

Does Your **CULTURE** Encourage **INNOVATION?**



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For many years military leaders have been calling for the U.S. Armed Forces to be more agile, adaptive, and innovative in order to defeat future and emerging threats. To assist the military in this endeavor, the University of Alabama in Huntsville explored Department of Defense (DoD) culture at the organizational level. Having the proper organizational culture can improve performance by empowering members to interact better with their environment, to communicate

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and act rapidly, and, perhaps most importantly, to innovate. If organizational culture does not encourage innovation, however, organizations can improve innovativeness through culture manipulation. By implementing identified actions that influence cultural attributes, culture can be modified, and subsequently organizations can improve innovativeness, enabling them to meet new and complex challenges.

Calls from Senior Leadership

Over the past several years, senior military leaders and DoD civilians have been calling for more military innovation and adaptability. Retired Chairman of the Joint Chiefs of Staff Marine General Peter Pace 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). Retired Navy Admiral Mike Mullen, also a former Chairman of the Joint Chiefs of Staff, stated that “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” (Mullen, 2008, p. 4).

During the *Defense Strategic Guidance* briefing held in the Pentagon on January 5, 2012, President Barack Obama, former Secretary of Defense Leon Panetta, and Chairman of the Joint Chiefs of Staff Army General Martin Dempsey introduced a new military strategy that shifts strategic focus to the Pacific and Asia. In his remarks, Panetta commented that the military’s “great strength will be that it will be more agile, more flexible, ready to deploy quickly, innovative, and technologically advanced. That is the force of the future” (Panetta, 2012).

Furthering a culture of innovation within the DoD will contribute to the achievement of these transformational visions. Senior DoD leaders have endorsed and promulgated a culture of innovation dating back to at least 2001 when former President George W. Bush challenged officers during a speech at the U.S. Naval Academy to “risk failure, because in failure, ‘we will learn and acquire the knowledge that will make successful innovation possible’” (Williams, 2009, p. 59). Since his speech, DoD’s culture of innovation has improved, as evidenced by former Secretary of Defense Donald Rumsfeld’s 2006 testimony to Congress during which he stated that the DoD’s culture is “changing from one of risk avoidance to a climate that rewards achievement and innovation” (Fairbanks, 2006, p. 37).

How can the DoD continue this trend? The recent research has produced some very interesting results outlined in this article, on organizational culture, which may provide at least part of the answer.

Culture and Innovativeness

Webster's Ninth New Collegiate Dictionary defines culture as “the customary beliefs, social forms, and material traits of a racial, religious, or social group” (Culture, 1990, p. 314). The DoD’s culture is influenced heavily by its famous hierarchical, mechanistic organizational structure. Organizational structure is described as a continuum. A mechanistic structure is on one extreme of the organizational system continuum. Typically mechanistic structures have a process where problems and tasks are strictly defined via instructions and orders issued by superiors who receive information as it flows up to them. Information follows a vertical path up and down the chain of command, enabling superiors to maintain their command hierarchy (Burns & Stalker, 1966). Mechanistic structures (and cultures) are characterized as controlled, formalized, and standardized (Reigle, 2003), and mechanistic organizations operate to meet orders from management to avoid mistakes or disturbances. A widely accepted premise in the research literature is that a mechanistic structure can inhibit innovativeness (Beyer & Trice, 1978; Damanpour, 1991; Tsai, Chuang, & Hsieh, 2009). Therefore, one can reasonably conclude that the DoD’s mechanistic structure and culture would inhibit innovativeness.

On the other extreme of the organizational system continuum is an organic structure and culture (Burns & Stalker, 1966). Organic structures are believed to foster innovativeness (Prakash & Gupta, 2008; Robbins & Judge, 2009; Walker, 2007). These structures adapt to unstable conditions and change. They are characterized by individuals performing their tasks outside of a clearly defined hierarchy, considering their understanding of the workload of the organization while accomplishing their tasks. Control of information flow no longer rests with superiors (Burns & Stalker, 1966). An organic organization can operate flexibly and adapt quickly to a rapidly changing environment (Jones, 2004). Organic cultural values encourage creativity and innovation (Jones, 2004; Lamore, 2009), and innovative behavior (Hartmann, 2006).



