



Effects of Institutional and Cultural Barriers on the U.S.
Army's Test and Evaluation Planning

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Abstract

The research develops a model of Army innovation that follows theories on the Social Shaping of Technology. This model highlights the societal forces (cultural, institutional, economic, and social) that influence innovation. The research then examines institutional barriers to innovation by analyzing the content and staffing requirements for developing a Test and Evaluation Master Plan (TEMP). By compounding the content requirements, starting with Department of Defense requirements and working down to Program Executive Office requirements, and determining the type and formality of the requirements will lead to a conclusion on the coercive or enabling nature of the overall requirements. Compounding the staffing requirements with the content requirements creates a composite analysis of the coercive nature of these requirements for development of the TEMP. The research also looks at cultural barriers that effect a team's group intelligence or ability to learn together. Recommendations include balancing staffing and content requirements and creating a culture of psychological safety.

Introduction

The U.S. Army is working to bring modernization and readiness efforts into balance. While the Army's number one priority remains to be ready to fight and win the nation's wars, that priority is intricately woven into the Army's ability to fight and win tomorrow's wars. General Mark Milley and the Honorable Ryan McCarthy released a memorandum highlighting the modernization priorities for the U.S. Army. The memo states "the competitive advantage that the United States has long enjoyed, however, is eroding. We are being challenged in every domain of warfare: land, maritime, air, cyber and space, and the challenges are growing in scale and complexity" (Milley & McCarthy, 2017, p. 1). The memorandum also establishes a streamlined unity of command for modernization efforts that will "enable disruption – the messy, chaotic work that is the hallmark of truly innovative organizations" (Milley & McCarthy, 2017, p. 2).

Modernization and innovation work in unity. The Army must modernize in order to defeat currently unknown threats. Innovation has been said to be "an exercise in the management and reduction of uncertainty" (Kline & Rosenberg, 2010, pp. 275-276). Innovative teams and organizations will accomplish the task of Army modernization. With the formation of a new organization within the Army whose mission is to innovate, questions quickly arise such as what does an innovative organization look like, what are possible barriers or impediments to organizational innovation, and can a bureaucratic organization accomplish wholesale innovation.

Background

The U.S. Army has shown a proclivity for innovation, whether technology, methods, or ideas throughout its history. Jon Hoffman (2009), in *A History of Innovation: U.S. Army Adaptation in War and Peace*, writes “the U.S. Army has a long history of innovation, from the exploits of the Lewis and Clark Expedition at the beginning of the nineteenth century to the medical and engineering advances associated with the construction of the Panama Canal” (p. v). General James McConville and Thomas Kelly confirm this in the forward of the recently published *Army Innovation Strategy*, “the Army has always been an innovative organization” (U.S. Army, 2016). Interestingly enough, this proclivity for innovation is historically greeted by resistance and impediments. Consider two stories of Army innovation:

The M1 Garand rifle

The idea of a semi-automatic rifle as the primary weapon of an infantry soldier was being considered prior to World War I. However, the technology at the time had not matured enough to produce a reliable weapon that would have enough firepower and durability to survive the rugged environments of infantry fighting. John Garand was hired by the Army’s Springfield Armory in 1919, and “he immediately began work on a semiautomatic rifle” (Hoffman, 2009, p. 6). After 17 years of trial and error the Army adopted Garand’s M1 rifle as the standard. Why were Garand’s innovative efforts able to succeed where countless others had failed? Garand experienced the same competition, resistance by the Army and Marine Corps (both were comfortably confident in the Springfield Model 1903 bolt action), and requirements changes (initially working a .276-caliber solution until General MacArthur changed the requirement to .30-caliber in 1932) yet he was able to develop a novel, simple solution to a 30 year old problem.

General Patton, in 1945, “declared ‘the M1 rifle the greatest battle implement ever devised’” (Hoffman, 2009, p. 13).

Armored force organization

In 1920, the U.S. Congress deactivated the Army’s Tank Corps, thus both the infantry and the cavalry began to develop armored forces, equipment and doctrine, independent of each other. During the period between World War I and World War II, the Army’s strategic focus was “fighting a future war primarily with infantry as the main maneuver arm supported by field artillery” (Hoffman, 2009, p. 52). The German blitzkrieg through Belgium and France in 1940 quickly shifted the strategic focus of the Army. A number of Army Generals and Colonels identified the need to consolidate the mechanized forces of the infantry and cavalry into a single force. Resistance came quickly from the cavalry and infantry commanders. In addition, from within the core group of proponents, there was a fierce competition of ideas, yet the Armored Force was established by General Marshall in 1940 and given “responsibility for developing doctrine and for training both units and individuals” (Hoffman, 2009, p. 55). Although tactics, equipment, and organization of the armored forces evolved during the war, the key principle of “allowing small unit commanders to proceed on their own initiative after orders” (Hoffman, 2009, p. 55) remained constant. This innovative flexibility proved to be essential in the success of the Armored Forces and the U.S. Army, from Normandy to Germany. Eventually the Armored Forces would replace the cavalry as a branch of the Army.

The previous vignettes show that while there are similarities to how and why innovation occurs, there appears to be no clear pattern or process that always guides innovation. The M1 Garand appears to be a clear case of what researchers call the heroic inventor who “in a flash of

genius, a radically new idea presents itself almost ready-formed in the inventor's mind" (MacKenzie & Wajcman, 1999, p. 10). The Armored Forces Organization was the result of a collective or team oriented innovation process. Some research (Balconi, Brusoni, & Orsenigo, 2010; Godin, 2005) contends that there is a basic deliberate pattern to innovation occurring in a linear process. Other research (Russell & Williams, 2002; MacKenzie & Wajcman, 1999; Williams & Edge, 1996) hypothesizes that innovation is not a linear or deliberate process but rather a natural result of the societal forces that shape the thoughts of those (individuals or teams) that are being innovative. The thrust of this research is to examine barriers to innovation in teams working within the U.S. Army.

Problem Statement

The bureaucratic organizational structure of the Executive Branch of the Federal Government is in place to hold people "accountable for their actions because they are required to act in accordance with well specified and agreed-upon rules and standard operating procedures" (Jones, 2004, p. 144). The Department of Defense's implementation of a bureaucratic structure contains a definitive hierarchy and regulations. The Army, nested within the Department of Defense, contains a specific hierarchy and regulations, as do each of the organizations within the Army. The Army creates a layering of regulations, guidance, and standardized processes. The hierarchy, denoting divisions of labor and authority, and regulations are in place to ensure adherence to statutory requirements levied by congress. The layering of regulations, guidance, and standardized processes has become the institutional standard and created a distinct culture within the U.S. Army. To understand how the institution and culture of the Army affects team-based innovation, this research examines the layering of regulations and guidance on a Test and

Evaluation Working-level Integrated Product Team (T&E WIPT) within an analysis framework of the social shaping of technology (Williams & Edge, 1996). The Test and Evaluation Master Plan (TEMP) is the primary product of the T&E WIPT and the requirements for the development and approval narrow the focus on regulations and guidance to a single product.

Research Question

What are the impacts of the DOD's, Army's, PEO's, and ATEC's requirements for the development and approval of the TEMP on the T&E WIPT's ability to be innovative and produce a new and novel test strategy that is appropriate for the program?

Research Methodology

The problem with researching a topic such as the impact of bureaucracy on innovation is the plethora of available literature. A quick search using Google Scholar of the search term "impact of bureaucracy on innovation" yields about 273,000 results. By adding the terms "U.S." and "Army," the results narrow to a mere 113,000. The intent of this research is to study innovation by performing a literature analysis on innovation and how it occurs. The research directed a requirements analysis for developing and staffing a TEMP, and an assessment of social and bureaucratic impacts on innovation.

