attributes that better develop and apply innovations? A growing body of literature regarding this seemingly dichotomous relationship indicates they can.

A number of attributes have been identified that influence innovation, and understanding their role in innovativeness may contribute to answering the preceding question. Twenty-seven attributes that influence innovation were listed in the previous chapter, but this is a large number of attributes to research. To simplify this study and reduce the number of hypotheses that need to be developed for testing, these twenty-seven attributes were evaluated for adequacy and similarities. Nineteen of the attributes were deemed appropriate for further study. The remaining eight were deemed not compatible because of their nature. These eight possess qualities that differentiate themselves. For example, the attributes organizational mission, organizational task, corps

of professionals, and vision all are organizationally unique and wouldn't provide general conclusions if measured (organizational mission and vision may not even be defined in every organization). Additionally, for a public organization, these attributes are likely not modifiable, so their study would not provide options to improve organizational culture or innovative climate. Further, the attribute formalization is conditional and immature, warranting further study (Prakash and Gupta 2008), so drawing general conclusions based on this attribute was not desirable. Finally, specialization, functional differentiation, and horizontal differentiation are structural in nature, and, although they definitely influence culture, they are regarded as organic system attributes (Miller and Friesen 1982; Damanpour 1991) and not necessarily cultural attributes. These attributes then, because they are not compatible with the other nineteen, were not evaluated further. To evaluate nineteen attributes, still, is cumbersome.

The nineteen attributes designated for study share some commonalities, so, to make the number of attributes to study more manageable, like attributes were grouped together and placed in broader attribute categories. The consolidated attributes are support for innovation, resource supply for innovation (made up of the slack resources and adequacy of resources attributes), collaboration (made up of the collaboration, organizational communication, cross-fertilization, encouraging participation in decision making, internal and external communication, and debate attributes), workforce autonomy (made up of the failure tolerated, organization autonomy, flexibility, adaptation, managerial attitude toward change, and autonomy attributes), managerial trust, and workforce enthusiasm (made up of the encouraging enthusiasm, infusing joy, and instilling hope attributes). These six attributes contribute to an innovative climate

(Burns and Stalker 1966; Damanpour 1991; Ashkanasy, Widerom, and Peterson 2000; Roxborough 2000; Legree 2004; Kenny and Reedy 2006; Walker 2007; Prakash and Gupta 2008; Ruiz-Moreno, Garcia-Morales, and Llorens-Montes 2008; Robbins and Judge 2009) and studying their relationship with each other and on innovation will contribute to understanding the relationship shared between organizational culture and innovative climate.

Organizations can have both organic and mechanistic cultural and structural attributes that better develop and apply innovations, which can be advantageous to organizations, depending upon the type of environment in which they operate. Organizational culture and structure interact creating organizations that can either innovate well, implement innovations well, or both depending on the combination of culture and structure type. Also, there is a growing body of knowledge (Thompson 1965; Miller and Friesen 1982; Gresov 1984; Damanpour 1988; Daft 1989; Damanpour 1991; Walker 2007; Chen and Chen 2008; Prakash and Gupta 2008; Williams 2009) that states that mechanistic systems are suited for implementing or even developing particular innovations. However, blending organic and mechanistic systems in response to environmental influences to foster innovativeness is a complicated endeavor. It is clear that the conventional wisdom that organic culture encourages innovation while mechanistic culture inhibits innovation is not entirely accurate. Many nuances affect innovativeness.

Research is needed that provides evidence of the relationship between perceived organizational culture and perceived innovative climate in public organizations. The literature review confirmed the need for this research by revealing that little empirical

evidence exists that demonstrates this cultural relationship, less exists with respect to public organizations, and none exists for any portion of the Department of Defense. The Department of Defense is famously mechanistic and hierarchical, but it does have a legacy of independent thinking, initiative, and encouraging an innovative culture. The verdict seems mixed, though, on whether the Department of Defense is good at innovation or not.

The Department of Defense performs a myriad of missions. These missions encompass extremely complex tasks that do not have readily evident solutions or paths forward for the Soldiers, Sailors, Airmen, Marines, and Department of Defense civilians faced with them. Being able to interpret their environment and act accordingly (bound by laws and the chain of command), frees the Department of Defense to innovate while at the same time maintaining a command structure that enables broad implementation of successful innovations. Department of Defense senior leadership is communicating that, as an organization, the Department of Defense must become more adaptive and innovative. Transforming in this way requires fostering a climate of innovation.

However, besides senior leadership calling for this transformation, why change at all? This transformation is necessary because the Department of Defense, and in particular the military, often finds itself operating in an environment of uncertainty. As previously stated, an organic organizational design improves performance in environments of high task uncertainty and low or high levels of organizational horizontal dependence (demanding external communication). If organizational design (and hence culture) does not fit with the demands of the work environment, performance suffers (Gresov 1989). So, the Department of Defense would benefit greatly from better

understanding the relationship between organizational culture and innovative climate so that it can discover how best to transform to encourage adaptability and innovation.

B. Research Objectives

The objectives of this research are to 1) provide evidence that there is a relationship between perceived organizational culture and perceived innovative climate in a public organization, 2) to discover a model of the relationships between innovation affiliated attributes that contribute to a climate of innovation in a public organization, and 3) to develop a tool that public organizations can use to simultaneously assess their perceived degree of organic or mechanistic organizational culture and innovative climate. There is some empirical evidence that supports organizational culture's link to an innovative climate, but further study is needed, particularly to better understand this relationship in public organizations. The need for an innovative climate in the Department of Defense was established, but does this culture exist throughout the Department of Defense or does it only exist in tactical units faced with turbulent, uncertain environments? Are there means available that can be utilized to begin answering this question?

Indeed, measuring an organization to determine its degree of organic or mechanistic organizational culture and innovative climate can be accomplished by applying assessment tools. Knowing what the tools measure and if they are applicable to a specific type of organization (e.g., a public organization) are key factors influencing tool selection. The value of self-assessing organizational culture is that it can better

prepare organizations to interact with their environments, but the endeavor is complex and not easily accomplished especially when attempting to measure organic or mechanistic organizational culture and innovative climate due to the immaturity of this field of study.

It was also established that utilizing survey methods is the preferred means of measuring organizational culture and innovative climate within the Department of Defense. To conduct this research, validated instruments were available for measuring the organic/mechanistic organizational culture and innovative climate in an organization. Application of measurement tools to determine if an organization's culture is suited for particular tasks within its environment and if it is aligned with strategic guidance can be an effective means of ensuring organizational effectiveness. Understanding the Department of Defense's organizational culture and innovative climate, all key elements to success and effectiveness, would offer great value and utility to leadership. However, development of a methodology to explore organizational effectiveness by investigating the relationship between an organization's organizational culture and innovative climate within the Department of Defense has not occurred. To accomplish this, a community of organizations within the Department of Defense was examined.

C. Research Questions and Hypotheses

To address these issues, this research will attempt to answer the following questions by providing evidence that supports the listed hypothesis:

- Research Question #1: Can the relationships between cultural attributes that contribute to an innovative climate be determined within a Department of Defense community of organizations?
- Hypothesis #1A: Resource supply for innovation positively influences support for an innovative climate within a Department of Defense community of organizations.
- Hypothesis #1B: Collaboration positively influences support for an innovative climate within a Department of Defense community of organizations.
- Hypothesis #1C: Workforce autonomy positively influences support for an innovative climate within a Department of Defense community of organizations.
- Hypothesis #1D: Managerial trust positively influences support for an innovative climate within a Department of Defense community of organizations.
- Hypothesis #1E: Workforce enthusiasm positively influences support for an innovative climate within a Department of Defense community of organizations.
- Research Question #2: Is there a relationship between the perceived organizational culture and innovative climate of a specified Department of Defense community of organizations?
- Hypothesis #2: There is a linear relationship between the perceived organizational culture and innovative climate of a specified Department of Defense community of organizations.

D. Contribution to the Field

Answering the research questions will provide a better understanding of the relationship that perceived organizational culture shares with a perceived innovative climate in a specific Department of Defense community (representative of a typical large public organization). The literature review confirmed the significance of this research by revealing that little empirical evidence exists that demonstrates this cultural relationship, less exists with respect to public organizations, and none exists for any portion of the typically mechanistic and hierarchical Department of Defense. This would seem to indicate that further empirical investigation needs to be conducted to better understand this relationship.

Further, this dissertation will provide a tool and a process for public organizations to use so that they may better understand their organizational culture as a first step in an effort to better align themselves with their environment. This in turn could improve effectiveness and foster innovative thinking in an inexpensive, non-material manner. An increasing amount of literature is now focusing on organizational cultures' affect on military innovation and how it influences military organizational behavior (Terriff 2006). This research will contribute to this growing body of knowledge.

Chapter IV

RESEARCH METHODOLOGY

A. Research Method Chosen

In the previous chapter, a description of how twenty-seven attributes that influence innovation was reduced to nineteen that were deemed appropriate for further study in this research was provided. The remaining eight were deemed not compatible, and rationale that was used to eliminate those remaining eight attributes was presented. These attributes then, because they are not compatible with the previous nineteen, were not evaluated further. To evaluate even nineteen attributes, though, is cumbersome.

The nineteen remaining attributes share some commonalities, so, to make the number of attributes to study more manageable, like attributes were grouped together and placed in broader attribute categories. This helped minimize the number of hypotheses to develop. The consolidated attributes are support for innovation, resource supply for innovation, collaboration, workforce autonomy, managerial trust, and workforce enthusiasm.

It is interesting to note that, based on a rudimentary frequency analysis of how often these nineteen attributes occurred in my literature review (per their groupings), resource supply for innovation, collaboration, and workforce autonomy, equally, were predicted to be the most significant attributes that influence innovation. Support for

innovation trailed these attributes slightly. Workforce enthusiasm and then managerial trust were expected to be the least influential attributes.

To verify this finding, data collection was needed to analytically test the relationships between and influence of these attributes. Also, data collection was needed to test if the relationship shared between organizational culture and innovative climate is linear. To accomplish this data collection, surveying individuals over a short, common time frame from a requisite sample size was the research method chosen for this study. Surveying individuals is appropriate for a number of reasons. Glisson and James (2002) stated that measuring organizational culture via individual responses is applicable when the study focuses on behavioral expectations and normative beliefs of the individuals of the organization. Using self-report surveys offer respondents the opportunity to report their own perceptions of reality. Rentsch (1990) stated that behavior and attitudes are determined by perceptions of reality and not objective reality, so recording respondent perceptions instead of attempting to record reality is appropriate. This measurement approach is also appropriate because recall is unreliable, necessitating a short, common time frame from which to extract individual perceptions of values and beliefs which may have been influenced by recent actions (Walker and Enticott 2004). Further, it has also been found that peer ratings are preferred when investigating researchers' innovativeness. Previous peer rating findings have been found to be reliable and became more so with an increased number of raters (Stahl 1977).

There are, however, some potential shortcomings associated with surveying. Phillips (1981) stated that elite surveying (surveying the top or a very small number of people at the top of an organization) may produce unreliable results, and the conclusions

drawn from such surveys may be overly simplistic. Further, it is becoming more recognized that while conducting organizational culture research, using quantitative measures and statistically reductive approaches may be counterproductive because the richness of a culture may be overlooked due to oversimplification (Martin 1990; Marcoulides and Heck 1993; Denison 1996; Hawkins 1997; Ashkanasy, Wilderom, and Peterson 2000). Also, questionnaires that seek perceptions of organizational innovation have historically varied substantially due to the subjective perspectives of respondents (Tsai, Chuang, and Hsieh 2009). This may be partially attributable to social desirability bias by individuals while responding. Assuring anonymity can help assuage fears of retribution for honest answers and thus reduce this bias (Ruiz-Moreno, Garcia-Morales, and Llorens-Montes 2008). However, due to innovation's collaborative nature, tolerance of subjective measures is necessary. Improving measures that quantify innovation dimensions may rely on improving qualitative, subjective measures (U.S. Department of Commerce 2008).

Despite these shortcomings, many researchers have assessed that measuring organizational culture can be accomplished through the use of surveys and questionnaires (Kraut et al. 1996; Ashkanasy, Wilderom, and Peterson 2000). Surveys also offer a number of advantages over other methods (like interviews and observations). Because the sample selected for this research is spread throughout the United States, ease of distribution, quick administration, and minimum financial cost were major considerations. Surveys best meet these criteria, plus they offer better post data collection analysis options despite fears of oversimplification due to quantitative, reductive approaches. For example, using statistical software packages to conduct

analysis of collected interval level data is facilitated by administering surveys. Further, surveys offer consistent responses, unlike other methods (Benfield 2005). Utilizing survey methods, then, is the preferred means of measuring organizational culture and innovative climate within the Department of Defense. Therefore, a survey selection and, subsequently, survey development process was undertaken.

B. Survey Selection and Development

Since surveying was selected as the preferred research method to collect data, a thorough review of the literature was conducted to find instruments that measure organizational culture (along the organic and mechanistic continuum) and innovative climate. Twenty-four candidate survey instruments were identified. Eleven of these surveys measured organizational culture, and thirteen measured organizational innovative culture or climate. Criteria were established for evaluation to determine which one survey from each of these two categories should be selected for this research. The criteria were slightly different for each and will be presented in the following sections.

1. Organizational Culture Survey Selection

Eleven surveys were identified in a review of literature on measuring organizational culture. Criteria were developed so that the best survey would be selected to collect data for this research. These criteria were grouped into two categories. The first category was required criteria. If all of these criteria were not met, then there was no

further consideration of selection. These included: exclusively measures organic and mechanistic culture, is free, is reliable and valid, yields numerical results to allow mathematical analysis, applies to Department of Defense organizations (public / governmental), and measures organizations at the individual level. To better discern all candidates that met all these criteria, convenience criteria were selected. They included appears to be immediately available for academic use, takes less than twenty minutes to complete, requires one administration, and is easily understood (Benfield 2005; Henriksen 2007). Table 4.1 shows the matrix used to select the best survey instrument.

Table 4.1 Organizational Culture Survey Selection Matrix

Survey	**Required Criteria**	Exclusive Org/Mech Culture Measure	Free	Reliable and Valid	Numerical Results Allows Mathematic Analysis	Applies to Department of Defense Organizations	Measures Organizations at Individual Level	**Proceed Through Gate?**	**Convenience Criteria**	Immediately Available for Academic Use	< 20 Minutes to Complete	Requires One Administration	Instrument is Easy to Understand	**Total Convenience Score**
A Survey on Organizational Innovation in Higher Education (Obenchain 2002)			X	X	X	X	X	N		X	X	X	X	4
Organization Supportive/Empowered Culture Survey (Gudmundson, Tower, and Hartman 2003)			X	X	X	X	X	N		X	X	X		3
Organizational Culture Assessment Revision B (Reigle 2003)		X	X	X	X	X	X	Y		X	X	X	X	4
Organizational Culture Profile (O'Reilly, Chatman, and Caldwell 1991)			X			X	X	N		X	X	X	X	4
Organizational Culture Inventory (Cooke, Szumal 1993)				X			X	N						0
Organizational Culture Assessment Questionnaire (1990 Copyright, Marshall Sashkin)				X	X	X	X	N			X	X	X	3
Measures and Operationalizations (Deshponde, Farley, and Webster 1997)			X		X			N		X	X	X	X	4
Culture Measures (Hurley and Hult 1998)			X	X	X	X	X	N		X	X	X	X	4
Organizational Climate Measure (Patterson et al 2005)					X	X	X	N				X	X	2
Diagnosing Organizational Culture (Harrison and Stokes 1992)			X		X	X	X	N		X	X	X	X	4
Organizational Culture Assessment Instrument (Cameron and Quinn 2005)			X	X	X	X	X	N		X	X	X	X	4

From Table 4.1, the Organizational Culture Assessment Revision B emerged as the best survey to measure organizational (organic and mechanistic) culture for this research study. No other survey measures perceived organizational culture along the organic and mechanistic continuum as the Organizational Culture Assessment Revision B does (Reigle 2003); therefore, no other instrument was acceptable for this research. Permission was granted from the author, Dr. Ronda Reigle, to use the Organizational Culture Assessment Revision B for this study. For completeness, the convenience criteria were evaluated, but this step was not necessary.

The Organizational Culture Assessment Revision B is a twenty question survey utilizing an eight point Likert scale with response selections ranging from “strongly disagree” to “strongly agree.” Factor analysis utilizing Varimax rotation produced three factors (espoused values/basic underlying assumptions, artifacts and symbols, and patterns of behavior). However, five factors were expected based on five culture elements defined during the development of this survey (language, artifacts and symbols, patterns of behavior, espoused values, and basic underlying assumptions). Because of this unexpected result, the Organizational Culture Assessment Revision B should be treated as descriptive instead of prescriptive (Reigle 2003). For the current research effort this is acceptable since there is no expectation to identify these culture elements within organizations, but there is an expectation that using the Organizational Culture Assessment Revision B will provide a means to describe an organization’s perceived position on the organic and mechanistic continuum. Reigle’s (2003) factor analysis provides evidence that the Organizational Culture Assessment Revision B demonstrates construct validity, or evidence that the survey measures the factors or

constructs that it is designed to measure (Brewerton and Millward 2006). Further, this survey was shown to have face validity (questions are understandable) and content validity (survey draws on judgment of expert sources), and it is reliable since it has a Cronbach Alpha of 0.92 (Reigle 2003; Brewerton and Millward 2006). A Cronbach Alpha in the 0.60 to 0.70 range (Brewerton and Millward 2006) or at least 0.70 (Kline 1986) indicates a minimum acceptable reliability.

2. Organizational Innovation Survey Selection

Thirteen surveys were identified in a review of the literature on measuring innovative climate or culture. Criteria were developed so that the best survey would be selected to collect data for this research. These criteria were grouped into two categories. The first category was required criteria. If all of these criteria were not met, then there was no further consideration for selection. These included: measures innovative culture/climate, is free, is reliable and valid, yields numerical results to allow mathematical analysis, applies to Department of Defense organizations (public / governmental), and measures organizations at the individual level. To better discern all candidates that met all these criteria, convenience criteria were selected. They included: appears to be immediately available for academic use, takes less than twenty minutes to complete, requires one administration, and is easily understood (Benfield 2005; Henriksen 2007). Table 4.2 shows a matrix used to select the best survey instrument.

Table 4.2 Innovative Climate Survey Selection Matrix

Survey	**Required Criteria**	Measures Innovative Culture/Climate	Free	Reliable and Valid	Numerical Results Allows Mathematic Analysis	Applies to Department of Defense Organizations	Measures Organizations at Individual Level	**Proceed Through Gate?**	**Convenience Criteria**	Immediately Available for Academic Use	< 20 Minutes to Complete	Requires One Administration	Instrument is Easy to Understand	**Total Convenience Score**
Scale for Perceived Innovation (Prakash and Gupta 2008)		X		X	X		X	N			X	X		2
Survey for Investigating Relationship Between Manager Innovativeness and Team Performance (Section 3: Manager Innovativeness –from Scales for Measurement of Innovation (Hurt, Joseph, and Cook 1977; Henriksen 2007)			X	X	X	X	X	N		X	X	X	X	4
Danish Survey of Organizational Innovation (Martensen, Dahlgaard, Park-Dahlgaard, Gronholdt 2007)		X	X	X	X	X	X	Y		X		X	X	3
Utah Survey of Innovation-Supportive Organizational Culture (Chandler, Keller, and Lyon 2000)		X	X		X	X	X	N		X	X	X		3
Product Innovation Performance (Efficacy/Efficiency) Survey (Alegre and Chiva 2006)			X	X	X		X	N		X	X	X		3
Organisational Innovativeness Construct (Wang and Ahmed 2004)		X	X	X	X	X	X	Y		X	X	X	X	4
Value Innovation Potential Assessment Tool (Aiman-Smith, Goodrick, Roberts and Scinta 2005)		X	X	X	X	X	X	Y		X	X	X	X	4
Survey of Innovation Trends Conducted by the Confederation of British Industry (CBI) (Coombs and Tomlinson 1998)		X	X			X	X	N		X	X	X	X	4
Team Climate Inventory (Anderson and West 1998)		X	X	X	X	X		N		X	X	X	X	4
Generalized Innovation Culture Construct (Dobni 2008)		X	X	X	X	X	X	Y		X		X	X	3
The 1992 Innovation Survey (Adweek 1992)			X				X	N		X		X		2
A Survey on Organizational Innovation in Higher Education (Obenchain 2002)			X	X	X		X	N		X	X	X	X	4
Climate for Innovation Measure (Scott and Bruce 1994)		X	X	X	X	X	X	Y		X	X	X	X	4

From Table 4.2, five surveys were deemed acceptable to measure innovative culture or climate. Convenience criteria were evaluated for all candidates but only applied to these five selectees. As can be seen from Table 4.2, three of these selectees received convenience criteria scores of four and two received scores of three. Because no clear choice emerged from this evaluation, a second, more thorough examination of these five selectees was conducted. Table 4.3 shows the results of this second examination.

Table 4.3 Second Innovative Climate Survey Selection Matrix

	Survey Selection Criteria	Measures Innovative Culture/Climate Very Well	Very Good Reliability and Validity	Very Good at Yielding Numerical Results Allowing Mathematic Analysis	Applies to Department of Defense Organizations Very Well	Immediately Available for Academic Use	< 20 Minutes to Complete	Requires One Administration	Instrument is Easy to Understand	**Total Score**
Survey										
Danish Survey of Organizational Innovation (Martensen, Dahlgaard, Park-Dahlgaard, Gronholdt 2007)						X		X	X	3
Organisational Innovativeness Construct (Wang and Ahmed 2004)			X	X		X	X	X	X	6
Value Innovation Potential Assessment Tool (Aiman-Smith, Goodrick, Roberts and Scinta 2005)						X	X	X	X	4
Generalized Innovation Culture Construct (Dobni 2008)		X	X	X		X		X	X	6
Climate for Innovation Measure (Scott and Bruce 1994)		X	X		X	X	X	X	X	7

The approach this time was to separate the surveys by entering an "X" in a category in which that survey was deemed the best. Eight of the original ten criteria were used (all five surveys were deemed to be free and to measure at the individual level so these categories did not discriminate the surveys further) in an effort to subjectively score these surveys. In hindsight, "immediately available for academic use" should not have been included, but its inclusion did not alter the final result. Because of extremely similar characteristics in some of the categories, more than one "X" was entered. All but one category ("applies to Department of Defense Organizations very well") had more than one "X." After this evaluation, one survey did emerge as the best of this group. The Climate for Innovation Measure (Scott and Bruce 1994) is most applicable for this research. This is so because it was deemed most suitable for use with the Department of Defense. Additionally, it measures support for innovation and resource supply for innovation, two attributes from literature that influence an innovative climate. Permission was granted from the author, Dr. Suzanne Scott, to use the Climate for Innovation Measure for this study.

The Climate for Innovation Measure measures the degree to which a climate is perceived to be innovative. Two factors were discovered by using factor analysis with Varimax rotation: support for innovation and resource supply (making it applicable to this research). Ashkanasy, Widerom, and Peterson (2000) describe support for innovation as a shared value that defines climate. The Climate for Innovation Measure measures shared values, and, as previously stated, support for innovation and resource supply, thus making it an appropriate instrument to use with the Organizational Culture Assessment Revision B.

The Climate for Innovation Measure is a twenty-two question survey that uses a five point Likert scale with response selections ranging from "strongly disagree" to "strongly agree." Cronbach Alpha for support for innovation was 0.92 and for resource supply was 0.77 (Scott and Bruce 1994). A Cronbach Alpha in the 0.60 to 0.70 range (Brewerton and Millward 2006) or at least 0.70 (Kline 1986) indicates a minimum acceptable reliability. The Climate for Innovation Measure also demonstrates face (questions are understandable), content (draws from previously published, expert judgment), and construct (factor analysis) validity (Scott and Bruce 1994; Reigle 2003; Brewerton and Millward 2006).

3. Perceived Organizational Culture and Innovative Climate Assessment Tool

The survey instrument for this dissertation was developed by combining the Organizational Culture Assessment Revision B and the Climate for Innovation Measure, eliminating one Climate for Innovation Measure question due to unclear language (one question used the term "rock the boat" which was deemed too cliché to include), and adding thirteen questions that measure a Department of Defense's culture more directly. A fifty-four question survey, the Perceived Organizational Culture and Innovative Climate Assessment Tool (POCaICAT), was formed. This survey can be viewed in Appendix A.

A preliminary validity evaluation of the POCaICAT revealed that it appeared to be valid. Validity is the "degree to which an instrument actually represents what it purports to represent" (Brewerton and Millward 2006, p. 90). Three types of validity are

commonly evaluated: face, content, and construct. The POCaICAT demonstrated face validity because its questions appeared to be understandable. Content validity was demonstrated because POCaICAT questions were primarily drawn from previously published, reliable, and valid surveys (Organizational Culture Assessment Revision B and the Climate for Innovation Measure). Construct validity could not be demonstrated yet because principal component factor analysis hadn't been conducted yet, so it had not been determined that distinct principal components would be found (Reigle 2003; Brewerton and Millward 2006). However, this preliminary validity evaluation provided confidence that the POCaICAT would prove to be a valid survey.

