NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

LEVERAGING SOCIAL NETWORKS TO ENHANCE INNOVATION

by

William J. Huff

March 2018

Thesis Advisor: Wayne Porter
Co-Advisor: Matthew Larkin

Approved for public release. Distribution is unlimited.

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** March 2018	**3. REPORT TYPE AND DATES COVERED** Master's thesis	
4. TITLE AND SUBTITLE LEVERAGING SOCIAL NETWORKS TO ENHANCE INNOVATION			**5. FUNDING NUMBERS**
6. AUTHOR(S) William J. Huff			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) Deputy Under Secretary of the Navy for Manpower			**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB number ____N/A____.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited.			**12b. DISTRIBUTION CODE**

13. ABSTRACT (maximum 200 words)

This thesis explores the Department of the Navy's innovation initiatives to determine how to leverage social networks to enhance innovation inside the Navy. Using the results of a social network analysis that mapped and measured the informal Navy Innovation Network, and examining how other military branches and industry pursue innovation, this qualitative research seeks to identify gaps and redundancies in the current Navy Innovation Network. Furthermore, recommendations are proposed that provide a more effective and structured approach to capturing innovative ideas from Sailors and Marines to improve Department of Navy operations and policies.

.

14. SUBJECT TERMS Navy Innovation Network, NIN, innovation, networking, network			**15. NUMBER OF PAGES** 73
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-1

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release. Distribution is unlimited.

LEVERAGING SOCIAL NETWORKS TO ENHANCE INNOVATION

William J. Huff
Lieutenant, United States Navy
B.S., The Pennsylvania State University, 2007
M.F.A., Seton Hill University, 2016

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 2018

Approved by: Wayne Porter, Ph.D.
Thesis Advisor

Matthew Larkin
Co-Advisor

Yu-Chu Shen, Ph.D.
Academic Associate
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

This thesis explores the Department of the Navy's innovation initiatives to determine how to leverage social networks to enhance innovation inside the Navy. Using the results of a social network analysis that mapped and measured the informal Navy Innovation Network, and examining how other military branches and industry pursue innovation, this qualitative research seeks to identify gaps and redundancies in the current Navy Innovation Network. Furthermore, recommendations are proposed that provide a more effective and structured approach to capturing innovative ideas from Sailors and Marines to improve Department of Navy operations and policies.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

CNO	Chief of Naval Operations
CRIC	CNO's Rapid Innovation Cell
CDR	Commander
CO	Commanding Officer
COTS	Commercial off the shelf
CORE	Common Operational Research Environment
DEF	Defense Entrepreneur's Forum
DHS	Department of Homeland Security
XO	Executive Officer
JO	Junior officers
LT	Lieutenant
NIAC	Naval Innovation Advisory Council
NPS	Naval Postgraduate School
NAVSEA	Navy Sea Systems Command
NIN	Navy Innovation Network
NWDC	Navy Warfare Development Command
OPC	Organizational Performance Consultants
SNA	Social Network Analysis
SPAWAR	Space and Naval Warfare Systems Command
SSG	Strategic Studies Group
SWOT	Strengths, Weaknesses, Opportunities, and Threats
SUBSAFE	Submarine Safety Program

SWO	Surface Warfare Officer
TANG	Tactical Advancements for the Next Generation
TFI	Task Force Innovation
PACFLT	U.S. Pacific Fleet
USCG	United States Coast Guard
USC-ICT	University of Southern California's Institute for Creative Technologies

ACKNOWLEDGMENTS

To my family and my SHU family (Scott & Katie J, Nirina H, Krissy T, Chris S, Jenn M, my Tropes, Sky G [rubber ducky], Lawrence & Cassie N, Ari, Joey L, and Leah G): My strength is derived from the love and faith you all have in me. Thank you for making—and keeping—me strong.

To Wayne Porter: Doc, thank you for believing in me and affording me an ample amount of patience. Developing this thesis has been a blessing, and I hope it bears fruit. I put that last line in there specifically because of how much you love my hyperbole.

To LCDR Matthew Larkin: Your insights in class and on the thesis were instrumental. I cannot thank you enough for always encouraging me.

To Rob Schroeder (faculty associate for research, CORE Lab) and Kristen Wheeler: Thank you for doing the legwork and providing a sounding board on data analysis. Your insights, analysis, and experience were invaluable!

To Lawrence G. Shattuck: Doc, your class truly helped me develop a multi-faceted approach to this problem, and I appreciate you taking the time to share. I hope that you will have me in your class rolls again soon!

To Monica Ruane Rogers (assistant professor and research, assessment and outreach librarian): Our SHU family is the greatest, and I will forever be in your debt for helping me transition from creative to technical writing. I am a better writer because of your help, and I am a better man because of your friendship! Go Hogwarts!

To Alison W. Scharmota (Graduate Writing Center coach): Thank you for all the hours you spent toiling over this creative writer's attempts at technical content. It did afford both of us a fair amount of laughs at my expense, but here is the end result. Thanks for being my pilot (and remember, not in the air).

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

With the U.S. military's research and development budget stretched like never before, and our adversaries' capabilities growing and maturing, the military branches face a conundrum. They need to exploit as many innovation avenues as possible to maintain their technological superiority while being more efficient. This thesis examines how best to use the findings of the Naval Postgraduate School's (NPS) Common Operational Research Environment (CORE) Lab's social network analysis of the Navy Innovation Network to develop a more sustainable and institutionalized approach to networked innovation across the force.

Currently, there are both official and grass roots innovation programs in each branch of the military that draw ideas from the war fighter. Programs like the Defense Entrepreneur's Forum (DEF), HATCH, ATHENA, Tactical Advancements for the Next Generation (TANG), and The BRIDGE capture new and innovative ideas from those on the front lines to improve the U.S. military.

The ATHENA project identifies itself as "an initiative, founded in the Surface Community, focused on harnessing deck plate innovations to create a cadre of forward-thinking, creatively confident Sailors for the Fleet of tomorrow" (ATHENA, 2015). The program accomplishes this goal by creating an open and casual environment that arms tomorrow's fleet leaders with a creative confidence and a way to express themselves (ATHENA, 2015).

The TANG initiative uses the design thinking process to revolutionize the submarine community's advanced development group by focusing on the warfighter and his or her needs (Smith, 2013). In order to best support submarine sailors, the group targeted junior officers as well as E-6 and below who are subject matter experts with the latest commercial technology (Smith, 2013).

The U.S. Pacific Fleet (PACFLT) designed The BRIDGE initiative to build and encourage collaboration and idea generation through "advancing education, enabling empowerment, stimulating connections, and spurring transition"

(Commander, U.S. Pacific Fleet, "PACFLT Bridge-MD5 Boot Camp"). PACFLT wants to inspire creativity and support a continued culture of change, not to just relay ideas. (Commander, U.S. Pacific Fleet, "PACFLT Bridge-MD5 Boot Camp").

While this is not an exhaustive list, each of these entities is making significant progress towards capturing innovative ideas from the Navy's sailors and officers, but each of these initiatives has limited reach and capabilities. This hinders the Navy's ability to take full advantage of the knowledge and experience of its war fighters, who are eager to help make improvements to the Fleet.

This work uses the exploratory research method to analyze previous innovation research conducted by the United States Navy and the United States Coast Guard, along with additional historical references, in an attempt to identify a more efficient method of leveraging formal and informal Navy Innovation Networks.

Specifically, this thesis examines the lessons learned from the Navy's ATHENA and TANG projects, the Coast Guard's Innovation program, and other innovation initiatives. This investigation identifies factors that contributed to success in the past and gaps that hampered or prevented the exploitation of innovative ideas. Finally, recommendations are offered to provide more structure in order to better incorporate innovation.

A. BACKGROUND

The Navy Innovation Network (NIN) consists of formal and informal collaborations that include the Chief of Naval Operations' (CNO) Strategic Studies Group (SSGs), CNO's Rapid Innovation Cell (CRIC), The ATHENA Project, Task Force Innovation (TFI), the Naval Innovation Advisory Council (NIAC), and the BRIDGE. It also capitalizes on several social media groupings and innovation fora (both physical and virtual) that attract hundreds, if not thousands, of bright, motivated sailors and Navy civilians with creative ideas to share. While the Navy is cognizant of these groups' potential, it struggles to better connect these individuals and groups, to cultivate ideas from them, and to translate those ideas from concept to prototype.

When attempting to innovate inside any large organization, a multitude of barriers can stifle progress (Hall, 2013). Denning and Dunham's *The Innovator's Way* explains these roadblocks by first acknowledging how certain kinds of organizational processes and different levels of individual skills can affect innovation inside an organization. These organizations require policies that encourage and reward new ideas, but they also need personnel with basic innovation skills. If either of these components is missing, innovative ideas will not flow smoothly, if at all (Denning, Dunham & Brown, 2012). The Navy has its own roadblocks, as former President Franklin D. Roosevelt acknowledged, "to change anything in the Navy is like punching a feather bed. You punch it with your right and you punch it with your left until you are finally exhausted, and then you find the damn bed just as it was before you started punching" (Neal, 2004). In order to change the organization, an accepting culture and a supporting process need to be in place or needs to be adopted. Laszlo Bock, senior vice president of Google's People Operations, further explains that giving employees the ability to voice their ideas is a key factor in organizational effectiveness, quality decisions, and employee performance (Bock, 2015).