Fortunately, for a mechanistic organization such as the DoD, some organic subordinate units are possible. In fact, a blend of these opposite structures can be advantageous to an organization. This concept is particularly true of organic structures operating within mechanistic structures. For example, units or departments may have their own organic structures, but the overall culture of the organization outside the unit or department may be influenced by its mechanistic, formalized chain of command. Organic structures and 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 (Gresov, 1984, 1989).

Culture and structure interact with each other, creating organizations that either innovate well, implement innovations well, or achieve both depending on the combination of culture and structure type (Gresov, 1984; Prakash & Gupta, 2008). This idea that organic and mechanistic



culture and structure can exist simultaneously, even symbiotically, within one organization is demonstrated daily by naval forces afloat. This concept has been implemented for decades in the Command by Negation construct in which local commanders have the freedom to conduct warfare in their specified area of responsibility until guidance from the chain of command above redirects their efforts. Command by Negation fosters initiative and innovation, particularly at the subordinate organizational level (LeGree, 2004).

Despite a decade's long use of Command by Negation, the research literature lacks empirical evidence that describes the relationship between an organization's structurally defined culture and its proclivity for innovation. This study adds to the literature and provides insight into how an organization can manipulate its culture to become more innovative. The rest of this article details our data collection, analysis, findings, and managerial insights.

Data Collection

This study focused on surveying a representative sample large enough to provide statistical rigor. The surveyed sample comes from a unique Navy community of organizations that share a common goal. Even though it was not one cohesive unit, unity of purpose provided the members of this community a common bond. This group of professionals consisted of roughly 1,100 individuals composed of scientists, engineers, operators, trainers, academics, and requirements officers.

The sample consisted of individuals who were active duty Navy personnel, government civilians, and contractors. Demographics are displayed in Table 1, and as can be seen, many similarities exist between the sample and the comparison demographics.

Upon inspection, the sample demographics more closely match Navy Officer Corps demographics than overall Navy demographics, especially regarding gender and the percentage of Caucasians. 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 1. These results are expected since the sample is made up of professionals with significant experience, closely matching percentages and trends from U.S. college graduates and the college-educated U.S. science and engineering labor force.

TABLE 1. 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						
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%

Although the sample generally reflects of the active duty Navy, U.S. college graduates, and the college-educated U.S. science and labor force, it is not reflective of gender percentages in all three groups, notably in U.S. college graduates (over 49% are women) (Kannankutty, 2005). When viewed holistically in Table 1, however, the sample is reflective of the active duty Navy, 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 (Kannankutty, 2005; National Science Board, 2010; U.S. Navy, 2010). Because of the composition of this sample, it can broadly be considered a typical cross-section of the professionals who constitute the DoD.

Measuring organizational culture can be accomplished through the use of surveys and questionnaires (Ashkanasy, Wilderom, & Peterson, 2000; Kraut et al., 1996). Using self-report surveys, in particular, offers 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 et al., 2000). Thus, it was determined that using self-report surveys was the preferred means of measuring organizational culture and innovative climate within the DoD. Therefore, to collect data, a 7-point Likert scale survey was administered in March and June 2010 to evaluate perceived organizational culture and innovative climate.

A quick note on culture and climate is prudent. Climate describes organizational expectations for behavior and outcomes. People respond to those expectations by shaping their behavior to achieve positive results like self-satisfaction and self-pride (Scott & 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. Denison (1996) concluded that culture and climate are a common phenomenon and that each describes organizational social context. Culture and climate research should be integrative and not mutually exclusive (Denison, 1996).