C. Statistical Analysis

Statistical analysis was performed on survey results to discern the preponderant culture of a specific Department of Defense sample (the sample is described in a following section), to discern cultural differences between organizations within the sample, to discover the relationship between innovative climate and organizational culture in the sample, and to measure attributes that contribute to an innovative climate and their relationship to each other. Analytic tools used included Minitab® for statistical analysis, Statistical Package for the Social Sciences® (SPSS) Inc.'s Predictive Analytics Software (PASW) for principal component factor analysis, SPSS® Inc's Analysis of Moment Structures (AMOS™) for structural equation modeling analysis, Survey Monkey™ for data collection and demographic analysis, and Microsoft Office Excel® for data collation and preparation for further statistical analysis.

Statistical techniques used in the study, outside of structural equation modeling (to be covered in the following section) included the single-sample t test to determine the preponderant culture of the sample and the degree to which cultural attributes exist in the sample, the Wilcoxon signed-ranks test (used to verify single-sample t test results where appropriate), Analysis of Variance (ANOVA) and Tukey's Honestly Significant Difference (HSD) test to determine cultural differences between organizations within the sample, and simple linear regression to determine if a relationship between an innovative climate and an organizational culture exists in a public organization. Further details will be presented in the next chapter.

D. Structural Equation Modeling

Structural Equation Modeling provided an effective technique for further analysis. It provided insight into the relationship between attributes that contribute to an innovative climate (the independent latent variables). These attributes were determined by utilizing principal component factor analysis, and the results of this analysis and the attributes that it revealed will be delineated in the next chapter. The manifest variables (indicators) used were the questions of the Perceived Organizational Culture and Innovative Climate Assessment Tool (which were grouped according to principal component factor analysis). SPSS® Inc. statistical software packages PASW and AMOS™ were utilized to conduct Structural Equation Modeling, and results from this analysis are presented in the next chapter (Blunch 2008).

E. Population

A population "consists of the sum total of subjects or objects that share something in common with one another…" (Sheskin 2004, p. 1). The description of population targeted for sampling "should be as explicit as possible with respect to content, units, extent, and time so as to avoid ambiguity regarding which elements belong to it and which do not belong to it" (Pedhazur and Schmelkin 1991, p. 319). A sample, then, refers to "a set of subjects or objects which have been derived from a population. For a sample to be useful in drawing inferences about the larger population from which it is drawn, it must be representative of the population" (Sheskin 2004, p. 1). These definitions provide the standard which should be used to select a sample. For this study, this standard was met based on the sample frame chosen (the specific factors that describe the population (Pedhazur and Schmelkin 1991)). The sample frame consisted of a Navy community within the Department of Defense which shares a common goal. Although specific organization names and their common goal are not provided (so as not to report on any shortcomings of these organizations in a public document), such information is not needed for this study. The fact that this community exists and has a common goal is sufficient. Further sample size and demographic data will demonstrate that the sample studied is adequate and typical of Department of Defense organizations.

To select a requisite portion of a population to be used as a sample, a sample design was created which included the "rules and operations by which the sample is to be chosen from the population" (Pedhazur and Schmelkin 1991, p. 319). For this study, the sample design consisted of using simple random sampling. Subsequently, all members of this Navy community's population were asked to participate within a similar time frame

(therefore, this is not an elite sample nor is the data time lagged). Each member of the population was given the same opportunity to participate and therefore was as likely to respond as any other member.

Collective responses from this sampling frame represent overall community results. Examples of similar research and similar samples are numerous. Sawner (2000) wrote "An Empirical Investigation of the Relationship between Organizational Culture and Organizational Performance in a Large Public Sector Organization" in which he drew on data from 28,650 individuals from seventy-four Wings from the U.S. Air National Guard. The culture of each unit was measured to obtain a "comprehensive assessment of the culture of a major public sector organization, the Air National Guard" (Sawner 2000, p. 3). Obenchain (2002) surveyed 1053 academic administrator responses from 922 U.S. academic institutions in a study titled "Organizational Culture and Organizational Innovation in Not-for-Profit, Private and Public Institutions of Higher Education." She drew general conclusions on academic institutions and comparisons between culture types were made. Walker's 2007 paper "An Empirical Evaluation of Innovation Types and Organizational and Environmental Characteristics: Towards a Configuration Framework" involved sampling 101 English local governments from two echelons (corporate and service officers) using lagging survey data from 2001 (1,123 officers) and 2002 (967 officers). From this sample, general conclusions about these public organizations were drawn.

Chang and Lee (2007) wrote "The Effects of Organizational Culture and Knowledge Management Mechanisms on Organizational Innovation: An Empirical Study in Taiwan" drawing on results from 138 responses from department managers to

business chairman of multiple firms. General conclusions were drawn on Taiwanese businesses from this research. Sarros, Cooper, and Santora's 2008 study "Building a Climate for Innovation Through Transformational Leadership and Organizational Culture" sampled 1,158 private sector managers (members of the Australian Institute of Management), and general conclusions were drawn for Australian private sector organizations. Similarly, Prakash and Gupta (2008) wrote "Exploring the Relationship Between Organisation Structure and Perceived Innovation in the Manufacturing Sector in India" based on surveying 250 employees from four Indian manufacturers representing two industry sectors. General conclusions were drawn for the Indian manufacturing industry and comparisons between sectors were made.

These studies, most examining organizational culture or innovation or both, all drew general conclusions from the data collected. This dissertation does the same, and although it too examines organizational culture and innovation, it is unique in its approach, sample surveyed, and data collected. To obtain data, surveying Department of Defense organizations within the Navy was accomplished. However, the Department of Defense sample surveyed does not represent the Department of Defense as a whole. The sample does, though, represent a unique community within the Department of Defense. This community has a common goal which unites its eleven organizations. This community contains roughly 1100 individuals made up of scientists, engineers, operators, trainers, academics, and requirements officers. A normal population (based on the central limit theorem) will be assumed as will homogeneity of variance, so parametric statistical analysis was performed.

1. Sample Size

Based on tables provided by Cohen (2009), a sample of 393 individuals was desired. To determine this sample size, the statistical methods chosen for this research were evaluated. The first method examined was the single-sample t test, chosen to determine if there was a difference in the means of survey results and the center value of the scale of the survey. This method was chosen to discover if there was statistical evidence that this Navy community has a mechanistic or organic culture and if there is a perceived innovative climate or not (non-directional for both).

Utilizing Cohen's tables for the t test with an alpha value of 5%, a power of 80%, and an effect size of 0.2, the required sample size is 393. An alpha value of 5% is, according to Cohen (2009), the standard of proof a sample result will occur less than 5% of the time if the null hypothesis is true. This value is somewhat subjective, but a 5% chance of rejecting the null hypothesis when it is true is acceptable. Therefore, a 5% alpha value, or Type I error rate, was chosen for this research. Power conveys that the statistical test "will lead to the rejection of the null hypothesis" (Cohen 2009, p. 4). Again, this value is somewhat subjective. The beta value, which when subtracted from 1 produces the power of the test, is inversely proportional to the alpha value. Therefore, if the alpha value goes down, the beta value goes up. A balance must be struck between these two values. Beta is a measure of Type II error which is accepting the null hypothesis when it is false. So a beta of 20% and a power of 80% are acceptable for this research, meaning that the null hypothesis will be correctly rejected 80% of the time when it is false. Type I error is more severe than Type II error, and this approach has

placed a relative seriousness of four to one for rejecting a true null hypothesis to accepting a false null hypothesis (Cohen 2009).

Before proceeding further, it is appropriate to introduce the concept of effect size. Cohen (2009, p.9) indicates that an effect size is "the degree to which the phenomenon is present in the population" or "the degree to which the null hypothesis is false." Therefore, if the null hypothesis is true, then the effect size for the treatment is zero. So, if a null hypothesis is false, it is false to some degree, or effect size (a non-zero value). The larger this value is, the larger the degree of manifestation of the phenomenon. Larger sample sizes are needed to detect a smaller effect.

An effect size of 0.2, or a small effect size for the t test, is applicable for this research because, according to Cohen (2009, p. 25), in new research areas where "the phenomena under study are typically not under good experimental or measurement control or both…the influence of uncontrollable extraneous variables makes the size of the effect small relative to these." However, with an effect size of 0.3 and the remaining criteria being the same, the required sample size is 175. An effect size of 0.3 falls in the range between small and medium effect size. An effect size of 0.5 is considered a medium effect size and is defined as "one large enough to be visible to the naked eye. That is, in the course of normal experience, one would become aware of an average difference…between members of professional and managerial occupations groups (Super 1949, p. 98)" (Cohen 2009, p. 26). So, an effect size in the small to medium range seems appropriate for this Navy community. A sample size of 175 was deemed achievable (a return rate of only 16% is needed) and offers acceptable statistical rigor.

The next statistical method evaluated for required sample size was Analysis of Variance. To draw comparisons between organizations in this Navy community, the Analysis of Variance and Tukey's HSD tests were carried out to determine if the mean scores for innovativeness and organizational culture between organizations were significantly different. Based on the number of individuals in these organizations, it was estimated that five to ten groups could be compared. This assessment is based on the average requisite sample size from each organization required to maintain statistical rigor. For example, for an alpha of 5%, a power of 80%, and a small effect size (0.10 is considered a small effect size for ANOVA), a group of five would need to average approximately 250 results per group for meaningful ANOVA statistical tests to be run. According to Cohen (2009) a group of ten would need to average approximately 160 results per group. These returns are not realistic for this Navy community's organizations, so one of the criteria (alpha, power, or effect size) had to be relaxed.

If a medium effect size (0.25 for ANOVA) were used, then the required returns for organizational comparison would be more easily attained. Per the same rationale previously stated for the applicability of a medium effect size, a medium effect size was deemed acceptable to compare organizations within this Navy community (academics, operators, engineers, etc.). So, for a group of five, an average of thirty-nine results is required per group to maintain an alpha of 5% and a power of 80%. For a group of seven, an average of thirty-two results is required, and for a group of ten, an average of roughly twenty-six results is required per group (Cohen 2009). These returns are in better accordance with the size of most of the organizations of this Navy community and were deemed much more achievable.

The other primary statistical method used was simple linear regression. This analysis was used to determine whether there is a relationship between an organizational culture and an innovative climate within this Navy community. For one independent factor (degree of organic/mechanistic culture), an effect size of 0.1 (considered small for simple linear regression), an alpha value of 5%, and a power of 80%, simple linear regression analysis requires 783 results for statistical rigor. However, this too is not achievable for this Navy community, so a medium effect size (0.3 for simple linear regression) was deemed sufficient per previously stated rationale and was used to determine a required sample size. According to Cohen, only eighty-five results are required, so a return that supports a range of small to medium effect size is achievable (Cohen 2009).

2. Demographics

The sample for this research, even if deemed large enough, must also be representative of the population from which it comes. It must reflect the population's significant characteristics. Since this community exists within the U.S. Navy, it is appropriate to compare the demographics of this sample to the demographics of the active duty Navy. Data collection for this research occurred from March to July 2010, so comparison to U.S. Navy demographic data from a similar time frame (1 January to 31 March 2010) was conducted. The Navy is made up of 84.2% males and 15.8% females and 4.55% Native American, 5.59% Asian, 18.4% African American, 1.04% Pacific Islander, 62.6% Caucasian, and 18% Hispanic Sailors (U.S. Navy 2010).

These ethnic categories add up to 110%, but this is accounted for because the Navy collects demographic data in such a way that an individual may be counted in more than one category. However, these figures give a general ethnic breakdown of the total active duty force within the U.S. Navy. Further, since this Navy community is comprised of professionals (scientists, engineers, operators, trainers, academics, and requirements officers), it is also appropriate to examine the demographic data of college graduates and the science and engineering labor force.

From 2003 data on U.S. college graduates (the most recent found), college graduates are 0.4% Native American, 6.7% Asian, 6.1% African American, 0.3% Pacific Islander, 81.4% Caucasian, and 5.1% Hispanic (Kannankutty 2005). The college educated science and engineering labor force in the U.S. is 1.5% Native American, 14% Asian/Pacific Islander, 5% African American, 84% Caucasian, and 3.5% Hispanic (National Science Board 2010).

Demographic data on age was also collected from the sample. No comparable data is available from the Navy, but since this Navy community is comprised of scientists, engineers, operators, trainers, academics, and requirements officers, its age breakdown is expected to be more reflective of a group of professionals with substantial experience than the total force of a Military Service (which recruits teenagers). Comparing the ages of this Navy community with a group of similar professionals would be more appropriate. First, comparison to U.S. college graduates is warranted. This group is made up of the following age groups: 6.5% are 29 years of age or under, 26% are 30 – 39, 27.6% are 40 – 49, 23.9% are 50 – 59, 11.5% are 60 – 69, and 4.5% are 70 years of age or over (Kannankutty 2005). Second, comparison to the college educated

science and engineering labor force in the U.S. is prudent. This group is made up of the following age groups: 11% are 29 years of age or under, 27.5% are 30 – 39, 27% are 40 – 49, 21.5% are 50 – 59, and 14.5% are 60 years of age or over (National Science Board 2010). Demographic comparison data is presented in Table 4.4 in the next section.

F. Pilot Study

Before the full research study was conducted, a pilot study was completed once the POCaICAT was drafted. The purpose of the pilot study was three-fold: 1) to identify if the POCaICAT needed clarification, 2) to discover distribution and collection discrepancies (Henriksen 2007), and 3) to test the application of statistical software and tests intended for the full study. Two of eleven organizations within this Navy community were asked to participate in March 2010. The POCaICAT was distributed via the web site Survey Monkey™. A solicitation e-mail with a link to the survey was distributed to the community members within these two organizations, and thirty-two responses out of a potential fifty-seven were collected, a 56% success rate. The pilot study sample represented only 4% of the total community population, so if these survey results were not deemed usable in the full study, there would still be a large population (over 1,000) from which to draw a sufficient sample. Plus, with such a good success rate, the pilot study instilled confidence that a requisite sample for statistical rigor would be achieved.

Demographic data obtained from the pilot study are similar to the U.S. Navy demographic data listed in the previous section. Pilot study percentages within the

sample were 3% Native American, 0% Asian Indian, 3% Asian (Far East), 0% Asian (Middle East), 6% African American, 0% Pacific Islander, 84% Caucasian, and 3% Hispanic. The gender response percentages were 84% male and 16% female. The age composition for the pilot study sample is as follows: 20-30 years of age – 3%, 31-40 years of age – 25%, 41-50 years of age – 41%, 51-60 years of age – 19%, 61-70 years of age – 13%, and 71+ years of age – 0%. These demographic results and trends were roughly what were expected based on the comparable demographic data previously listed which instilled further confidence that a reflective sample from the population for the full study could be obtained. Table 4.4 displays the demographic results.

Table 4.4 Pilot Study Demographic Data

Gender	Pilot Study Demographics	Comparison Demographics	U.S. Navy Total Active Duty Force Demographic Data (Jan – Mar 2010) (U.S. Navy 2010)		U.S. College Graduates (Kannankutty 2005)	U.S. College Educated Science and Engineering Labor Force (National Science Board 2010)
Males	84%		84.2%		50.6%	74%
Females	16%		15.8%		49.4%	26%
Ethnicity						
Native American	3%		4.55%		0.4%	1.5%
African American	6%		18.4%		6.1%	5%
Hispanic	3%		18.%		5.1%	3.5%
Subgroup Total	12%		41%		11.6%	10.0%
Asian Indian	0%					
Asian (Far East)	3%					
Asian (Middle East)	0%					
Asian (total)	3%		5.59%		6.7%	
Pacific Islander	0%		1.04%		0.3%	
Subgroup Total	3%		6.63%		7.0%	14%
Caucasian	84%		62.6%		81.4%	84%
Age (in years)				**Age (in years)**		
20 - 30	3%			<= 29	6.5%	11%
31 – 40	25%			30 – 39	26%	27.5%
41 – 50	41%			40 – 49	27.6%	27%
51 – 60	19%			50 – 59	23.9%	21.5%
61 +	13%			60 +	16%	14.5%

Principal component factor analysis was conducted and six principal components were found. These six explained 73% of the variability for this analysis. Varimax rotation was not conducted since pilot study results were not intended to be used to

contribute to substantive findings but rather were intended to be used to test the functionality of the software and statistical tests selected. All statistical tests were successfully conducted and were determined to be suitable to test hypotheses utilizing the interval data collected. Statistical software packages likewise were tested and were found to be suitable. One exception was SPSS® Inc.'s AMOS™ Structural Equation Modeling software, but this was due to limited pilot study returns. Thirty-two responses were not enough for the software to carry out its algorithms.

Principal component factor analysis of POCaICAT questions was conducted to determine if modification was necessary. A threshold of 0.3 for principal component loading was used (Sheskin 2004), although others consider principal component loadings 0.4 or 0.5 as significant (Pedhazur and Schmelkin 1991). However, for the pilot study, the less stringent threshold of 0.3 was deemed acceptable. Not all questions loaded sufficiently on one of the six principal components, but each was placed in the principal component in which it loaded the highest. However, instead of dismissing these questions outright due to poor principal component loading, a more holistic approach to question retention was taken. To consider eliminating questions from the survey, four criteria were set to determine if compelling evidence existed for their elimination. Before listing these criteria, though, it is necessary to define one of the measures included. Cronbach Alpha is a measure of reliability which describes the internal consistency of a group of questions via correlation analysis. Alpha figures range from 0 to 1.0 (the higher the figure the better the consistency) (Brewerton and Millward 2006). The criteria for elimination, then, included Cronbach Alpha improvement of its principal component if the question was eliminated, poor question

and intra-item principal component correlation, poor overall correlation of question with the rest of the survey, and poor principal component loading from principal component factor analysis. If a question met at least two of these four criteria, it was considered for elimination. Eight questions were subsequently evaluated. For this evaluation, question content and origin were factored into the decision to retain or eliminate. Seven of these eight questions originated either from the Organizational Culture Assessment Revision B or the Climate for Innovation Measure, both reliable and valid surveys, so they were retained in the POCaICAT because it was decided that a pilot study of only thirty-two responses was not sufficient to invalidate these questions. The last question considered for elimination did load onto a principal component surpassing the threshold of 0.3, therefore it was retained as well. Finally, it was decided that all fifty-four questions of the POCaICAT would be retained for use in the full study.

For a one time administration of a survey, its reliability can be measured through an evaluation of its internal consistency or the degree of content similarity that grouped items (such as principal components) share (Brewerton and Millward 2006). The reliability of the survey from pilot study results was deemed acceptable since all principal components of the survey generated Cronbach Alpha scores above 0.7 (Brewerton and Millward 2006). The POCaICAT was also considered valid based on pilot study results. The POCaICAT demonstrated face validity (questions were understandable; two distinct groups within the pilot study sample produced consistent results), content validity (draws from previously published, expert judgment (Organizational Culture Assessment Revision B and the Climate for Innovation Measure)), and construct validity

(distinct principal components found from analysis) (Reigle 2003; Brewerton and Millward 2006).

The POCaICAT demonstrated good reliability and validity during the pilot study. The pilot study results built confidence that the Navy community to be studied would be reflective of the active duty U.S. Navy and that a sample size could be obtained that would be large enough to produce statistically significant results. Further, there were two dissemination lessons learned from the pilot study. First, it was apparent that it must be stressed in the full study that all questions must be answered or responses will not be useful. Second, it was clear that it must be stressed in the full study that respondents should keep their parent organization in mind and not their specific work-center or immediate surroundings while answering questions to obtain perspectives on the eleven organizations that comprise this Navy community.

G. Full Study

The POCaICAT was disseminated in June 2010 and collection ceased in mid-July 2010. The number of responses received was 219. When the thirty-two responses from the pilot study were combined with these 219 responses, 251 total responses (or about a 25% return rate) was obtained. The thirty-two pilot study responses were used in the full study since the questions in the POCaICAT were unaltered and the time frame used to gather all responses were very similar. Results of the full study are discussed in the next chapter.

H. Summary

It was determined that surveying a sample of the population of interest was the preferred research method to conduct this study. Two valid and reliable surveys were chosen that measured the organizational culture and innovative climate of an organization, respectively. These surveys were combined, and an additional thirteen questions were added to create the POCaICAT. Statistical tests and software were selected for analysis, and a requisite sample size was determined. Further, the sample size collected for this study was determined to be appropriate, and demographic data of the pilot study sample was shown to be reflective of the larger parent organization, the U.S. Navy. The pilot study conducted also instilled confidence in the reliability and validity of the POCaICAT and built confidence that the approach for the full study was achievable.

Chapter V

DATA ANALYSIS AND RESULTS

A. Data Collection

Eleven organizations participated in this study. They each have a common goal and represent a specific Navy community, even though they are geographically dispersed. Data was collected by disseminating a link via e-mail to an on-line survey. Surveys were collected from March to July 2010, and all levels of these organizations were solicited for participation.

1. Sample Size Achieved

After the data for this research was collected, 251 responses were available for analysis (both pilot study and full study results were deemed usable since the same questions were disseminated in each and all data was collected within a five month time frame). This sample size was large enough to provide statistical rigor and significance to this study. First, for the t test, a sample size of 251 allowed a 5% alpha, 80% power, and 0.251 effect size level for the statistical analysis. An effect size of 0.251 is within the small (0.2) and medium (0.5) effect size range for the t test (Cohen 2009). For ANOVA, seven organizations produced enough responses to average thirty-four per organization, resulting in statistical analysis conducted at the 5% alpha, 83% power, and medium (0.25) effect size level (Cohen 2009). Finally, for linear regression, a sample size of 251 produced an alpha of 5%, power of 80%, and effect size of 0.175 for statistical analysis.

An effect size of 0.175 is within the small (0.10) and medium (0.3) effect size range for simple linear regression (Cohen 2009). A sample size of 251 for this research is large enough, then, to produce statistically significant results.

2. Demographics

For this research, the sample of 251 included active duty Navy, government civilians, and contractors. The demographic results are displayed in Table 5.1, and as can be seen, many similarities exist between the sample and the comparative data. For example, the sample contained 84.9% males and 15.1% females. These figures are quite similar to the active duty Navy. The active duty Navy is made up of 84.2% males and 15.8% females (U.S. Navy 2010). This is not surprising since a large number of the government civilians and contractors in this community were at one time part of the active duty component of the Navy. The ethnic breakdown for the sample did not match the Navy quite as well but was roughly similar. The POCaICAT broke down ethnicities into eight categories while the Navy used six categories. Part of the discrepancy may be accounted for by the multiple ethnic counting conducted by the Navy, but regardless, the Caucasian percentage for the sample is relatively high compared to the Navy data, although both are a majority.

Table 5.1 Full Study Demographic Data

Gender	**Study Demographics**	**Comparison Demographics**	U.S. Navy Total Active Duty Force Demographic Data (Jan – Mar 2010) (U.S. Navy 2010)	U.S. Navy Officer Corps Demographic Data (Jan – Mar 2010) (U.S. Navy 2010)		U.S. College Graduates (Kannankutty 2005)	U.S. College Educated Science and Engineering Labor Force (National Science Board 2010)
Males	84.9%		84.2%	84.8%		50.6%	74%
Females	15.1%		15.8%	15.2%		49.4%	26%
Ethnicity							
Native American	2.0%		4.55%	0.69%		0.4%	1.5%
African American	3.6%		18.4%	8.29%		6.1%	5%
Hispanic	5.6%		18%	6.1%		5.1%	3.5%
Subgroup Total	11.2%		41%	15.1%		11.6%	10.0%
Asian Indian	1.2%						
Asian (Far East)	5.2%						
Asian (Middle East)	1.6%						
Asian (total)	8.0%		5.59%	3.99%		6.7%	
Pacific Islander	2.4%		1.04%	0.33%		0.3%	
Subgroup Total	10.4%		6.63%	4.32%		7.0%	14%
Caucasian	78.5%		62.6%	81.1%		81.4%	84%
Age (in years)					**Age (in years)**		
20 - 30	15.1%				<= 29	6.5%	11%
31 – 40	20.7%				30 – 39	26%	27.5%
41 – 50	38.2%				40 – 49	27.6%	27%
51 – 60	16.3%				50 – 59	23.9%	21.5%
61 +	9.6%				60 +	16%	14.5%

It is interesting to note that the sample demographics more closely match Navy Officer Corps demographics than overall Navy demographics, especially with regard to gender and the percentage of Caucasians. This apparent correlation of the sample demographics and the Navy's Officer Corps may indicate that this Navy community is composed primarily of current and former Naval Officers, but such data was not collected for this study. Regardless, the percentages demonstrate similar trends and are relatively close, demonstrating the sample is representative of the active duty U.S. Navy.