Literature Review Focus and Approach

By performing a literature review of the "journal articles, books, and other documents that describes the past and current state of information" (Creswell, 2015, p. 80) on relevant topics, a picture of the barriers and aids to team innovation began to emerge. Topics reviewed included Army innovation, innovation, bureaucracy and innovation, DOD and Army regulations

concerning the TEMP, and team performance factors. The sequence of the research, begins at innovation to team learning, conducting the sources together to crescendo with recommendations for continuing the Army's "long history of innovation" (Hoffman, 2009, p. v).

Literature chosen on Army innovation focuses on the intent of current Army leadership to drive modernization. Strategic documents, current memoranda, and publications from DOD and Army think tanks form the basis of the literature. Key documents include the *Army Innovation Strategy* and *The Pentagon's Pivot*. The next literature focus area is on innovation.

Understanding what innovation is and how it occurs is necessary to understand how the Army will innovate for modernization. Two competing thoughts on innovation are reviewed – the linear method and social shaping.

The research reviews applicable literature examining the impact of bureaucracy and regulations on innovation to study the barriers and aids to innovation in a bureaucratic organization like the U.S. Army. Adler and Borys (1996) provide a look at enabling and coercive bureaucracies and their associated organizational effects. Dr. Patrick McLaughlin's (2013) testimony to the Senate Judiciary Committee provides examples of the growth of U.S. regulations and the impact of these regulations in terms of human costs.

The research analyzes the requirements for developing and staffing the TEMP by reviewing the DOD and Army directives, instructions, regulations, guides and pamphlets, requirements associated with the development of the TEMP. Internal organizational requirements from ATEC and a Program Executive Office are included in the analysis. Finally, as learning is key to innovation, a search through relevant literature on team learning and performance provided insights into common traits of innovative teams.

Limitations and Recommended Areas of Additional Research

Due to the limited time to complete the research, only a small portion of the available information could be reviewed. One possible area for a follow on study would be to develop a database for T&E WIPT members to provide data on the development and staffing of the TEMP. Metrics on quality turn backs, staffing times, deviations, and waivers would be useful in performing a qualitative analysis on the TEMPs. This qualitative data is missing from this analysis.

A second limitation is a metric on how much innovation is necessary for a TEMP. Testing provides the knowledge necessary to manage “risks, to measure technical progress, and to characterize operational effectiveness, operational suitability and survivability (including cybersecurity), or lethality” (Defense Acquisition University, 2017, p. NP) of a weapon system and there should be repetitive testing. However, the introduction of Design of Experiments into developing test methodologies has shown that there are new and creative ways to sequence test runs to decrease the amount of testing required to get an equivalent analysis. Another future study might research the effects of Design of Experiments on test programs.

Finally, the author’s bias is a limitation. Attempting to remain completely objective, twenty years of experience in Army Research, Development, Test, and Evaluation may bias the research. The reader has been encouraged to examine the evidence presented and root out any bias.

Literature Review

The purpose of this literature review is to research relevant literature associated with team based innovation and the impact of bureaucratic regulation on a team's ability to do "novel or different things intelligently, to produce useful outcomes" (Edmondson, 2003, p. 28). The research discovered thousands of research papers, articles, pamphlets, regulations, briefings, memoranda, and other literature. The following is a review of 29 pertinent documents to this study.

Army Innovation Strategy

In the forward of the *Army Innovation Strategy 2017-2021*, Thomas Kelly and General James McConville, declare that the "Army has always been an innovative organization" (U.S. Army, 2016, p. ii). The document lays out the strategy for the Army to "gain competitive advantage today and into the future by embracing an enduring culture of innovation and entrepreneurship that drives solutions to win in a changing world" (U.S. Army, 2016, p. 1). The strategy comprises five challenges (risk averse culture, programming and resourcing, talent recruitment and management, leadership commitment, and process and outcome alignment) that the Army must overcome in order to achieve its vision for innovation as well as goals and objectives to overcome those challenges.

The Pentagon's Pivot

Adam Harrison (2017), documents how the Defense Industrial Base (DIB) is transitioning from the use of professional requirements developers to lead users developing requirements. Lead users are considered a "source of market research based on their exposure to

experienced needs” and may “serve as agents of minimum viable product development” (Harrison, 2017, pp. 2-3). Harrison concludes that the use of lead users by the DIB is an innovative approach to product development.

An Overview of Innovation

In *Studies on Science and Innovation*, Kline and Rosenberg (2010) write, “an important and useful way to consider the process of innovation is as an exercise in the management and reduction of uncertainty” (pp. 275-276). Defining innovation as the creation of something new in which “the new contains elements that we do not comprehend at the beginning and about which we are uncertain” (Kline & Rosenberg, 2010, p. 294). Two models of innovation are introduced, the Linear Model and the Chain-Linked Model.

In Defence of the Linear Model

Balconi, Brusoni, and Orsenigo (2010) lay out the origins, strengths, and weaknesses of the linear model of innovation. They conclude that while the linear model “is certainly not a general theory of innovation” it “may still be useful, at least in some domains of analysis” (Balconi, Brusoni, & Orsenigo, 2010, p. 12). However, Balconi et al, also highlight the most destructive critique of the linear model, the idea of linearity itself. The model lacks feedback paths to each of the stages, which limits its usefulness as a general theory of innovation.

The Linear Model of Innovation: The Historical Construction of an Analytical Framework

Benoit Godin (2005), in a series of papers on the *History and Sociology of Science and Technology Statistics*, lays out the basic postulates of the linear model of innovation, how the model evolved, and provides a valuable taxonomy of innovation. The linear model describes

innovation as a linear process, beginning with research and concluding in product diffusion.

Godin points out that the DOD was a pioneer in the use of the linear model to manage technology programs. Yet by the 1960's the DOD began to doubt the linear model's usefulness, particularly the idea that basic research shapes innovation (Godin, 2005). However, "efforts to modify or replace the model have been limited with regard to their impact," as the other models which include multiple feedback paths may not be a "useful analytical framework" (Godin, 2005, p. 35).

The Social Shaping of Technology

Williams and Edge (1996) examine the "particular processes involved in innovation," reviewing technological determinism and providing a model of social shaping (p. 1). Early models conceived a linear process, supplemented by feedback, but these models have not been sufficient at portraying the complexity of social (economic and political) forces that affect innovation and technology. Because social shaping of technology emphasizes feedback, "the emerging interactive model conceives innovation as a complex social activity: an iterative or spiral process that takes place through interaction amongst an array of actors and institutions involved and affected" (Williams & Edge, 1996, p. 12).

Introductory Essay: The Social Shaping of Technology

In the introductory essay to *The Social Shaping of Technology*, MacKenzie and Wajcman (1999) present their audience with the idea that technology evolves, not from a linear process, but rather by a process, that includes previous technological innovation and societal forces. MacKenzie and Wajcman (1999) declare that mass media accounts portray technological

innovation occurring and society reacting to that innovation, referred to as technological determinism. However, arguing while previous technologies play a key role in innovation, “technological change is best explained by seeing technology not as outside of society... but as inextricably part of society” (MacKenzie & Wajcman, 1999, p. 20).

Social Shaping of Technology: Frameworks, Findings, and Implications for Policy

In this writing, Russell and Williams (2002) provide a useful summary of social shaping of technology approaches:

- technologies are produced and used in particular social contexts, and the processes of technological change are intrinsically social rather than simply being driven by a technical logic;
- technologies function as such in an immediate setting of knowledge, use practices, skills, meanings and values, problems and purposes, and objects which they act on;
- technologies in many applications are best considered to operate as sociotechnical *systems* or *configurations*;
- technological change is always part of a *sociotechnical* transformation – technology and social arrangements are *co-produced* in the same process. (p. 45)

Russell and Williams (2002) conclude that in its current state, social shaping of technology research may be most useful for policy makers and practitioners, as opposed to researchers, as qualitative research is limited.