To conduct this research, a sample of 251 individuals was obtained by administering the Perceived Organizational Culture and Innovative Climate Assessment Tool (POCaICAT), a survey developed specifically for this research. A thorough review of the literature was conducted to

find instruments for use that measure organizational culture (along the organic and mechanistic continuum) and innovative climate. Twenty-four candidate survey instruments were identified. Eleven of these surveys measure organizational culture and 13 measure organizational innovative culture or climate (Whittinghill, 2011). The POCaICAT Revision A was developed by combining two valid and reliable Likert scale surveys. Surveys combined were the Organizational Culture Assessment (Reigle, 2003), which measures organizational culture, and the Climate for Innovation Measure (Scott & Bruce, 1994), which measures innovative climate.

Reliability

The researchers used Principal Component Factor Analysis to produce principal components, which were used to create a scale with items that reflected the construct being measured. The test of reliability used was Cronbach's alpha (Cronbach, 1951). Cronbach's alpha is regarded as the lower bound on reliability for a set of congeneric measures (Bollen, 1989). It assumes each of the items within the scale contributes equally to the underlying trait (Zeller & Carmines, 1980). The alphas are reported in Table 2.

TABLE 2. RELIABILITY DATA FOR POCaICAT REVISION A

Principal Component	Cronbach's Alpha
Support for Innovation	0.95
Workforce Autonomy	0.808
Collaboration	0.807
Managerial Trust/Workforce Enthusiasm	0.774
Resource Supply for Innovation	0.555

As indicated by the reliabilities, the measures are relatively homogeneous for the construct they purport to measure. Typically, reliabilities greater than 0.70 are considered adequate for measurement analysis (Nunnally, 1978). All but one measure in our analysis met this standard. Resource Supply for Innovation had a Cronbach alpha score of 0.555. This score, however, is sufficient. Cronbach's alpha values at or above 0.50 have been cited as acceptable for research (Caplan, Naidu, & Tripathi, 1984; Nunnally, 1967; Pedhazur & Schmelkin, 1991). The POCaICAT Revision A also demonstrated face, content, and construct validity (Whittinghill, 2011).

Sample Size

A sample size of 251 was found to be large enough to provide statistical significance to this study. The single-sample *t* test, Analysis of Variance (ANOVA), and linear regression were used throughout the research. First, for the single-sample *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) to medium effect (0.5) size range for the *t* test (Cohen, 2009). For ANOVA, seven of 11 organizations surveyed produced enough responses to average 34 per organization, resulting in statistical analysis conducted at the 5% alpha, 83% power, and medium effect (0.25) 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) to medium effect (0.3) size range for simple linear regression (Cohen, 2009).

Before proceeding, a brief discussion on the concept of effect size is offered. 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 nonzero 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. According to Cohen (2009, p. 25), a small effect size is applicable for new research areas because 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.” A medium effect size 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 occupational groups (Super, 1949, p. 98)” (Cohen 2009, p. 26). Although this research is being conducted in a relatively new research area, consistent dissemination of, and response to, a reliable and valid Likert-scale survey amongst professional and managerial groups led us to determine an effect size in the small to medium range was appropriate. A sample size of 251, therefore, was large enough to produce statistically significant results.

Analysis

The primary research question being addressed in this study was "Is there a relationship between the perceived organizational culture and innovative climate of this Navy community?" To answer this question, a hypothesis was formulated: that there is a linear relationship between the perceived organizational culture and the innovative climate of this Navy community. Linear regression was used to test the hypothesis. Before proceeding further, however, it is appropriate to note that with a sample size of 251, the central limit theorem (i.e., the sampling distribution approaches normality as sample size increases) applies, and a normal population distribution was assumed (Sheskin, 2004).

Parametric statistical analysis (i.e., single-sample t tests supported by the nonparametric Wilcoxon signed-ranks tests, ANOVA, and Tukey's honestly significant difference [HSD] tests) performed between organizations produced results that indicated a correlation exists between an organization's perceived organizational culture and its perceived innovative climate.

To validate these findings, simple linear regression analysis of the data was conducted. This portion of the research sought to determine whether a relationship exists between organizational culture and innovative climate within the surveyed 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 was not achievable for the surveyed Navy community, so a medium effect size (0.3 for simple linear regression) was deemed sufficient as previously rationalized. The medium effect size (0.3) was then used to determine a required sample size. According to Cohen, only 85 results are required, so the sample achieved provided a range of small to medium effect size (Cohen, 2009).