This Navy community is also representative of a group of professionals, especially scientists and engineers. This can be seen both ethnically and by age in Table 5.1. These results are expected from a group of professionals with significant experience and closely match percentages and trends from U.S. college graduates and the college educated U.S. science and engineering labor force. The sample's age data was combined in Table 5.1 for two groups, 61 – 70 and 71 +, to coincide better with National Science Board groupings.

The sample is reflective of the active duty Navy, U.S. college graduates, and the college educated U.S. science and labor force. However, the sample is not reflective of gender percentages in all three groups, notably in U.S. college graduates (over 49% are women) (Kannankutty 2005). The sample does correlate well with active duty Navy, Navy Officer Corps, and even the college educated science and engineering labor force (although to a lesser degree). Ethnically, the sample correlates well with all groups and trends similarly (majority of members are Caucasian and percentages of each ethnicity are roughly the same (i.e., within seven percentage points)). The exception is the active duty Navy which has a higher percentage of African Americans and Hispanics and fewer

Caucasians, but the trend is roughly the same. The age groups of the sample correlate well with the other groups (where data was available), following the trend that a majority of each group fall within the 30 – 50 year age group. Therefore, when viewed holistically, the sample is reflective of the active duty Navy (particularly the Navy Officer Corps), U.S. college graduates, and the college educated science and engineering labor force. The sample is most reflective, though, of the Navy Officer Corps and the college educated U.S. science and engineering labor force, and, based on the composition of the sample, this is expected.

B. Principal Component Factor Analysis Phase I

Principal component factor analysis was first conducted with all fifty-four questions of the POCaICAT. SPSS® PASW software was utilized for this analysis. A combination of eigenvalues and variance thresholds were used to determine the meaningful, principal components. According to Pedhazur and Schmelkin (1991) an accepted minimum description of variance for principal component factor analysis is subjective but generally the first two or three principal components should account for over 50% of the variance. The first three principal components accounted for 51.9% of the variance, so the analysis (to this point) was deemed acceptable. Further, Pedhazur and Schmelkin (1991) and Johnson and Wichern (2007) indicate that setting a threshold of one for eigenvalues is a standard convention that attempts to minimize the number of principal components. Upon review, ten principal components had eigenvalues above one and described 68.2% of the cumulative variance. Combined, then, eigenvalue and variance analysis resulted in ten principal components.

Varimax rotation was then used to simplify the loadings to aid in identifying patterns (Johnson and Wichern 2007). Varimax rotation seeks to maximize variances (Pedhazur and Schmelkin 1991). There has been some controversy, though, surrounding the use of Varimax rotation in conjunction with principal component analysis (Pedhazur and Schmelkin 1991). However, Varimax rotation is appropriate for use with principal component factor analysis, although a general, dominant principal component may be obscured (Johnson and Wichern 2007). No general, dominant principal component was expected from this study, so this concern was deemed to not be applicable.

Of the original fifty-four questions of the POCaICAT, principal component factor analysis revealed that thirty-seven had a loading greater than 0.5 on a single principal component while all other principal component loadings for that question were below 0.4. Loadings above 0.4 or 0.5 are generally considered meaningful (Pedhazur and Schmelkin 1991), so a threshold for loadings above 0.5 and below 0.4 is appropriate. Results are displayed in Table 5.2. Significant loadings (i.e., those above 0.5 with all others below 0.4) are shown in bold type.

Table 5.2 Principal Component Factor Loadings from First Principal Component Factor Analysis

	Principal Components									
Question	1	2	3	4	5	6	7	8	9	10
1	.219	.152	.093	.004	.125	**.777**	.043	.105	.045	.119
2	.343	.069	.400	.285	.072	.467	.081	.096	.199	-.144
3	.321	.358	**.534**	.159	.071	.010	.220	-.201	.106	-.011
4	.196	.207	.247	.218	**.520**	.388	.248	-.053	-.027	-.046
5	-.033	.130	.087	-.064	**.741**	-.122	-.052	.056	.136	-.158
6	.275	.127	.140	.320	-.067	**.514**	-.052	.045	.045	.269
7	.081	.231	**.528**	.164	-.108	.126	-.014	.198	.157	.108
8	.263	.368	.102	**.645**	-.067	.060	-.009	.036	.016	.091
9	.141	.250	.272	**.559**	.167	.206	-.040	.357	.177	.062
10	.219	.160	**.585**	.127	.228	.126	.072	.015	.166	.258
11	.255	.089	.374	.378	.141	.440	.089	.090	-.011	-.314
12	.185	.220	.164	.052	**.618**	.313	.103	.110	.015	.184
13	.136	.473	.325	.241	.407	.202	.090	.150	-.015	.028
14	.132	.240	.511	.068	.343	-.112	-.008	.473	-.068	-.078
15	.207	.217	**.595**	.346	.252	-.005	.046	.229	-.075	-.135
16	.354	.215	.211	**.638**	.148	.150	.125	-.075	.047	.065
17	.287	.042	.122	**.690**	.015	-.001	-.054	-.143	.025	.128
18	.251	.243	**.554**	.075	.311	.243	.119	.044	-.123	.202
19	.314	-.044	.078	.288	-.033	.163	-.105	.015	.062	**.643**
20	**.741**	.014	.203	.288	.216	.107	-.034	.004	.022	.190
21	**.762**	.136	.172	.270	.259	.078	-.001	-.034	.005	.189
22	.628	.190	.210	.415	.237	.126	.001	.041	.014	.102
23	**.533**	.271	.159	.385	.096	.081	.066	.243	-.231	.140
24	.239	.388	.257	.135	**.506**	.083	-.027	.032	-.060	.165
25	.180	**.558**	.379	.271	.127	.119	-.043	.178	-.012	.077
26	**.672**	.250	.059	.250	-.072	.215	-.164	-.001	-.032	-.087
27	.383	.558	.444	.221	.092	.117	.027	.060	.057	-.093
28	.340	**.621**	.314	.183	.138	.097	-.017	.111	-.124	.104
29	.300	**.571**	.277	.206	.264	.235	.058	.100	-.154	-.007
30	**.710**	.297	.211	.158	-.033	.213	-.076	-.004	-.080	-.053
31	.200	.205	**.645**	.105	.158	.117	.066	.085	.049	-.051
32	.402	.505	.361	-.203	.142	.146	.136	.053	-.113	.168
33	.467	.475	.373	.092	.046	.207	.181	-.020	-.073	.129
34	**.700**	.208	.255	.198	.114	-.013	.206	.093	-.022	.115
35	.663	.050	.159	.110	.034	-.010	.415	.170	.052	.052
36	.392	.042	.099	.000	.039	.166	.439	.619	.005	-.022
37	.087	-.047	.075	-.013	.001	-.012	**.746**	.092	.181	-.164

Table 5.2 (continued)

Principal Components										
Question	1	2	3	4	5	6	7	8	9	10
38	.029	.210	-.014	.038	.103	.081	**.640**	.350	-.258	.165
39	.299	.046	.167	-.070	.063	.108	.227	**.723**	.139	.033
40	.602	.171	.129	.080	.170	.047	.028	.222	.423	.155
41	**.611**	.100	.176	.121	.186	.104	.038	.096	.396	.261
42	.496	.309	.079	.200	.058	.228	.144	.099	.341	.146
43	.405	.030	.092	.416	.108	.179	.042	.139	.436	.015
44	**.684**	.148	.159	.182	.065	.223	.141	.265	.075	.023
45	.548	.355	.157	.487	-.075	.191	.051	.028	.216	-.002
46	.190	**.719**	.056	.088	.228	.047	-.003	.042	.084	-.126
47	.219	**.593**	.278	.254	.145	.097	.147	-.016	.314	-.010
48	**.649**	.308	.088	.204	.032	.113	.055	.143	.115	.291
49	.448	.186	.378	-.076	-.030	.094	.486	-.031	-.048	.007
50	**.789**	.217	.155	.081	.036	.179	.130	.133	-.022	-.073
51	**.703**	.304	.140	.259	.088	.109	.135	.172	.246	-.042
52	**.814**	.223	.126	.024	.023	.114	.110	.132	.058	-.038
53	.483	.575	.210	.105	.085	-.061	.124	-.052	.258	.029
54	.519	.452	.176	.282	.133	.006	.226	.136	.212	.097

Any questions whose loading did not meet this threshold were eliminated. This standard was sought so as to avoid questions being confounded amongst multiple principal components. It is prudent to avoid confounding so that questions that load meaningfully on a single principal component are easily identified allowing researchers to more clearly describe principal components (Johnson and Wichern 2007). Since no general, dominant principal component was expected in this study, conceived dimensions are not expected to intercorrelate (Pedhazur and Schmelkin 1991). Meaningful loadings for individual questions, then, were expected to occur on only one principal component (i.e., no crossloadings where questions have loadings over 0.5 on two or more principal components). Following this analysis, these thirty-seven questions underwent another

principal component factor analysis in an attempt to simplify and reduce the number of principal components.

From the second principal component factor analysis, the first three principal components described 51.6% of the variance indicating a meaningful analysis. Evaluating the principal components determined that there were six principal components with eigenvalues above one that described 61.6% of the variance. After Varimax rotation, thirty of the remaining thirty-seven questions had a loading greater than 0.5 on one principal component with all other principal component loadings for that question loading below 0.4. Results are displayed in Table 5.3. Non-significant loadings have been hidden from view.

Table 5.3 Principal Component Factor Loadings from Second Principal Component Factor Analysis

	Principal Components					
Question	1	2	3	4	5	6
1						**.689**
3						
4				**.555**		
5				**.725**		
6						**.593**
7						
8		**.629**				
9		**.601**				
10						
12				**.668**		
15		**.541**				
16		**.592**				
17		**.655**				
18				**.501**		
19						
20	**.760**					
21	**.765**					
23	**.531**					
24				**.555**		
25						
26	**.685**					
28			**.665**			
29			**.658**			
30	**.714**					
31						
34	**.706**					
37					**.711**	
38					**.663**	
39					**.624**	
41	**.659**					
44	**.712**					
46			**.700**			
47						
48	**.695**					
50	**.801**					
51	**.742**					
52	**.837**					

The six principal components were titled: Support for Innovation, Resource Supply for Innovation, Collaboration, Workforce Autonomy, Managerial Trust / Workforce Enthusiasm, and Problem Solving Autonomy. A holistic evaluation of the questions grouped within each of these principal components was conducted, and, based on question content, the principal component titles listed were derived and assigned accordingly (Johnson and Wichern 2007). Obtaining these principal components demonstrated the POCaICAT had construct validity (Reigle 2003; Brewerton and Millward 2006). Additionally, face validity was demonstrated because groups within the Navy community surveyed produced similar results, indicating a common understanding of the POCaICAT questions. Details are provided later in this chapter. Content validity was demonstrated because POCaICAT questions were primarily drawn from previously published, reliable, and valid surveys (Organizational Culture Assessment Revision B and the Climate for Innovation Measure) (Reigle 2003; Brewerton and Millward 2006). The principal components of this valid measurement tool (and their associated questions), then, were entered into SPSS® AMOS™ for structural equation modeling and subsequent modification indices analysis to determine the relationships these principal components share.

C. Structural Equation Modeling Phase I

The thirty remaining questions from the POCaICAT were grouped into their principal components and entered into SPSS® AMOS™. The principal components were latent variables (i.e., not directly measurable), and the POCaICAT questions were the manifest variables (i.e., operationalized latent variables or indicators) (Blunch 2008).

Connections between the principal components were then theorized and tested. Figure 5.1 shows a model based on the premise that an organization's position on the organic/mechanistic continuum, an organization's commitment to resourcing for innovation, and specific aspects of support for innovation (i.e., represented by manifest variables only) determines to what level an organization supports innovation and subsequently an innovative climate.

The Workforce Autonomy, Problem Solving Autonomy, Collaboration, and Managerial Trust / Workforce Enthusiasm principal components together determine where on the organic/mechanistic continuum an organization falls (i.e., most questions come from the Organizational Culture Assessment Revision B), and these principal components represent elements of an organizational culture as defined in Chapter II. Also, per the literature (Damanpour 1991; Walker 2007; Prakash and Gupta 2008; Robbins and Judge 2009), these principal components have a causal relationship with an innovative climate, best represented by the Support for Innovation principal component. The Support for Innovation principal component is made up primarily of questions from the Climate for Innovation Measure and original questions generated specifically to measure support for innovation and an organization's innovative climate. The literature also states that the Resource Supply for Innovation principal component has a causal relationship and contributes to an innovative climate (Ruiz-Moreno, Garcia-Morales, and Llorens-Montes 2008; Robbins and Judge 2009).

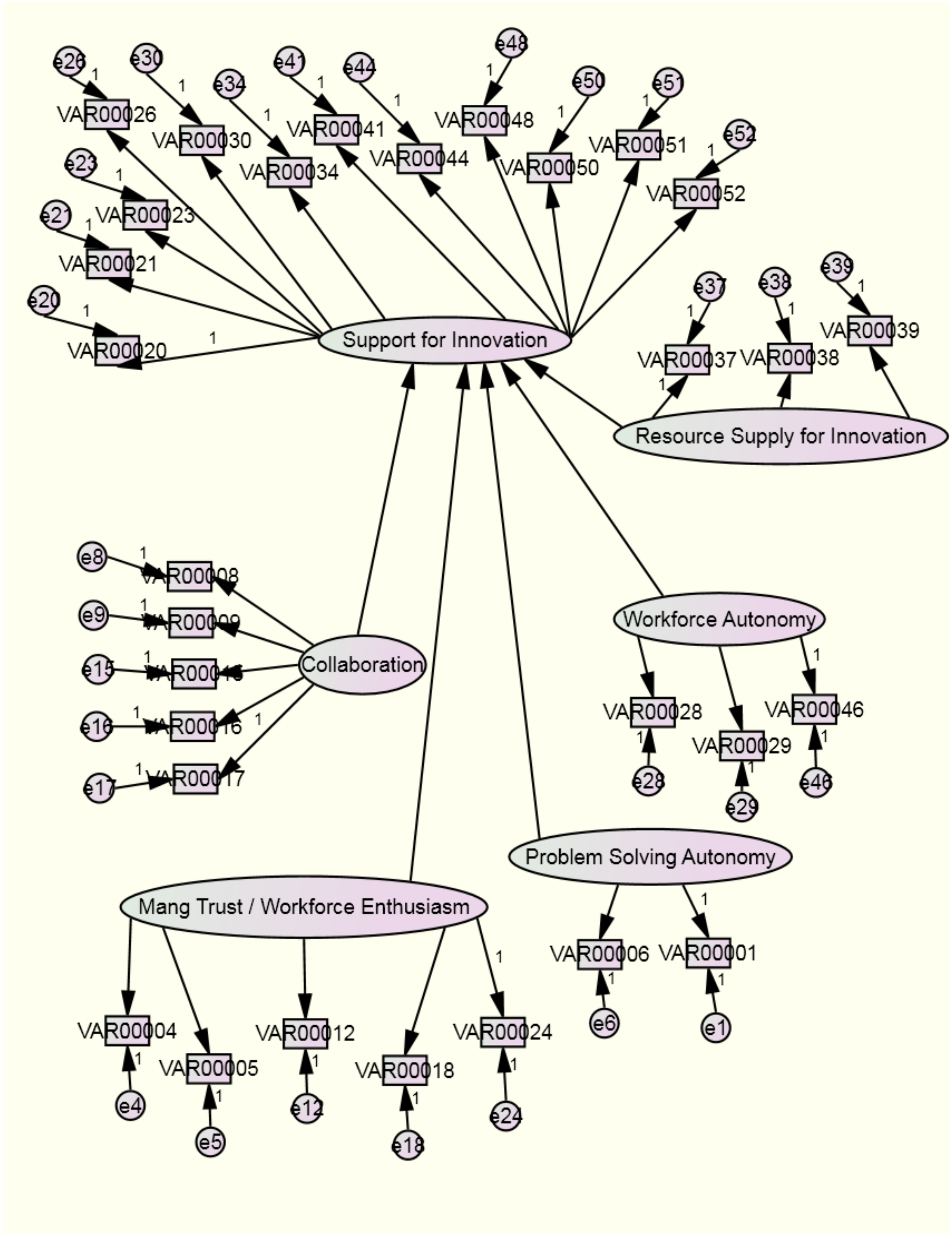

Figure 5.1 Structural Equation Model for 30 Remaining Questions of POCaICAT after Two Principal Component Factor Analyses

To evaluate model fit, a number of fit indices produced by SPSS® AMOS™ were examined. Blunch (2008) recommends reporting chi-square with associated degrees of freedom and p-value, the Root Mean Square of Approximation (RMSEA) with 90% confidence interval, and PCLOSE. In addition, Kline (2011) also recommends reporting the Goodness of Fit Index (GFI), the Comparative Fit Index (CFI), and the Standardized Root Mean Square Residual (SRMR). However, SPSS® AMOS™ does not produce an SRMR value. All other results are displayed in Table 5.4.

Table 5.4 Model Fit Summary for all Principal Components Directly Related to the Support for Innovation Principal Component Without Modification Indices Applied

Model Fit Indices	POCaICAT Revision A Result	Acceptable Values	Good Fit?
Chi-Square (CMIN)	1350	N/A	N/A
Degrees of Freedom (DF)	401	N/A	N/A
CMIN/DF	3.37	1.00 – 3.00	Undetermined (see below)
p-value	<0.0001	N/A	N/A
Root Mean Square of Approximation (RMSEA)	.097 LO 90 = 0.092 HI 90 = 0.103	~ 0.05	No
PCLOSE	<0.0001	N/A	N/A
Goodness of Fit Index (GFI)	0.717	0 – 1.0 (closer to 1.0 indicates better fit)	Marginally Acceptable
Comparative Fit Index (CFI)	0.783	0 – 1.0 (closer to 1.0 indicates better fit)	Marginally Acceptable

Blunch (2008) reports that a good absolute fit measure is CMIN/DF and that a value close to 1.00 is an indication of good fit. CMIN is the minimum value of chi-square achieved after a minimization process carried out by SPSS® AMOS™. If the null hypothesis (i.e., the model is correct) is true, then the expected value of chi-square (or CMIN in this case) is the degrees of freedom of the model. Therefore, a CMIN/DF equal to 1.00 indicates that the null hypothesis is true. Blunch (2008) indicates the closer CMIN/DF is to 1.00, the better the fit. A less stringent threshold is recommended by Carmines and McIver (1981). They stated that a CMIN/DF even between 2.00 and 3.00 shows acceptable fit. This POCaICAT model produced a CMIN/DF of 3.37 which does not indicate a good fit. However, Kline (2011) warns that the CMIN/DF, or the normed chi-square, should not be used in any model fit assessment because this value and associated thresholds have insufficient logical or statistical foundation. Therefore, CMIN/DF is discounted as a good measure of model fit and other measures were considered.

A similar conclusion can be drawn after evaluating the p-value affiliated with CMIN. Kline (2011) recommends reporting this figure to communicate whether a model fails the exact fit test or not. The null hypothesis of the exact fit test states that the model is correct. A large p-value, then, would fail to reject the null hypothesis meaning there is no statistical evidence to indicate the model is incorrect. A small p-value (i.e., less than 0.05 (Kline 2011)) would provide the statistical evidence necessary to reject the null hypothesis, indicating model misfit. Kline (2011) recommends noting model misfit when it occurs and acknowledging that diagnosing magnitude and sources of this misfit are needed (this step is beyond the scope of this research, though). For the current model, a

p-value of less than 0.0001 resulted, indicating model misfit. A p-value of 0.0001 means there is a 0.01% chance of obtaining a larger CMIN (i.e., worse CMIN) from a different sample. Therefore, finding a worse model fit with a new sample is very unlikely. This observation is not concerning, though. It is unrealistic to expect that the null hypothesis is true. Byrne (2010) states that even the best postulated models can only fit real sample data approximately, making it unrealistic to find models that fit empirical research data well. Further, Blunch (2008) states that a large p-value could indicate over-fitting which could necessitate model simplification. Because the p-value can be discounted as a good measure of model fit like CMIN/DF, other, more meaningful measures were considered.

The Root Mean Square of Approximation (RMSEA) is a fit index based on the non-central chi-square distribution. This fit index is premised on the fact that models are only approximately correct, not completely correct. The ordinary (central) chi-square distribution would result in CMIN equaling the model's degrees of freedom and thus would indicate a perfect fit. As the model fit worsens, the difference between CMIN and the model's degrees of freedom grows. Therefore, small differences are sought. RMSEA is a value that conveys this difference by taking a normalized difference value (i.e., difference divided by the size of the sample) and then dividing it by the model's degrees of freedom. RMSEA values close to 0.05 demonstrate a good fit. Blunch (2008) indicates that values above 0.10 should be dismissed. Byrne (2010) advocates that scores as high as 0.80 are acceptable. This POCaICAT model produced an unacceptable RMSEA value of 0.097 which fell in a 90% confidence interval between 0.092 and 0.103. The PCLOSE value is a p-value for a null hypothesis test that the RMSEA value is less than 0.05 (Blunch 2008). With a PCLOSE value less than 0.0001, this null hypothesis

can be rejected (which is expected because RMSEA had a value of 0.097), indicating that there is no evidence of over-fitting and subsequent simplification is not required.

The Goodness of Fit Index (GFI) is an approximate fit index that can have values ranging between 0 and 1.00. Values closer to 1.00 indicate better fits (Byrne 2010; Kline 2011). This POCaICAT model produced a GFI score of 0.717, indicating a marginally good fit. The Comparative Fit Index (CFI) is also an approximate fit index that can produce values ranging between 0 and 1.00. Like the GFI, values closer to 1.00 indicate better fits (Kline 2011). This POCaICAT model produced a CFI score of 0.783, indicating a marginally good fit. Blunch (2010), however, states that CFI values greater than 0.95 are "usually" interpreted as indications of good fit. Byrne (2010) also advocates a score close to 0.95. Since this threshold is rather subjective, the less stringently defined threshold was used for model fit evaluation.

Considering RMSEA, PCLOSE, GFI, and CFI holistically, the sample data does not fit this POCaICAT model very well. The next step in structural equation modeling is to evaluate the regression weights of the relationships between the latent variables. Table 5.5 displays these regression weights and their statistical significance.

Table 5.5 Structural Equation Modeling Regression Weights Without Modification Indices Application

Latent Variable		Latent Variable	Regression Weight Estimate	Standard Error	Critical Ratio	p-value
Support for Innovation	←	Resource Supply for Innovation	.448	.113	3.961	<0.001
Support for Innovation	←	Collaboration	.457	.072	6.383	<0.001
Support for Innovation	←	Workforce Autonomy	.335	.062	5.438	<0.001
Support for Innovation	←	Managerial Trust / Workforce Enthusiasm	.008	.044	.181	.856
Support for Innovation	←	Problem Solving Autonomy	1.758	.390	4.505	<0.001

According to SPSS® AMOS™, four of the five regression weights, or parameter estimates, are significant at the 0.05 level (i.e., p-value threshold used throughout this study). Only the Managerial Trust / Workforce Enthusiasm latent variable does not produce a statistically significant result, indicating that there is no evidence that its regression weight is significantly different from zero (Blunch 2008). This means that Support for Innovation does not depend on Managerial Trust / Workforce Enthusiasm (Arbuckle 2007).

For the remaining four latent variables (Resource Supply for Innovation, Collaboration, Workforce Autonomy, and Problem Solving Autonomy), when the score of each on the 7 point Likert scale goes up by one, the Support for Innovation latent variable goes up 0.448, 0.457, 0.335, and 1.76, respectively. These regression weights

predict the score of the Support for Innovation latent variable (principal component) (Montgomery, Peck, and Vining 2006; Brewerton and Millward 2006; Arbuckle 2007). Therefore, positive changes in Problem Solving Autonomy would produce larger positive changes in Support for Innovation than the other latent variables (principal components). Collaboration would produce the next largest result followed by Resource Supply for Innovation then Workforce Autonomy.

The model does not fit the data well, however, so these results are suspect. To improve model fit, modification indices analysis was conducted in an attempt to improve and possibly simplify the model. Specifically, modification indices analysis was executed to determine if any manifest or latent variables did not fit the model well. Per Arbuckle (2007), modification indices analysis is performed to evaluate whether potential model modifications will result in decreasing the model's chi-square score. The chi-square score is a measure of the extent the data is incompatible with the model (i.e., the lower the score the better the fit). Care must be taken when setting the threshold for modification indices. The threshold indicates that any correlation between variables that reduces the chi-square score by at least the threshold value will be displayed. A threshold that is too small will result in the display of numerous correlations, many of which will not be significant. Therefore, a meaningful modification indices threshold was sought.

A modification indices threshold of thirty was set. This value was selected because when the threshold was set at twenty instead of thirty, the number of covariance modification indices nearly doubled and the number of variance modification indices nearly quadrupled. To keep the model as simple as possible but to apply meaningful modifications, a threshold of thirty seemed reasonable. Byrne (2010) agrees that

modifications, or injecting additional parameters, should be meaningful, but she also recommends evaluating model fit. Since the chi-square score can be reduced substantially according to this modification indices evaluation, there is some model misfit readily apparent which warrants further investigation. Results of this modification indices analysis are presented in Table 5.6 and include, in the right hand column, a minimum reduction of chi-square values that will occur if the recommendations presented in the table are adopted (Byrne 2010).