Bureaucracy and Innovation

Victor Thompson (1965) studies the relationship between bureaucratic structure and conditions conducive to individual creativity. Thompson (1965) labels bureaucracies focused on production and control ideology as monocratic organizations. Monocratic organizations are hierarchical in nature. In the past, monocratic organizations worked well because leaders were on unequal social standing with their subordinates and technology was simple. Bureaucracies, designed to suppress conflict, can limit creativity and “novel solutions using resources in a new way are likely to appear threatening” (Thompson, 1965, p. 7). In contrast, innovative organizations encourage diverse input, put less emphasis on command and control, and empower their subordinates.

Two Types of Bureaucracy: Enabling and Coercive

Adler and Borys (1996) attempt to reconcile the positive view (provide guidance, clarify responsibilities, ease role stress, and increase worker effectiveness) and the negative view (stifle creativity, breed dissatisfaction, demotivate workers) of bureaucracies. Adler and Borys (1996) narrow the previous work of Gouldner. Gouldner (1954) proposed three patterns of bureaucracy, representative, punishment-centered, and mock bureaucracies, into simply coercive and enabling bureaucracies. Four generic features characterize each type: repair, internal transparency, global transparency, and flexibility. Adler and Borys use these four features to compare coercive bureaucracies to enabling bureaucracies. Concluding that enabling bureaucracies “help committed employees do their jobs more effectively and reinforce their commitment” (Adler & Borys, 1996, p. 83).

On the Human Costs of the U.S. Regulatory System

In his testimony to the Senate Judiciary Committee, Dr. Patrick McLaughlin (2013) documents the growth of federal regulations and provides three particular areas where this growth negatively affects human costs. Dr. McLaughlin's metrics to document regulatory growth are the page count and number of restrictions within the *Code of Federal Regulations*. In 1975, the Code of Federal Regulations contained 71,224 pages of regulations; by 2012, this had grown to 174,545 pages. In 1997, there were around 830,000 restrictions in the Code; by 2012, those restrictions (the use of the words "such as shall, must, and may not") had grown to over a million (McLaughlin, 2013, p. 3). McLaughlin (2013) states that three areas of human cost, innovation and entrepreneurship, unintended consequences to low-income households, and low quality regulations leading to poor execution, suffer from the growth of federal regulation.

The Defense Acquisition System, DODD 5000.01

This Department of Defense directive applies to all acquisition programs throughout DOD. The Defense Acquisition System defined as "the management process by which the Department of Defense provides effective, affordable, and timely systems to the users" (Defense, Department of, 2007, p. 4). The directive states that the Director of Operational Test and Evaluation has the authority to issue Instructions, Publications, and directive-type memoranda. The document also directs "Test and evaluation shall be integrated throughout the defense and acquisition process" (Defense, Department of, 2007, p. 6). While the *Defense Acquisition System* does not address the Test and Evaluation Master Plan (TEMP), subordinate documents do address the TEMP.

Operation of the Defense Acquisition System, DODI 5000.02

This Department of Defense Instruction provides the framework, procedures, and standards for the Defense Acquisition System. DODI 5000.02 states that the Test and Evaluation Master Plan “should generally not be prepared solely for staff review and approval, but be intended primarily for use within the program as planning and management tools that are *highly specific to the program and tailored* to meet program needs” (Defense, Department of, 2017, p. 4). Approval for the Test and evaluation master plan is delegated to Department of Defense Components, except for those programs on the Director of Operation Test and Evaluation Oversight List. The Director of Operational Test and Evaluation must approve those Test and Evaluation Master Plans along with the components. The *Operation of the Defense Acquisition System* provides some content requirements for a Test and Evaluation Master Plan and suggests when a Test and Evaluation Working-level Integrated Product Team (T&E WIPT) should be established. DODI 5000.02 also defines the minimum level of representation in the T&E WIPT from test data stakeholders.

Memorandum for Users of the DOT&E TEMP Guidebook

This memorandum describes the recent updates to the guidebook and provides some guidance on how a Program Manager should prepare and update the TEMP making it the “primary planning and management tool for all test activities starting at Milestone A” (Gilmore, 2017, p. 1). Program Managers are given leeway to deviate from the TEMP format, being advised to “use common sense to apply the guidance to fit your program” (Gilmore, 2017, p. 2)

DOT&E TEMP Guidebook Version 3.1

Pages 1-27 of this guidebook set the structure and provide suggestions on the content for each section and subsections of the Test and Evaluation Master Plan. The guide contains at least twenty-four direct requirements for the structure and content of the TEMP. The remainder of the document, pages 28-235, contain best practices for baseline evaluation, understanding the concept of operations (CONOPS), Design of Experiments, and guidance and examples of Cybersecurity, Defense Business Systems, End-to-End Testing, Force Protection and Personnel Casualties, Integrated Survivability Assessment, and Integrated Testing (Director, 2017, p. 2).

U.S. Army Acquisition Policy, AR 70-1

This regulation is the Army's implementation of *The Defense Acquisition System, DODD 5000.01* and the *Operation of the Defense Acquisition System, DODI 5000.02*. Chapters 5 and 6 are devoted to the Developmental, Operational, and Live Fire Test and Evaluation of Army acquisition programs. According to the policy, the following positions have approval authority for the Test and Evaluation Master Plan: the Army T&E Executive (OSD oversight programs, ACAT 1C, and II) and the Milestone Decision Authority (non-OSD oversight programs). For both developmental and operational testing the "T&E WIPT resolves issues and assists Army MATDEVs in developing and coordinating the documented TEMP" (U.S. Army, 2017, p. 16).

U.S. Army Test and Evaluation Policy, AR 73-1

This regulation is the Army's implementation of the test and evaluation requirements contained within *The Defense Acquisition System, Operation of the Defense Acquisition System*, and the *U.S. Army Acquisition Policy*. The material developer charters the T&E WIPT for all

army acquisition systems, regardless of ACAT level, “as soon as practical after the Material Development Decision” (U.S. Army, 2016, p. 2). The T&E WIPT’s purpose is the development of T&E strategy and documentation of that strategy in the TEMP. Chapter 8 of the document provides details on the role and composition of the T&E WIPT.

According to the U.S. Army Test and Evaluation Policy, the TEMP “provides a framework for the delivery of the data and information, along with the goals and objectives of each data source (that is, tests, models, simulations, and analyses), which are used to provide the scope for resources and timelines” (U.S. Army, 2016, p. 1). A TEMP is required for all Army acquisition programs except those detailed in paragraphs 10-2c(8) and 10-2c(9). Chapter 10-2 contains more information on the approval authority, purpose, and contents at each acquisition milestone for the TEMP.

Test and Evaluation in Support of Systems Acquisition, DA Pam 73-1

This pamphlet establishes guidance and procedures for implementing the *U.S. Army Test and Evaluation Policy*. Chapter 2 establishes the membership, role, and the document review process of the T&E WIPT. Chapter 3 provides “procedural guidance for preparing, staffing, and gaining approval of the TEMP” (U.S. Army, 2003, p. 15). The format of the TEMP is tailorable to the programs T&E strategy. Appendix C of *Test and Evaluation in Support of Systems Acquisition* gives examples of TEMP approval page formats.

System Test and Evaluation Policy, ATEC 73-1

This U.S. Army Test and Evaluation Command (ATEC) regulation sets the policy and guidance for developmental, operational, and integrated test and evaluation of Army acquisition

systems. The policy establishes the ATEC System Team (AST) to “ensure coordination of all actions related to a system’s T&E” (ATEC, 2013a, p. 8). The AST provides input to the TEMP, participates in the T&E WIPT, and develops the System Evaluation Plan. The AST chair signs the coordination page of the TEMP. The Commanding General of ATEC signs the TEMP for all oversight programs. The Director of the Army Evaluation Command will sign the TEMP for non-oversight programs.