In this research, 7-point Likert-scale data were considered interval data and analyzed with parametric statistical tests vice ordinal data analyzed with nonparametric statistical tests. This approach was appropriate since the robustness of parametric tests and their use with ordinal data were supported in literature (Labovitz, 1967; Norman, 2010). Additionally, it was appropriate to consider data from the POCaICAT Revision A to be interval-level data since the data are in 7-point Likert-scale format (Boone & Boone, 2012); the POCaICAT Revision A is

both valid and reliable as shown through Principal Component Factor Analysis; and normality is assumed through the central limit theorem (Allen & Seaman, 2007). Additionally, nonparametric tests were used to validate the parametric tests in this research, further demonstrating that the results are robust.

Regression analysis was conducted to quantify the relationship between perceived organizational culture (i.e., the independent variable) and perceived innovative climate (i.e., the dependent variable or response).

Results produced substantial evidence that a statistically significant relationship existed between:

1. The degree to which an organization perceives itself to be organic; and
2. The degree to which it perceives itself to be innovative.

Table 3 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 the null hypothesis—that the slope of the regression line is zero—can be rejected, and therefore conclude that a linear relationship exists between the predictor and response (Montgomery, Peck, & Vining, 2006). Also, 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 et al., 2006).

TABLE 3. REGRESSION ANALYSIS RESULTS			
Perceived Innovative Climate Score = 1.14 + 0.706 (Perceived Organizational Culture Score)			
Regression <i>p</i> -value	Lack of Fit <i>p</i> -value	<i>R</i> ²	<i>R</i> ² Adjusted
<0.005	.413	48.4%	48.2%

Further, 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 & 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 was 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 3) is a sufficient score for this study. Devore (1995) stated 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; 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 assumptions of normality of the residual data, homogeneity of variance, and independence of the data were evaluated and none was violated (Whittinghill, 2011).

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The discovered relationship revealed that the more organic an organization perceived itself to be, the more it perceived itself to be innovative. Therefore, the data suggest that organizations can improve innovativeness through culture modification. However, to accomplish this, an organization must understand which attributes to develop in creating a more organic culture and subsequently a more innovative organization.

The literature review provided supporting evidence that the principal components previously identified were the attributes that can be modified to create a more organic culture and innovative climate. From the literature review, 27 attributes were found that contribute to innovativeness. This was a large number of attributes to study, and they needed to be reduced to a more manageable size. Initially, the 27 attributes were evaluated for adequacy and similarities, with 19 of the attributes deemed

appropriate for further study (Whittinghill, 2011). These 19 attributes share some commonalities, so like attributes were grouped together and placed in broader attribute categories (Whittinghill, 2011).

Whittinghill identified five attributes:

1. **Support for Innovation.** This is an organization's encouragement of creativity and willingness to change. It entails communicating the importance of creative, innovative thinking and recognizing innovators. Of all the attributes, this one, according to a review of the research literature, is most closely related to an organization's affinity for innovativeness (Ashkanasy et al., 2000; Scott & Bruce, 1994).
2. **Resource Supply for Innovation.** This is defined as having time, manpower, and funding available to pursue innovative endeavors.
3. **Collaboration.** This is defined as a high rate of interaction among organization members. It is encouraged by valuing all organization members' thoughts and ideas, and by having open door policies.
4. **Workforce Autonomy.** This is defined as having the flexibility to approach problems the way an organizational member sees fit based on available information, free from group-think, and not overly impeded by regulations.
5. **Managerial Trust/Workforce Enthusiasm.** This is best described as a workforce motivated by their work and trusted to perform their work without being micromanaged. Note that Principal Component Factor Analysis revealed a correlated relationship between managerial trust and workforce enthusiasm, so these attributes were combined into one.