Table 5.6 Structural Equation Modeling Phase I Modification Indices

Covariances			Modification Indices
Managerial Trust / Workforce Enthusiasm	↔	Workforce Autonomy	106
Collaboration	↔	Workforce Autonomy	89.6
Collaboration	↔	Managerial Trust / Workforce Enthusiasm	71.3
Error Variable 6 (e6)	↔	Collaboration	42.4
Error Variable 1 (e1)	↔	Managerial Trust / Workforce Enthusiasm	36.3
Error Variable 1 (e1)	↔	Error Variable 6 (e6)	33.6
Error Variable 50 (e50)	↔	Error Variable 52 (e52)	53.7
Error Variable 20 (e20)	↔	Error Variable 21 (e21)	49.2
		Total:	482
Variances (Regression Weights)			
Variable 6	←	Collaboration	42.4
Variable 6	←	Variable 8	31.5
Variable 6	←	Variable 9	40.2
Variable 1	←	Managerial Trust / Workforce Enthusiasm	36.3
Variable 1	←	Variable 29	31
Variable 18	←	Variable 34	32.9
		Total:	214

Evaluating these results, it was apparent that modifications to the model were appropriate. However, blindly using these modification indices to alter the model without considering whether the recommended modifications make theoretical or common sense is not advised. Such an approach can result in an incorrect, even absurd, model. This technique, then, can be easily misused, so care must be taken when deciding whether to implement recommended modification indices or not. This technique, does, however, have a legitimate role in exploratory research (Arbuckle 2007). According to the Modification Indices results, the chi-square value could be reduced by 482 if covariance lines were drawn between the latent variables and questions as recommended, accounting for a relationship between these variables. Further, chi-square could also be reduced by 214 if direct influence lines were drawn to account for the predictive relationship between latent variables and questions.

With the preceding concern in mind, though, only some of the recommended modifications to the model were adopted. First, covariance lines were added to the error variables 20/21 and 50/52 as recommended. When questions contain overlapping content, even when worded differently, error covariance can occur (Byrne 2010). This appears to be the case, so it is reasonable to add covariance lines since questions 20/21 and 50/52 both measure similar phenomenon and are manifest variables for the same latent variable (Support for Innovation). Covariance lines were also added between the latent variables Collaboration, Workforce Autonomy, and Managerial Trust/Workforce Enthusiasm. This is reasonable since all three are principal components that contribute to an organization's position on the organic/mechanistic culture continuum and are therefore related. It is also reasonable to conclude that collaboration would be present if

managerial trust and workforce enthusiasm exists (i.e., it would be difficult for management to build trust and the workforce to build enthusiasm for their work if there was no collaboration). Collaboration would also be present if workforce autonomy exists (i.e., it would be difficult to work autonomously if organizational members were not able to collaborate), and managerial trust and workforce enthusiasm would be present if workforce autonomy exists (i.e., it would be difficult to work autonomously without managerial trust or workforce enthusiasm).

However, recommendations to add covariance lines to error variables 1 and 6 and latent variables were disregarded. This specific recommendation was disregarded because even though these questions are related (i.e., they are the two questions that comprise the Problem Solving Autonomy latent variable), the variance (regression weight) portion of the modification indices revealed some problems with regard to these questions. The model would fit better if some of the latent and manifest variables (Collaboration, Managerial Trust / Workforce Enthusiasm, and variables (questions) 8, 9, and 29) predicted variables (questions) 1 and 6. This does not make sense, so these variables (questions) were eliminated from the model. The recommendation that variable (question) 34 predict variable (question) 18 was also discounted because the two variables measure different phenomenon.

After variable (questions) 1 and 6 were removed from the Structural Equation Model, they were also removed from the POCaICAT because if they don't make conceptual sense in the model then they should be removed from the survey tool . The POCaICAT Revision A resulted, and another round of principal component factor analysis was conducted. For the remainder of this work, question numbers in the

POCaICAT Revision A will reflect the same number assignments as found in the POCAICAT. Appendix B contains the POCaICAT Revision A with POCaICAT number assignments while Appendix C contains the POCaICAT Revision A with a new, sequential numbering scheme.

D. Principal Component Factor Analysis Phase II

A third principal component factor analysis was conducted, this time for the 28 question POCaICAT Revision A (28 questions remained after the elimination of questions 1 and 6). The first two principal components described 50.4% of the variance, and the first three principal components described 56.8% of the variance, indicating a meaningful analysis. Evaluating the principal components determined that there were five principal components with eigenvalues above one that described 64.8% of the variance. Results are shown in Table 5.7 Figure 5.2 shows a scree plot of all of the eigenvalues in descending order. The scree plot shows the bend in the elbow which ceases after the fifth eigenvalue. The bend is the threshold associated with meaningful results (Johnson and Wichern 2007).

Table 5.7 Principal Component Factor Analysis for 28 Question POCaICAT Revision A

Principal Component	Eigenvalues	% of Variance	Cumulative % of Variance
Support for Innovation	11.929	42.605	42.605
Collaboration	2.181	7.791	50.396
Managerial Trust / Workforce Enthusiasm	1.790	6.392	56.787
Workforce Autonomy	1.192	4.259	61.046
Resource Supply for Innovation	1.042	3.723	64.769

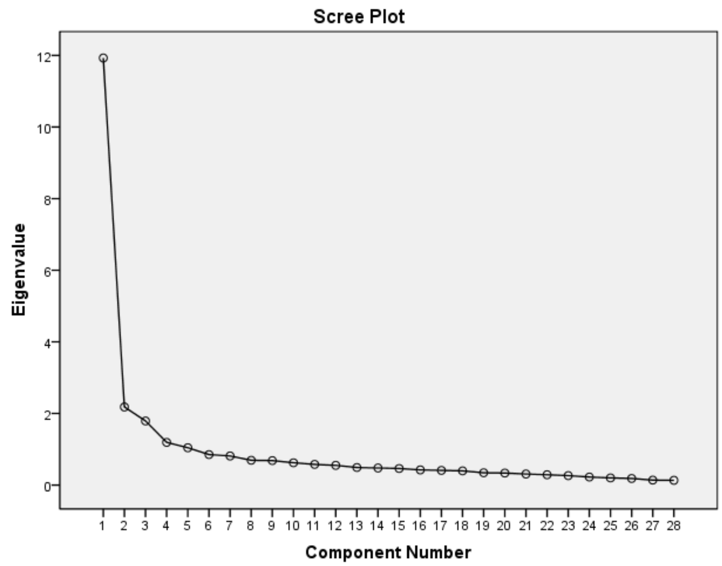

Figure 5.2 Scree Plot for 28 Question POCaICAT Revision A Principal Component Factor Analysis

The five principal components observed after conducting Varimax rotation were Support for Innovation, Resource Supply for Innovation, Collaboration, Workforce Autonomy, and Managerial Trust / Workforce Enthusiasm. With the elimination of questions 1 and 6, the Problem Solving Autonomy principal component was not observed. Varimax rotation also revealed a small number of discrepancies with the principal components. Table 5.8 shows these results. Non-significant loadings are hidden from view.

Table 5.8 Principal Component Factor Loadings from Third Principal Component Factor Analysis

	Principal Components				
Question	1	2	3	4	5
4			**.634**		
5			**.735**		
8		**.737**			
9		**.677**			
12			**.701**		
15		**.481**			
16		**.668**			
17		**.713**			
18			**.536**		
20	**.771**				
21	**.769**				
23	**.531**	**.421**			
24			**.565**	**.408**	
26	**.693**				
28				**.653**	
29				**.623**	
30	**.732**				
34	**.702**				
37					**.721**
38					**.730**
39					**.601**
41	**.685**				
44	**.739**				
46				**.739**	
48	**.716**				
50	**.808**				
51	**.735**				
52	**.843**				

Twenty-five of twenty-eight questions had loadings greater than 0.5 on a single principal component while all other principal component loadings for that question were below 0.4. The first discrepancy found was with question 15. Question 15's most significant loading value was 0.481. All other loadings for this question were below 0.4. Since 0.4 is considered a meaningful loading value and 0.481 is close to 0.5 (the loading threshold), question 15's factor loading was deemed meaningful. Further, the Collaboration principal component's Cronbach's Alpha would not improve if question 15 was eliminated (shown later in Table 5.15). The other discrepancies in this principal component factor analysis were evident after evaluating the factor loadings of questions 23 and 24. Questions 23 and 24 were confounded (i.e., more than one meaningful load above 0.4 on a principal component), but there was one load over 0.5 for each. Also, the Cronbach's Alpha for each of the principal components they are associated with (i.e., Support for Innovation and Managerial Trust / Workforce Enthusiasm, respectively) would not improve if they were deleted (shown later in Table 5.15). Therefore, questions 23 and 24 were retained.

These five principal components were described based on the previous holistic evaluation of what the questions in each principal component were asking (Johnson and Wichern 2007). These principal components did not change since each question was matched to the same principal component as before. Principal Component and POCaICAT Revision A question pairings are presented in Table 5.9.

Table 5.9 Principal Component and POCaICAT Revision A Question Pairing

Principal Component	Questions
Support for Innovation	20, 21, 23, 26, 30, 34, 41, 44, 48, 50, 51, 52
Collaboration	8, 9, 15, 16, 17
Managerial Trust / Workforce Enthusiasm	4, 5, 12, 18, 24
Workforce Autonomy	28, 29, 46
Resource Supply for Innovation	37, 38, 39

These principal components and their associated questions were then entered into SPSS® AMOS™ for structural equation modeling and subsequent modification indices analysis to further verify the relationships these principal components share. It was determined that if the next iteration of structural equation modeling supported this latest principal component factor analysis, then the results reported in this section would be finalized for the POCaICAT Revision A.

E. Structural Equation Modeling Phase II

The twenty-eight questions from the POCaICAT Revision A were grouped into their principal components and entered into SPSS® AMOS™. Connections between the principal components were maintained from the first structural equation modeling, minus the Problem Solving Autonomy principal component. Figure 5.3 shows the model.

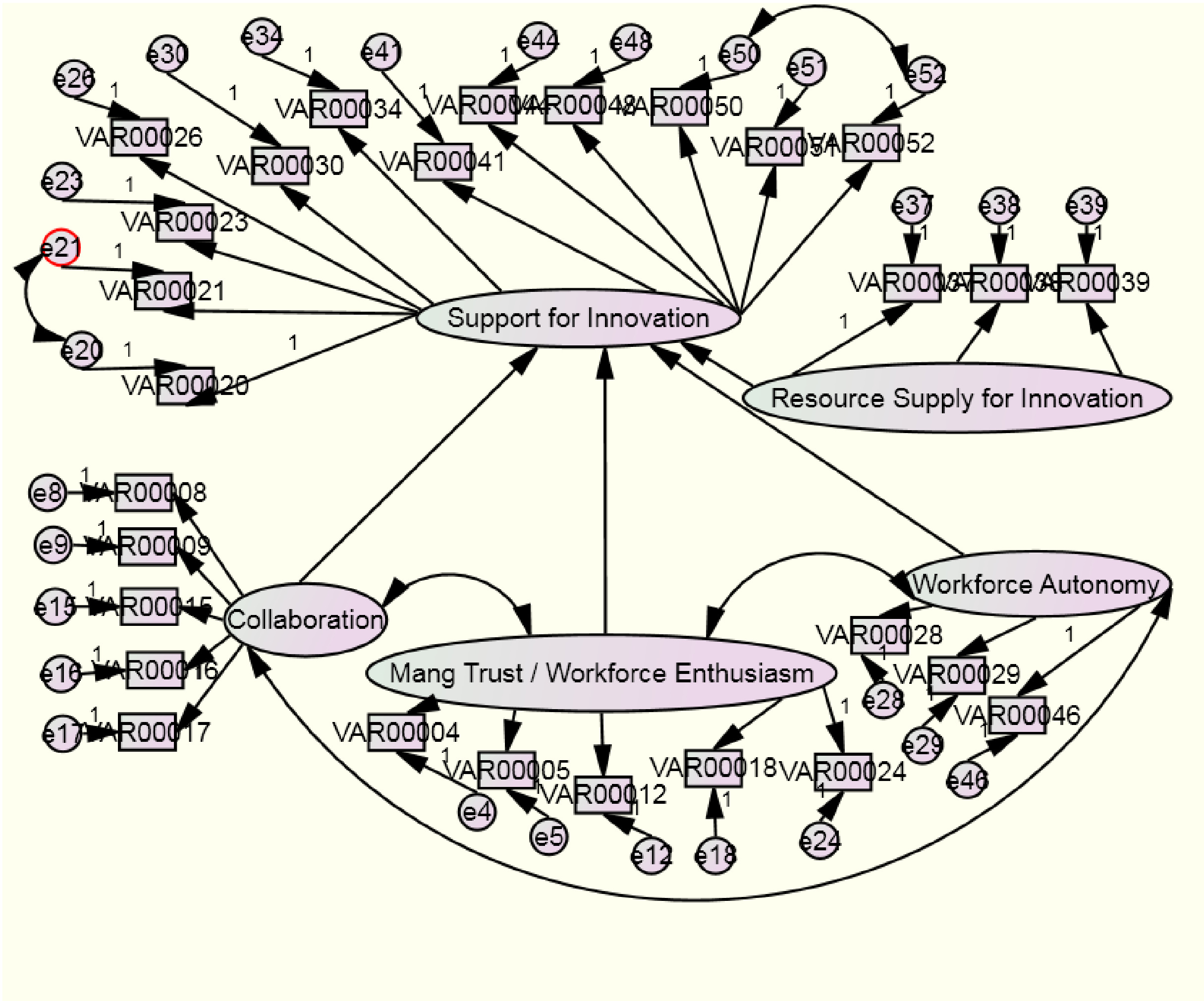

Figure 5.3 Structural Equation Model for 28 Remaining Questions of POCaICAT Revision A after Three Principal Component Factor and One Modification Indices Analyses

The Workforce Autonomy, Collaboration, and Managerial Trust / Workforce Enthusiasm principal components together determine where an organization falls on the organic/mechanistic continuum (i.e., most questions still come from the Organizational Culture Assessment Revision B), and these principal components represent elements of an organizational culture as defined in Chapter II. Also, as previously stated, these principal components have a causal relationship with an innovative climate (Damanpour 1991; Walker 2007; Prakash and Gupta 2008; Robbins and Judge 2009), best represented

by the Support for Innovation principal component (i.e., the largest principal component of the five and primarily made up of questions from the Climate for Innovation Measure and questions generated for this research designed to measure support for innovation and an organization's innovative climate). The Resource Supply for Innovation principal component, also previously stated, has a causal relationship with the Support for Innovation principal component.

Modification indices analysis was done to determine if any manifest or latent variables did not fit the model well. A modification indices threshold of thirty was maintained for consistency. No modification indices met this threshold, indicating that no further meaningful model modifications would result in a better model fit.

To evaluate model fit, the fit indices evaluated for the initial structural equation model were examined. All results are displayed in Table 5.10.

Table 5.10 Model Fit Summary for all Principal Components Directly Related to the Support for Innovation Principal Component

Model Fit Indices	POCaICAT Revision A Result	Acceptable Values	Good Fit?
Chi-Square (CMIN)	797	N/A	N/A
Degrees of Freedom (DF)	342	N/A	N/A
CMIN/DF	2.33	1.00 – 3.00	Undetermined (see below)
p-value	<0.0001	N/A	N/A
Root Mean Square of Approximation (RMSEA)	0.073 LO 90 = 0.066 HI 90 = 0.080	~ 0.05	Marginally Acceptable
PCLOSE	<0.0001	N/A	N/A
Goodness of Fit Index (GFI)	0.812	0 – 1.0 (closer to 1.0 indicates better fit)	Acceptable
Comparative Fit Index (CFI)	0.892	0 – 1.0 (closer to 1.0 indicates better fit)	Acceptable

This POCaICAT Revision A model produced a CMIN/DF of 2.33 which appears to indicate a good fit. However, as previously stated, Kline (2011) warns that the CMIN/DF, or the normed chi-square, should not be used in any model fit assessment because this value and associated thresholds have insufficient logical or statistical foundation. Therefore, CMIN/DF is discounted as a good measure of model fit and other measures were considered.

A similar conclusion can be drawn after evaluating the p-value affiliated with CMIN. For the current model, a p-value of less than 0.0001 resulted, indicating model misfit. A p-value of 0.0001 means there is a 0.01% chance of obtaining a larger CMIN (i.e., worse CMIN) from a different sample. Therefore, finding a worse model fit with a

new sample is very unlikely. As previously stated, it is unrealistic to expect that the null hypothesis is true. Because the p-value can be discounted as a good measure of model fit like CMIN/DF, other, more meaningful measures were considered.

RMSEA values close to 0.05 demonstrate a good fit. Blunch (2008) indicates that values above 0.10 should be dismissed. Byrne (2010) advocates that scores as high as 0.80 are acceptable. The POCaICAT Revision A model produced an acceptable RMSEA value of 0.073 which fell in a 90% confidence interval between 0.066 and 0.080. The PCLOSE value is a p-value for a null hypothesis test that the RMSEA value is less than 0.05 (Blunch 2008). With a PCLOSE value less than 0.0001, this null hypothesis can be rejected (which is expected because RMSEA had a value of 0.073), indicating that there is no evidence of over-fitting and subsequent simplification is not required.

The Goodness of Fit Index (GFI) is an approximate fit index that can have values ranging between 0 and 1.00. Values closer to 1.00 indicate better fits (Byrne 2010; Kline 2011). The POCaICAT Revision A produced a GFI score of 0.812, indicating a relatively good fit. The Comparative Fit Index (CFI) is also an approximate fit index that can produce values ranging between 0 and 1.00. Like the GFI, values closer to 1.00 indicate better fits (Kline 2011). The POCaICAT Revision A produced a CFI score of 0.892, indicating a relatively good fit.

Considering RMSEA, PCLOSE, GFI, and CFI holistically, the sample data fits the POCaICAT Revision A model relatively well. The next step in structural equation modeling is to evaluate the regression weights of the relationships between the latent variables. Table 5.11 displays these regression weights and their statistical significance.

Table 5.11 Structural Equation Modeling Regression Weights

Latent Variable		Latent Variable	Regression Weight Estimate	Standard Error	Critical Ratio	p-value
Support for Innovation	←	Resource Supply for Innovation	1.77	.498	3.55	<0.001
Support for Innovation	←	Collaboration	.695	.126	5.52	<0.001
Support for Innovation	←	Workforce Autonomy	.328	.128	2.56	.011
Support for Innovation	←	Managerial Trust / Workforce Enthusiasm	-.058	.094	-.620	.535

According to SPSS® AMOS™, three of the four regression weights, or parameter estimates, are significant at the 0.05 level (i.e., p-value threshold used throughout this study). Only the Managerial Trust / Workforce Enthusiasm latent variable does not produce a statistically significant result, a similar result from the initial structural equation model, indicating that there is no evidence that its regression weight is significantly different from zero (Blunch 2008). This means that Support for Innovation does not depend on Managerial Trust / Workforce Enthusiasm (Arbuckle 2007). Further, a negative regression weight between the Managerial Trust / Workforce Enthusiasm and Support for Innovation latent variables is not intuitive since managerial trust typically does not depend on support for innovation (although workforce enthusiasm could depend on support for innovation).

For the remaining three latent variables (Resource Supply for Innovation, Collaboration, and Workforce Autonomy), when the score of each on the

7 point Likert scale goes up by one, the Support for Innovation latent variable goes up 1.77, 0.695, and 0.328, respectively. These regression weights predict the score of the Support for Innovation latent variable (principal component) (Montgomery, Peck, and Vining 2006; Brewerton and Millward 2006; Arbuckle 2007). Therefore, positive changes in Resource Supply for Innovation would produce larger positive changes in Support for Innovation than the other latent variables (principal components). Collaboration would produce the next largest result followed by Workforce Autonomy.

Although the model fits the data well, it is not satisfying that the relationship between Managerial Trust / Workforce Enthusiasm and Support for Innovation is not statistically significant. Even though this is a significant finding in itself (i.e., Support for Innovation does not directly depend on Managerial Trust / Workforce Enthusiasm), better defining the Managerial Trust / Workforce Enthusiasm principal component's relationship with the other principal components in the model was sought.
Two approaches were evaluated. The first was to directly link Managerial Trust / Workforce Enthusiasm to Collaboration. After evaluation it was found that one of the relationships in the model was not statistically significant. So, another attempt was made to evaluate a direct link from Managerial Trust / Workforce Enthusiasm to Workforce Autonomy. This link makes intuitive sense because work cannot be done autonomously without enthusiasm (motivation) and the trust of management that the job is performed correctly without direct supervision. Modification indices analysis from Structural Equation Modeling Phase I (displayed in Table 5.6) supports this assertion since the covariance recommended for the Workforce Autonomy and Managerial Trust / Workforce Enthusiasm latent variables was the largest and would have the largest impact

on improving model fit. Hence, the latent variables that define an organizational culture most closely related to each other are Workforce Autonomy and Managerial Trust / Workforce Enthusiasm. The model in Figure 5.3 was modified slightly to reflect this new approach. A direct link from the Managerial Trust / Workforce Enthusiasm latent variable to the Workforce Autonomy latent variable was added. Figure 5.4 shows the new model.

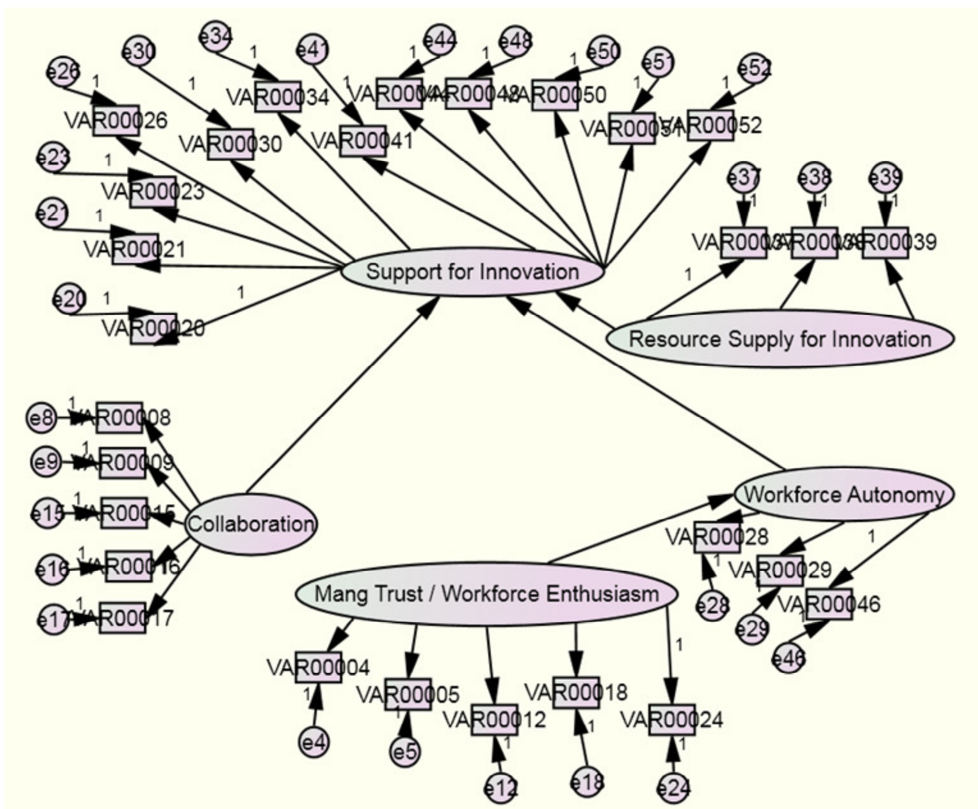

Figure 5.4 Structural Equation Model for 28 Remaining Questions of POCaICAT Revision A with Managerial Trust / Workforce Enthusiasm Directly Related to Workforce Autonomy

This model next underwent modification indices analysis. Only three covariance indices surpassed the threshold value of 30 (previously established), so further modifications were minor. Table 5.12 displays the Modification Indices analysis results. If all modification indices recommendations to draw covariance lines as presented in Table 5.12 were incorporated in the model, the chi square would be reduced by 199.

Table 5.12 Structural Equation Modeling Modification Indices for Managerial Trust / Workforce Enthusiasm Directly Related to Workforce Autonomy

Modification Indices			
Covariances			Modification Indices
Collaboration	↔	Managerial Trust / Workforce Enthusiasm	96.7
Error Variable 50 (e50)	↔	Error Variable 52 (e52)	52.8
Error Variable 20 (e20)	↔	Error Variable 21 (e21)	49.4
		Total	199

Figure 5.5 displays the covariance relationships added to the model found in Figure 5.4. As can be seen, minor modifications were made to reduce chi square. All three covariance lines found in the new model were in the previous structural equation model. As previously stated, covariance lines drawn between error variables are justified due to overlapping question content, and a covariance line drawn between the latent variables Collaboration and Managerial Trust / Workforce Enthusiasm is justified due to their relationship that results from their common contribution to organizational culture.