System Test and Evaluation Procedures, ATEC Pam 73-1

This pamphlet establishes guidance and procedures for implementing ATEC’s *System Test and Evaluation Policy*. Chapter 2-19 details the responsibilities, core membership, and procedures of the AST. Chapter 3-15 details how the AST provides input and comments on the TEMP as well as the staffing and approval process of the TEMP. The System Test and Evaluation Procedures provides the ATEC internal signature authority for the TEMP (ATEC, 2013b).

PEO GCS Test and Evaluation Master Plan Standard Operating Procedure

This Standard Operating Procedure from Program Executive Office Ground Combat Systems (PEO GCS) provides an overview of the PEO’s TEMP development SOP and the approval process for getting PEO approval of the TEMP. The PEO provides a TEMP Template and Checklist to the Program Managers to develop their program specific TEMP (GCS, 2013). The Standard Operating Procedure details 32 steps to develop, generate, and conduct TEMP reviews for final approval of the TEMP.

What Google Learned from its Quest to Build the Perfect Team

Charles Duhigg (2016) documents the research and analysis that Google performed to discover why some teams excelled and others do not. Google's research team, called Project Aristotle, learned that a group's norms were influential in a team's ability to be successful. However, there was no clear grouping of norms to produce successful teams. As Google continued the study, two patterns of behavior were always associated with the 'good' groups: "team members spoke in roughly the same proportion" and "they were skilled at intuiting how well others felt based on their tone of voice, their expressions and other nonverbal cues" (Duhigg, 2016, p. NP). These two traits are characteristics of psychological safety or "a sense of confidence that the team will not embarrass, reject or punish someone for speaking up" (Duhigg, 2016, p. NP).

Evidence for a Collective Intelligence Factor in the Performance of Human Groups

As psychology has shown that there is a measurable factor of general intelligence, is there also a measurable factor of collective intelligence when groups work together on cognitive tasks? Woolley, Chabris, Pentland, Hashmi, and Malone (2010) performed two studies with 699 people working in small groups and found converging evidence of a collective intelligence factor. The factor was not associated with the general intelligence of each of the group members. Rather, the factor was associated with three traits: "average social sensibility of the group members," "equal distribution in conversational turn-taking," and the "proportion of females in the group" (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010, p. 688).

Psychological Safety and Learning Behavior in Work Teams

Amy Edmondson (1999) performed a study of 51 work groups to examine “what extent and under what conditions learning occurs naturally in organizational work groups” (p. 351). The study showed that learning behavior in teams is “highly dependent on psychological safety” (Edmondson, 1999, p. 376). Ms. Edmondson defines team psychological safety as “a shared belief that the team is safe for interpersonal risk taking” (Edmondson, 1999, p. 354). Team psychological safety goes beyond trusting teammates. Team psychological safety portrays a team climate of trust and respect where people are secure in being themselves. Supportive, coaching-oriented team leadership, where a leader has non-defensive reactions to candid questions and challenges, enhances team psychological safety and facilitates team learning.

Psychological Safety, Trust, and Learning in Organizations

Edmondson (2003) continues research into the effects of team psychological safety by differentiating the term from trust. Edmondson provides a model of antecedents and consequences that can be used to understand characteristics that must exist in order to provide “a climate in which people are comfortable being and expressing themselves” (Edmondson, 2003, p. 1) and the expectations when team psychological safety is present. Edmondson explores the impact of team psychological safety on innovation, suggesting that team psychological safety may influence the quality and quantity of innovation. Concluding that there is “an important role for psychological safety in facilitating collaborative work, in particular when work groups face uncertainty and change and need to learn together” (Edmondson, 2003, p. 37).

Organizational Structuring and Project Team Structuring in Integrated Product Development Project

Investigating the impact of project team structuring in managing integrated product development projects, Rauniar and Rawski (2012) identify two organizational structures and three project structures helpful in reducing design glitches, development cost, and development time. The two organizational structures are Project Strategic Fit and Heavyweight Product Manager. The three project team structures are Shared Project Mission, Clear Project Targets, and Team Integration. Rauniar and Rawski find that “integrated cross-functional teams adopt functional behaviors that can eliminate waste, duplication and unnecessary processes” and recommend that managers “allow such teams to be readily involved in joint problem solving activities” (2012, p. 948) for optimal solutions.

Analysis & Findings

During the literature review of relevant topics, a picture of the barriers and aids to team innovation began to emerge. The literature analysis assisted in determining the Army’s leadership definition of innovation and academia and industry’s definition of innovation. The analysis then compares the two. The analysis follows a sequence to discover how innovation occurs, effects of bureaucracy on innovation, a survey of the requirements for creating a TEMP, possible influences on the T&E WIPT, and impacts on team performance.

Army Innovation

The *Army Innovation Strategy 2017-2021* declares innovation to be “the result of critical and creative thinking and the conversion of new ideas into valued outcomes” and “the specific

tool of entrepreneurs, the means by which they exploit change as an opportunity” (U.S. Army, 2016, p. 1). Taken together, these statements indicate that, to the Army, innovation is both a system and an instrument. Rehtin (1991) defines a system as “a set of different elements so connected or related as to perform a unique function not performable by the elements alone” (p. 7). Inputs to the system are critical and creative thinking and the system output is ‘valued outcomes.’ As an instrument, innovation exploits the right change at the right occasion. Therefore, Army innovation is critical and creative thinking producing useful change at the appropriate time.

Exploring the idea of Army innovation further, one could envision a model with inputs and outputs. If Army innovation behaves as a stable function, changes to the inputs should create predictable outputs. Figure 1 is a simple representation of that model. Critical thinking, “a process of assessing or judging” (Paul & Elder, 2008, p. 4) and creative thinking, thinking that “masters a process of making or producing” (Paul & Elder, 2008, p. 4), are the inputs to the model. A useful change, a product, method, or process that is different than what is currently available and fulfills mission needs, is the output of Army innovation. While overly simplistic, the model will serve in continuing a discussion on innovation.



Figure 1. Model of Army innovation as a system. Critical thinking and creative thinking are the inputs and useful change is the output of Army innovation. Currently the process that is Army innovation is undefined.

Army innovation is occurring all the time, but the pace of the innovation is questionable (Harrison, 2017; Milley & McCarthy, 2017; U.S. Army, 2016), especially in the arena of new product development (NPD). The model in Figure 1, while helpful in visualizing inputs and outputs of Army innovation, does not give insight as to what drives the pace of innovation. In order to understand the pace of Army innovation an exploration into the process that is Army innovation must be completed. The Army must neutralize a threat that is evolving “at the pace of Moore’s Law” (Harrison, 2017, p. 1), yet “simply initiating military NPD can take years to accomplish” (Harrison, 2017, p. 5). Moore’s Law is the principle that the number of transistors in an integrated circuit will double every 2 years (Moore, 1965). To understand the process of Army innovation, a shift to academic research is required.

Innovation Defined

A simple google search of *innovation definition* yields 414,000,000 results. Narrowing down a single definition of innovation is tricky. Nick Skillicorn (2016) interviewed 15

innovation experts asking them to provide their definition of innovation, performed data analytics on the answers, and provides a composite definition of innovation. The composite definition of innovation is “executing an idea which addresses a specific challenge and achieves value for both the company and the customer” (Skillicorn, 2016, p. NP). Edmondson (2003) provides a definition for innovative behavior as “doing novel or different things intelligently, to produce useful outcomes” (p. 28). Comparing these definitions with the one of Army innovation above, congruencies emerge. All contain cognitive actions (thinking, ideas, and intelligence) that produce something that is valuable or useful.