Encouraging large cultural shifts in the Navy that reward the behaviors frequently associated with innovation is not easily achieved in a short period of time. Where examples of these shifts do exist, crisis often forced their adoption. For instance, after the loss of the nuclear submarine USS *Thresher*, the Navy instituted the Submarine Safety Program (SUBSAFE), a sweeping quality assurance program that included safety requirements and manufacturing accountability (Sullivan, 2003). Smaller, more incremental changes are more common, but even these often take years to be implemented institutionally. Mohan (2013) expounds upon this in his thesis by noting how infrequently major breakthroughs occur. These groundbreaking innovations are more often the result of numerous, incremental advances, the small benefits of which supported a larger goal (Mohan, 2013).

Mohan (2013), with the assistance of Chandy and Tellis (1998), discusses two ends of an innovation spectrum. Using existing product as a baseline, those innovations that principally involve new technology and provide a significant increase in customer benefits represent a radical innovation. At the other end of the spectrum would be incremental technological changes that provide a minor increase in benefits (Mohan, 2013). Mohan (2013) further cites Garcia and Calantone (2002) who suggest that a simple radical versus incremental dichotomization does not adequately capture the various levels of innovation, some of which fall in between radical and incremental.

In order for an innovative idea to produce tangible results, there must be a willingness to take calculated risks and to accept failure. Encouraging risk is an essential avenue for innovation to proceed from ideas to implementation (Eriksen, 2015). Christo Eriksen's thesis further explains this through an examination of firms in Silicon Valley (2015). Inventors operate in a risk-tolerant ecosystem that top universities and leading businesses support. Social, institutional, and political structures and policies promote low formalization, low centralization, competition, and a sense of urgency to encourage innovation and to get new ideas to the market (Eriksen, 2015).

B. PREVIOUS RELATED RESEARCH

This thesis builds upon research previously undertaken by students of the Naval Postgraduate School (NPS) in the areas of social network analysis (Woodham, 2016), design thinking (Johnston, 2014), and organizational change management (Kluckhuhn, 2008). Student theses using these disciplines have addressed various factors that either directly contribute to the innovation process or describe how certain initiatives have accelerated the innovation process. There are three theses that are specifically germane to this document: Christopher Cannon's *A case study of project ATHENA: tactical level technological innovation aboard the* USS *Benfold*, Kevin Johnston's *A case study of introducing innovation through design*, and Christopher Kluckhuhn's *An examination of four successes in*

the Coast Guard's innovation program and implications for innovation within Homeland Security. These are further considered in the literature review.

C. PROBLEM STATEMENT

When considering social networks and their implications, it is important to characterize the relationships and attributes and connect network members or agents. Kadushin (2012) defines a network as "a set of objects (called nodes) and a mapping or description of relations between the objects/nodes."

Networks exist in a variety sizes, shapes, and configurations. They can consist of as few as two nodes, with scale-free networks that are limitless. (Kadushin, 2012).

This thesis explores how the various networks inside the Navy (personnel, ships, squadrons, fleets, etc.) currently attempt to assist the Navy's goal of innovation. Through the examination of the case studies and other resources, this thesis suggests how the Navy can better utilize its social network to make its innovation efforts more agile.

D. PURPOSE STATEMENT

The purpose of this thesis is to analyze previous innovation case studies and research to identify best practices used by commands to create a culture of innovation, and to develop a Navy strategy for sustaining innovation that leads to rapid prototyping and Fleet integration.

E. RESEARCH QUESTIONS

This thesis seeks to address a gap in previous research, which has not fully explored the value of formal and informal social networks in the military as engines for innovation or the means to institutionalize a pathway from innovation to Fleet integration. The following two research questions will be addressed within the context of the Navy Innovation Network:

How can the Navy more effectively bridge together individuals and clusters within the social network of Navy innovators?

What process improvements can be made to encourage wider participation in the Navy Innovation Network by providing a clear pathway to implement change?

F. RESEARCH METHOD, PROPOSED DATA, OBSERVATION, AND ANALYSIS METHODS

This thesis employs a qualitative, exploratory research approach. It examines existing case studies, current literature, previous research, and current social network mapping and analysis. Using the exploratory research method enables the interpretation of data and results from multiple case studies. Conclusions may then be drawn through inductive reasoning.

G. POTENTIAL BENEFITS AND LIMITATIONS

This research will focus on how best to use the findings of the Naval Postgraduate School's Common Operating Environment (CORE) Lab's social network analysis of the Navy Innovation Network to develop a more sustainable and institutionalized approach to networked innovation across the Force. By capitalizing on the ideas and expertise found inside the NIN, the Navy would have access to novel solutions to problems currently plaguing it today and in the future, better contact with subject matter experts working inside and outside of the service, and better cost savings through the utilization of design thinking and rapid prototyping. Greater employment of the NIN, and ideas cultivated from it, will also encourage more sailors to share their ideas, to participate in the network, and to feel they have a voice in the systems they operate.

II. LITERATURE REVIEW

Grass-roots organizations like the Defense Entrepreneur's Forum (DEF), ATHENA, and others grow in popularity and numbers daily because they provide a forum and a supportive network of peers (Lynch, 2017). Members want to improve their communities of interest with their ideas (DEF, 2017). Retired Admiral and previous Chairman of the Joint Chief of Staff Michael Mullen and other key Service leaders recognize this desire to contribute to the improvement our military as a national treasure (Mullen, 2018). With each service branch facing dynamic challenges that require imaginative solutions, empowering these organizations and innovation is imperative (Mullen, 2018). These independent thinkers' revolutionary, and sometimes disruptive, ideas may offer solutions to complex problems.

Many of those sailors and Navy civilians who choose to participate in the innovation programs deal daily with the problems they are attempting to solve. These are the subject matter experts, the "doers," the "fixers," the ones relied upon to ensure mission success (Cannon, 2014). Their duty stations afford them a unique vantage point and sense of urgency, since they are often personally affected by the problem. They do not have the luxury of observing the problem from a dispassionate vantage point and waiting five to ten years for resolution, correcting the problem is in their best interest. They make a broken or inefficient system work (Cannon, 2014).

As early informal, collaborative efforts began bearing fruit, groups like ATHENA, DEF, and TANG, emerged, and the Navy took notice. These organizations are part of a network of sailors willing to offer creative technologies and approaches to improve the Navy's effectiveness. The Navy has referred to them collectively as the "Navy Innovation Network" (NIN).

While the Chain of Command hierarchy must be respected, the Navy recognizes that, as in industry, innovation can flourish through horizontal, informal

ties among peers (McRaven, 2017). The “informal network” leverages relationships with present and former shipmates, other divisions within the command, previous military members, and those with a commercial or academic interest in Navy innovation. Each of these can bring their professional experiences to bear so that problems and opportunities are properly defined, viable ideas can be presented, and the most likely candidates can be pursued.

With every branch of service attempting to maintain an advantage over our adversaries, even while stretching their respective budgets, determining how to more effectively bridge together individuals and clusters within the Navy Innovation Network is of paramount interest. Specifically, it is important to identify what process improvements encourage wider participation in the Navy Innovation Network to implement change.

A. SOCIAL NODES, TIES, AND THE TYPES OF NETWORKS

The Navy Innovation Network is, “a network of [Department of the Navy] personnel working toward the shared goal of maintaining and advancing the operational advantages of our Naval Services” (Navy Innovation Network [NIN], 2017). In other words, it is a system containing any combination of individuals, units, and groups interconnected by formal and/or informal ties used to share information that can contribute to advances in the US Navy. As with any other network, it has components consisting of nodes and various types of ties.

A “node” refers to a specific agent that can represent an individual, group, event, or other network member. A “network” is comprised of nodes connected through ties of relationships.

Using the Navy as an example, an individual sailor could represent a node. When viewing that sailor within a ship’s network and chain of command hierarchy, he or she is one voice of many that is sending and receiving information inside a particular division. At the same time, that division also functions as a node inside a specific department (e.g. the Navigation Division with the Operations

Department). Zooming out further, each department serves as a node within the ship's network.

Social Network Analysis (SNA) measures how these nodes and ties organize to form the structure of the network. Measuring the structure and nature of a network provides the means to compare its behavior with other networks (Porter, 2017). Nodes inside a network connect to one another through different types of "ties." These connections can vary in strength and density, and they connect the nodes either directly or indirectly. The strength of ties is characterized as either strong or weak and direct or indirect. A strong tie is characterized by the frequency, depth, and quality of communication. Over time, these strong ties may have a normalizing effect on the nodes where each acts and thinks in a similar fashion. One of the most common sources of network connectivity is the phenomenon of homophily, in which those agents with like-attributes (similar background, beliefs, and interests) are attracted to others who share attributes. As a result, clusters form where like-minded individuals share strong ties with similar perspectives. Weak ties are the connections between acquaintances, distant relatives, or friends of friends. Where strong ties may create a normalizing effect, weak ties are disruptive. They are the harbingers of new information, different points of view, or truth tellers. Granovetter refers to them as "conduits bearing information and influence" (as cited in Kadushin, 2012 p.31).

Indirect ties occur when two nodes have no direct contact with one another, but share a connection with a mutual third party. Density measures the number of ties divided by the number of possible ties in a network. It may be a rough indicator of the levels of trust, cohesiveness, social support, and the social capital network members share (Porter, 2017). Wasserman and Faust offered the following examples of ties:

1) Ties of sentiment (friendship, liking, respect),
2) Resource ties (business transactions, financial flows),
3) Ties of association or affiliation (members of the same church or club),

4) Behavioral ties (communication ties),

5) Ties based on geographic movement (migration, physical mobility),

6) Ties based on status movement (social mobility),

7) Formal ties (organizational hierarchy),

8) Biological ties (kinship). (p. 18)

Understanding the nature of ties within a network can provide insight into its structure and behavior.