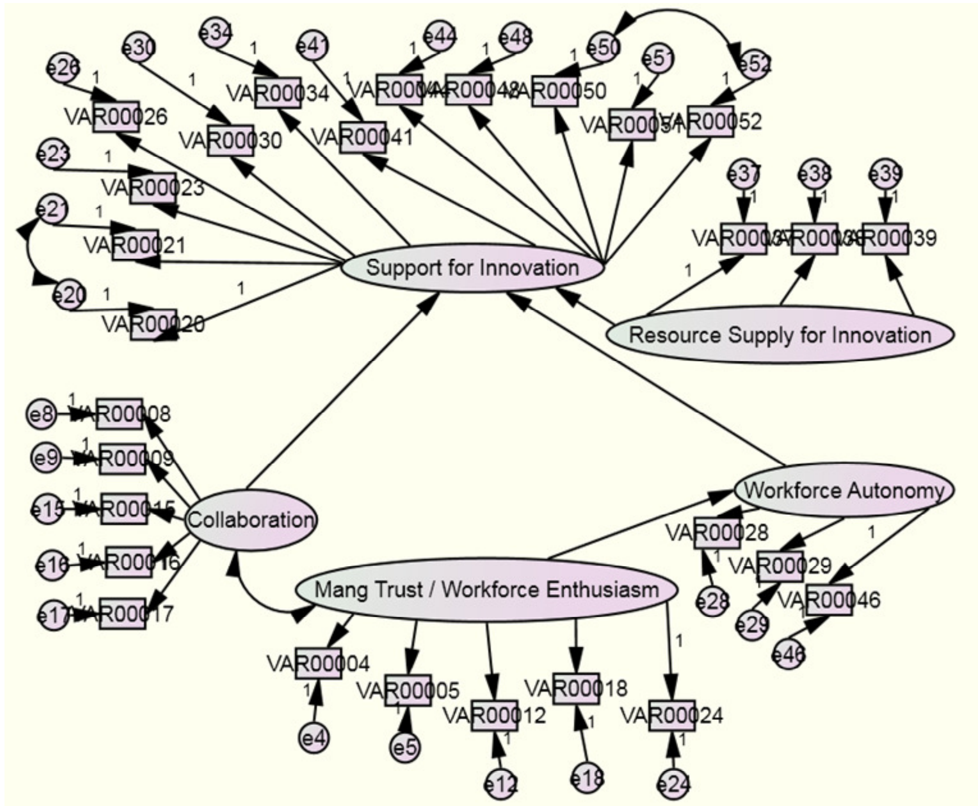

Figure 5.5 Structural Equation Model for 28 Remaining Questions of POCaICAT Revision A with Managerial Trust / Workforce Enthusiasm Directly Related to Workforce Autonomy post Modification Indices Analysis

Table 5.13 displays the model fit for this new model. After evaluation based on the criteria previously established, the data fits the model well. Compared to the model fit data in Table 5.10, this model does not fit the data quite as well as this previous model. However, the previous model produced a negative, not statistically significant regression weight between the Managerial Trust / Workforce Enthusiasm and Support for Innovation latent variables. Now, all regression weights are positive (i.e., behave as expected) and are statistically significant, producing an overall better model.

Table 5.13 Model Fit Summary for Model with Managerial Trust / Workforce Enthusiasm Directly Related to Workforce Autonomy

Model Fit Indices	POCaICAT Revision A Result	Acceptable Values	Good Fit?	Previous Model Fit Results for Comparison
Chi-Square (CMIN)	845	N/A	N/A	797
Degrees of Freedom (DF)	345	N/A	N/A	342
CMIN/DF	2.45	1.00 – 3.00	Undetermined (previously stated)	2.33
p-value	<0.0001	N/A	N/A	<0.0001
Root Mean Square of Approximation (RMSEA)	0.076 LO 90 = 0.070 HI 90 = 0.083	~ 0.05	Marginally Acceptable	0.073 LO 90 = 0.066 HI 90 = 0.080
PCLOSE	<0.0001	N/A	N/A	<0.0001
Goodness of Fit Index (GFI)	0.797	0 – 1.0 (closer to 1.0 indicates better fit)	Acceptable	0.812
Comparative Fit Index (CFI)	0.881	0 – 1.0 (closer to 1.0 indicates better fit)	Acceptable	0.892

Even though the data may not fit the new model quite as well as the previous model, the difference is marginal. This POCaICAT Revision A model produced an acceptable RMSEA value of 0.076, an acceptable Goodness of Fit Index (GFI) of 0.797, and an acceptable Comparative Fit Index (CFI) of 0.881, indicating a relatively good fit. Considering RMSEA, GFI, and CFI holistically, the sample data fits this POCaICAT Revision A model relatively well. Upon review of the regression weights in Table 5.14, it is apparent that this new model is better because all modeled relationships between principal components are statistically significant and positive.

Table 5.14 Final Structural Equation Modeling Regression Weights

Latent Variable		Latent Variable	Regression Weight Estimate	Standard Error	Critical Ratio	p-value
Support for Innovation	←	Resource Supply for Innovation	1.87	.553	3.39	<.001
Support for Innovation	←	Collaboration	.688	.127	5.412	<.001
Support for Innovation	←	Workforce Autonomy	.266	.096	2.764	.006
Workforce Autonomy	←	Managerial Trust / Workforce Enthusiasm	.798	.092	8.642	<.001

For the latent variables Resource Supply for Innovation, Collaboration, and Workforce Autonomy, when the score of each on the 7 point Likert scale goes up by one, the Support for Innovation latent variable goes up 1.87, 0.688, and 0.266, respectively. These regression weights (or regression coefficients) predict the score of the Support for Innovation latent variable (principal component) (Montgomery, Peck, and Vining 2006; Brewerton and Millward 2006; Arbuckle 2007). More specifically, if the score on the 7 point Likert scale from the POCaICAT Revision A for Resource Supply for Innovation were to go up 1.00, it is expected that the score of Support for Innovation to go up 1.87. Therefore, positive changes in Resource Supply for Innovation would produce larger positive changes in Support for Innovation than the other latent variables (principal components). Collaboration would produce the next largest result followed by Workforce Autonomy. If the Managerial Trust / Workforce Autonomy latent variable goes up by one, then the Workforce Autonomy latent variable would go up by 0.798.

This relationship is statistically significant and better defines the relationship of the Managerial Trust / Workforce Enthusiasm latent variable in the model. It has an indirect effect, then, on the Support for Innovation latent variable (principal component).

The results also support Hypotheses #1A, #1B, and #1C:

Hypothesis #1A: Resource supply for innovation positively influences support for an innovative climate within a Department of Defense community of organizations.

Hypothesis #1B: Collaboration positively influences support for an innovative climate within a Department of Defense community of organizations.

Hypothesis #1C: Workforce autonomy positively influences support for an innovative climate within a Department of Defense community of organizations.

However, these results only partially support Hypotheses #1D and #1E because managerial trust and workforce enthusiasm were observed to indirectly influence support for innovation.

Hypothesis #1D: Managerial trust positively influences support for an innovative climate within a Department of Defense community of organizations.

Hypothesis #1E: Workforce enthusiasm positively influences support for an innovative climate within a Department of Defense community of organizations.

All hypothesis testing results are summarized in Table 5.33.

F. Reliability and Validity of the Perceived Organizational Culture and Innovative Climate Assessment Tool (POCaICAT)

The reliability of the POCaICAT Revision A was deemed acceptable. All principal components had Cronbach's Alpha scores above 0.70 (Brewerton and Millward 2006) except for one (i.e., Resource Supply for Innovation). However, the literature reports that the Resource Supply for Innovation principal component's Cronbach's Alpha score of 0.555 is sufficient (Nunnally 1967; Caplan, Naidu, and Tripathi 1984; Pedhazur and Schmelkin 1991). The POCaICAT Revision A was also considered valid by demonstrating face, content, and construct validity. Further details follow in this section.

1. Reliability

As previously mentioned, the reliability of the POCaICAT Revision A was deemed acceptable. All principal components had Cronbach's Alpha scores above 0.70 except for one (Resource Supply for Innovation's Cronbach's Alpha was 0.555). Support for Innovation, Collaboration, Managerial Trust / Workforce Enthusiasm, and Workforce Autonomy principal components had Cronbach's Alpha scores of 0.950, 0.807, 0.774, and 0.808, respectively. A Cronbach's Alpha in the 0.60 to 0.70 range (Brewerton and Millward 2006) or at least 0.70 (Kline 1986) indicates a minimum acceptable reliability. Therefore, these principal components demonstrate a minimum acceptable reliability.

The one principal component that did not have a Cronbach's Alpha score above 0.60, though, was Resource Supply for Innovation. Its Cronbach's Alpha score was low at 0.555. This score, however, is sufficient for this research. Cronbach's Alpha values at

or above 0.50 have been cited as acceptable for research (Nunnally 1967; Caplan, Naidu, and Tripathi 1984; Pedhazur and Schmelkin 1991). The user of the data must decide on a tolerance level of error based on the circumstances of the research (Pedhazur and Schmelkin 1991). Therefore, since a Cronbach's Alpha score of 0.555 is just below Breweton and Millward's (2006) acceptable minimum level of 0.60, is above 0.50, and is associated with initial research, it is appropriate to accept the Resource Supply for Innovation principal component as reliable. Further details of reliability data are provided in Table 5.15.

Table 5.15 Reliability Data for POCaICAT Revision A

Principal Component	Questions	Cronbach's Alpha	Cronbach's Alpha if Question Removed
Support for Innovation		0.950	
	20		0.945
	21		0.944
	23		0.948
	26		0.949
	30		0.946
	34		0.946
	41		0.949
	44		0.946
	48		0.946
	50		0.944
	51		0.944
	52		0.944
Collaboration		0.807	
	8		0.751
	9		0.765
	15		0.800
	16		0.744
	17		0.788
Managerial Trust / Workforce		0.774	
	4		0.707
	5		0.790
	12		0.709
	18		0.729
	24		0.719
Workforce Autonomy		0.808	
	28		0.688
	29		0.680
	46		0.833
Resource Supply for Innovation		0.555	
	37		0.467
	38		0.406
	39		0.489

As can be seen from Table 5.15, eliminating question 5 from the Managerial Trust/Workforce Enthusiasm principal component would increase Cronbach's Alpha from 0.774 to 0.790, a marginal improvement for an already acceptable value. Therefore, since question 5 loaded significantly on this principal component, it was retained.

Also, it can be seen that eliminating question 46 from the Workforce Autonomy principal component would increase Cronbach's Alpha from 0.808 to 0.833, also a marginal improvement for an already acceptable value. Since question 46 loaded significantly on this principal component, it was also retained.

The POCaICAT Revision A, then, is deemed reliable. All principal components had Cronbach's Alpha values within an acceptable range, and only marginal improvements to reliability result from eliminating two questions. Minor adjustments to questions could improve reliability, and follow on testing could further establish reliability of the POCaICAT Revision A. However, for this research, the POCaICAT Revision A was deemed reliable.

2. Validity

Validity, generally, is the "degree to which an instrument actually represents what it purports to represent" (Brewerton and Millward 2006, p. 90). Three types of validity were evaluated: face, content, and construct. The POCaICAT Revision A demonstrated face validity because its questions were understandable. Groups within the Navy community surveyed produced statistically significant, similar results, indicating a common understanding of the POCaICAT Revision A questions. Between groups, they

also had statistically different responses, further demonstrating agreement in understanding of the questions. Details are provided later in this chapter. Content validity was demonstrated because POCaICAT Revision A questions were primarily drawn from previously published, reliable, and valid surveys (Organizational Culture Assessment Revision B and the Climate for Innovation Measure). Construct validity was demonstrated because distinct principal components were found from principal component factor analysis (Reigle 2003; Brewerton and Millward 2006). Further, intra-item correlation values of 0.4 or above were deemed meaningful and indicated a relationship between items (Pedhazur and Schmelkin 1991). This was observed among principal components, contributing to the evidence that the principal components were meaningful and subsequently that construct validity was meaningful.

Tables 5.16 through 5.20 show the principal component intra-item correlations. Items below 0.4 are in bold type.

Table 5.16 Support for Innovation Principal Component Intra-Item Correlation Matrix

Item	20	21	23	26	30	34	41	44	48	50	51	52
20	1.00	.796	.554	.580	.604	.640	.586	.616	.599	.656	.618	.664
21	.796	1.00	.609	.599	.609	.699	.617	.628	.647	.633	.660	.650
23	.554	.609	1.00	.506	.585	.576	.442	.562	.556	.545	.595	.540
26	.580	.599	.506	1.00	.665	.498	.432	.574	.531	.588	.555	.582
30	.604	.609	.585	.665	1.00	.613	.518	.586	.593	.654	.674	.617
34	.640	.699	.576	.498	.613	1.00	.571	.598	.641	.657	.707	.639
41	.586	.617	.442	.432	.518	.571	1.00	.554	.630	.529	.634	.555
44	.616	.628	.562	.574	.586	.598	.554	1.00	.672	.717	.662	.707
48	.599	.647	.556	.531	.593	.641	.630	.672	1.00	.627	.626	.636
50	.656	.633	.545	.588	.654	.657	.529	.717	.627	1.00	.736	.829
51	.618	.660	.595	.555	.674	.707	.634	.662	.626	.736	1.00	.762
52	.664	.650	.540	.582	.617	.639	.555	.707	.636	.829	.762	1.00

Table 5.17 Collaboration Principal Component Intra-Item Correlation Matrix

Item	8	9	15	16	17
8	1.00	0.520	0.420	0.563	0.523
9	0.520	1.00	0.523	0.511	**0.391**
15	0.420	0.523	1.00	0.491	**0.282**
16	0.563	0.511	0.491	1.00	0.509
17	0.523	**0.391**	**0.282**	0.509	1.00

Table 5.18 Managerial Trust / Workforce Enthusiasm Principal Component Intra-Item Correlation Matrix

Item	4	5	12	18	24
4	1.00	**0.298**	0.566	0.501	0.466
5	**0.298**	1.00	**0.311**	**0.221**	**0.325**
12	0.566	**0.311**	1.00	0.463	0.458
18	0.501	**0.221**	0.463	1.00	0.475
24	0.466	**0.325**	0.458	0.475	1.00

Table 5.19 Workforce Autonomy Principal Component Intra-Item Correlation Matrix

Item	28	29	46
28	1.00	0.716	0.516
29	0.716	1.00	0.524
46	0.516	0.524	1.00

Table 5.20 Resource Supply for Innovation Principal Component Intra-Item Correlation Matrix

Item	37	38	39
37	1.00	**.324**	**.256**
38	**.324**	1.00	**.305**
39	**.256**	**.305**	1.00

As can be seen from these matrices, the intra-item correlations for POCaICAT Revision A principal components are largely above 0.4. There are exceptions, though. For example, questions 5 and 17 and the Resource Supply for Innovation principal

component show weaker correlations than the other questions and principal components, although they are not substantially different from 0.4 (all are greater than 0.2). Further investigation may be warranted in future research. Table 5.21 displays the average correlation score of each principal component. Correlations of 1.00 (i.e., an item's correlation with itself) were discounted when calculating these averages.

Table 5.21 Average Principal Component Intra-Item Correlations

Principal Component	Average Correlation
Support for Innovation	0.614
Collaboration	0.473
Managerial Trust / Workforce Enthusiasm	0.408
Workforce Autonomy	0.585
Resource Supply for Innovation	0.295

Overall, the POCaICAT Revision A is a reliable and valid measurement instrument. Its principal components produced Cronbach's Alpha scores above accepted levels, and they demonstrated face, content, and construct validity. Two questions, though, warrant further review in future research. Question 17 was shown to have a weak intra-item correlation within the Collaboration principal component, but it had an acceptable factor loading (0.713 from Table 5.8) within the same principal component. Also, it does not improve the Cronbach's Alpha value of this principal component if deleted. Based on this analysis, it is recommended for retention. Question 5 also has a weak intra-correlation within the Managerial Trust / Workforce Enthusiasm principal component and would increase the Cronbach's Alpha value of this principal component if

deleted (although marginally). However, it loads satisfactorily (0.735 from Table 5.8) in its principal component. Therefore, based on this analysis, it is also recommended for retention.

The Resource Supply for Innovation has the lowest Cronbach's Alpha score (although acceptable) and an average correlation below 0.4. This principal component does demonstrate face, content, and construct validity, though. Face validity was demonstrated utilizing the t test. From the entire sample of 251 participants, the t test was performed for the Resource Supply for Innovation principal component. Utilizing a 7 point Likert scale, the mean response for the sample was 3.3094 with a p-value less than 0.005 indicating that this mean is statistically different from the middle score on the Likert scale (4.0 = neither agree nor disagree). The standard deviation (1.13) is the second smallest standard deviation of all the principal components (i.e., only Collaboration is smaller at 1.07). These points indicate that the sample consistently agreed that resources for innovation are lacking across this Navy community, indicating a common understanding of the questions. A p-value less than 0.005 means that there is less than a 0.5% chance of committing a Type I error of rejecting the null hypothesis (i.e., that the mean equals 4.0) when it is true. Further details are provided in the next section.

Content validity for the Resource Supply for Innovation principal component was already shown and still holds because each question from this principal component comes from the reliable and valid Climate for Innovation Measure. Further, despite low correlations within this principal component, it is a principal component with meaningful factor loadings, demonstrating construct validity. It is the least reliable and valid of the principal components, but it still demonstrates acceptable reliability and validity. Future

testing with new groups will aid in discrepancy resolution. Plus, this is an initial research study into this relationship. The reported reliability and validity shortfalls are not significant enough to discard the Resource Supply for Innovation principal component. Therefore, it was retained.

The POCaICAT Revision A is a reliable and valid measurement tool ready to be applied to public organizations. This current research effort has shown that it is particularly applicable to military organizations with science and engineering roles and responsibilities. Application to new groups (public and private) will further refine the POCaICAT Revision A and verify its reliability and validity.

G. Parametric Statistical Analysis of Interval Data

To begin evaluating whether there is a correlation between perceived organizational culture and perceived innovative climate, parametric statistical analysis of interval data was utilized. Minitab® statistical software was used to conduct the statistical analysis found in this section. The first test performed was the single-sample t test utilizing interval data. Interval data is characterized by the relative order of measures. Also, equal differences of measurements correspond to equal differences in the attribute being measured (Sheskin 2004). When a population's standard deviation is not known, the single-sample t test is used to determine if a sample's mean yields a significant difference from the hypothesized population mean. If a significant difference results, then it can be concluded that it is likely that the sample is from a population with a different mean (Sheshkin 2004). Also, two conditions must be assumed when using the single-sample t test. First, the sample must be a random sample from the population it

represents. This has been shown to be the case previously (Chapter IV). Second, the data distribution of the population from which the sample is drawn is normal (Sheshkin 2004). Upon inspection of histograms of all the data, the normality assumption was not violated for any single-sample t test performed. Plus, in the following tests that contain sample sizes of 251, the Central Limit Theorem (i.e., the sampling distribution approaches normality as sample size increases) applies, and a normal population distribution is assumed (Sheshkin 2004). So, both assumptions hold, and the single-sample t test is applicable for use with this data.

The single-sample t test was used to determine if the respondents perceived whether the principal component (Support for Innovation, Collaboration, Managerial Trust / Workforce Enthusiasm, Workforce Autonomy, and Resource Supply for Innovation) scores derived from the POCaICAT Revision A were statistically different from a score of 4.0 (neither agree nor disagree). A score above 4.0 indicates the degree to which the sample perceives the principal component is present within the community (e.g., collaboration is sufficiently utilized throughout the community), and a score below 4.0 indicates the degree to which the sample perceives the principal component is not present within the community (e.g., collaboration is not properly utilized throughout the community). Higher scores mean you'll find more of a given principal component throughout the community, and lower scores mean you'll find less of a given principal component throughout the community. The hypothesis tested was whether the sample is from a population in which all principal components measured (each tested separately) are equal to the average score of 4.0 (Sheskin 2004). Scores can range from 1.0 to 7.0 based on a 7 point Likert scale. Table 5.22 displays the results.

Table 5.22 Single-Sample t Test of Principal Components

Principal Component	n	Mean	Standard Deviation	95% Confidence Interval	p-value
Support for Innovation	251	4.86	1.14	(4.71, 5.00)	<0.005
Collaboration	251	5.34	1.07	(5.21, 5.48)	<0.005
Managerial Trust / Workforce Enthusiasm	251	4.57	1.2	(4.42, 4.72)	<0.005
Workforce Autonomy	251	4.36	1.31	(4.20, 4.52)	<0.005
Resource Supply for Innovation	251	3.31	1.13	(3.17, 3.45)	<0.005

As can be seen from Table 5.22, statistically significant results were observed at that 5% significance level. Any p-value less than 0.05 (or 5%) indicates statistically significant results and justification to reject the hypothesis that the sample comes from a population with a mean of 4.0. So, for each principal component, the recorded mean is statistically significantly different from 4.0.

Analyzing these results reveals that the sample “somewhat agrees” that it has support for innovation, collaboration, managerial trust and workforce enthusiasm, and workforce autonomy (to varying degrees). The sample “somewhat disagrees” that it has resource supply for innovation. All results are different from “neither agree nor disagree” indicating that there is agreement in the sample that there is a perception that there is either the presence or absence of these principal components. Overall, it appears the sample somewhat agrees it has present the attributes that contribute to an organic organizational culture. The sample has mixed results regarding the presence of attributes of an innovative climate.

The next single-sample t test performed was done to determine if the respondents perceived that the organization had an organic or mechanistic organizational culture and an innovative or non-innovative climate. Statistically significant results at a 5% significance level were observed. Results are displayed in Table 5.23.

Table 5.23 Single-Sample t Test of Perceived Organizational Culture and Innovative Climate

Perceived Culture	n	Mean	Standard Deviation	95% Confidence Interval	p-value
Organic/Mechanistic	251	4.82	1.00	(4.70, 4.945)	<0.005
Innovative	251	4.55	1.01	(4.42, 4.67)	<0.005

The sample "somewhat agrees" that it has an organic organizational culture (scores above 4.0 indicate an organic culture based on the organic and mechanistic culture continuum). The sample also "somewhat agrees" that it has an innovative climate, although to a slightly lesser degree than an organic culture.

To this point, no explanation has been offered describing how an organic/mechanistic organizational culture or innovative climate was measured. To accomplish this measurement, the five principal components were grouped in two categories: organic/mechanistic organizational culture and innovative climate. To obtain a perceived organic/mechanistic organizational culture score, the Collaboration, Managerial Trust / Workforce Enthusiasm, and Workforce Autonomy principal component questions were grouped and an average score for each respondent was tabulated. This grouping was based on the literature review (Burns and Stalker 1966;

Gresov 1989; Damanpour 1991; Jones 2004; LeGree 2004; Walker 2007; Prakash and Gupta 2008; Robbins and Judge 2009) and the Organizational Culture Assessment Revision B (it measures the organic/mechanistic culture continuum and a majority of the questions used for this analysis came from the Organizational Culture Assessment Revision B). A single-sample t test was then performed as previously mentioned. A similar process was used to measure perceived innovative climate. The questions from the Support for Innovation and Resource Supply for Innovation principal components were grouped based on the literature (Ashkanasy, Widerom, and Peterson 2000; Su-Chao Chang and Ming-Shing Lee 2007; Ruiz-Moreno, Garcia-Morales, and Llorens-Montes 2008; Robbins and Judge 2009). Additionally, most of these questions came from the Climate for Innovation Measure (which measures an innovative climate by combining support for innovation and resource supply for innovation factors) and questions added that measure aspects of an organization's innovative climate. An average score for each respondent was tabulated, and a single-sample t test was then performed as previously mentioned. For reference, Table 5.9 shows the principal components and their associated POCaICAT Revision A questions.

Next, the single-sample t test was applied to the seven organizations from this community of eleven organizations that had enough respondents to qualify them for Analysis of Variance (ANOVA) analysis between groups (described in Chapter IV with results presented in the next section). These seven organizations averaged 34.1 responses which were greater than the required 32 responses needed to achieve an alpha of 5%, power of 80%, and a medium effect size for ANOVA between groups analysis. This does not imply that a small to medium or medium effect size is assumed for this single-

sample t test. This test was conducted to provide further insight into differences amongst organizations and insight into the ANOVA analysis in a following section. No significant effect size is assumed. Organizational names were removed and functional descriptions of these organizations were added so as not to publish any potentially negative information about any of these organizations.