These five attributes contribute to an innovative climate (Ashkanasy et al., 2000; Burns & Stalker, 1966; Damanpour, 1991; Kenny & Reedy, 2006; LeGree, 2004; Ruiz-Moreno, Garcia-Morales, & Llorens-Montes, 2008; Prakash & Gupta, 2008; Robbins & Judge, 2009; Roxborough, 2000; Walker, 2007). Of these five, support for innovation best represents an

innovative climate because it most directly influences organizational expectations for innovative behavior. Expectations influencing behavior are fundamental to the definition of climate (Scott & Bruce, 1994).

The workforce autonomy, collaboration, and managerial trust/workforce enthusiasm attributes together determine where on the organic/mechanistic continuum an organization falls (Whittinghill, 2011). Also, per the literature (Damanpour, 1991; Prakash & Gupta, 2008; Robbins & Judge, 2009; Walker 2007), these attributes have a causal relationship with an innovative climate. The literature also states that the resource supply for innovation attribute has a causal relationship and contributes to an innovative climate (Robbins & Judge, 2009; Ruiz-Moreno et al., 2008).

Taken together, support for innovation and resource supply for innovation define an organization's affinity for innovativeness. The degree to which collaboration, workforce autonomy, and managerial trust/workforce enthusiasm are present (or not) determines whether an organic or a mechanistic culture is present, and subsequently how it influences an innovative climate.

Since support for innovation is most closely related to an innovative climate, the other attributes were theorized, supported by the previously cited research literature, to influence directly an organization's support for innovation. This theory was successfully tested utilizing a mathematical technique called structural equation modeling (Whittinghill, 2011).

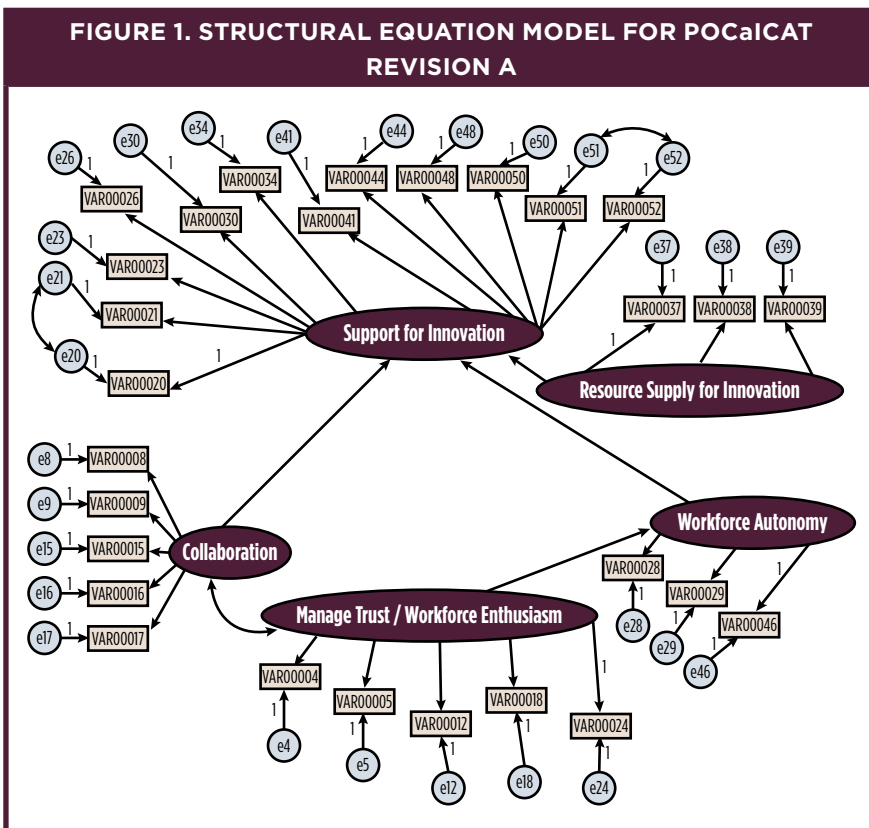
Creating an Innovative Organization

Structural equation modeling, as depicted in Figure 1, was employed to estimate attribute influence and theorize attribute relationships (Bollen, 1989). It provided an effective technique for quantitative analysis, based on a premise that determines to what level an organization supports innovation, and subsequently an innovative climate. The premise is influenced by three primary factors:

1. An organization's position on the organic/mechanistic continuum;
2. An organization's commitment to resourcing for innovation; and

3. Specific aspects of support for innovation represented only by manifest variables (made up of POCaICAT Revision A questions).