B. INFORMAL NETWORKS

One characterization of networks is whether they are formal or informal. In most companies, formal networks serve as the skeleton for the organization, providing the business' structure. By contrast, informal networks act like the body's circulatory system, carrying everything the skeleton needs to survive (Krackhardt, 1997). Mapping a company's formal and informal networks may assist managers in not only identifying the symptoms of a problem, but also diagnosing its source.

Ralph Stacey, an accomplished leadership and management author, describes informal networks as a variation of a Boolean network. Individuals connect to others both inside and outside an organization through chance social encounters. He further postulated that successful organizations find that innovation and creative ideas often emerge from areas of dynamic instability within the organization through informal networks (Stacey, 1995).

Understanding an informal network's dynamic is complicated, as David Krackhardt and Robert N. Stern (1998) concede in *Social Psychology Quarterly*. They used Miles and Randolph's "Organization Game" to evaluate how friendships can either enhance or hinder a group's ability to function in times of crisis inside a company environment. The findings demonstrated that a significant proportion of influence and work is attributed to informal networks. Krackhardt and Stern also noted that few organizations attempt to harness informal networks. If not properly cultivated within an organization, informal networks can lead to inefficiencies or

even dysfunction i. The authors detailed how at-work friendships develop through proximity and the amount of interaction between individuals.

1. Issues with Informal Networks

Understanding how informal networks function, and how they benefit (or hinder) organizations is critical to an organization's success. Managers, or "authorities," often fail to recognize the impact of informal networks within their organizations. Those accustomed to a rigid hierarchical structure often view informal networks with skepticism or anxiety because of the often nebulous and ungovernable tendencies of informal networks (Cross & Prusak, 2002). These managers do not fully grasp how their subordinates' interpersonal connections can benefit the organization, and some even lack accurate information about their personnel. Krackhardt (1997) comments that "although [managers] may be able to diagram accurately the social links of the five or six people closest to them, their assumptions about employees outside their immediate circle are usually off the mark" (p. 132). As a result, managers do not always understand how to interact with or utilize informal networks. Krackhardt expounded in his journal article that some attempt to enforce rigid rules for interaction among employees based on titles or positions within the hierarchy. Others attempt to place "moles" inside the departments to control the influence of informal networks. Not only do these attempts fail to cultivate more productivity, they actually reduce efficiency. "Ambiguity aversion has a detrimental effect on the performance of front-end innovation activities due to a suppression of decision-making comprehensiveness" (Mohan, 2013). Put more succinctly, had authorities invested the time to learn how these hubs (nodes that serve as connectors within clusters) and coalitions functioned, utilization of the informal network could help solve problems and improve the company's performance (Krackhardt, 1997).

A common characteristic of informal networks is that relationships are often formed through homophily, with members seeking ties with those who share their interests or who have attributes in common. Krackhardt and Stern found that there

was a greater flow of information between subgroups, more trust between them, and a greater spirit of teamwork because of their friendship/informal network links (Krackhardt & Stern, 1988). However, this apparent advantage can also be a disadvantage. Krackhardt and Stern found that such close relationships can benefit the specific subgroup through solidarity, but they can hinder the company's overall productivity by creating an "us versus them" mentality, especially in a resource-constrained environment. They found that in times of crisis, organizations whose employees develop and maintain friendships between divisions (called the "optimal" group) instead of strong friendships inside the division (called the "natural" group) would be more successful. The optimal group performed better in the face of a dynamic crisis scenario. Additionally, the optimal group demonstrated less accusation and more job satisfaction than their natural group counterparts. Stacey explains that an organization's changeability is directly linked to the diversity of self-organizing, informal networks (Stacey, 1995).

C. PSYCHOLOGY

In the 1940s and '50s, the psychologist Abraham Maslow postulated that individuals require certain basic needs to be met before they can pursue higher order needs (McLeod, 2017). Informal social networks are defined by the individuals and relationships that comprise them. Participants need to feel safe, valued in the group, and acknowledged for their participation and achievements (Cannon, 2014). Since this research will explore ways to better utilize social networks, the underlying factors that lead personnel to contribute and interact through informal networks must be addressed.

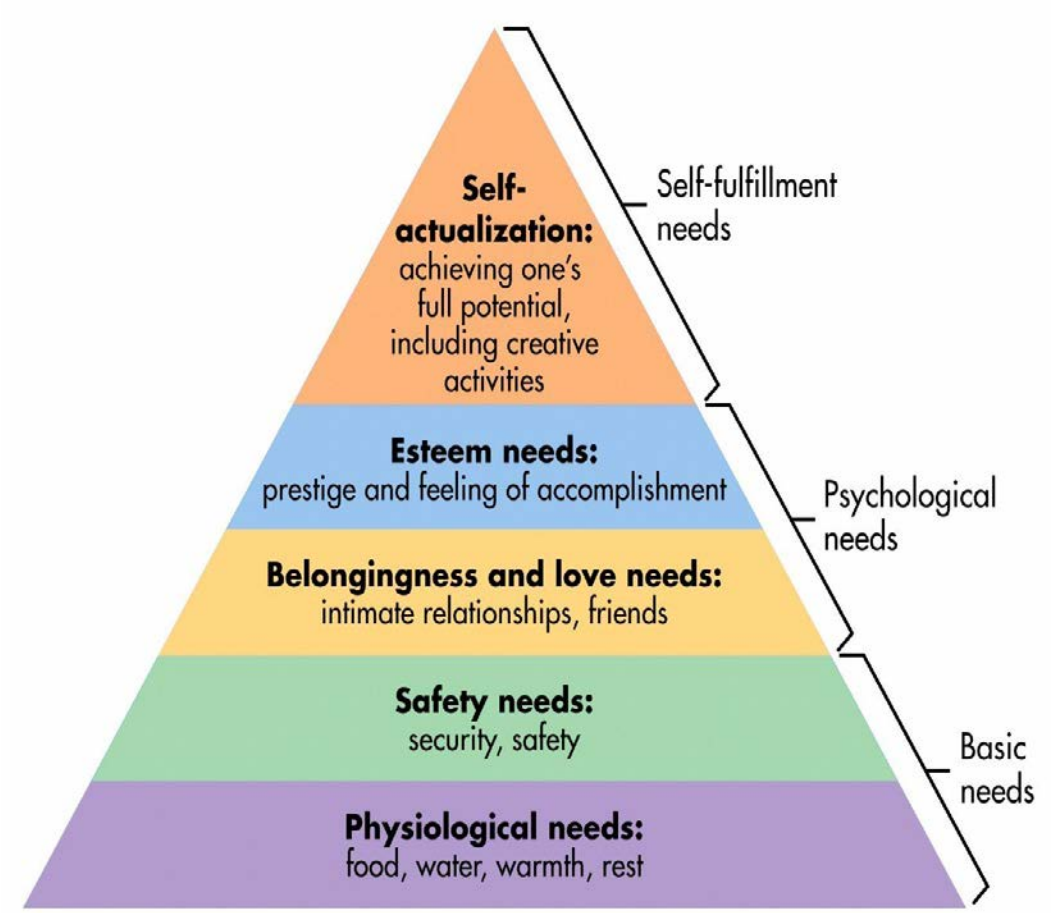

Figure 1. Maslow's Triangle. Source: McLeod (2017).

A military member may meet his or her psychological and self-fulfillment needs met, but while at work, he or she may only have basic needs met (Figure 1). Supporting higher-level needs by acknowledging collaborative, positive contributions may be critical to encourage involvement of personnel in the NIN. Research conducted by Laslo Bock, and feedback received from ATHENA and DEF participants, points to the importance of empowering teams and team members. The ATHENA Project case study offered specific feedback, anecdotes, and critiques from participating members. Two particular comments detail the "shut up and color" mentality permeating the Navy. Individuals are told where to go, what to do, how to do it, but never asked for their feedback or opinion (Cannon, 2014). Whether managers discount a person because of their duty station, age, or

perceived experience, these biases stifle voices and restrict a member's ability to climb higher on Maslow's triangle.

While some see the problem residing in managers who punish those willing to question the status quo (Fisher, 2018), other military professionals stated that one of the largest hurdles innovation faces in the Navy is the intense bureaucratic or technical resistance (Adams et al, 2017). This was illustrated when an unnamed US Navy captain criticized the USS *Benfold*'s innovation effort, because it permitted a non-qualified Surface Warfare Officer (SWO) to participate. The senior officer implied that the unqualified ensign should have focused upon his SWO qualifications instead of innovation (Cannon, 2014). In order to encourage innovation and empower individuals, Krackhardt asserts that three of the most important steps are ensuring that every member's opinion is respected, that every voice is heard, and that two-way communication exists (Krackhardt, 1997).

D. PREVIOUS RESEARCH

To better understand innovation initiatives already attempted, three specific military case studies were evaluated. The first two case studies represent elements within the informal Navy Innovation Network. The final case study documented the United States Coast Guard's innovation program. All of these are excellent examples of successful innovation programs with relatively flat organizational structures operating inside the rigid, vertical hierarchy of the military. Each illustrates that while there are smart, innovative individuals in the Navy who are willing to contribute, the institutional approach by which the Navy attempts to solicit ideas is, at best, insufficient.

1. Project ATHENA

Lieutenant Colonel Christopher Cannon investigated the ATHENA project through the lens of organizational change management and design thinking. This case study dealt with an initiative to improve technological innovation at the tactical unit level (Cannon, 2014).