First, an examination of these seven groups' perceived organizational cultures was conducted. Like the overall sample's perception that this Navy community is somewhat organic, each organization evaluated perceived its organization was organic to varying degrees as well. All results were statistically significant at the 5% significance level. As can be seen in Table 5.24, the science and technology and research and development (acquisition) organizations perceived themselves most organic in this community, followed closely by academics and then operations and requirements organizations.

Table 5.24 Single-Sample t Test of Perceived Organic/Mechanistic Organizational Culture

Organization	n	Mean	Standard Deviation	95% Confidence Interval	p-value
Science and Technology Organization	18	5.64	0.705	(5.29, 6.00)	<0.005
Acquisition Organization #1	54	5.17	0.962	(4.9, 5.43)	<0.005
Acquisition Organization #2	15	5.06	1.24	(4.37, 5.74)	0.005
Academic Organization	28	5.03	0.752	(4.74, 5.32)	<0.005
Operations Organization #1	23	4.60	0.840	(4.23, 4.96)	0.003
Requirements Organization	31	4.57	1.04	(4.19, 4.95)	0.004
Operations Organization #2	70	4.30	0.906	(4.08, 4.52)	0.007

Because some of the organizations have less than thirty respondents, bringing into question the normality assumption of the single-sample t test, the Wilcoxon signed-ranks test was utilized to verify the single-sample t test results (Sheshkin 2004). Although there is no evidence the normality assumption was violated, as a precaution, the Wilcoxon signed-ranks test was utilized to verify these single-sample t test results. The Wilcoxon signed-ranks test is the nonparametric equivalent to the single-sample t test. It determines whether a sample comes from a population with a specified median value (vice mean). Interpretation of results is the same as with the single-sample t test. Assumptions used for the Wilcoxon signed-ranks test are that the sample is randomly selected from the population (same as from the single-sample t test and shown earlier), data is in interval form (same as the single-sample t test and shown earlier), and the population's distribution is symmetrical (Sheshkin 2004). From inspection of histograms of the data, there is no evidence that the population's distribution is not symmetrical. So,

use of the Wilcoxon signed-ranked test is appropriate to verify single-sample t test results. Wilcoxon signed-ranks test results for the perceived organizational culture of the same seven organizations is presented in Table 5.25.

Table 5.25 Wilcoxon Signed-Ranks Verification Test of Perceived Organic/Mechanistic Organizational Culture

Organization	n	Estimated Median	p-value
Science and Technology Organization	18	5.73	<0.005
Acquisition Organization #1	54	5.27	<0.005
Acquisition Organization #2	15	5.06	0.012
Academic Organization	28	5.04	<0.005
Operations Organization #1	23	4.60	0.006
Requirements Organization	31	4.58	0.008
Operations Organization #2	70	4.31	0.006

As can be seen, the same results occurred. All results are statistically significant and verify the results obtained from the single-sample t test. Next, a similar series of tests was performed for perceived organizational innovative climate. Results are displayed in Table 5.26.

Table 5.26 Single-Sample t Test of Perceived Innovative Climate

Organization	n	Mean	Standard Deviation	95% Confidence Interval	p-value
Science and Technology Organization	18	5.19	0.622	(4.86, 5.52)	<0.005
Acquisition Organization #1	54	4.80	1.04	(4.52, 5.09)	<0.005
Acquisition Organization #2	15	4.58	0.876	(4.09, 5.06)	0.023
Academic Organization	28	5.03	0.820	(4.72, 5.35)	<0.005
Operations Organization #1	23	4.27	0.877	(3.89, 4.65)	0.159
Requirements Organization	31	4.16	1.01	(3.79, 4.53)	0.375
Operations Organization #2	70	4.18	1.05	(3.93, 4.43)	0.163

As can be seen from Table 5.26, these seven groups' perceived innovative climates were similar to yet were distinctly different from their perceived organizational culture. Like the overall sample's perception that this Navy community is somewhat innovative, each organization evaluated perceived its organization was innovative to varying degrees as well. As can be seen in Table 5.26, the science and technology and academic organizations perceived themselves as most innovative in this community, followed closely by research and development and then operations and requirements organizations. This order is different than the perceived organizational cultures observed with the academic and research and development organizations transposed. However, not all results were statistically significant at the 5% significance level. The operations and requirements organizations did not produce statistically significant results at the 5% significance level. This means that although their means were above 4.0, the hypothesis that their mean score is different from 4.0 cannot be rejected. Therefore, there is no evidence that their means are different from 4.0, so it cannot be determined if they

are innovative or non-innovative. The Wilcoxon signed-ranks test was used again to verify the single-sample t test results. Wilcoxon signed-ranks test results are shown in Table 5.27.

Table 5.27 Wilcoxon Signed-Ranks Verification Test of Perceived Innovative Climate

Organization	n	Estimated Median	p-value
Science and Technology Organization	18	5.27	<0.005
Acquisition Organization #1	54	4.87	<0.005
Acquisition Organization #2	15	4.65	0.031
Academic Organization	28	5.03	<0.005
Operations Organization #1	23	4.23	0.108
Requirements Organization	31	4.13	0.405
Operations Organization #2	70	4.27	0.033

As can be seen from Table 5.27, similar results occurred, verifying the single-sample t test results. So, from inspection, there appears to be a correlation between an organization's perceived organizational culture and its perceived innovative climate. Further, it appears that the more an organization perceives itself to be organic, the more it also perceives itself to be innovative. The next statistical analysis conducted was Analysis of Variance and Tukey's Honestly Significant Difference (HSD) test for these seven organizations. This was done to determine which organizations were statistically different with regard to perceived organizational culture and innovative climate to more definitively understand which organizations are the most organic (based on single-sample t test results, these organizations do not perceive they have mechanistic cultures) and the most innovative.

H. Analysis of Variance Between Organizations

To conduct the single-factor between-subject analysis of variance (ANOVA) test, Minitab® statistical software was used. This test was used to determine if there was a statistically significant difference between at least two samples' means. This test is employed using interval/ratio data and is premised on three assumptions. The first assumption is that the sample has been randomly selected from its population. The second assumption is that the distribution of data from the population is normal. These two assumptions still hold as explained in the previous section. The third assumption is that the variances of the samples (or organizational data) are all equal to each other (homogeneity of variance). If any of these assumptions are violated, the reliability of the single-factor between-subjects analysis of variance could come into question (Sheshkin 2004).

Since the first two assumptions still hold, only the third assumption must be addressed. If the homogeneity of variance assumption is violated, an increased chance of committing a Type I error results. Further, if there are unequal numbers of subjects in each sample, violating the homogeneity of variance assumption exacerbates inaccuracies in ANOVA (Sheshkin 2004). Such a violation, then, could have a serious impact on ANOVA results. Acknowledging the seriousness of such a violation, exploring available methods to test for homogeneity of variance to determine if such a violation occurred was carried out.

A standard practice to evaluate homogeneity of variance is offered by Devore (1995). He states that if the largest sample standard deviation is no more than about two times the smallest sample standard deviation then it is reasonable to assume

homogeneity of variance. The sample standard deviations resulting from the two ANOVA procedures conducted were then evaluated.

The sample standard deviations from the ANOVA analysis evaluating differences between organizational perceptions of organizational culture were first examined, and it was discovered that the largest sample standard deviation was only 1.76 times larger than the smallest sample standard deviation. Therefore, homogeneity of variance can be assumed. Next, the sample standard deviations from the ANOVA analysis evaluating differences between organizational perceptions of innovative climate were examined, and it was discovered that the largest sample standard deviation was only 1.69 times larger than the smallest sample standard deviation. Therefore, homogeneity of variance is assumed.

Additionally, this result was verified using Minitab® statistical software. Minitab® has an application which performs a homogeneity of variance test utilizing Bartlett's test and Levene's test. The two tests have attributes that make them applicable for use under certain conditions. For example, Bartlett's test is better suited for use with normal distributions. In this case, since the normality assumption is valid, using Bartlett's test to verify homogeneity of variance is appropriate. Levene's test, however, can be used when the sample's distribution is not necessarily normal. It has applicability with smaller samples, and even though using Levene's test is not required to complete a test for equal variances in this case, it is not precluded either (Minitab Inc. 2006).

The null hypothesis for both tests states that the variances of the samples are equal. Therefore, a significant result would allow rejection of the null hypothesis,

invalidating the assumption of equal variances (Minitab Inc. 2006). Both tests were utilized to verify homogeneity of variance for each ANOVA evaluation. First, the ANOVA analysis evaluating differences between organizational perceptions of organizational culture was examined and resulted in a Bartlett's test p-value of 0.21 and a Levene's test p-value of 0.114. At the 0.05 significance level, these results were not significant, so the assumption of equal variance for this ANOVA evaluation held. Next, the ANOVA analysis evaluating differences between organizational perceptions of innovative climate was examined and resulted in a Bartlett's test p-value of 0.287 and a Levene's test p-value of 0.263. Again, at the 0.05 significance level, these results were not significant, and the assumption of equal variance for this ANOVA evaluation held. All three assumptions, then, were deemed valid, and analysis of ANOVA results could continue.

Table 5.28 shows the results of the ANOVA and Tukey's Honestly Significant Difference (HSD) analysis conducted to determine if statistically significant differences exist between the seven organizations with sample sizes large enough for ANOVA evaluation (established in Chapter IV). Their average sample size was 34.1, so a 5% significance level (alpha), 83% power, and medium effect size were achieved (previously stated in this chapter). Organizational names were removed and functional descriptions of these organizations were added so as not to publish any potentially negative information about any of these organizations.

Tukey's HSD test was also conducted using Minitab® statistical software and was utilized because ANOVA analysis will only reveal if there is a statistical difference between the means of groups but not which groups differ from each other. Tukey's HSD

test is used to make pairwise comparisons between all groups evaluated (Sheshkin 2004). Table 5.28 also contains the results of Tukey's HSD test, indicating which organizations have statistically different means from other organizations.

Table 5.28 Analysis of Variance and Tukey's Honestly Significant Difference (HSD) Comparison of Organic/Mechanistic Organizational Culture

Statistically Significantly Different? p-value < 0.005 for ANOVA Analysis Organization	Science and Technology Organization	Acquisition Organization #1	Acquisition Organization #2	Academic Organization	Operations Organization #1	Requirements Organization	Operations Organization #2
Science and Technology Organization	_____	No	No	No	Yes	Yes	Yes
Acquisition Organization #1	No	_____	No	No	No	No	Yes
Acquisition Organization #2	No	No	____	No	No	No	No
Academic Organization	No	No	No	____	No	No	Yes
Operations Organization #1	Yes	No	No	No	____	No	No
Requirements Organization	Yes	No	No	No	No	____	No
Operations Organization #2	Yes	Yes	No	Yes	No	No	_____

Inspection of Table 5.28 reveals that there was a difference between the Science and Technology Organization and the Requirements and Operations Organizations with regard to perceived organizational culture. Also, in addition, Operations Organization #2 (the organization with the lowest organic culture mean) had a statistically different mean from Acquisition Organization #1 and the Academic Organization. These results are expected because science and technology, acquisition (or research and development), and academic organizations have more freedom to be creative and innovative in an effort to develop new products, services, and capabilities (more organic) while operations and

requirements organizations are expected to follow checklists and guidance (more mechanistic) in a stricter hierarchical chain of command to carry out their missions and duties. Operations and requirements organizations can be organic, though, as shown in the single-sample t test results, but are expected to be less so than flexible and adaptable science, technology, research, development, and academic organizations. These results support this premise. Further details regarding organizational culture can be found in Chapter II.

A similar analysis was conducted for these same seven organizations evaluating perceived innovative climate. These results are displayed in Table 5.29. One major difference between comparing groups with respect to perceived innovative climate as opposed to perceived organic/mechanistic organizational culture was that the Requirements and Operations Organizations did not have means statistically different from 4.0 (neither agree nor disagree). However, this was not prohibitive to ANOVA and Tukey's HSD analysis.

Table 5.29 Analysis of Variance and Tukey's Honestly Significant Difference Comparison of Innovative Climate

Statistically Significantly Different? p-value < 0.005 for ANOVA Analysis Organization	Science and Technology Organization	Acquisition Organization #1	Acquisition Organization #2	Academic Organization	Operations Organization #1	Requirements Organization	Operations Organization #2
Science and Technology Organization	_____	No	No	No	Yes	Yes	Yes
Acquisition Organization #1	No	_____	No	No	No	No	Yes
Acquisition Organization #2	No	No	____	No	No	No	No
Academic Organization	No	No	No	____	No	Yes	Yes
Operations Organization #1	No	No	No	No	____	No	No
Requirements Organization	Yes	No	No	Yes	No	____	No
Operations Organization #2	Yes	Yes	No	Yes	No	No	_____

Inspection of Table 5.29 reveals that there was a difference between the Science and Technology and Academic Organizations and the Requirements Organization and Operations Organization #2 with regard to perceived innovative climate. Also, Operations Organization #2 had a statistically different mean than Acquisition Organization #1. This latter result did not include, as one would expect, the Requirements Organization (which had a lower mean for perceived innovative climate than Operations Organization #2). A lower Requirements Organization mean for perceived innovative climate than Operations Organization #2 should result in a statistically significant difference between the Requirements Organization and

Acquisition Organization #1, but because of greater uncertainty in the Requirements Organization's 95% Confidence Interval for its mean, such a determination could not be made. The 95% confidence interval for the Requirements Organization ranges from approximately 3.8 to 4.5 while the 95% confidence interval for Operations Organization #2 ranges from approximately 3.95 to 4.4. So, even though the mean for the Requirements Organization is lower, there is less agreement amongst the Requirements Organization regarding this mean. This result affected the Tukey's HSD analysis because it is based on comparing means and is sensitive to the variability associated with those means (Sheskin 2004). Since the Requirements Organization has more variability associated with its mean than Operations Organization #2, Tukey's HSD analysis was unable to produce a significant difference between the Requirements Organization and Acquisition Organization #1. Thus a definitive statement that a statistical difference exists between the Requirements Organization and Acquisition Organization #1 was not possible.

Overall, these results are expected because science and technology, acquisition (or research and development), and academic organizations are expected to be creative and innovative via experimentation to develop new products while operations and requirements organizations are not expected to experiment but to routinely carry out their missions and duties. Operations and requirements organizations were not shown to perceive themselves as innovative or non-innovative, verified in the single-sample t test results. However, the science, technology, research, development, and academic organizations all perceived themselves to be innovative to varying degrees. Additional details regarding innovative climate can be found in Chapter II.

To conclude this section, it again appears, based on very similar results from the previous ANOVA analysis, there is a correlation between the degree of perceived organic organizational culture and perceived innovative climate. The next section describes the regression analysis conducted to determine more definitively if there is such a correlation.

I. Regression Analysis

Minitab® statistical software was used to conduct a regression analysis to quantify the relationship between perceived organizational culture (i.e., the independent variable) and perceived innovative climate (i.e., the dependent variable or response) from the sample of 251 members of this Navy community. This was the final statistical analysis conducted for this study, and three regression models were produced. More details will follow describing why three regression analyses were performed, but first, an examination of the relationship between a perceived organizational culture and innovative climate, as previously defined, is offered.

Table 5.30 displays the result of the first regression analysis. The model indicates that as organizations become more organic they also become more innovative.

Table 5.30 Regression Analysis Results

Perceived Innovative Climate Score = 1.14 + 0.706*(Perceived Organizational Culture Score)			
Regression p-value	Lack of Fit p-value	R^2	R^2 Adjusted
<0.005	.413	48.4%	48.2%

Table 5.30 shows that this regression analysis was significant because the regression analysis p-value (<0.5%) was less than the accepted level of significance (5%)

indicating that the null hypothesis, that the slope of the regression line is zero, can be rejected and therefore conclude that there is a linear relationship between the predictor and response (Montgomery, Peck, and Vining 2006). Further, the lack of fit p-value is greater than the accepted significance level of 5% indicating that the null hypothesis (the model is linear) cannot be rejected (Montgomery, Peck, and Vining 2006).

Finally, the coefficient of determination values R^2 and R^2 Adjusted indicate that the model explains over 48% of the variance of the data. So, over 48% of the variation of the dependent variable can be explained by the independent variable (Downing and Clark 1997). This means that over 48% of the variation in perceived innovative climate can be explained by perceived organizational culture. Further interpreting this score is rather subjective, but the closer the score is to 100% the better. Explaining over 48% of the variance of the data, then, could be improved, but an R^2 Adjusted value of 48.2% (from Table 5.30) is a sufficient score for this study. Devore (1995) states that the square root of the coefficient of determination (or correlation coefficient R) indicates strong correlation between variables when this value is greater than or equal to 0.8 and less than or equal to 1.0, medium correlation when this value is greater than 0.5 and less than 0.8, and weak correlation when this value is less than or equal to 0.5. The square root of the coefficient of determination (R^2 Adjusted) for this regression model is 0.694, indicating a medium level of correlation (or degree of linear relationship) between variables. For initial research, this is acceptable.

Further, the coefficient of determination is most valuable when trying to determine how many variables a model should contain. If unexplained variability is reduced by adding additional variables, then the coefficient of determination is a very

useful tool that aids in determining how many variables make the best model. However, in this case, there is only one variable or regressor and additional variables will not be added, so the coefficient of determination will not aid in selecting the best model (Montgomery, Peck, and Vining 2006). Also, models with high coefficients of determination do not necessarily indicate a sufficient model (i.e., they may not be statistically significant) (Montgomery, Peck, and Vining 2006). Further testing and refinement of the POCaICAT Revision A could improve this aspect of the regression model.

Table 5.30 also shows the linear relationship shared between perceived organizational culture and innovative climate. The regression equation produced that mathematically explains this relationship states that a constant value of 1.14 is added to the product of 0.706 and a perceived organizational culture score. Figure 5.6 displays this relationship graphically within a scatter plot of the data.

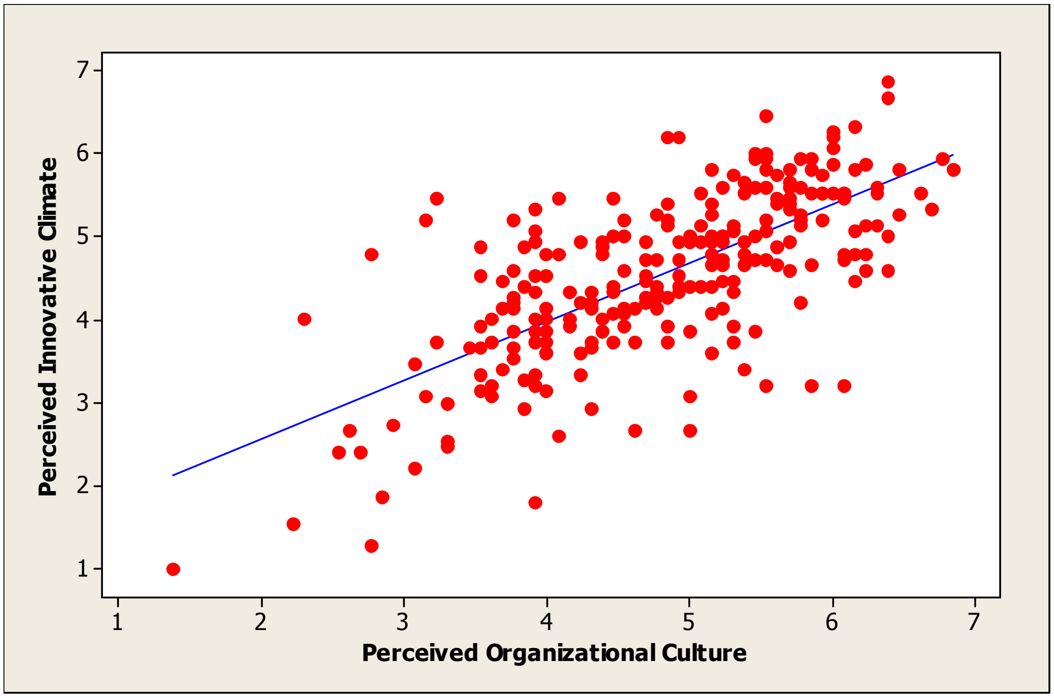

Figure 5.6 Scatterplot of Perceived Innovative Climate versus Perceived Organizational Culture

This relationship reveals how these cultural phenomenon interact. For example, if an organization somewhat agreed it was organic (a Likert scale score of 5.0), this model would predict it would also somewhat agree it was innovative, only to a slightly lesser degree (a Likert scale score of 4.67). Similarly, if an organization agreed it was organic (a Likert scale score of 6.0), this model would predict it would somewhat agree it was innovative (a Likert scale score of 5.38). Finally, as an example, if an organization strongly agreed it was organic (a Likert scale score of 7.0), this model would predict it would agree it was innovative (a Likert scale score of 6.08). So, as can be seen, an organization is predicted to have a more innovative climate when it moves to the more organic end of the organic/mechanistic organizational culture continuum, but this improvement to innovative climate lags improvements to an organization's organic

culture. Based on this regression analysis, the study has produced substantial evidence that a relationship exists between the degree of perceived organic/mechanistic organizational culture and perceived innovative/non-innovative climate.

However, before definitively declaring that this model is statistically significant and accurate, three assumptions must be evaluated. These assumptions include normality of the residual data, homogeneity of variance, and independence of the data. Figure 5.7 provides information that will be used to verify these assumptions.

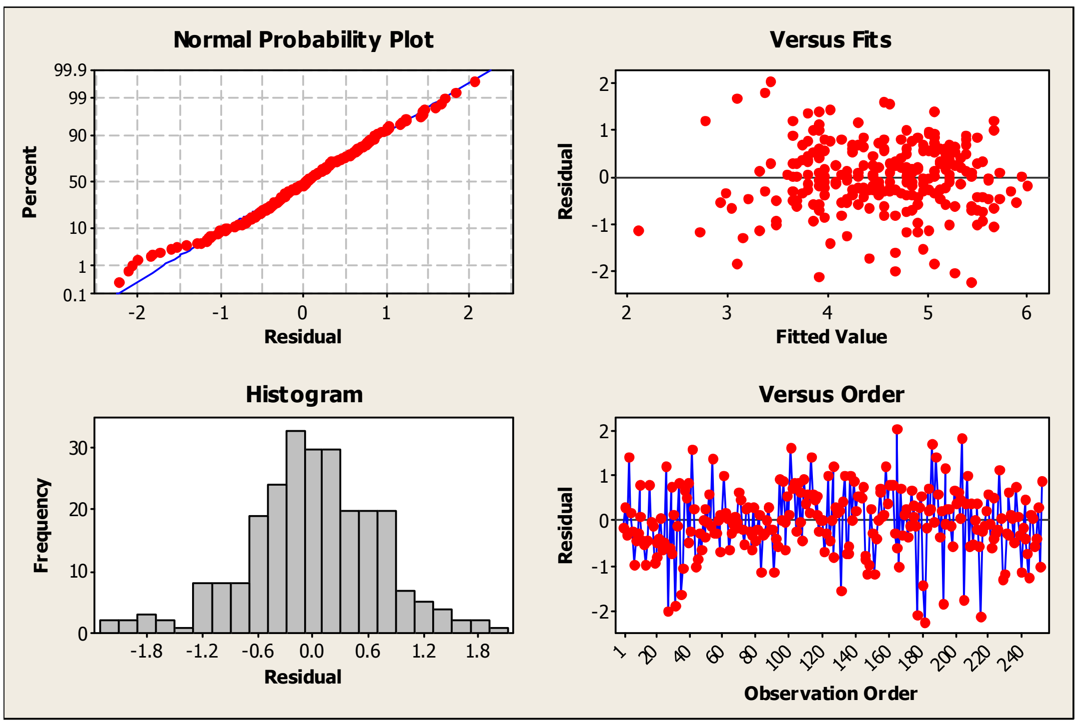

Figure 5.7 Residual Plots for Perceived Innovative Climate versus Perceived Organizational Culture

Normality affects confidence and prediction intervals in regression analysis, so departures from normality can affect the model, although small departures typically do

not affect the model substantially. Large tails outside of a normal distribution may mean that a small portion of the data may have an unduly large affect on the model. To check for normality, evaluation of a normal probability plot of residuals (upper left plot in Figure 5.7) is recommended. If a normal distribution is present, then a straight line is expected. Large deviations from a straight line in the plot indicate that a non-normal distribution is present (Montgomery, Peck, and Vining 2006). Upon inspection of the normal probability plot of residuals in Figure 5.7, no large straight line deviations from the cumulative probability line are noted. A small lower tail was observed, but this tail is not significant enough to warrant concern. Also, the histogram of residuals (graph in bottom left corner of Figure 5.7) roughly assumes the shape of a typical normal distribution's bell curve which further supports the assumption that the distribution of the data is normal (Devore 1995).

However, application of a more rigorous procedure to determine normality is warranted. Utilizing the Anderson-Darling test for normality resulted in an Anderson-Darling value of 0.705 (the lower the score the better the data fits the distribution) and a p-value of 0.065. These results indicate that at the 5% significance level there is not enough evidence to state that the data is not from a normal distribution, validating the earlier observation that the data comes from a normal distribution (Minitab Inc. 2006).