Innovation and technology growth models

While the convergence of definitions are helpful to see that the Army, Industry, and Academia are using a similar language, the definitions do not address barriers or aids that can affect the pace of innovation. In order to explore the pace of innovation more thoroughly, an examination of how innovation occurs needs to be undertaken. Researchers (Balconi, Brusoni, & Orsenigo, 2010; Godin, 2005) contend that there is a linear, deliberate pattern to innovation. Other researchers (Russell & Williams, 2002; MacKenzie & Wajcman, 1999; Williams & Edge, 1996) posit that innovation is not a linear process but rather a result of the societal forces that shape the thoughts of those innovating.

Linear model of innovation

The linear model of innovation describes innovation as a system with at least four distinct phases: Basic Research, Applied Research, Development, and Production/Diffusion (Balconi, Brusoni, & Orsenigo, 2010; Godin, 2005). The model has been very influential through the years, often used to justify “government support to science” (Godin, 2005, p. 4). Believing that

investing in research would drive innovation, post-World War I saw a rapid expansion of industrial research. Governments were aiding this expansion and “in the United States, it was the newly created National Research Council that gave itself the task of promoting industrial research” (Godin, 2005, p. 9). The U.S. Department of Defense began “using the linear model to manage its programs” (Godin, 2005, p. 34) by the 1950’s.

The linear model depicts a division of labor where “basic research is conducted in universities and public laboratories, while applied research and technological development are carried out by firms” (Balconi, Brusoni, & Orsenigo, 2010, p. 5). Figure 2 presents the linear model applied to the Army innovation Model from Figure 1. As a generic representation of innovation, this model appears applicable.

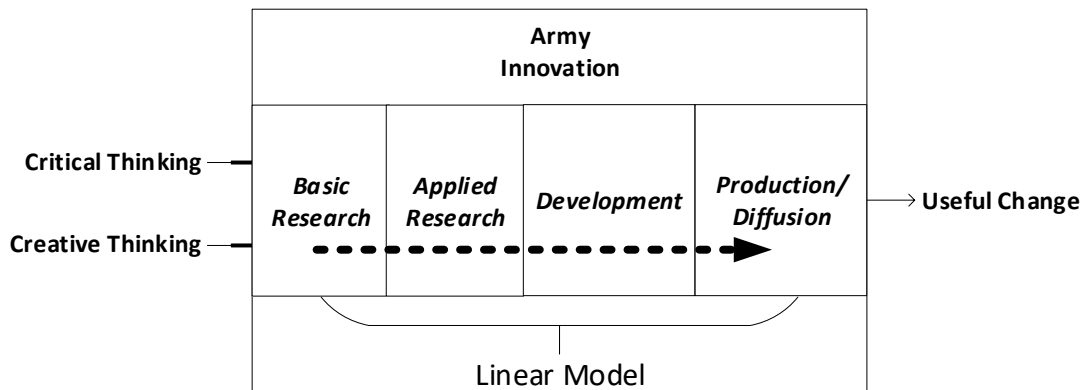


Figure 2. Model of Army innovation with the Linear Model. Critical thinking and creative thinking are the inputs and useful change is the output of Army innovation. Applying the linear model, the flow from basic research to production/diffusion is displayed as a linear progression.

However, “the linear model distorts the reality of innovation” (Kline & Rosenberg, 2010, p. 286). A common critique of the linear model is the absence of feedback paths between any of the phases. This distortion of reality overlooks the fact that innovation “demands feedback, and effective innovation demands rapid, accurate feedback with appropriate follow on actions” (Kline & Rosenberg, 2010, p. 286). Another criticism is that the linear model posits that science is central to innovation. While “it is moot whether science has depended more on technological processes and products than innovation has depended on science” (Kline & Rosenberg, 2010, p. 287). The fact remains that much innovation has occurred because of feedback from problems during implementation of the innovation. Therefore, the idea that research initiates innovation “is wrong most of the time” (Kline & Rosenberg, 2010, p. 288). By the mid-1960’s the Department of Defense was “beginning to question aspects of the linear model” (Godin, 2005, p.

34). Yet management of defense acquisition programs still use the principles of the linear model.

Social shaping of technology

Continued innovation research shows “that technology does not develop according to an inner technical logic but is instead a social product, patterned by the conditions of its creation and use” (Williams & Edge, 1996, p. 2). Social shaping of technology stresses choices in both the design and direction of innovation, describing innovation as “a garden of forking paths” (Williams & Edge, 1996, p. 2) where different routes may lead to different or similar outcomes. Stressing the negotiability¹ and irreversibility² of technology, social shaping of technology investigates the ways in which social, institutional, economic and cultural factors have shaped:

- i. the direction as well as the rate of innovation
- ii. the form of technology: the technological artefacts and practices
- iii. the outcomes of technological change for different groups in society. (Williams & Edge, 1996, p. 4)

Contrasted to the linear model, social shaping stresses feedback in innovation, where “learning by struggling” (Williams & Edge, 1996, p. 11) is involved in “a spiraling rather than a linear process” (p. 12). The resulting iterative model regards innovation as a complex social

¹ Negotiability of technology: “the scope for particular groups and forces to shape technologies to their ends and the possibility of different kinds of technological and social outcome” (Williams & Edge, 1996, p. 2).

² Irreversibility of technology: “the extent and manner in which choices may be foreclosed” (Williams & Edge, 1996, p. 2).

activity of iterative processes taking place amongst a litany of factors: social, economic, culture, and institutional. A visual representation might now move from that of a box driven, sequential process map, as in Figure 2, to that of a spiraling tornado. Figure 3 shows Army innovation as a tornado where critical and creative thinking along with social, culture, economic, and institutional forces all work together to leave a path of useful change. Critical and creative thinking are the moisture that fuels the tornado. Social forces create an unstable atmosphere ripe for circulation and economic forces provide the lift to begin circulating warm moist air with cooler air at altitude. The final innovation forces, culture and institutional, are likened to wind shear and near surface environment, both of which are required for a tornado to spawn from a simple thunderstorm (Carter, 2015).

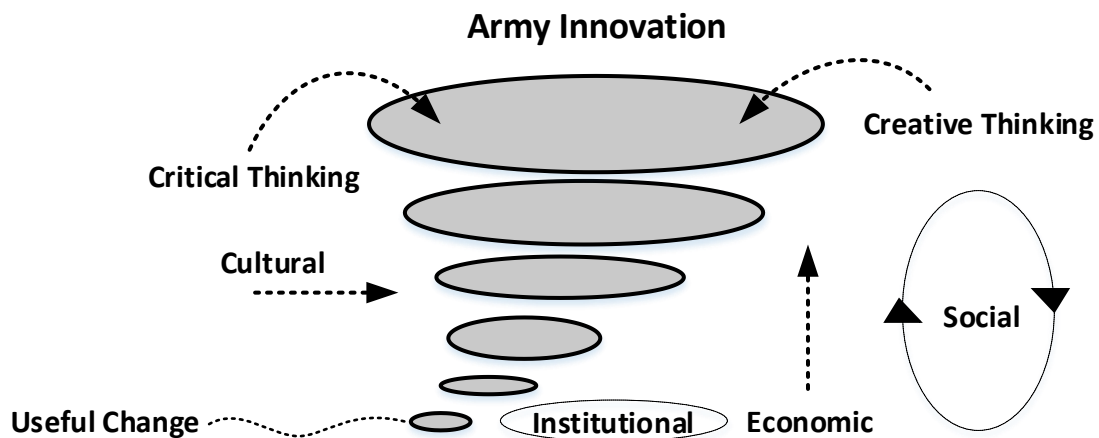


Figure 3. Model of Army innovation as socially shaped. Critical and creative thinking, cultural, social, institutional, and economic forces fuel Innovation, represented as a tornado.