The project originated onboard the USS *Benfold* (DDG 65) after the Executive Officer (XO), Commander (CDR) Richard LeBron, USN expressed a desire to encourage his wardroom to think beyond what was “doctrinally defined” and suggest improvements and innovations on both procedural and policy levels. With the help of Lieutenant (LT) David Nobles, USN, the *Benfold* created the “Wiki Wardroom.” The premise was simple: the officers received one day off work to fix any problem facing the ship. The only catch was that each individual had to give a five-minute presentation describing a specific problem and his or her proposed solution, to receive the day off.

From the start, a majority of the junior officers (JOs) aboard *Benfold* were engaged and wanted to contribute, despite the fact it required significantly more effort and time both during and after the workday. During the first meeting, 11 officers made presentations. Nearly all dealt with ways to improve processes onboard the ship. The first meeting also revealed areas for improvement in subsequent meetings. These improvements included standardizing the presentation process and a peer ranking system. One major limitation LT Nobles and the rest of the wardroom noted was that once a great idea was identified, there was no process in place to advance it further.

The *Benfold*’s second meeting, now dubbed the ATHENA project, invited the entire crew, as well as members of the University of Southern California’s Institute for Creative Technologies (USC-ICT) and representatives from other commands, to participate. The results of the meeting were not documented. However, the apparent success of the second meeting caught the attention of the Navy Warfare Development Command (NWDC) special projects arm, known as the CNO’s Rapid Innovation Cell (CRIC), and members of the Navy’s Space and Naval Warfare Systems Command (SPAWAR).

ATHENA Meetings III through V continued to expand the project’s success and influence. Attendance continued to increase from 15 to 20 commands with over a dozen major civilian companies/institutions joining them. During the events, presentations were made for innovative problem solutions and military members

and civilians continued an open dialogue to bring concepts closer to implementation or further exploration. Additionally, LT Nobles provided feedback on previously pitched ideas.

Evaluating the ATHENA project through the lenses of Organizational Change Management and Design Thinking, LtCol Cannon's research demonstrated how a properly motivated crew could advance Navy innovation when given a fertile and safe environment. It also highlights some of the challenges faced by both the foundering members and the participants.

2. TANG Forum

In their master's thesis at NPS, Lieutenant Commander Kevin Johnston, USN, and Captain Robert Featherstone, USMC, investigated the Technical Advancements for the Next Generation (TANG) forum in Pearl Harbor in which submarine officers from across the fleet participated in a design thinking conference (Johnston and Featherstone, 2014). The goal of the conference was to harness both the technical and creative potential of these officers and apply it to the implementation of new and innovative technologies. After the first forum, participants offered 11 inventive ideas to the submarine community to improve command effectiveness. Those assembled recognized the value of collaboration, but they also realized that implementing these solutions in a hierarchical system required skillful execution of change management. The forum required submarine officers of all ranks to work in small groups on problems facing the submarine community. Participants wore civilian clothes and used first names in order to promote a more horizontal working environment. Every effort was made to improve the manner in which commands and leadership utilize change management and design thinking theories.

Johnston and Featherstone's thesis explained how leaders in the Navy provide a "command vision" that describes a desired end state, charts a figurative course for their personnel to achieve that goal, and then holds their personnel accountable when they deviate from that direction. They opined that while this

authoritarian style works well for strict adherence to policy and procedure, it stifles innovation and creativity. Instead, they recommended, leaders should adopt a more “sense-maker” approach in providing guidance and insight to their subordinates. This approach “loosens the reins” and allows fresh ideas and different perspectives to flourish with less fear of speaking up. It allows leaders to convey trust at both the enterprise (squadrons to their COs) and unit (COs to their officers and crews) levels.

Other traditional views of change theory challenged in Johnston and Featherstone’s thesis included the dependence on outside “change agents,” and the need for urgency, to effect change. They suggested that change could come from anywhere, if a disruptive-thinking person has the fortitude to speak and a receptive audience willing to accept some risk. While moving swiftly to enact change is often essential to overcome objections and inertia, the authors also cited research that suggested a “fits and starts” methodology. Instead of constantly innovating, a sprint-then-coast strategy may afford better results. This alternate strategy pursues the rapid innovation of technology, policies and/or procedures during the sprint phase and allows personnel to acclimate to change during the coast phase (p. 129).

The DOD employs a rigorous systems engineering process in order to guide a project from concept development to functional design and fielding. It considers, among other things, the customer’s needs, the operating environment, costs and other functional constraints, and all associated systems that affect operational employment of the designed system (see diagram). It focuses upon work processes, optimization methods, simulation and modelling, and risk management tools. TANG, on the other hand, employed the use of rapid prototyping techniques where crude mockups were used to allow groups to share a common picture of an identified need and to explore ideas as well as potential problems. This path requires far fewer resources and a significant reduction in investments.

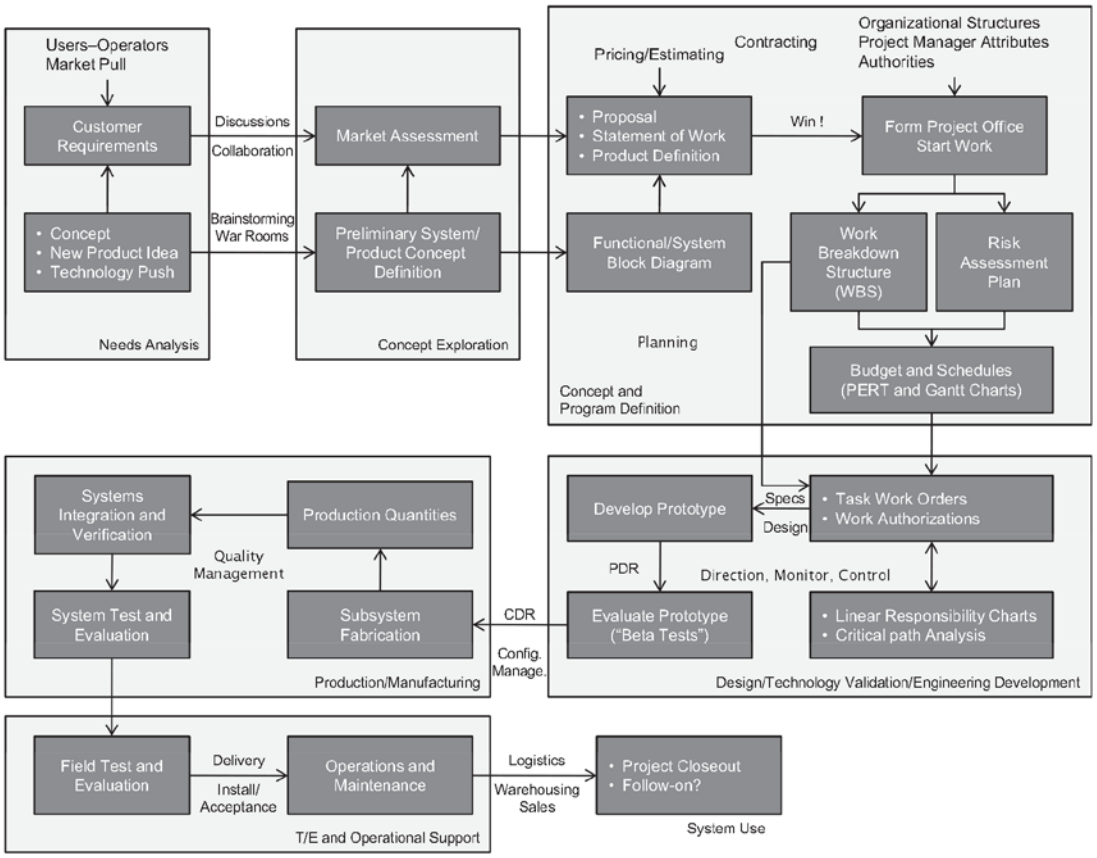

Figure 2. Systems Engineering Diagram. Source: Kossiakoff and Sweet (2006).

Johnston and Featherstone's research recognized the importance of involving in TANG process the junior enlisted sailors who were actually working aboard the submarine. While these junior personnel may not fully grasp all engineering or in-depth aspects of highly technical or complex problems, they can help by providing an operator's hands-on experience. These individuals often have insights of existing commercial off the shelf (COTS) technology that might offer a more cost effective and readily available alternative to replacing legacy systems, then having to design new replacements.

Finally, employing lessons from both design thinking and change management, Johnston and Featherstone opined that working in a collaborative

environment can result in a superior product as well as in an enhanced user experience for all involved.

3. USCG's Innovation Program

Kluckhuhn's thesis explores the United States Coast Guard (USCG) Innovation program's attempts to leverage USCG personnel to evaluate, and respond to, emerging trends (Kluckhuhn, 2008). The work acknowledges that while innovation provides significant benefits, innovation also requires investments of time and money that are often not available, and new ideas can be seen as a threat to the status quo. Progress on projects may not be readily distinguishable during much of its maturation, and the risks of the innovation failing to produce the desired results can scare decision makers into inaction or rejection. All of these things often result in ideas being undervalued. However, the USCG's Innovation project started with $9.5 million of capital and used a loose support structure to nurture the creative ideas of its operational personnel. This gamble resulted in process improvements valued at approximately $300 million that enhanced numerous operational capabilities.

As in the ATHENA and TANG projects, Kluckhuhn recognized the advantages of empowering personnel regardless of rank, flattening out the hierarchical structures of the groups, limiting bureaucracy, recognizing and accepting that failure is possible, and increasing both monetary and non-monetary incentives. He cited other research that found the majority of innovations predominantly come from a diverse population "on the front lines" who have a better understanding of the existing processes and new technology than those further removed. Kluckhuhn went on to categorize obstacles to innovation as being either political, external, or bureaucratic, but he identified the single biggest hurdle as a lack of adequate resources. He concluded that with the proper resources (and persistence), most other obstacles were able to be overcome.