Next, the homogeneity of variance assumption was investigated. It is recommended that a plot of residuals versus corresponding fitted values (graph in upper right corner of Figure 5.7) be evaluated to determine if this assumption is valid. If residuals fall in a horizontal band and no funnel or double-bow patterns or curvature is noted, then homogeneity of variance can be assumed (Montgomery, Peck, and Vining

2006). This was the case for this regression analysis, so homogeneity of variance was assumed.

Finally, the independence assumption was considered. The observation order of the residuals (the graph in the bottom right corner of Figure 5.7) is recommended for evaluation to determine if this assumption has been violated. Patterns that indicate whether residual errors from one time period are somehow correlated with residual errors from other time periods are sought. Such patterns are indications of autocorrelation (Montgomery, Peck, and Vining 2006) which means that the independence of data assumption has been violated. The lower right hand graph of Figure 5.7 does not show any patterns. Thus, autocorrelation is not a concern, and the independence assumption was deemed to be valid.

This regression model, then, is statistically significant and appears accurate. No violations of any assumptions were noted, and like the rest of the statistical and structural equation modeling, regression analysis produced significant results.

However, since the structural equation model does not contain a relationship between any principal component that plays a role in describing an organic/mechanistic organizational culture and the Resource Supply for Innovation principal component, further analysis was required. It was unclear how the organizational culture principal components can predict a perceived innovative climate that includes Resource Supply for Innovation if there is no identifiable relationship between Resource Supply for Innovation and the organizational culture principal components. The previous regression model, which describes how three principal components that describe a perceived

organizational culture predicts two principal components that describe a perceived innovative climate, is a legitimate, statistically significant regression model, but without a clear understanding of the relationship between Resource Supply for Innovation and the organic/mechanistic principal components, a better regression model that excludes Resource Supply for Innovation data may exist. Another regression analysis was conducted that did not include the Resource Supply for Innovation principal component or any of its data to determine if this is the case. Table 5.31 displays the results of this second regression analysis.

Table 5.31 Second Regression Analysis Results

Perceived Innovative Climate Score = 1.01 + 0.798*(Perceived Organizational Culture Score)			
Regression p-value	Lack of Fit p-value	R^2	R^2 Adjusted
<0.005	.322	49.1%	48.9%

As can be seen from Table 5.31, a statistically significant regression model resulted. A slightly higher percentage of the variability is explained resulting in a correlation coefficient of 0.699 indicating a medium level of correlation between variables (Devore 1995), but the lack of fit p-value is lower, indicating that there is a greater chance that the null hypothesis will be rejected in error when it is indeed true (Type I error). The p-value for lack of fit is still well above the significance value of 0.05 indicating there is no concern that the model is not linear, but the higher the p-value for lack of fit, the better the data fits the model. Figure 5.8 displays the scatter plot and relationship between the Support for Innovation principal component and organizational culture principal components for this analysis.

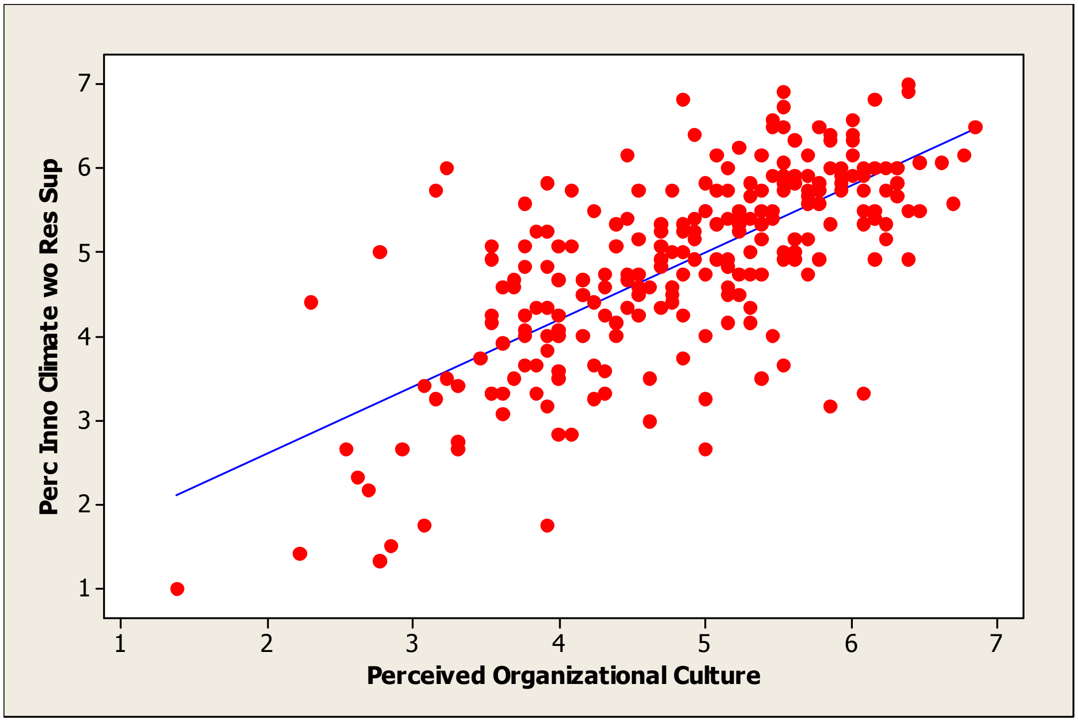

Figure 5.8 Scatterplot of Perceived Innovative Climate w/o Resource Supply for Innovation Principal Component versus Perceived Organizational Culture

However, before definitively declaring that this model is statistically significant, accurate, and better than the previous one, three assumptions must be evaluated. The same regression assumptions still apply: normality of the residual data, homogeneity of variance, and independence of the data. Figure 5.9 provides information that will be used to verify these assumptions.

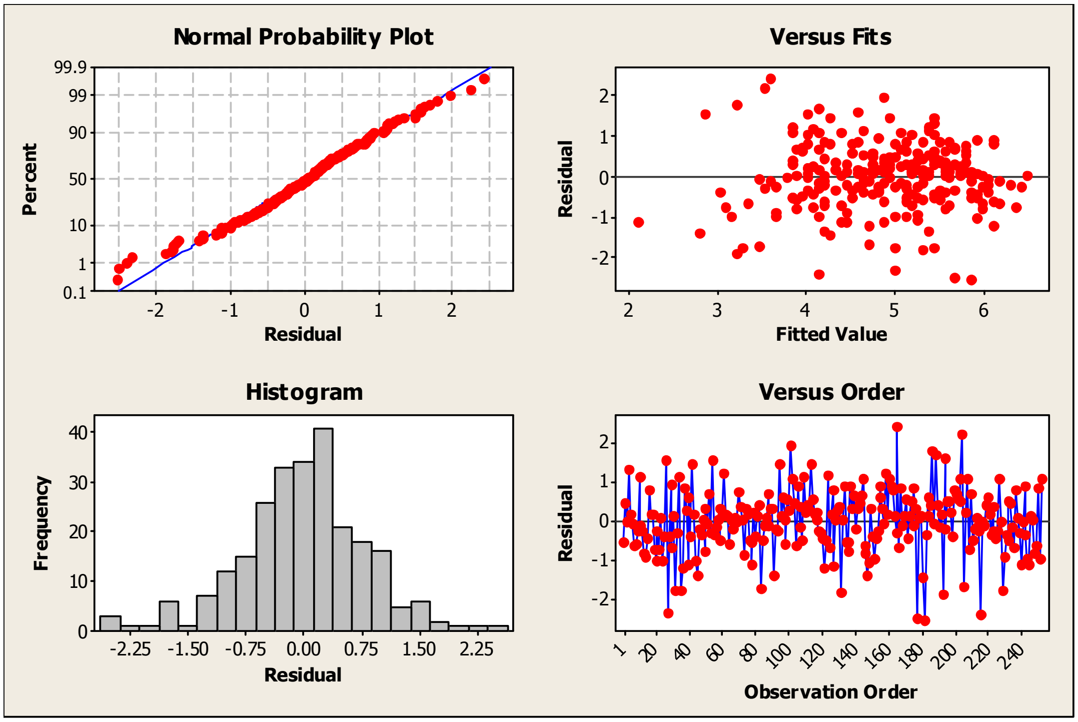

Figure 5.9 Residual Plots for Perceived Innovative Climate w/o Resource Supply for Innovation Principal Component versus Perceived Organizational Culture

The homogeneity of variance assumption was confirmed since the plot of residuals versus corresponding fitted values (graph in upper right corner of Figure 5.9) fall in a horizontal band and no funnel or double-bow patterns or curvature is noted (Montgomery, Peck, and Vining 2006). The independence of data assumption was also considered and found to be valid. The observation order of residuals (graph in the bottom right corner of Figure 5.9) was evaluated and no patterns that indicate residual errors from one time period are somehow correlated with residual errors from other time periods were observed (Montgomery, Peck, and Vining 2006).

Upon inspection of the normal probability plot of residuals in Figure 5.9, no large straight line deviations from the cumulative probability line were noted. Small lower and upper tails were observed, but these tails are not significant enough to warrant concern,

so the normality assumption appears valid (Montgomery, Peck, and Vining 2006). Also, the histogram of residuals (graph in bottom left corner of Figure 5.9) roughly assumes the shape of a typical normal distribution's bell curve which further supports the assumption that the distribution of the data is normal (Devore 1995). However, application of the Anderson-Darling test for normality resulted in an Anderson-Darling value of 0.951 (higher than the 0.705 value in the previous regression model) and a p-value of 0.016. These results indicate that at the 5% significance level the null hypothesis that the data is from a normal distribution can be rejected, countering the earlier observation that the data comes from a normal distribution (Minitab Inc. 2006).

Since the data was not from a normal distribution, a data transformation was conducted. Data transformation can be used to convert data into a new form when, for example, data comes from a non-normal distribution and needs to be normalized. Results of analysis after a data transformation has been carried out should be evaluated with practical consequences in mind, though. Data transformations can be misused to support a favored hypothesis, so caution must be exercised when employed. If a data transformation can consistently replicate significant, practical results, then it may be viewed as a reliable technique (Sheshkin 2004).

Using a Box-Cox plot developed by Minitab®, a lambda value of 1.77 was generated as an estimated exponent to be applied to the innovative climate scores (minus Resource Supply for Innovation data). Applying this exponent to innovative climate scores and then plotting them against organizational culture scores in a regression model would hopefully linearize the residuals in the normal probability plot, indicating the data comes from a normal distribution. Such analysis was conducted, and it was found that a

significant regression model resulted. Results can be viewed in Table 5.32, and a scatterplot can be viewed in Figure 5.10.

Table 5.32 Third Regression Analysis Results

(Perceived Innovative Climate Score)^1.77 = -4.25 + 4.41*(Perceived Organizational Culture Score)			
Regression p-value	Lack of Fit p-value	R^2	R^2 Adjusted
0.003	.730	48.1%	47.9%

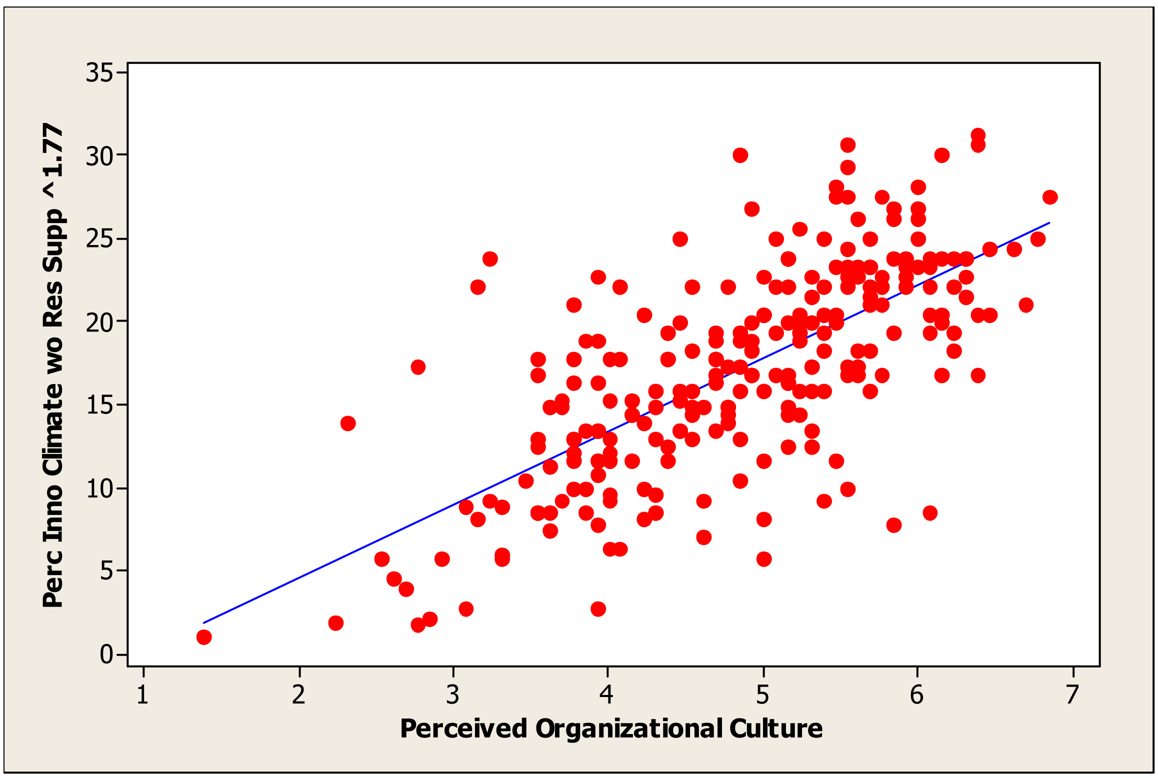

Figure 5.10 Scatterplot of Transformed Perceived Innovative Climate w/o Resource Supply for Innovation Principal Component versus Perceived Organizational Culture

Coefficient of determination data is comparable to previous models and is not a concern. Normality was also verified (at the 5% significance level) by utilizing the

Anderson-Darling test (p-value = 0.057 and Anderson-Darling value = 0.728 (higher than the 0.705 value found from the first regression model). Like the previous regression models, the homogeneity of variance and independence of data assumptions also held after examination of the "Versus Fits" and "Versus Order" plots in Figure 5.11. No patterns were observed in either.

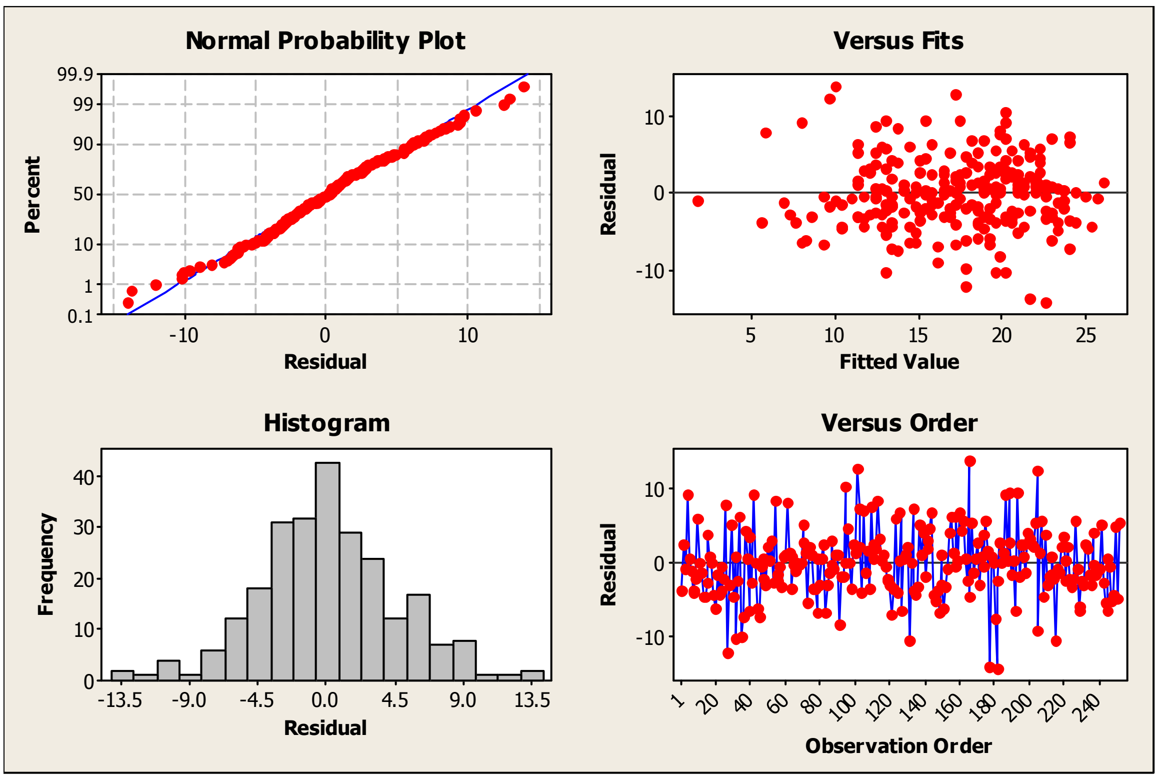

Figure 5.11 Residual Plots for Transformed Perceived Innovative Climate w/o Resource Supply for Innovation Principal Component versus Perceived Organizational Culture

However, this regression model and its application are not straightforward or practical and therefore not necessarily better. Its use would be cumbersome to a manager, and such a result was not intended. Further, neither the second or third regression models account for the influence resource supply for innovation has on an

innovative climate. It has been stated that structural equation modeling did not produce clear evidence of a relationship between resource supply for innovation and perceived organic/mechanistic organizational culture, but a regression model that did include resource supply for innovation (Table 5.30) was significant and did not violate any assumptions (therefore a transformation was not required). Because of the statistical significance of this first regression model, there is some sort of relationship between resource supply for innovation and perceived organizational culture, but further research is needed to better understand it. Such an effort is beyond the scope of this research, however.

What the data transformation of the second regression model did produce, though, is a statistically significant regression model that did not violate any assumptions and predicts perceived innovative climate based on perceived organizational culture without accounting for resource supply for innovation data. This model could prove to be useful (although more cumbersome) if resource supply for innovation data were discounted or were not available. However, the first regression model (Table 5.30), is recommended for more general, broad managerial use.

The statistically significant results from the first regression (Table 5.30) supports Hypothesis #2.

Hypothesis #2: There is a linear relationship between the perceived organizational culture and innovative climate of a specified Department of Defense community of organizations

These results, displayed with all other hypothesis testing results in Table 5.33, add more evidence to a small body of knowledge of empirical evidence that a correlation exists between perceived innovative climate and organizational culture. This is the first such evidence as of this writing pertaining to the Navy or the Department of Defense.

J. Summary of Results

Eleven organizations participated in this study. They represent a specific Navy community with a common goal, even though they are geographically dispersed. Data was collected by disseminating a link via e-mail to a survey available online. Surveys were collected from March to July 2010, and all levels of these organizations were solicited for participation. A sample size of 251 was collected and found to be large enough for this research to produce statistically significant results. The sample is reflective, when viewed holistically, of the active duty Navy, U.S. college graduates, and the college educated U.S. science and labor force.

From principal component factor analysis of the data, five principal components were observed and described as Support for Innovation, Resource Supply for Innovation, Collaboration, Workforce Autonomy, and Managerial Trust / Workforce Enthusiasm. The derived structural equation model, composed of these principal components, fit the data collected by the POCaICAT Revision A relatively well. The POCaICAT Revision A was found to be a reliable and valid measurement tool ready to be applied to public organizations. Further, it is particularly applicable to military organizations with science and engineering roles and responsibilities. In the second to last structural equation model produced, the Managerial Trust / Workforce Enthusiasm latent variable (principal

component) did not produce a statistically significant result while the others did, indicating that the Support for Innovation latent variable (principal component) has relationships (all positive) with and is influenced by the Collaboration, Workforce Autonomy, and Resource Supply for Innovation latent variables (principal components), particularly Resource Supply for Innovation. A new structural equation model was then developed to discern the Managerial Trust / Workforce Enthusiasm latent variables relationship in the model, and it was found that it was directly linked to the Workforce Autonomy latent variable (principal component). This new model also fit the data well, but not as well as the previous model. This latest model, though, was deemed the best because all relationships were statistically significant.

Parametric statistical analysis (i.e., single-sample t tests supported by the nonparametric Wilcoxon signed-ranks tests, ANOVA, and Tukey's HSD tests) produced results that indicate there is a correlation between an organization's perceived organizational culture and its perceived innovative climate. Further, it appears that the more an organization perceives itself to be organic, the more it also perceives itself to be innovative. Regression analysis supported these findings, and through regression analysis substantial evidence that a correlation exists between the degree of perceived organizational culture and perceived innovative climate has been produced. Table 5.33 displays the hypotheses tested through structural equation modeling and parametric statistical analysis and the associated results.

Table 5.33 Summary of Hypothesis Testing Results

Hypothesis	Hypothesis #1A: Resource supply for innovation positively influences support for an innovative climate within a Department of Defense community of organizations.	Hypothesis 1B: Collaboration positively influences support for an innovative climate within a Department of Defense community of organizations.	Hypothesis 1C: Workforce autonomy positively influences support for an innovative climate within a Department of Defense community of organizations.	Hypothesis #1D: Managerial trust positively influences support for an innovative climate within a Department of Defense community of organizations.	Hypothesis #1E: Workforce enthusiasm positively influences support for an innovative climate within a Department of Defense community of organizations.	Hypothesis #2: There is a linear relationship between the perceived organizational culture and innovative climate of a specified Department of Defense community of organizations.
Supported?	Yes	Yes	Yes	Partially	Partially	Yes
Reference	Page 116	Page 116	Page 116	Page 116	Page 116	Page 156

Also discovered in parametric statistical analysis was evidence that all organizations in this community consider themselves organic (to varying degrees) even though they exist in hierarchical organizational structures.

So, achievements of this research include development of a new valid and reliable survey, development of a perceived organizational culture and innovative climate regression model (perceived innovative climate is predicted by perceived organizational

culture), development of a perceived organizational culture and innovative climate structural equation model, and evidence that organizations can perceive themselves as innovative/organic while existing in a hierarchical/mechanistic structure. The next chapter will explore practical applications, recommendations for use of this research, limitations of this research, recommendations for further research, and conclusions.

Chapter VI

CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

Gresov (1984) wrote that analyzing and modifying cultural patterns to improve innovation holds great promise. Such an approach holds financial, manpower, and technological resources constant while retaining strengths and ameliorating weaknesses. This research has taken this premise and applied it to a large public organization, discovering there is a relationship between the degree to which an organization perceives itself to be organic and the degree to which it perceives itself to be innovative. The more organic an organization perceives itself to be, the more it perceives itself to be innovative. Also, evidence that hierarchically structured organizations can perceive themselves to be organic was gained, showing that a hierarchically structured organization does not necessarily have employees that blindly follow rules and regulations but can have employees who interact with their environments and have the freedom to innovate and properly execute their duties as they see fit. Further, relationships between attributes of organizational culture were obtained, offering insight into which attributes should be addressed first to maximize effort to improve innovativeness. These findings are a first for a Department of Defense sample, and they contribute to a small but growing body of knowledge of cultural and climate empirical evidence.

This dissertation contributes to the literature by demonstrating the relationship that perceived organic/mechanistic organizational culture shares with perceived

innovative climate in large public organizations. The literature review confirmed the significance of this research by revealing little empirical evidence exists that demonstrates this cultural relationship, less exists with respect to public organizations, and none exists for any portion of the typically mechanistic and hierarchical Department of Defense, which could benefit greatly from a better understanding of its culture and climate to help meet senior leadership calls for more agility, adaptability, and innovativeness. Public organizations in this area have not been studied as much as private organizations. The literature recommends, then, that further empirical investigation be conducted to better understand this relationship, and this is what this research has sought to accomplish.

Before proceeding further, though, a quick review of the significant findings is in order. Five principal components describing organizational culture and innovative climate were observed and described as Support for Innovation, Resource Supply for Innovation, Collaboration, Workforce Autonomy, and Managerial Trust / Workforce Enthusiasm. The derived structural equation model, composed of these principal components, shows that the Managerial Trust / Workforce Enthusiasm latent variable (principal component) did not directly influence the Support for Innovation latent variable (principal component) while the others did (all positive influences), particularly Resource Supply for Innovation. The Managerial Trust / Workforce Enthusiasm latent variable did, however, influence the Workforce Autonomy latent variable (principal component).

Structural equation modeling showed that Resource Supply for Innovation was the principal component most influential on an innovative climate followed by

Collaboration, then Workforce Autonomy, and then Managerial Trust / Workforce Enthusiasm (Support for Innovation was not measured in this way since it represented an innovative climate). It is interesting to note that this order of influence closely matched the order of influence that frequency analysis of my literature review produced. The main difference between the two analyses was that Collaboration and Workforce Autonomy were the second and third most influential principal components from structural equation modeling but from literature review frequency analysis were expected to be as influential as Resource Supply for Innovation. Otherwise the order was quite similar.