Additionally, structural equation modeling provided insight into the relationships between attributes that contribute to an innovative climate (i.e., the independent latent variables). The attributes modeled were the five attributes previously listed. The manifest variables (i.e., indicators) used were the questions of the POCaICAT Revision A (which were grouped according to the attributes they represent). Based on the causal relationships found in the literature review, a structural equation model was developed.



The derived structural equation model fit the data collected by the POCaICAT Revision A relatively well. This model produced an acceptable Root Mean Square Error of Approximation (RMSEA) value of 0.076

(Blunch, 2008; Byrne, 2010), an acceptable goodness of fit index of 0.797 (Kline, 2011), and an acceptable comparative fit index of 0.881 (Byrne, 2010; Kline, 2011), indicating a relatively good fit.

With model data fit established, the regression weights were reviewed (Table 4). All modeled relationships (displayed in Figure 1) between principal components were statistically significant and positive.

TABLE 4. 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 (i.e., attributes) resource supply for innovation, collaboration, and workforce autonomy, when the score of each on a 7-point Likert scale went up by one, the support for innovation latent variable would go up 1.87, 0.688, and 0.266, respectively. These regression weights (i.e., regression coefficients) predict the score of the support for innovation attributes (Arbuckle, 2007; Brewerton & Millward, 2006; Montgomery et al., 2006). If the managerial trust/workforce enthusiasm attribute went up by one, then the workforce autonomy latent variable would go up by 0.798 (and subsequently support for innovation would go up by 0.212). Thus, workforce autonomy has an indirect effect on the support for innovation attribute.

Conclusions

For this research study, a structural equation model was developed based on the results of a prior research literature review and populated with survey data from the DoD, which provided the basis for identifying the magnitude of attribute influence on innovativeness. The analysis of the model revealed that attributes influenced innovativeness to varying degrees.

1. Support for innovation has the greatest influence on innovativeness (per literature review and successful structural equation model using manifest variables).
2. Resource supply for innovation is the next most influential attribute (from structural equation modeling).
3. Collaboration is the third most influential (from structural equation modeling).
4. Workforce autonomy is a distant fourth (from structural equation modeling).
5. Managerial trust/workforce enthusiasm is the least influential, but almost as influential as workforce autonomy (from structural equation modeling).

Future efforts to further develop these attributes within an organization should consider each attribute's relative influence on innovativeness. Also, it should be understood that results may vary for different organizations and groups.

Before proceeding further, two quick notes are warranted:

1. Resource supply for innovation is extremely influential according to the structural equation model. Since personnel and funding allocated for innovative endeavors is expensive, providing time for such endeavors is the most practical resource to allocate.
2. As shown previously, collaboration, workforce autonomy, and managerial trust/workforce enthusiasm (if present in an organization) all have a positive influence on innovativeness, although to diminishing degrees.

Recently, DoD's senior leaders have promulgated several public statements promoting innovation throughout the DoD workforce. Linear regression analysis revealed that the more organic an organization perceived itself to be, the more it perceived itself to be innovative. This finding suggested that organizations can improve innovativeness through culture manipulation. If the culture does not encourage innovation, the most effective and practical actions to be taken to change the organizational culture and subsequently improve innovativeness, in priority order, are:

1. Communicate and demonstrate the importance of creative, innovative thinking.
2. Give members time to think innovatively.
3. Allow and encourage members to collaborate.
4. Allow members flexibility to approach problems as they see fit, free from group-think.
5. Assign motivating work and trust members to perform without being micromanaged.