The USCG's Innovation program, CG-0931, reports directly to the Chief of Staff of the Coast Guard, operates with twenty-two personnel at the headquarters

and twenty-four personnel dispersed throughout the United States. It is tasked with "supporting continuous improvement, business intelligence, innovation, and performance excellence" (Kluckhuhn, 2008).

An innovation council, consisting of twenty-seven military and civilian volunteers who represent each of the USCG's nine districts, meets quarterly to review innovation suggestions, decides how to distribute seed money, determines which ideas will win coveted awards, and helps transition field innovations to major USCG programs that warrant additional support. Council members also act as "connectors," linking together individuals or groups working on similar projects.

The twenty-four geographically-dispersed individuals, called Organizational Performance Consultants (OPCs), are selected based upon a person's proven track record of success in multiple fields, and on their expertise in continuous improvement. OPCs are equally divided between government civilians and uniformed Coast Guard personnel. Civilian personnel are permanently assigned, while uniformed members rotate on four-year tours, preventing stagnancy. Beyond receiving specific training in consulting and facilitation, these individuals have earned degrees in business or mathematics. Typical OPCs hold advanced degrees in these disciplines and are encouraged to pursue further education in consulting and other related fields (Kluckhuhn, 2008). These OPCs are specifically tasked promote innovation by supporting teams working at the National Graduate School. They also serve as internal consultants for commands and facilitate the innovation process by helping units navigate bureaucratic processes.

Kluckhuhn (2008) delineated the USCG's five-step innovation process.

(1) Idea Submission: All USCG members have access to the innovation database. They can review any past or present innovation project. They can request support for an idea. An attached form prompts them to define the problem or explain the idea they would like to address, to describe how the idea will address time and/or money that could be saved in solving the

problem, and to explain what assistance the member needs to support their endeavor.

(2) Initial Review: Once the member submits the form, both headquarters and regional field council representatives receive an e-mail alert with a link to the submission. Upon an initial review, a reviewer is assigned based upon the member's geographic location and the type of solution suggested.

(3) Primary Review: After the initial review determines the proposed solution has potential, a primary reviewer gathers additional ideas needed to better define the problem and evaluate the idea. Once satisfied, the primary reviewer coordinates a more in-depth evaluation by experts. The goal is to determine viability of the innovation as expeditiously as possible, decide if the solution can be applied to any existing project, and determine how best to proceed. Primary reviewers then submit a formal report to the appropriate Innovation Council for ultimate disposition.

(4) Classification/Action: The Innovation Council must determine how the proposed solution may impact the USCG. Once approved, the Council empowers the innovator to proceed with their efforts.

(5) Final Disposition: Reviewed quarterly, project status and updates are discussed to determine whether additional assistance is required (p. 34).

The USCG recognized that not all ideas yield a return on investment. These ideas however, are not seen as failures but as glimpses into the future. They remain in the database not only to show where the research stopped or hit an impasse, but also to inspire a different path to success for someone else. The OPCs routinely communicate with each other as well as with industry and government leaders at Innovation Expos. OPCs get to see what is currently being produced and to assess what related capabilities industry may have. This constant learning and networking can resurrect a stalled project.

Kluckhuhn found that keys to the USCG Innovation program's success included the partnership with the National Graduate School, voluntary involvement with private-sector firms, and the USCG's "Trained Initiative." This initiative states that Coast Guardsmen can freely deviate from standard procedures as needed to accomplish their missions. They accept accountability for their actions and

decisions, because they know their commands will support them provided they are in line with the USCG's guiding principles (Kluckhuhn, 2008). With senior leaders embracing the program and protecting the OPCs from dissenters, personnel from diverse backgrounds and specialties contribute to innovation projects. This collaboration results in a powerful tool.

Kluckhuhn observed that the program's success was not without personal cost to some participants and leaders. These individuals expended an exceptional amount of effort and energy to keep the program functioning, often sacrificing their careers, marriages, and even their health because of legacy processes that are either inefficient or in direct conflict with a forward-thinking initiative. Kluckhuhn also identified a possible missed opportunity for broader application and effects. He noted that while the program reaches nearly every level of the Coast Guard, it is not coordinated within the greater department of Homeland Security (DHS), the Coast Guard's parent organization.

Despite these shortcomings, the USCG program, along with ATHENA and TANG projects, proved that collaboration among diverse partners can lead to innovation success.

III. METHODOLOGY

A. EXPLORATORY RESEARCH

This exploratory research analyzes previous case studies and incorporates social network analysis research conducted at the Naval Postgraduate School for the Office of the Deputy Under Secretary of the Navy (Management). The goal is to answer the research question, “How can the Navy more effectively bridge together individuals and clusters within the social network of Navy innovators.” The principle reason for using this method was to gain a greater understanding of the current environment, understand how ideas present themselves, and to develop multiple potential solutions (Research Methodology, 2018).

Defined as “an examination into a subject in an attempt to gain further insight,” the exploratory research approach allows for the further evaluation of a topic that has already been identified as having potential but with little or no previous data to refer or rely upon (Study.com, 2018). It relies on a review of secondary research including literature, interviews, and case studies. While exploratory research may not offer a specific, definitive answer to a problem, it provides additional analysis of qualitative data that can contribute to generalizable theories, conclusions, and the means to identify further research that may be required (Singh, 2008).

The majority of the research cited in this thesis originates from case studies. A case study is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2009 p.18). A strength of using the case-study method rests in the knowledge gained by immersion in a real-world environment. Case studies can offer a more complete understanding of a research area by providing qualitative observations of the subjects involved. Case studies assist researchers in answering the difficult questions of “how” or “why” a social development or construct works (Yin, 2009).

Some scholars and researchers are critical of the case-study method. They view this type of research as overly interpretive, allowing for the possible incorporation of biased or prejudicial opinions. Furthermore, this approach lacks a controlled experimental design. Any one of these issues can skew a researcher's results. Yin acknowledges that case-study research is one of the most challenging to accomplish successfully due to the concerns previously mentioned (Yin, 2009). Case study findings, however, may lead to more in-depth exploratory research.

This research focuses on the Navy's Innovation Network (NIN). The NIN consists of various individuals and groups who voluntarily communicate with one another to support and encourage innovative advancements to enhance the Navy's effectiveness. These members' included active-duty officers and enlisted from all branches, veterans from all branches, defense contractors, and researchers. At the time of this research, there were over twenty-four self-organized and Navy-sponsored programs.

IV. ANALYSIS

The following chapter will analyze several sources, platforms, and media for common traits that support, encourage, and empower innovation in both civilian and military organizations. It will also search for common barriers to innovation and explore why those barriers exist, and how civilian and military entities overcome these challenges. It will specifically look for these common themes in existing successful U.S. military innovation networks and successful innovation programs.

A. COMMON POSITIVE TRAITS

During the research phase of this thesis, some common positive and negative traits emerged from the case studies, observations, and theoretical postulations. It is important to note that while these characteristics appear in the investigation, the combination of traits is unique to the specific organization or entity.

1. Team Organization (Flat Hierarchical Structures)

The first building block of the ATHENA Project, the TANG initiative, and the USCG's Innovation program was the empowerment of individuals by flattening the command hierarchy as much as possible. Flat hierarchies have characteristics that aid the innovation process.

As the name suggests, a flat hierarchical structure is one where there are as few levels of management between the innovator doing the work and the ultimate decision maker as possible (Figure 3. This conscious decision to remove bureaucracy encourages communication and endows workers with a more active voice in the innovation and decision-making processes (Meehan, 2018). The desire of many of today's sailors to have a positive impact is clear in each of the case studies. These warfighters often seek direct communication with those who design the equipment, tools, and systems they employ, but numerous roadblocks, including the vertical chain-of-command structure, stymie their efforts (Cannon,

2014). Because of this, few homegrown ideas and initiatives make it to fruition. Frustration with the process drives many of these innovators out of the services, to the commercial sector where innovation is better accepted and easier to sell (Bladen, 2016; Cannon, 2014; Kluckhuhn, 2008).

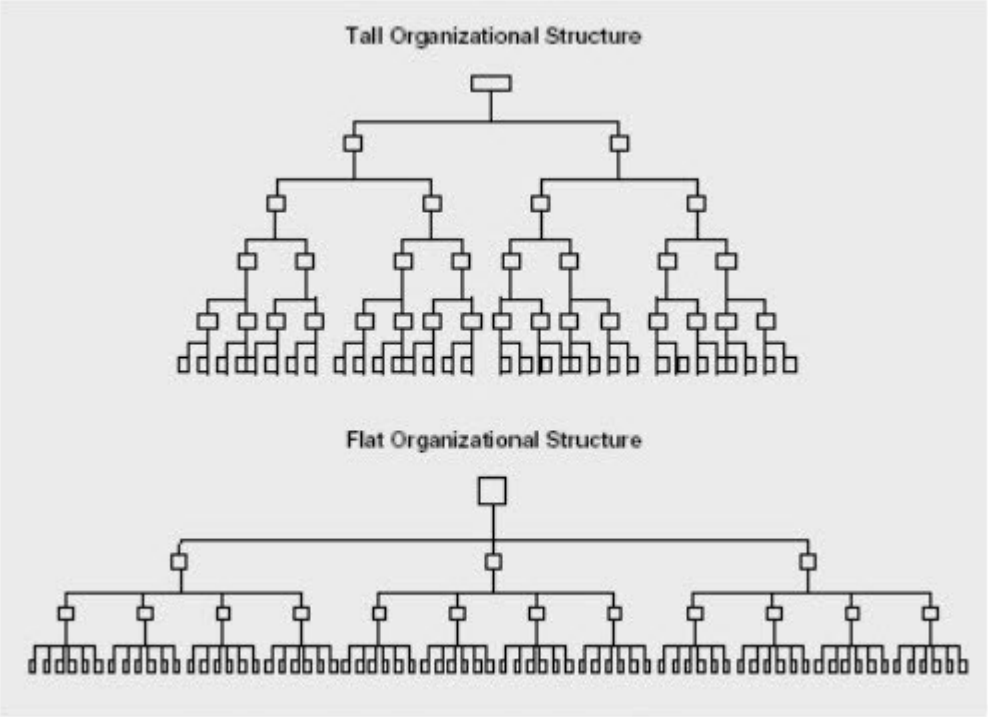

Figure 3. Hierarchical versus Flat Organizational Structure.