Further, parametric statistical analysis produced results that indicate there is a correlation between an organization's perceived organizational culture and its perceived innovative climate. Further, it appears that the more an organization perceives itself to be organic, the more it also perceives itself to be innovative. Regression analysis supported these findings, and through regression analysis substantial evidence was found that a correlation exists between the degree of perceived organizational culture and perceived innovative climate. Also, evidence was discovered in parametric statistical analysis that organizations in this community consider themselves organic and innovative (to varying degrees) even though they exist in hierarchical organizational structures.

The structural equation model was based on the premise that an organization's position on the organic/mechanistic continuum, an organization's commitment to resourcing for innovation, and specific aspects of support for innovation (represented by manifest variables only) determines to what level an organization supports innovation and subsequently an innovative climate. A good fit between POCaICAT Revision A data

and the final structural equation model verified this premise and sufficiently explained the relationships between all latent variables (principal components).

The Collaboration, Managerial Trust / Workforce Enthusiasm, and Workforce Autonomy principal components together determine where on the organic/mechanistic continuum an organization falls and these principal components represent elements of an organizational culture as defined in Chapter II. Also, per the literature, these principal components have a causal relationship with an innovative climate, best represented by the Support for Innovation principal component (primarily made up of questions designed to measure support for innovation and an organization's innovative climate). The Resource Supply for Innovation principal component also, per the literature, has a causal relationship with the Support for Innovation principal component.

B. Recommendations

The POCaICAT Revision A is a reliable and valid measurement tool ready to be applied to public organizations and is recommended for use. This research has shown that it is particularly applicable to military organizations with science and engineering roles and responsibilities. A public organization (or organizations) can administer the POCAICAT Revision A and collect information and gain insight into organizational culture and innovative climate.

The POCaICAT Revision A offers a low cost approach to better understand organizational culture and subsequently is a first step to improving mission effectiveness. Constrained fiscal budgets dictate that low cost methods be utilized, and if a low cost tool

is available that will aid organizations' efforts to improve innovativeness and operations in uncertain environments, it should be used. The POCaICAT Revision A and the methodology laid out in this and the previous chapters offer researchers and managers a means to measure perceived organizational culture and innovative climate. This is a first step in an inexpensive approach to improve innovativeness and mission effectiveness. It is recommended, though, that care be taken to recognize the nuances of this research and associated analysis techniques.

Many practical applications can also be derived from this research. Administering the POCaICAT Revision A to an organization can produce results that reveal cultural insights about that organization. These cultural insights can be examined and specific actions can be taken based on this examination that can improve organizational innovativeness. The following examples are provided as possible applications of this research. For the remainder of this section, the Navy community's data will be evaluated in its entirety and not at the organizational level.

To become more innovative, this Navy community has three courses of action it can take:

1. This Navy community can evaluate the principal components that together make up an organic/mechanistic organizational culture. From regression analysis, it was established that the Support for Innovation principal component score (and subsequently the perceived innovative climate) increases as the combined score of the organizational culture principal components (and subsequently the perceived organizational culture) increases per the equation 1.14 plus the product of 0.706 and the combined score of the organic/mechanistic principal components.

Of these principal components, according to the single-sample t test analysis conducted, the community somewhat agrees it is collaborative (score of 5.34), it somewhat agrees, but to a lesser degree, that it has the trust of management and an enthusiastic workforce (score of 4.57), and it somewhat agrees that the workforce is autonomous (score of 4.36). These scores can be seen in Table 5.22. Therefore, the most improvement can be made to the organic organizational culture by improving the Managerial Trust / Workforce Enthusiasm and Workforce Autonomy scores.

However, structural equation modeling analysis reveals a different perspective. Table 5.14 displays the regression weights of the relationships shared by the latent variables (principal components). This analysis reveals that if the Collaboration score were to increase by 1.0, then the Support for Innovation score would go up by 0.688. If the Workforce Autonomy score were to increase by 1.0, then the Support for Innovation score would go up by 0.266. The Management Trust / Workforce Enthusiasm latent variable influences the Workforce Autonomy score directly (and hence the Support for Innovation score indirectly), and if it were to increase by 1.0, then the Workforce Autonomy score would increase by 0.798. Therefore, all three organizational culture principal components should be examined in an attempt to improve Support for Innovation and subsequently the perceived innovation climate of the community.

If the community's Managerial Trust / Workforce Enthusiasm score were to go up by 1.0, then the Workforce Autonomy score would go up 0.798 and subsequently the Support for Innovation score would go up 0.212, a minor improvement. If the Workforce Autonomy score were to go up 1.0, irrespective of the influence of Managerial Trust / Workforce Enthusiasm, the Support for Innovation score would go up just 0.266.

Combined, these two principal components, if both had score increases of 1.0 independent of each other, would increase the Support for Innovation score by only 0.478. If the Collaboration score were to go up just 0.3, then the Support for Innovation score would go up by 0.206, nearly as much as a 1.0 increase in Managerial Trust / Workforce Enthusiasm, and if the Collaboration score were to go up by 0.7, then the Support for Innovation score would go up by 0.482, roughly the same amount if both Workforce Autonomy and Managerial Trust / Workforce Autonomy scores were to go up by 1.0. Therefore, this Navy community should focus on improving its collaboration first, despite the fact that the community perceives that this aspect of organizational culture is better than the others. More improvement in innovativeness for less effort can be achieved if collaboration is addressed.

Next, an examination of specific collaboration attributes could be pursued to determine which specific aspects of collaboration could be improved and what actions could be taken to improve them. For example, question 15 in the POCaICAT Revision A had the lowest collaboration score in the community. This question asks if members of the community think that, by their actions, managers assume they are the "thinkers" and employees are the "workers" in their respective organizations. The community somewhat disagrees this is the case (vice disagrees or strongly disagrees), so there is room for improvement. An improvement in this perception would equate to an improved innovativeness for the community. Further analysis of collaboration questions and thought of how to improve these scores would follow. After collaboration improvements are evaluated, then workforce autonomy, managerial trust, and workforce enthusiasm

improvements could be sought, but, collaboration improvements should have primacy because of the better rate of return in innovativeness they offer.

2. A second course of action that should be pursued is an evaluation of resource supply for innovation. No substantial evidence of a relationship between this principal component and the organic/mechanistic principal components was found from structural equation modeling, but structural equation modeling did reveal a substantial relationship between the Resource Supply for Innovation and the Support for Innovation latent variables (principal components). An increase in score of 1.0 for Resource Supply for Innovation results in an increased score of 1.87 in Support for Innovation, according to the last structural equation model developed. The structural equation model previous to this final one showed that an increased score of 1.0 in Resource Supply for Innovation resulted in an increased score of 1.77 in Support for Innovation. Even though this structural equation model had a better fit to the data than the final model, the relationships in the final model were better defined so it was chosen. However, the results for Resource Supply for Innovation in both are very similar, instilling further confidence that this result can be trusted.

This increase of 1.87 in Support for Innovation with an increased score of 1.0 for Resource Supply for Innovation is a substantial finding for this community. Each POCaICAT Revision A question for Resource Supply for Innovation produced a low score. These questions deal with funding, manning, and time for innovative pursuits. This community has shortfalls in each, especially funding and manning. Because the latter two resources are expensive, this community should first and more vigorously pursue providing more time for innovative pursuits. Such an investment could result in a

large increase in innovativeness throughout this community. Increases in funding and manpower would also be recommended, but due to expense, they may not be immediately practical, especially with tightly controlled budgets within the federal government.

3. A final course of action that can be pursued is to evaluate the Support for Innovation principal component itself and its questions and determine if there are specific, practical aspects that can be improved. This principal component is comprised of questions that measure an organization's direct and active support for innovation and a general, overall innovative climate perception. Questions 20, 21, 23, 34, 41, 44, and 48 best measure direct, active support for innovation, so they cover the practical areas that should be addressed to pursue improvements to innovativeness. For example, question 41 asks if innovative people are publicly recognized. A manager could evaluate his/her organization's score and determine if effort should be made to improve the organization's recognition program or not. If improvement is needed and pursued, the overall Support for Innovation score would improve.

Each of these courses of action, if pursued, could improve the organizational culture and innovative climate of this community. Further, the POCaICAT Revision A can be used to determine what culture and climate aspects need improvement.

A note is appropriate on the use of mean scores of POCAICAT Revision A questions. More rigorous statistical analysis could be pursued to establish standard deviations and differences from a neither agree nor disagree score (accomplished through single-sample t testing) to determine if results regarding specific questions are consistent

or not throughout the community, but this step is unnecessary. Even if a mean score does not convey a consistent community response, enough individuals would have scored the question low enough to drive down the mean, indicating that a problem could exist and improvement is possible. If mean scores are roughly the same and a researcher wishes to discern which areas may not have consistent responses or seeks to understand if problems are pervasive throughout (identified through consistent responses), then more rigorous statistical analysis is warranted. For this research and the examples offered, this step was unnecessary.

C. Limitations

There were a number of limitations associated with this research. This is true of any research, but cultural research especially constrains interpretations and applications of results (Akgun, Keskin, and Byrne 2009). This constraint did make interpretation of results challenging. For example, this research only offered minimal insight into why an organization's culture was perceived to be mechanistic or organic and climate perceived to be innovative. This research simply measured cultural phenomenon to better understand the current state of organizational culture in the Navy community surveyed. Also, this research did not provide methods to change organizational culture. It only identified areas that could be improved, not offering in depth analysis regarding how to improve.

Further, this research did not provide an exhaustive list of attributes that contribute to organizational culture or innovative climate nor did it aim to do so. Discovery of new attributes is still to be made (Sarros, Cooper, and Santora 2008). The

attributes that emerged from this research are based on the attributes found in the literature review and measured by the Organizational Culture Assessment Revision B and the Climate for Innovation Measure. Principal component factor analysis grouped questions according to responses from the surveyed Navy community, and these groupings were interpreted and then defined resulting in five attributes (the principal components).

A final limitation of this research was that mechanistic and non-innovative organizational cultures were not observed. Measuring some mechanistic and non-innovative organizations was expected but did not occur.

D. Further Research

Further research could apply the methodology described in this study to a wider Navy sample, other Military Services, the National Guard, the Coast Guard, a wider Department of Defense sample, other federal agencies, or even tactical units. The aim of such research would be to better understand organizational culture and climate as a first step to improve mission effectiveness. Also, surveying a wider audience to understand cultural differences between federal departments and agencies could be conducted. Such an effort would improve the reliability and validity of the POCAICAT Revision A, possibly offer observations that could be applied to improve the POCAICAT Revision A, and identify cultural shortcomings that if improved would subsequently improve innovativeness.

Another area warranting further research is determining if hierarchical organizational structures suppress the development of organic cultures. It was established that hierarchically structured organizations can perceive themselves as organic (to varying degrees), but further research to determine if they would be more organic if not hierarchically structured and if their professionals provide some sort of mediating effect would be enlightening. Also, since no perceived mechanistic organizational cultures and non-innovative climates were found, further research is needed to determine if the conclusions postulated for perceived organic organizational cultures and innovative climates are also applicable to perceived mechanistic organizational cultures and non-innovative climates at the organizational level.

Additionally, further research is needed to investigate and develop an exhaustive list of attributes that contribute to public organization culture. This could be carried out to better understand all influences and factors contributing to organizational culture and climate so that more opportunities for improvement within public organizations can be explored. Further research is also needed to better understand the relationships and influences the principal components (latent variables) identified through this research have on each other. It is interesting that the Managerial Trust / Workforce Enthusiasm principal component does not have a measurable influence on Support for Innovation. The premise that an organizational culture predicts an innovative climate has been supported through this research, but perhaps not all aspects of an organizational culture directly support an innovative climate. Further research in this area is worth undertaking.

Another relationship warranting further research involves the Resource Supply for Innovation principal component (latent variable). It was established that the Resource

Supply for Innovation principal component has an overall effect on innovativeness, and specifically for the sample surveyed, Resource Supply for Innovation had a limiting effect on innovativeness. This finding contradicts Roxborough's (2000) finding that resource constraints have seldom been observed to be a significant impediment to innovation. To resolve, this warrants additional investigation. Further, this principal component was not found to have an identified relationship with a perceived organizational culture. It is apparent, though, that a perceived organizational culture is a predictor of a perceived innovative climate. Further research and study, then, regarding the relationship between the Resource Supply for Innovation principal component and the organic/mechanistic principal components is warranted. Also, further research is needed to determine why the Resource Supply for Innovation principal component has the lowest Cronbach's Alpha score of all the principal components but has the highest regression weight in the structural equation model.

APPENDICES

APPENDIX A

Perceived Organizational Culture and Innovative Climate Assessment Tool

POCaICAT questions were presented with response options in a 7 point Likert scale as follows:

Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree	Strongly Disagree

Instructions for survey takers:

Please select the one answer that best describes your organization.

Please answer all questions including the demographic questions at the end of the survey (or I won't be able to record your responses).

Questions:

1. Employees in your organization actively look for ways to expand their knowledge in order to be able to do a better job.

2. Managers, by their actions, make their employees feel that they are the organization's most important assets.

3. New ideas are warded off by negative comments like "it won't work here."

4. Conversations in your organization exhibit no enthusiasm for the work.

5. Managers closely track their employee arrival and departure times.

6. Employees in your organization show genuine concern for the problems that face the organization by making suggestions about solving them.

7. Discussions concerning performance evaluations indicate that the process is inaccurate.

8. There are few closed office doors in your organization, allowing for a high rate of employee interaction.

9. Based on their actions, managers appear to consider their employees responsible.

10. Based on their actions, it appears that managers in your organization view non-managers as cogs in a machine.

11. Language used by people in your organization reflects respect for people at all levels in the organization.

12. The reward of a paycheck is the strongest motivation that employees in your organization have to come to work daily.

13. Performance in your organization is based on avoiding punishment.

14. There is a substantial amount of micromanagement in your organization.

15. Based on their actions, it appears that managers assume that they are the “thinkers” and their employees are the “workers” of your organization.

16. Collaboration is a formally recognized value in your organization.

17. Managers in your organization are located adjacent or close to non-managers in their work group.

18. People in your organization tend to shift responsibility for solving problems to someone else.

19. There are people in your organization who are held up as examples of innovative problem solvers.

20. Innovation is a formally recognized value in your organization.

21. Creativity is encouraged in your organization.

22. Your ability to function creatively is respected by your leadership.

23. In your organization, people are allowed to try to solve the same problems in different ways.

24. The main function of members in your organization is to follow orders which come down through channels.

25. In your organization, a person can get in a lot of trouble by being different.

26. Your organization can be described as continually adapting to change.

27. A person can't do things that are too different in your organization without provoking anger.

28. The best way to get along in your organization is to think the way the rest of the group does.

29. People in your organization are expected to deal with problems in the same way.

30. Your organization is open to change.

31. The people in charge in your organization usually get credit for others' ideas.

32. In your organization, people tend to stick to "tried and true" ways.

33. Your organization seems to be more concerned with the status quo than with change.

34. Assistance in developing new ideas is readily available.

35. There are adequate resources devoted to innovation in your organization.

36. There is adequate time available to pursue creative ideas in your organization.

37. Lack of funding to investigate creative ideas is a problem in your organization.

38. Personnel shortages inhibit innovation in your organization.

39. Your organization gives you free time to pursue creative ideas during the workday.

40. The reward system in your organization encourages innovation.

41. Your organization publicly recognizes those who are innovative.

42. Bringing required capabilities to warfighters in innovative ways is valued by your organization.

43. Finding satisfactory solutions to problems at low cost is rewarded in your organization.

44. Innovative solutions are regularly implemented in your organization.

45. Your chain of command is open to hearing about new approaches to solving difficult problems.

46. Strictly adhering to regulations is the only way to get things done in your organization.

47. Innovative solutions are immediately dismissed from consideration in your organization.

48. The importance of innovative thinking is communicated throughout your organization.

49. Implementing innovative ideas in your organization is a slow process.

50. Your organization is considered innovative.

51. Your organizational culture permits innovation.

52. Your organizational culture is best described as innovative.

53. Your organizational culture inhibits innovation.

54. The culture of your organization prohibits you from being innovative.

APPENDIX B

Perceived Organizational Culture and Innovative Climate Assessment Tool Revision A

(Original Numbering Scheme)

POCaICAT Revision A questions were presented with response options in a 7 point Likert scale as follows:

Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree	Strongly Disagree

Instructions for survey takers:

Please select the one answer that best describes your organization.

Please answer all questions including the demographic questions at the end of the survey (or I won't be able to record your responses).

Questions:

4. Conversations in your organization exhibit no enthusiasm for the work.

5. Managers closely track their employee arrival and departure times.

8. There are few closed office doors in your organization, allowing for a high rate of employee interaction.

9. Based on their actions, managers appear to consider their employees responsible.

12. The reward of a paycheck is the strongest motivation that employees in your organization have to come to work daily.

15. Based on their actions, it appears that managers assume that they are the “thinkers” and their employees are the “workers” of your organization.

16. Collaboration is a formally recognized value in your organization.

17. Managers in your organization are located adjacent or close to non-managers in their work group.

18. People in your organization tend to shift responsibility for solving problems to someone else.

20. Innovation is a formally recognized value in your organization.

21. Creativity is encouraged in your organization.

23. In your organization, people are allowed to try to solve the same problems in different ways.

24. The main function of members in your organization is to follow orders which come down through channels.

26. Your organization can be described as continually adapting to change.

28. The best way to get along in your organization is to think the way the rest of the group does.

29. People in your organization are expected to deal with problems in the same way.

30. Your organization is open to change.

34. Assistance in developing new ideas is readily available.

37. Lack of funding to investigate creative ideas is a problem in your organization.

38. Personnel shortages inhibit innovation in your organization.

39. Your organization gives you free time to pursue creative ideas during the workday.

41. Your organization publicly recognizes those who are innovative.

44. Innovative solutions are regularly implemented in your organization.

46. Strictly adhering to regulations is the only way to get things done in your organization.

48. The importance of innovative thinking is communicated throughout your organization.

50. Your organization is considered innovative.

51. Your organizational culture permits innovation.

52. Your organizational culture is best described as innovative.

APPENDIX C

Perceived Organizational Culture and Innovative Climate Assessment Tool Revision A

(Updated Numbering Scheme)

POCaICAT Revision A questions were presented with response options in a 7 point Likert scale as follows:

Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree	Strongly Disagree

Instructions for survey takers:

Please select the one answer that best describes your organization.

Please answer all questions including the demographic questions at the end of the survey (or I won't be able to record your responses).

Questions:

1. Conversations in your organization exhibit no enthusiasm for the work.

2. Managers closely track their employee arrival and departure times.

3. There are few closed office doors in your organization, allowing for a high rate of employee interaction.

4. Based on their actions, managers appear to consider their employees responsible.

5. The reward of a paycheck is the strongest motivation that employees in your organization have to come to work daily.

6. Based on their actions, it appears that managers assume that they are the “thinkers” and their employees are the “workers” of your organization.

7. Collaboration is a formally recognized value in your organization.

8. Managers in your organization are located adjacent or close to non-managers in their work group.

9. People in your organization tend to shift responsibility for solving problems to someone else.

10. Innovation is a formally recognized value in your organization.

11. Creativity is encouraged in your organization.

12. In your organization, people are allowed to try to solve the same problems in different ways.

13. The main function of members in your organization is to follow orders which come down through channels.

14. Your organization can be described as continually adapting to change.

15. The best way to get along in your organization is to think the way the rest of the group does.

16. People in your organization are expected to deal with problems in the same way.

17. Your organization is open to change.

18. Assistance in developing new ideas is readily available.

19. Lack of funding to investigate creative ideas is a problem in your organization.

20. Personnel shortages inhibit innovation in your organization.

21. Your organization gives you free time to pursue creative ideas during the workday.

22. Your organization publicly recognizes those who are innovative.

23. Innovative solutions are regularly implemented in your organization.

24. Strictly adhering to regulations is the only way to get things done in your organization.

25. The importance of innovative thinking is communicated throughout your organization.

26. Your organization is considered innovative.

27. Your organizational culture permits innovation.

28. Your organizational culture is best described as innovative.

APPENDIX D

Perceived Organizational Culture and Innovative Climate Assessment Tool Key

Table D.1 POCaICAT 7 Point Likert Scale Key

Question #	Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree	Strongly Disagree
1	7	6	5	4	3	2	1
2	7	6	5	4	3	2	1
3	1	2	3	4	5	6	7
4	1	2	3	4	5	6	7
5	1	2	3	4	5	6	7
6	7	6	5	4	3	2	1
7	1	2	3	4	5	6	7
8	7	6	5	4	3	2	1
9	7	6	5	4	3	2	1
10	1	2	3	4	5	6	7
11	7	6	5	4	3	2	1
12	1	2	3	4	5	6	7
13	1	2	3	4	5	6	7
14	1	2	3	4	5	6	7
15	1	2	3	4	5	6	7
16	7	6	5	4	3	2	1
17	7	6	5	4	3	2	1
18	1	2	3	4	5	6	7
19	7	6	5	4	3	2	1
20	7	6	5	4	3	2	1
21	7	6	5	4	3	2	1
22	7	6	5	4	3	2	1
23	7	6	5	4	3	2	1
24	1	2	3	4	5	6	7
25	1	2	3	4	5	6	7
26	7	6	5	4	3	2	1
27	1	2	3	4	5	6	7
28	1	2	3	4	5	6	7
29	1	2	3	4	5	6	7
30	7	6	5	4	3	2	1
31	1	2	3	4	5	6	7
32	1	2	3	4	5	6	7
33	1	2	3	4	5	6	7
34	7	6	5	4	3	2	1
35	7	6	5	4	3	2	1
36	7	6	5	4	3	2	1
37	1	2	3	4	5	6	7
38	1	2	3	4	5	6	7
39	7	6	5	4	3	2	1
40	7	6	5	4	3	2	1
41	7	6	5	4	3	2	1
42	7	6	5	4	3	2	1
43	7	6	5	4	3	2	1
44	7	6	5	4	3	2	1
45	7	6	5	4	3	2	1
46	1	2	3	4	5	6	7
47	1	2	3	4	5	6	7
48	7	6	5	4	3	2	1
49	1	2	3	4	5	6	7
50	7	6	5	4	3	2	1
51	7	6	5	4	3	2	1
52	7	6	5	4	3	2	1
53	1	2	3	4	5	6	7
54	1	2	3	4	5	6	7

APPENDIX E

Perceived Organizational Culture and Innovative Climate Assessment Tool Revision A (Updated Numbering Scheme) Key

Table E.1 POCaICAT Revision A 7 Point Likert Scale Key

Question #	Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree	Strongly Disagree
1	1	2	3	4	5	6	7
2	1	2	3	4	5	6	7
3	7	6	5	4	3	2	1
4	7	6	5	4	3	2	1
5	1	2	3	4	5	6	7
6	1	2	3	4	5	6	7
7	7	6	5	4	3	2	1
8	7	6	5	4	3	2	1
9	1	2	3	4	5	6	7
10	7	6	5	4	3	2	1
11	7	6	5	4	3	2	1
12	7	6	5	4	3	2	1
13	1	2	3	4	5	6	7
14	7	6	5	4	3	2	1
15	1	2	3	4	5	6	7
16	1	2	3	4	5	6	7
17	7	6	5	4	3	2	1
18	7	6	5	4	3	2	1
19	1	2	3	4	5	6	7
20	1	2	3	4	5	6	7
21	7	6	5	4	3	2	1
22	7	6	5	4	3	2	1
23	7	6	5	4	3	2	1
24	1	2	3	4	5	6	7
25	7	6	5	4	3	2	1
26	7	6	5	4	3	2	1
27	7	6	5	4	3	2	1
28	7	6	5	4	3	2	1

APPENDIX F

Human Subjects Committee Approval Letter

UAHuntsville

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Nicholaos Jones
332B Morton Hall
Phone: 256.824.2338
Fax: 256.824.2387
Email: irb@uah.edu

Craig Whittinghill
c/o Phillip Farrington, Ph.D.
EB-102B
Department of Industrial and Systems Engineering
UAHuntsville
Huntsville, AL 35899

April 9, 2010

Dear Mr. Whittinghill,

As chair of the IRB Human Subjects Committee, I have reviewed your proposal, *Assessing Culture and Innovativeness in the Department of Defense*, and have found it meets the necessary criteria for exemption from review according to 45 CFR 46. I have approved this proposal, and you may commence your research. Please note that this approval is good for one year from the date on this letter. If data collection continues past this period, a renewal application must be filed with the IRB.

Please contact me if you have any questions.

Sincerely,

Dr. Nicholaos Jones
Chair, UHSC

OFFICE OF THE VICE PRESIDENT FOR RESEARCH
Von Braun Research Hall M-17 Huntsville, AL 35899 T 256.824.6100 F 256.824.6783

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