Russell and Williams (2002) write that “social shaping of technology is, in almost all the cases we know of, a process in which there is no single dominant shaping force” (p. 28). Social,

institutional, cultural, and economic forces are all present in shaping innovation, but there is no determinate force in producing useful change. However, each force needs assessment to provide barriers and aids to innovation from the perspective of the force examined.

Critical and creative thinking

Soldiers, civilians, industry, and academic partners of the U.S. Army provide the basic elements of critical and creative thinking. As early as 1991, the Army Management Staff College redesigned the curriculum to begin “teaching for thinking” (Eichhorn, ND). By 2006, the Army War College followed suit, revamped the curriculum to include critical and creative thinking (Allen & Gerras, 2009). Critical and creative thinking are now the bedrock for Army education including the Civilian Education System. Further discussion of this part of the model is not applicable to this research.

Social and economic forces

The social force that compels innovation is generated by the society, or “a collection of individuals united by certain relations or mode of behavior” (Definitions of Society, 2018) in which the innovation occurs. For this study on Army innovation, the United States is the social boundary. A review of the United States social structure exceeds the scope of this research. Therefore, this research does not address the social forces of the model.

The economic forces are the choices that define “how society uses its scarce resources” (The Economist, 2018, p. NP). Because “economic ‘laws’ are, after all, specific to particular forms of society, not universal” (Russell & Williams, 2002, p. 22), the dominant economic force affecting Army innovation is the economy of the United States and the U.S. Army budget. The

complexities and intertwining of the Army budget with the U.S. economy are also outside the scope of this research.

Institutional and cultural forces

Miller (2011) defines institutions as “complex social forms that reproduce themselves such as governments, the family, human languages, universities, hospitals, business corporations, and legal systems” (p. NP). The U.S. Army is the institution. By examining the bureaucratic regulations and processes of the Army, impacts to innovation emerge. The second force studied is culture. A common definition of culture is:

“A pattern of basic assumptions – invented, discovered, or developed by a given group as it learns to cope with the problems of external adaptation and internal integration – that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.”

(Schein, 1985, p. 9)

This research explores both the institution and culture of the Army, forces within the control of Army leadership, to determine how each hinder or help innovation.

Institutional Barriers to Innovation

Bureaucracies, such as the Department of Defense and the U.S. Army are designed to allocate authority and control resources (Jones, 2004, p. 144). As such, both are conservative in nature and “more concerned with the internal distribution of power and status than with organizational goal accomplishment” (Thompson, 1965, p. 7). Innovation, or novel ideas, is threatening to bureaucracies (Thompson, 1965). Bureaucratic organizations have had to resort to segregating innovative units from the rest of the organization. This separation often results in

“two sets of conditions, two systems of rewards... one for innovation, the other for the rest of the organization’s activities” (Thompson, 1965, p. 8).

However, Adler and Borys (1996) posit there are actually two types of bureaucracies, enabling and coercive. In an organization the size of the U.S. Army, both may exist. Adler and Borys examine the philosophy behind automation equipment design and determine two rationales: “Equipment can be designed with a fool-proofing and deskilling rationale... alternatively, it can be designed with a usability and upgrading rationale” (Adler & Borys, 1996, pp. 67-68). The deskilling rationale sees labor as a source of problems and errors whereas the upgrading rationale sees labor as a source of skill, intelligence, and can intervene to rectify problems. Adler and Borys (1996) apply this examination to organizational design, stating that a coercive bureaucracy deskills the labor force and an enabling bureaucracy creates skilled labor.

By examining the formal procedures of an organization, the type of bureaucracy can be determined. An enabling organization views procedures as “valuable resources that help professionals meet clients’ needs” (Adler & Borys, 1996, p. 69). Whereas coercive organizations design procedures “to force reluctant compliance and to extract recalcitrant effort” (Adler & Borys, 1996, p. 69).

In his testimony to the Senate Judiciary Committee, Dr. Patrick McLaughlin (2013) uses the growth of the Code of Federal Regulations, from 71,224 pages of regulation in 1975 to 174,545 pages of regulation in 2012, to discuss the impact of regulation in terms of human costs. McLaughlin states, “accumulation of regulations stifles innovation and entrepreneurship and reduces efficiency” (McLaughlin, 2013, p. 2). In particular, inflexible regulations and those that

impose specific technologies “offer no incentive or ability for companies to find alternative solutions” (McLaughlin, 2013, p. 6).

A coercive, formalized structure compounded with inflated regulations limit innovation. In order to dive deeper, a single product, the Test and Evaluation Master Plan, requirements are analyzed to determine if the process is coercive and over burdensome or enabling and incentivizing.

Requirements Analysis of the TEMP

The requirements analysis for the TEMP contains two parts, content requirements and approval requirements. The content requirements govern the format and structure as well as the topics to be covered. The approval requirements govern the review cycles and signatures needed for TEMP approval at each milestone. The paper assesses the content and approval requirements for each governing document against Adler and Borys’ (1996) typology of organizations shown in Figure 4.

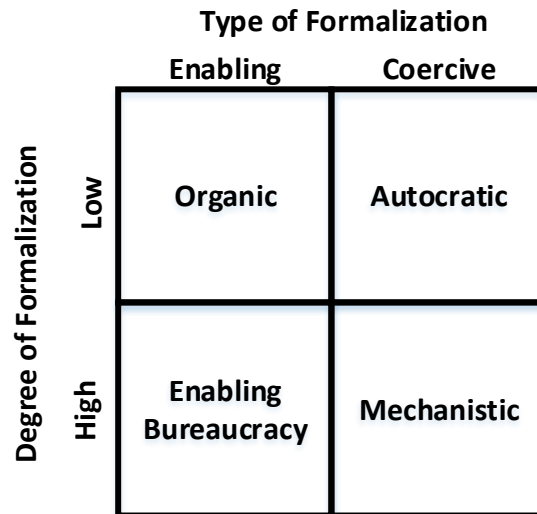


Figure 4. Adler and Borys (1996, p. 78) *Typology of Organizations*. From “Two Types of Bureaucracy: Enabling and Coercive,” by Paul S. Adler and Bryan Borys, 1996, *Administrative Science Quarterly*, p. 78.

TEMP content requirements

The first set of documents examined are the DOD documents that govern how the Army must document the T&E strategy: *Operation of the Defense Acquisition System, Memorandum for Users of the DOT&E TEMP Guidebook*, and *DOT&E TEMP Guidebook Version 3.1*. The number of shall, should, and will statements were tallied for each document, and the composite results are used, along with the type of requirements, to determine the typology the Army is held to for development of the TEMP. Table 1 details the number of requirements, represented by shall, should, and will statements, levied by the DOD requirements documents for the content of the TEMP.

Table 1
DOD Requirements for the TEMP

	<i>Operation of the Defense Acquisition System</i>	<i>Memorandum for Users of the DOT&E TEMP Guidebook</i>	<i>DOT&E TEMP Guidebook Version 3.1.</i>	<i>Total</i>
Shall	0	0	2	2
Should	8	13	13	34
Will	51	7	62	120
Totals	59	20	77	156

Note. Numbers may not be exact as each were determined to be associated with the development of the TEMP as opposed to the management of the TEMP.

The DOD requirements for the TEMP encourage tailoring each TEMP in accordance with the individual needs of a program. In particular, Dr. Gilmore (2017) writes, “Strict or immediate adherence to the new TEMP is not required. Use common sense to apply the guidance to fit your program” (p. 2). Compiling the amount of formal requirements, along with the guidebook detailing the structure and format of the TEMP leads to a high degree of formalization. The language, particularly in Dr. Gilmore’s memorandum, is enabling. The resultant typology is enabling bureaucratic requirements from the DOD, shown in Figure 5.