2. Voluntary Participation

The second building block used by the innovation programs was a concerted effort to encourage broad-based participation. Institutions like ATHENA, TANG, and the USCG's programs are voluntary, and they thrive by bringing people with diverse backgrounds together to solve dynamic problems. Teams self-organize to explore and answer a specific issue, and they demonstrate how informal networks draw information and ideas from other nodes and networks (Cross & Prusak, 2002; Kadushin, 2012). AthenaTHINK, a specific design-thinking workshop held at SPAWAR, for instance, serves as a communication hub linking

the warfighter to scientists (Baker, 2015). Linking these networks together through meetings and events, AthenaTHINK promotes collaboration through teaching, brainstorming, and design thinking (Baker, 2015).

3. Design Thinking

With a flat hierarchy and a voluntary creative outlet in place, the third building block used by the ATHENA Project, the TANG initiative, and the USCG's Innovation program was to incorporate concepts like Design Thinking to develop innovative ideas (see Figure 4). Stanford University's David Kelley describes Design Thinking as a human-based approach. This process encourages a free flow of ideas while considering how technology and other constraints affect the design (IDEO U, 2018). By bringing creative individuals from different networks together in a voluntary environment where everyone's opinions are heard, design teams are positioned to develop great ideas (Kluckhuhn, 2008).

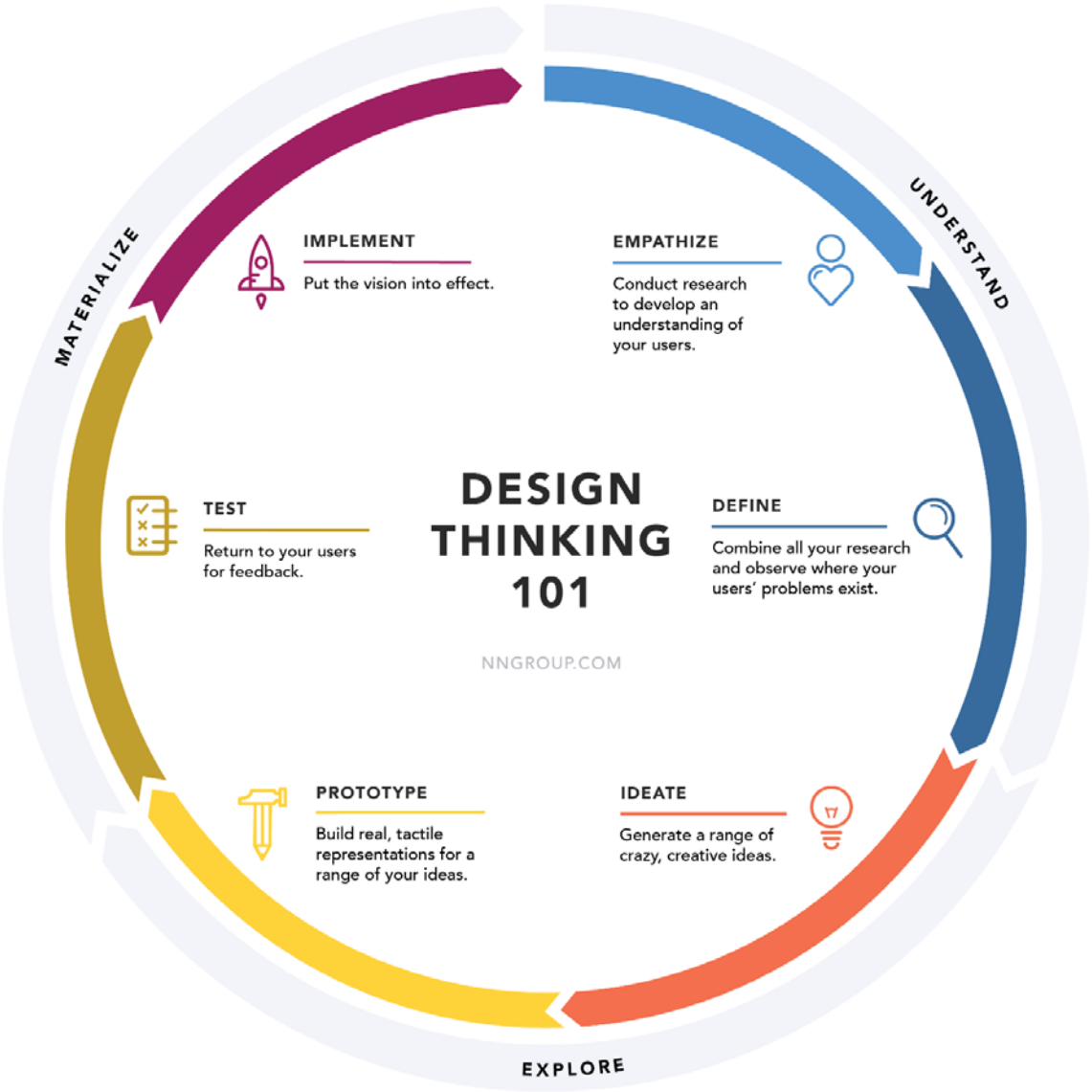

Figure 4. Design Thinking Cycle. Source: IDEO U (2018).

B. COMMON NEGATIVE TRAITS AND BARRIERS

As with the common positive traits, there were negative traits that emerged in the research. While vertical hierarchies have an important place in the Navy thanks to their ample promotion opportunities and other benefits (Meehan, 2018), some of these same benefits hinder the innovation process. It is important to emphasize that neither the flat nor the vertical hierarchical approach is necessarily

bad. Neither guarantees an innovation initiative will thrive. This thesis only recognizes that the evaluated case studies featured flat hierarchical structures.

1. Vertical Hierarchical Structures

A vertical hierarchical structure is common among large organizations and is defined by a pyramid-like structure where there is little-to-no direct communication between the bottom of the structure and the top (Bonomo, 2016). Systems like these reinforce the traditional chain of command by endowing managers with authority and assigning clear and specific tasks with little ambiguity. Unfortunately, while this system supports good order and discipline, it also creates anxiety when changes occur (Cannon, 2014; Eriksen, 2015).

2. Bureaucratic Issues

The CNO and SECNAV have repeatedly challenged Sailors and Navy civilians to innovate. Junior officers and enlisted sailors want to contribute and make a difference, but the path to submit ideas is often unclear. Leadership (at all levels), lack of command support, excessive workloads, and non-standardized submission methods can stifle the innovation process.

In the past, many in the Navy believed the only way to attain expertise and knowledge was through long years of experience. Many felt the school of life was the only accredited institution that conveyed knowledge and respect. This perspective asserts that those in command have all the answers as a result of their years of experience. (Johnston, 2014). Today, Navy leadership recognizes there are other approaches more conducive to modern innovation (Johnston, 2014).

Camaraderie, a shared culture, and being an accepted member of the Navy community are important to sailors, since trusting each other is essential for survival (Eriksen, 2015; Johnston, 2014). Nevertheless, this peer pressure to conform suppresses innovation and sometimes even a person's willingness to speak up (Cannon, 2014; Eriksen, 2015; Johnston, 2014). This may contribute two related types of behavior: the "naysayer" and the "frozen middle."

A “naysayer” is a risk-adverse decision maker or influencer. Officers and enlisted sailors can both fall into this category by failing to be open-minded when new ideas emerge, because it diverges from the currently accepted system. A naysayer may be risk averse to due fear or simply because the status quo or accepted approach is comfortable (Johnston, 2014). Naysayers operate in what Stacy (1995) characterized as a state of equilibrium, rather than embracing the innovation that can emerge from organizational instability and informal networks. This affront to the status quo often drives leaders to resist change through passive or active means (Eriksen, 2015).

Idea rejection can come from anywhere, and from any influencer or decision maker, but middle management is often the most culpable. This group of middle managers is referred to as “the frozen middle.” This was demonstrated when USS *Nimitz* personnel attempted to change the manner in which zone inspections were conducted. Being presented an apparently well-vetted plan, the Commanding Officer ordered it be instituted immediately throughout the aircraft carrier, but the “lower level middle management” resisted the idea and prevented its implementation (Eriksen, 2015).

3. Idea Submittal Avenues

As of February 2018, over two dozen different physical and virtual innovation hubs were contributing ideas to the Navy Innovation Network. There are a similar number of research locations (see figure 5), but despite all of these opportunities for moving innovation forward, determining how to submit an idea is another key issue. For those sailors not fortunate enough to work within a supportive command, determining with whom to speak or where to seek assistance is not easy.

Figure 5. Navy Centers of Innovation. Source: SECNAV (2018).