By implementing these actions, culture within an organization can be modified to improve its innovativeness, to advance its ability to overcome future and emerging threats, and to meet new and complex challenges.

References

- Allen, I. E., & Seaman, C. A. (2007). Likert scales and data analysis. *Quality Progress*. Retrieved from <http://mail.asq.org/quality-progress/2007/07/statistics/likert-scales-and-data-analyses.html>
- Arbuckle, J. L. (2007). *Amos™ 16.0 user's guide*. Spring House, PA: Amos Development Corporation.
- Ashkanasy, N. M., Wilderom, C. P., & Peterson, M. F. (Eds.). (2000). *Handbook of organizational culture and climate*. Thousand Oaks, CA: Sage.
- Beyer, J. M., & Trice, H. M. (1978). *Implementing change: Alcoholism policies in work organizations*. New York: Free Press.
- Blunch, N. J. (2008). *Introduction to structural equation modelling using SPSS and Amos*. London: Sage.
- Bollen, K. (1989). A new incremental fit index for general structural equation models. *Sociological Methods and Research*, 17(3), 303-316.
- Boone, H., Jr., & Boone, D. (2012). Analyzing Likert data. *Journal of Extension*, 50(2). Retrieved from <http://www.joe.org/joe/2012april/tt2.php>
- Brewerton, P., & Millward, L. (2006). *Organizational research methods*. London: Sage.
- Burns, T., & Stalker, G. M. (1966). *The management of innovation* (2nd ed.). London: Tavistock.
- Byrne, B. M. (2010). *Structural equation modeling with Amos* (2nd ed.). New York: Routledge/Taylor & Francis.
- Caplan, R. D., Naidu, R. K., & Tripathi, R. C. (1984). Coping and defense: Constellations vs. components. *Journal of Health and Social Behavior*, 25, 303-320.
- Cohen, J. (2009). *Statistical power analysis for the behavioral sciences*. New York: Psychology Press.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297-334.
- Culture. (1990). *Webster's ninth new collegiate dictionary*. Springfield, MA: Merriam-Webster.
- Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34(3), 555-590.
- Denison, D. R. (1990). *Corporate culture and organizational effectiveness*. New York: John Wiley & Sons.
- Denison, D. R. (1996). What is the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars. *Academy of Management Review*, 21, 619-654.
- Devore, J. L. (1995). *Probability and statistics for engineering and the sciences* (4th ed.). Pacific Grove, CA: Duxbury Press.
- Downing, D., & Clark, J. (1997). *Statistics the easy way* (3rd ed). Hauppauge, NY: Barron's Educational Series.
- Fairbanks, W. P. (2006). Implementing the transformation vision. *Joint Forces Quarterly*, 42(3), 36-42.
- Gresov, C. (1984). Designing organizations to innovate and implement: Using two dilemmas to create a solution. *Columbia Journal of World Business*, 19(4), 63-67.