		Type of Formalization	
		Enabling	Coercive
Degree of Formalization	Low		
	High	Enabling X	

Figure 5. DOD TEMP Requirements Typology. Adapted from Adler and Borys (1996, p. 78)

Typology of Organizations. The DOD requirements for the content of the TEMP are formal in nature, but allow for tailoring and encourage a common sense approach that is enabling.

The next set of documents examined are the Army documents that govern how Army program managers must document the T&E strategy: the *Army Acquisition Policy*, *Test and Evaluation Policy*, and *Test and Evaluation in Support of Systems Acquisition*. As with the DOD documents, the number of shall, should, and will statements were tallied for each document, and the composite results are used, along with the type of requirements, to determine the typology the Army has established for development of the TEMP.

Table 2

Army Requirements for the TEMP

	<i>Army Acquisition Policy</i>	<i>Test and Evaluation Policy</i>	<i>Test and Evaluation in Support of Systems Acquisition</i>	<i>Total</i>
Shall	0	0	0	0
Should	0	6	26	32
Will	0	20	35	55
Totals	0	26	61	87

Note. Numbers may not be exact as each were determined to be associated with the development of the TEMP as opposed to the management of the TEMP.

As with the DOD documents, the Army documents encourage tailoring of the TEMP. However, contrasted with the DOD, where common sense was to be used to determine the format and level of detail necessary to communicate the test and evaluation strategy of the program (Gilmore, 2017, p. 2), the Army policy requires adherence to a single TEMP format (U.S. Army, 2003, p. 25). While allowing some tailoring is certainly enabling, the extra restriction certainly is more controlling or coercive than the DOD typology.

		Type of Formalization	
		Enabling	Coercive
Degree of Formalization	Low		
	High	Enabling X	

Figure 6. Army TEMP Requirements Typology. Adapted from Adler and Borys (1996, p. 78)

Typology of Organizations.

As the T&E executive agent for the Army, the Army Test and Evaluation Command (ATEC) provides input to the TEMP through the ATEC Systems Team (AST). The ATEC documents examined establish the ASTs responsibility for influencing the TEMP: *System Test and Evaluation Policy* and *System Test and Evaluation Procedures*. The number of shall, should, and will statements were tallied for each document, and the composite results are used, along with the type of requirements, to determine how ATEC influences the organizational typology of the T&E WIPT developing the TEMP.

Table 3

ATEC Requirements for the TEMP

	System Test and Evaluation Policy	System Test and Evaluation Procedures	<i>Total</i>
Shall	0	0	0
Should	0	0	0
Will	5	5	10
Totals	5	5	10

Note. Numbers may not be exact as each were determined to be associated with the development of the TEMP as opposed to the management of the TEMP.

Because of the low number of requirements, along with the fact that many of the requirements are duplicative, the ATEC influence on the typology is minimal. This is likely a resultant of hierarchical control by the formalized requirements and as such, the resultant organizational typology as shown in Figure 7.

		Type of Formalization	
		Enabling	Coercive
Degree of Formalization	Low		
	High	Enabling X	

Figure 7. ATEC TEMP Typology. Adapted from Adler and Borys (1996, p. 78) Typology of Organizations.

Finally, a look at a single Program Executive Office’s TEMP requirement documents completes the requirements analysis. Examining the *PEO Ground Combat Systems TEMP Standard Operating Procedure* to determine the PEO’s influence on the organizational typology for developing the TEMP. The number of shall, should, and will statements were tallied and displayed in Table 4.

Table 4
PEO GCS Requirements for the TEMP

	PEO GCS TEMP SOP
Shall	0
Should	0
Will	18
Totals	18

Note. Numbers may not be exact as each were determined to be associated with the development of the TEMP as opposed to the management of the TEMP.

The PEO requirements are organized as a formal task list, increasing the formality of the organizational typography. However, the task list is simply a checklist reverberating the requirements from the previous documents, therefore not influencing the type of formalization. The resultant typology is in Figure 8.

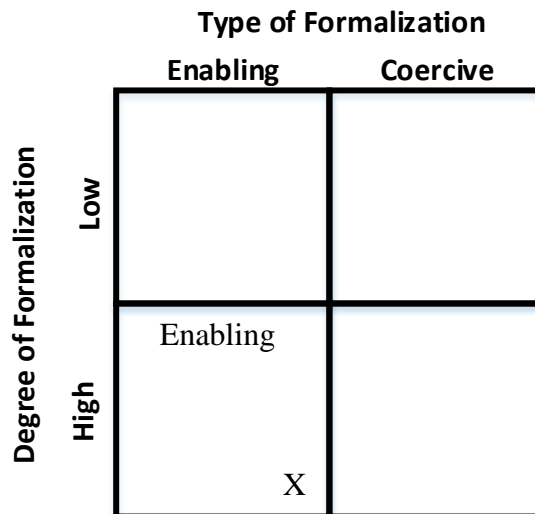


Figure 8. PEO GCS TEMP Typology. Adapted from Adler and Borys (1996, p. 78) Typology of Organizations.

There are 271 requirements, albeit not all are unique, that a T&E WIPT must sort through to develop a TEMP. Table 5 lays out where in the bureaucracy these requirements originate. Figure 9 displays how each layer of requirements increase the degree and type of formalization. A reasonable inference, per Adler and Borys (1996) is that as the Army increases the degree and type of formalization, innovation is limited.

Table 5
Composite Requirements for TEMP

	<i>DOD</i>	<i>Army</i>	<i>ATEC</i>	<i>PEO GCS</i>	<i>Total</i>
Shall	2	0	0	0	2
Should	34	32	0	0	66
Will	120	55	10	18	203
Totals	156	87	10	18	271

Note. Numbers may not be exact as each were determined to be associated with the development of the TEMP as opposed to the management of the TEMP.

		Type of Formalization	
		Enabling	Coercive
Degree of Formalization	Low		
	High	Enabling 1 2,3 4	

Figure 9. Composite TEMP Typology. Adapted from Adler and Borys (1996, p. 78) Typology of Organizations. 1-DOD Requirements, 2- Army Requirements, 3- ATEC Requirements,. 4- PEO Requirements.

TEMP approval process

Along with the amount of requirements, the quantity of approval layers is also an indication of the coerciveness of an organization. Figure 10 is a simplified visual representation of the approval flow of the TEMP, for programs that are not on the OSD oversight list. In this flow, each of the T&E WIPT members have already reviewed and approved the document. Each decision point in figure 10 is an opportunity for control and coercion, and that is when only a single signature is required. In reality, each decision point requires multiple approvals at each stage.