Submitting an idea to Google is simple. A quick search returns instructions to contact the company (see screen shot), but “the Navy” is not as accessible. Most people now use internet searches or videos online to learn how to do things or to conduct research. This is especially true with the current generation. Searching topics like “Navy Innovation Center” and “Submit an idea to the Navy” returns articles about the Navy’s innovation vision and some previous programs, but there is no clearly defined process to submit an idea. Even searching “Navy Innovation Network” does not return a clear-cut submittal process. Unless a sailor knows about a specific innovation hub, he or she may lose interest in contacting the Navy and abandon his or her efforts all together (Cannon, 2014).

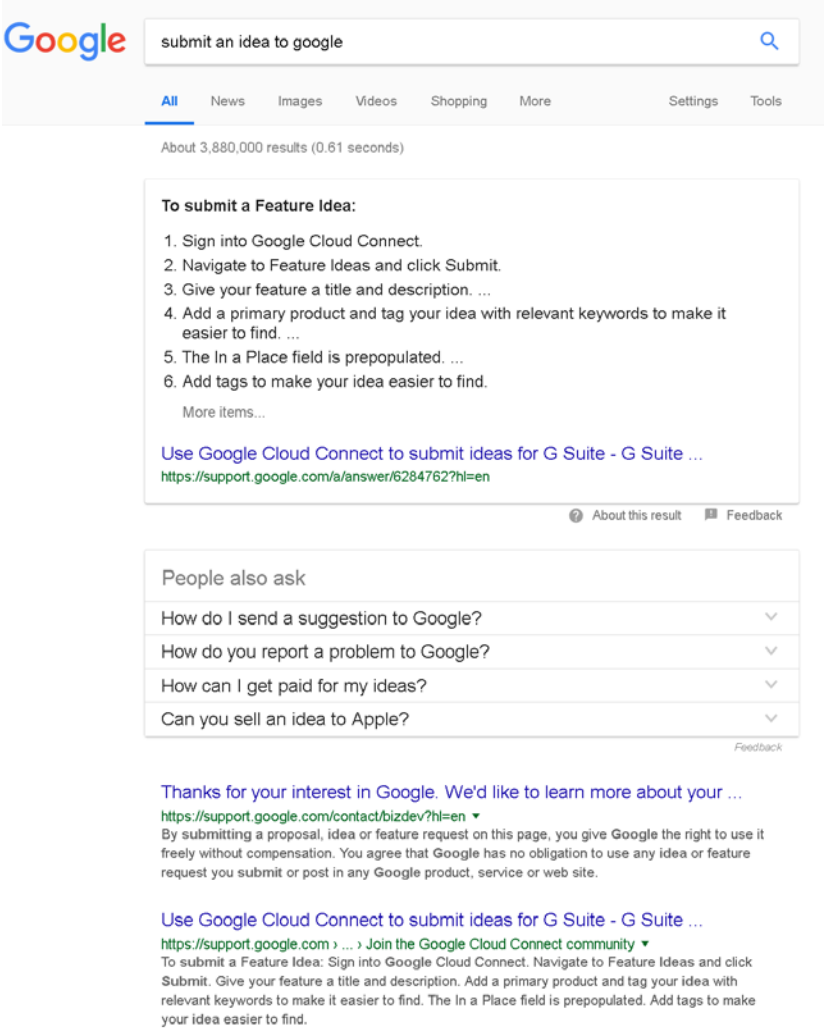

Figure 6. Google Search. Source: Google (2018).

Even if a sailor is able to locate one of the NIN hubs, this does not guarantee that node will have the ability to aid that individual. An ATHENA participant commented that while he enjoyed his experience pitching an idea, there were no members of industry at the event capable of commercializing it. Because of this apparent lack of interest in his ideas, he has not participated since (Cannon, 2014).

4. Overwork

The final issue to be discussed is the amount of work facing today's sailors. This is a sensitive subject due to recent events with the USS *Fitzgerald* and USS *John S. McCain*, but Derek Mason's NPS Master's thesis reinforces what the USS *Nimitz*'s sailors suggested: they are overworked and undermanned (Eriksen, 2015). Specifically, Mason (2009) found that the Navy Standard Workweek significantly underestimated the amount of hours sailors work and overestimated the amount of rest they receive during the week. While overwork can inspire sailors to be innovative to improve their quality of life, it can also strangle these efforts (Eriksen, 2015).

C. OVERCOMING OBSTACLES

Over time, the founders of the various NIN hubs discovered methods to encourage personnel to participate and overcome adversity. Generally, these methods address personnel because the majority of innovation hurdles involve people more than technology. Once again, it is important to note that methods developed by each organization in response to specific negative traits or barriers to progress encountered are necessarily unique to the organization.

1. Involve/get Buy-in from the "Middle"

One of the biggest threats to innovation comes from the naysayers and the frozen middle. Not only can they discourage creative minds on the ship, but they can also prevent those individuals from speaking up. Because of this, getting buy-in from these individuals/groups is essential. The first step to accomplishing this is through education. Peter Senge, author of the *Learning Organization*, specifically states that people must employ "adaptive" learning, or the ability understand the problem and the solution, and be able to determine how to get there (Schein, 2016). Naysayers religiously follow standard operating procedures, since the majority of these rules and processes are accepted as doctrine. In order for naysayers and those in the frozen middle to recognize change that is not directed from above as anything other than a threat, a thorough explanation, and possibly

even a demonstration of value, may be required. The second step is involvement. These middle managers bring a lot of knowledge and experience to the fight, but they can perceive change as a threat to their status. Seeking these people out as change agents and involving them in the innovation process, may reduce or eliminate those fears.

2. Respecting the Inventor(s)

When men and women join the Navy, they seldom do it for the money (Zimmerman, 2011). A 2011 thesis detailing the Navy's Combinatorial Retention Auction Mechanism (CRAM) confirmed this, when sailors chose desirable non-monetary benefits rather than financial rewards alone (Zimmerman, 2011). The Navy incentivizes inventors financially through OPNAVINST 1650.8 (series), but the instruction falls short of offering intrinsic rewards and recognition innovators may prefer (US Navy, 2007).

Today, good leaders realize that ideas involve multiple viewpoints and can emerge from anywhere, especially from the junior officers and enlisted sailors who deal daily with technical and policy deficiencies. (Eriksen, 2015). One way to recognize/incentivize an innovator was by providing that person time to pursue his or her project. These men and women are passionate about their projects. By assigning them to one of the two dozen labs, bases, or higher education locations where the Navy's innovation programs thrive, they can participate with a team to see their project to fruition. Other incentivizes will be discussed in the Recommendations and Conclusion chapter that follows.

V. RECOMMENDATIONS AND CONCLUSION

The following chapter offers suggestions for the Navy to bridge individuals and clusters within the social network of Navy innovators more effectively. These methods share a number of commonalities with the USCG's innovation program, but also incorporate elements from other successful initiatives. While the suggested steps focus on a technological approach to bringing people/nodes and organizations/networks together, it is imperative to recognize the importance of the other common problems mentioned in chapter four. To maximize the potential of the NIN, incorporation of policy and procedural changes are equally as important as the adoption of the proposed development of an Innovation Common Access Resource System (ICARS).

A. THE ICARS SYSTEM

As a result of the exploratory research cited earlier, the ICARS system is being proposed here as an application (app) with a Graphical User Interface that links historical documents, innovation databases, and fleet and industrial subject matter experts (SMEs) together with an institutionalized Department of Navy innovation team. The expressed purpose of this system is to encourage innovation throughout the Navy. The proposed ICARS system is intended to encourage and facilitate innovation by first providing innovators increased access to information and knowledge, then to link these individuals to groups that can help them develop their ideas. This is a combination of several successful systems currently in use by the Navy, other uniformed Services (including the United States Coast Guard), and industry.

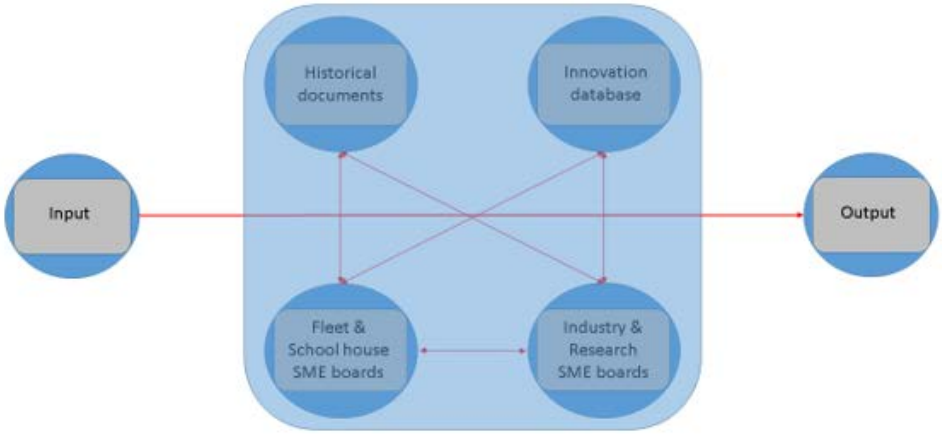

Figure 7. The Complete "ICARS" System

The Navy Innovation Network encompasses over two dozen separate organizations. While some personnel are members in multiple groups, creating weak times among them, ICARS seeks to consolidate these groups to improve communication, coordination, and interest in the innovation process.