- Gresov, C. (1989). Exploring fit and misfit with multiple contingencies. *Administrative Science Quarterly*, 34(3), 431-453.
- Hartmann, A. (2006). The role of organizational culture in motivating innovative behaviour in construction firms. *Construction Innovation*, 6(3), 159.
- Jones, G. R. (2004). *Organizational theory, design, and change: Text and cases*. Upper Saddle River, NJ: Pearson/Prentice Hall.
- Kannankutty, N. (2005). 2003 college graduates in the U.S. workforce: A profile. National Center for Science and Engineering Statistics InfoBrief (Report No. NSF 06-304). Retrieved from <http://www.nsf.gov/statistics/infbrief/nsf06304/>
- Kenny, B., & Reedy, E. (2006). The impact of organisational culture factors on innovation levels in SMEs: An empirical investigation. *Irish Journal of Management*, 27(2), 119-143.
- Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford Press.
- Kraut, A. I., Ashworth, S. D., Bracken, D. W., Hinrichs, J. R., Johnson, R. H., Johnson, S. R., ... Wiley, J. W. (1996). *Organizational surveys*. San Francisco: Jossey-Bass.
- Labovitz, S. (1967). Some observations on measurement and statistics. *Social Forces*, 46(2), 151-160.
- Lamore, P. R. (2009). *An empirical investigation of the antecedents of market orientation and organizational effectiveness* (Doctoral dissertation). University of Alabama in Huntsville.
- LeGree, L. (2004). Will judgment be a casualty of network-centric warfare? *The Naval Institute: Proceedings*. Retrieved from http://www.military.com/NewContent/0,13190,NI_1004_NCW-P1,00.html
- Montgomery, D. C., Peck, E. A., & Vining, G. G. (2006). *Introduction to linear regression analysis* (4th ed.). Hoboken, NJ: John Wiley.
- Mullen, M. (2008). Priorities and strategic objectives of the Chairman of the Joint Chiefs of Staff. *Joint Forces Quarterly*, 48(1), 4-5.
- National Science Board. (2010). *Science and engineering indicators 2010* (Report No. NSB 10-01). Arlington, VA: National Science Foundation.
- Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Sciences Education*, 15(5), 625-632.
- Nunnally, J. (1967). Psychometric theory. In E. J. Pedhazur (with L. P. Schmelkin), *Measurement, design, and analysis: An integrated approach* (1991). Mahwah, NJ: Lawrence Erlbaum Associates.
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- Pace, P. (2006). A word from the chairman. *Joint Forces Quarterly*, 40(1), 1-5.
- Panetta, L. E. (2012, January 5). *Defense strategic guidance* [Pentagon press briefing]. Retrieved from <http://www.defense.gov/home/features/travels/depsec.aspx>
- Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: An integrated approach*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Prakash, Y., & Gupta, M. (2008). Exploring the relationship between organisation structure and perceived innovation in the manufacturing sector in India. *Singapore Management Review*, 30(1), 55-76.

- Reigle, R. F. (2003). *Organizational culture assessment: Development of a descriptive test instrument* (Doctoral dissertation). University of Alabama in Huntsville.
- Rentsch, J. R. (1990). Climate and culture: Interaction and qualitative differences in organizational meanings. *Journal of Applied Psychology*, 75(6), 668-681.
- Robbins, S. P., & Judge, T. A. (2009). *Organizational behavior* (13th ed.). Upper Saddle River, NJ: Prentice Hall.
- Roxborough, I. (2000). Organizational innovation: Lessons from military organizations. *Sociological Forum*, 15(2), 367-372.
- Ruiz-Moreno, A. R., Garcia-Morales, V. J., & Llorens-Montes, F. J. (2008). The moderating effect of organizational slack on the relation between perceptions of support for innovation and organizational climate. *Personnel Review*, 37(5), 509-525.
- Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, 37(3), 580-607.
- Sheskin, D. J. (2004). *Handbook of parametric and nonparametric statistical procedures* (3rd ed.). New York: Chapman & Hall/CRC.
- Super, D. E. (1949). *Appraising vocational fitness*. New York: Harper.
- Tsai, M., Chuang, S., & Hsieh, W. (2009). Prioritization of organizational innovativeness measurement indicators using analytic hierarchy process. *The Business Review*, Cambridge, 12(1), 250-256.
- U.S. Navy. (2010). *Navy-wide demographic data for second quarter FY 2010 (01 Jan 10 through 31 Mar 10)*. Millington, TN: Navy Personnel Command, Equal Employment Opportunity.
- Walker, R. M. (2007). An empirical evaluation of innovation types and organizational and environmental characteristics: Towards a configuration framework. *Journal of Public Administration Research and Theory*, 18(4), 591-615.
- Whittinghill, C. (2011). *An evaluation of the perceived organizational culture and innovative climate of a Department of Defense community of organizations* (Doctoral dissertation). University of Alabama in Huntsville.
- Williams, T. M. (2009). Understanding innovation. *Military Review*, 89(4), 59-67.
- Zeller, R. A., & Carmines, E. G. (1980). *Measurement in the social sciences*. Cambridge, UK: Cambridge University Press.

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