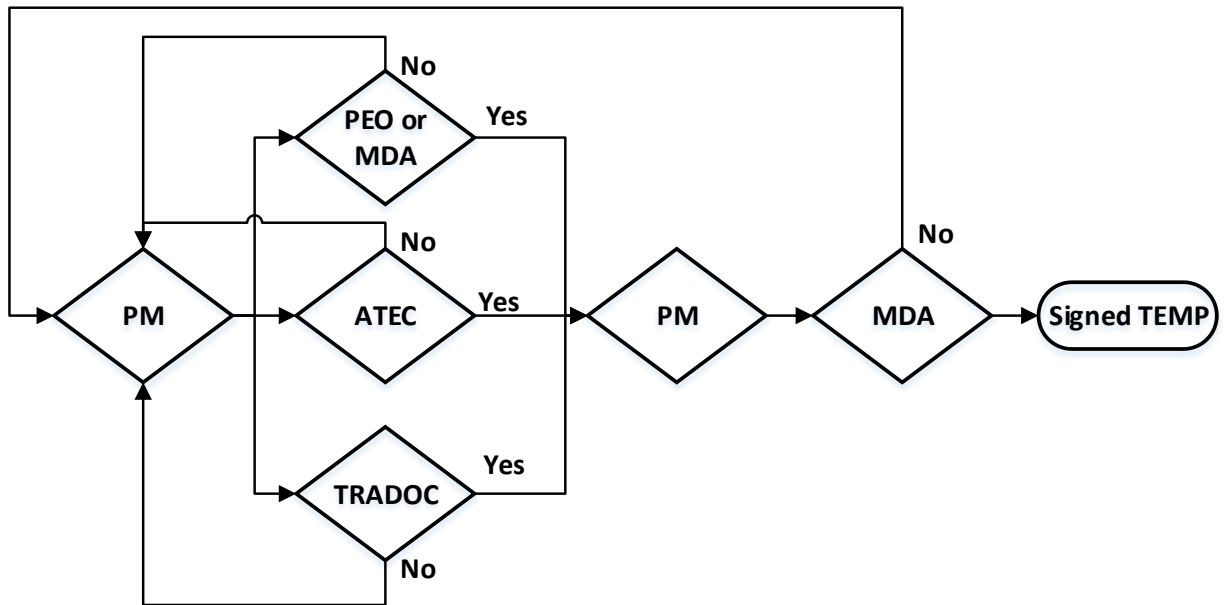


Figure 10. Non-DOD Oversight TEMP Approval Flow. Adapted from the language in *System Test and Evaluation Procedures* (ATEC, 2013b, p. 92).

By adding additional layers of approval at each decision point in the approval process, a more coercive environment is established. Research did not produce routing slips for each approval step so this is unknown. However, seldomly does a document touch a general officer's or senior executive service member's desk without going through their staff. A reasonable assumption would be at least two additional reviewers per major decision point, which would yield 12 opportunities for a returned TEMP to the PM "to force reluctant compliance and to extract recalcitrant effort" (Adler & Borys, 1996, p. 69). The resultant organizational typology is that of a mechanistic, coercive bureaucracy as shown in Figure 11.

		Type of Formalization	
		Enabling	Coercive
Degree of Formalization	Low		
	High		Mechanistic X

Figure 11. *Resultant, Requirements + Approvals, Typology*. Adapted from Adler and Borys (1996, p. 78) *Typology of Organizations*. Multiple layers of requirements and approvals at the institutional level, a mechanistic coercive institution emerges as a barrier to innovation.

Cultural Barriers to Innovation

Group or collective intelligence is “the general ability of the group to perform a wide variety of tasks” (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010, p. 687). Wooley, Chabris Pentland, Hashmi, and Malone (2010) researching group performance discovered a general collective intelligence factor (c). The intelligence factor, similar to the general intelligence factor or IQ, correlated significantly with two cultural factors. The two cultural factors were “average social sensitivity” and “variance in the number of speaking turns by group members” (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010, p. 688).

In 2012, Google’s People Analytics division began to study Google’s teams to understand characteristics that constitute a successful team. The study, Project Aristotle, began

reviewing data and literature on how teams function as well as gathering data on Google teams. After combing through data on hundreds of teams, two consistent cultural factors emerged “average social sensitivity” and “equality in distribution of conversational turn-taking” (Duhigg, 2016, p. NP). Both of these cultural factors are factors of what psychologist call psychological safety. Much like the Wooley, et al. (2010) study, Google discovered that a culture of “psychological safety, more than anything else, was critical to making a team work” (Duhigg, 2016, p. NP).

Amy Edmondson (1999) defines psychological safety as “a shared belief held by members of a team that the team is safe for interpersonal risk taking” (p. 350). Asking for help, admitting to errors, and discussing problems are learning behaviors in an innovative environment. A culture that encourages interpersonal risk taking and participation “promotes innovative behavior and innovation” (Edmondson, 2003, p. 30).

Leadership and organizational structure also influence innovation. Effective team leaders integrate their teams and serve as consistent translators of the team’s task or mission (Rauniar & Rawski, 2012). A leader clarifying project tradeoffs “not only help in identifying the best solution for design problems, but also help to identify new opportunities” (Rauniar & Rawski, 2012, p. 943). The organizational structure must facilitate cross-functional integration through strategic fit. Members must recognize the necessity to overcome “myopic, selfish behavior” where team members “fail to perceive and take into consideration each other’s views” (Rauniar & Rawski, 2012, p. 944).

Conclusions & Recommendations

The Army's innovation vision states: "The Army gains competitive advantage today and into the future by embracing an enduring culture of innovation and entrepreneurship that drives solutions to win in a changing world" (U.S. Army, 2016, p. 1). If innovation is the result of critical and creative thinking within appropriate social, economic, institutional, and cultural environmental conditions, the Army must understand the environmental conditions to create an "enduring culture of innovation." By reviewing two of the environmental conditions, institutional and cultural, this research proposes the following recommendations.

Recommendation 1: The Army must strike a balance between formal procedures and the levels of approval. Formal procedures can be enabling, especially when it is implicit that the procedure is there as a guide. However, by increasing the levels of approval required to indicate completion of a procedure, the more coercive the procedure becomes the ability to innovate shrinks. If a procedure must be overly formal and prescriptive, relatively few approvals should be required. If the procedure is more abstract in nature, approval levels may increase but without increasing the coercive burden. The research recommends the following actions:

- Department of the Army review the approval/concurrence requirements for the TEMP. Recommend the Milestone Decision Authority delegate approval of the TEMP to the PM when appropriate.
- Department of the Army review of all major Army acquisition doctrine from a risk/opportunity perspective. Determine the risk/opportunity of relaxing or increasing the prescriptiveness of the doctrine. Based on the results risk/opportunity analysis, set the appropriate formality levels of the doctrine and associated approval levels.

Recommendation 2: Leadership must create a culture of psychological safety. Team and organizational leaders must nurture risk taking and encourage active participation in order to harness the entrepreneurial spirit necessary for innovative solutions. Leaders must create and lead integrated cross-functional teams where the leader clearly communicates the team's task, mission, and project trade space. The research recommends the following actions for leadership at various U.S. Army organizations who seek to be innovative:

- Use command climate surveys to assess leadership traits that support innovation.
- Consider survey results in Officer Evaluation Reports and Civilian Performance Appraisals.
- Create a *Leading Innovation* program where senior leaders are educated in the culture of innovative organizations, leading in uncertainty, and leading cross-functional teams. Tailoring the program for front line supervisors through organizational leaders.

In conclusion, for the Army to achieve balance between modernization and readiness efforts, the Army must “enable disruption – the messy, chaotic work that is the hallmark of truly innovative organizations” (Milley & McCarthy, 2017, p. 2). Innovation, “an exercise in the management and reduction of uncertainty” (Kline & Rosenberg, 2010, pp. 275-276) requires the components of critical and creative thinking within an appropriate social, economic, institutional, and cultural environment. From an institutional perspective, the Army must balance the formal nature of procedures and doctrine with the number of approval levels. From a cultural perspective, Army leaders must provide a climate of psychological safety.

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Acronyms

ACAT	Acquisition Category
AR	Army Regulation
AST	ATEC System Team
ATEC	U.S. Army Test and Evaluation Command
CONOPS	Concept of Operations
DA	Department of the U.S. Army
DAU	Defense Acquisition University
DIB	Defense Industrial Base
DOD	Department of Defense
DODD	Department of Defense Directive
DODI	Department of Defense Instruction
DOT&E	Director Operational Test and Evaluation
GCS	Ground Combat Systems
MDA	Milestone Decision Authority
NPD	New Product Development
OSD	Office of the Secretary of Defense
PEO	Program Executive Officer
PM	Program Manager
SSCF	Senior Service College Fellowship
T&E	Test and Evaluation

TEMP	Test and Evaluation Master Plan
TRADOC	U.S. Army Training and Doctrine Command
WIPT	Working-level Integrated Product Team

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