B. THE PROCESS AND STRUCTURE: INNOVATION TEAMS AND PHYSICAL HUBS

1. Innovation Hunters

The first step in the proposed innovation process that includes ICARS is to develop a corps of Innovation Hunters (IHs). Innovation Hunters are Navy sailors (officers and enlisted) whose mission it is to seek out innovations and innovators inside their functional or geographic area of responsibility (AOR). These individuals would serve as informal network hubs to help connect local innovators. IHs need to be renaissance personnel, having experience and accomplishments across multiple fields and disciplines with core understandings of Science, Technology, Engineering, and Mathematics (STEM), as well as business. With that said these people must also be creative and resist institutional thinking. This creativity adds an A (Arts) to STEM, creating STEAM. Personnel in the IH realm need to understand how the Navy acquisition system works, so assigning a specific additional qualification designator AQD or Navy enlisted code NEC to Supply

Corps personnel would be the most likely path to implement such a sub-specialty, but other rates and designators could also apply.

2. Primary Reviewers

Once the IHs confirm that an idea appears viable, the innovator and his or her idea is forwarded to the primary reviewer (PR). In step two of this process, PRs gather additional information to more thoroughly vet the project, monitor the individual's progress, and coordinate testing of the concept. These members of the innovation team further link industry and military SMEs to the innovator to ensure the project's viability and ensure projects do not overlap. The PRs ultimate goal is to review innovative ideas as efficiently as possible to determine the feasibility of the projects. Once he or she is satisfied that the suggested concept will benefit the Navy, the PR submits his or her findings to the Innovation/Executive Council.

3. Innovation / Executive Council

The Innovation/Executive Council (IEC) consists of a quorum of military and civilian personnel from the various nodes within the NIN. Meeting quarterly, this group transmits innovation initiatives, demand signals, and information throughout the NIN, via ICARS. In step three of the process, this group also reviews innovations for duplication, funding, and/or forwarding to entities like the Office of Naval Research (ONR), Space and Naval Warfare Systems Command (SPAWAR), the Warfare Centers, NPS or other research facilities for further development and fielding. Finally, the IEC assists the DoN in rolling the new ideas out to the fleet to overcome resistance in the "frozen middle."

4. Locations

In addition to the steps noted above in the innovation process, there needs to be structure. Innovation Hunters and primary reviewers will have specific geographic and functional (warfare area) AORs. The IHs will be located at fleet concentration areas so that they may reach Navy personnel across the Fleet.

5. Hierarchy

A flat hierarchy is essential to promote collaboration and participation, and to limit bureaucracy. The less time required to submit ideas and receive feedback, and the more opportunity for collaboration and transparency, the higher the likelihood of an idea reaching fruition.

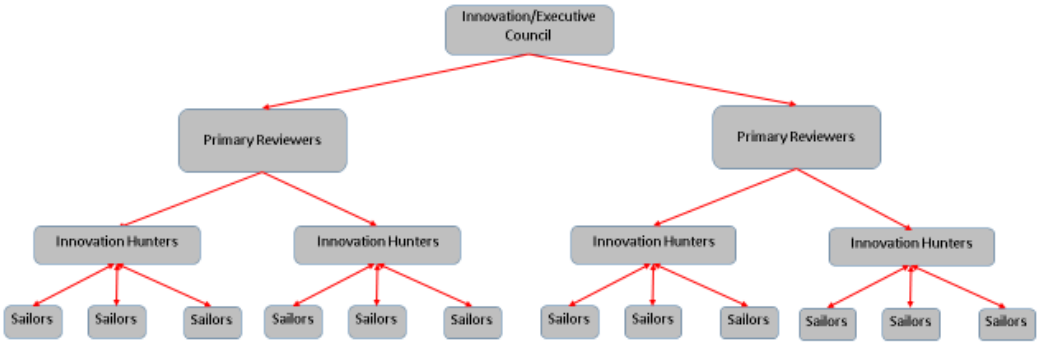

Figure 8. Hierarchy

C. ICARS APP

1. Access

An essential part of ICARS is ensuring it is sponsored by the Navy. To accomplish this, the installation on all Navy Marine Corps Intranet (NMCI) computer systems is essential. Specifically, there will be an ICARS icon located on every desktop. Additionally, ICARS will also be available by utilizing a virtual private network (VPN), permitting remote access for unclassified projects.

In order to access ICARS, every sailor, government employee, and contractor will register using an official email and ICARS administrators will assign a username. Once registered, an individual's command or employer must verify the member's identity and authenticate that individual's email address. This does reveal the member's username or whether the member utilizes ICARS; it merely authenticates that person's identity. This authentication process recurs periodically

to ensure the individual's contact information is up to date, and that his or her security clearance and access to government computers remain valid.

To avoid the naysayer and frozen middle obstacles, ICARS will assign a username to maintain the user's anonymity. At no time will a person's rank, affiliation, or other identifying characteristics be available to other users. Innovation hunters (IH) and other ICARS administrators are the only people who can access this information. All those employed by the Department of the Navy (DoN) with computer access will be encouraged to use and contribute to ICARS. To accomplish this, these individuals will require training on the purpose and proper usage of ICARS by the local IHs. This will not only introduce the IHs to the units, but it will also alleviate any possible negative bias and more thoroughly answer any questions related to purpose or usage.

2. Tracking and Statistics

Every user is tracked in ICARS to determine how active the person is in the system and in what ways he or she contributes to ICARS. Further, other members can "like" ideas, comments, and suggestions. Data will be used for statistical analysis, including a determination of value based upon peer recognition. This is similar to a person's Twitter "Klout" score (based on likes and retweets) that shows how much influence the idea has. Over time, the likes of a particular person's comments also can suggest whether that person should be invited to serve as a member of the innovation team. Conversely, if a person is repeatedly reported for abuses of the system, tracking data will be used to determine whether suspension, expulsion, or disciplinary action should be pursued.

3. Opening Screens

After logging into ICARS, users will be required to acknowledge the classification level and the penalty for transmitting information that exceeds that level. This ICARS app should be installed on both the Non-classified Internet Protocol (NIPR) and Secret Internet Protocol (SIPR) networks, so that a wider range of ideas can be cultivated.

Once inside ICARS, ease of use, intuitive flow, and minimal clicks to submit an idea will further encourage participation. With this in mind, members with ideas to submit will be asked to make simple choices to properly categorize where their innovation belongs (see “main page” figure below). After determining the warfare and topic concentration area in which to enter the idea (see “subpages 1 and 2” below), the innovator will be required to write a brief description using a dialogue box (see “dialogue box” below). Before submitting, users must re-verify that whatever he or she is about to submit meets the classification guidelines.

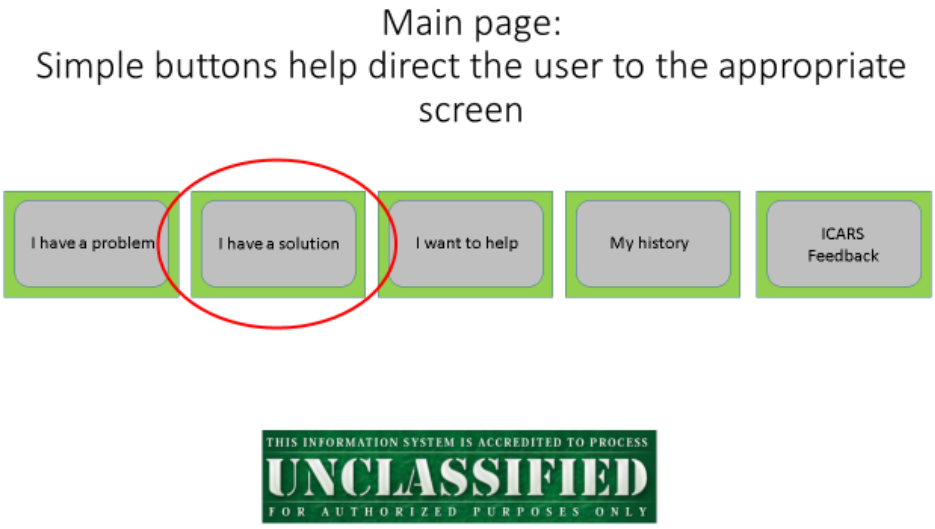

Figure 9. Main Page

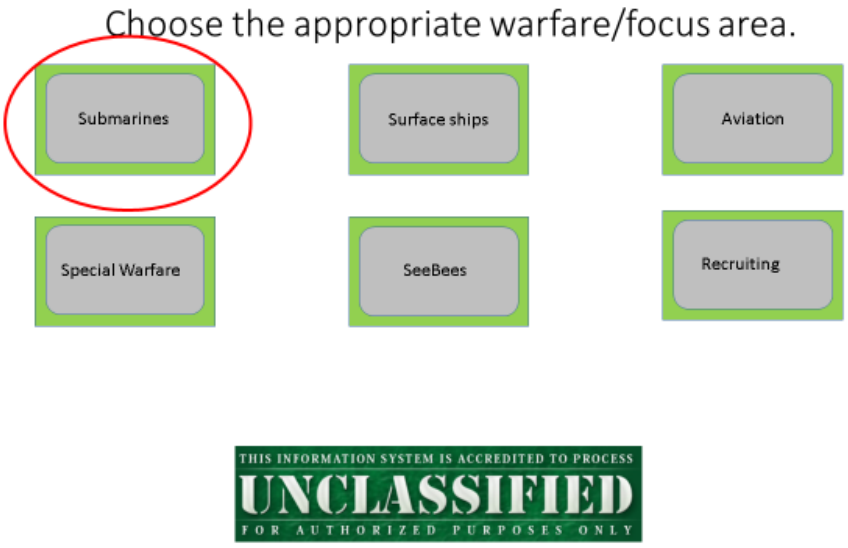

Figure 10. Subpage 1

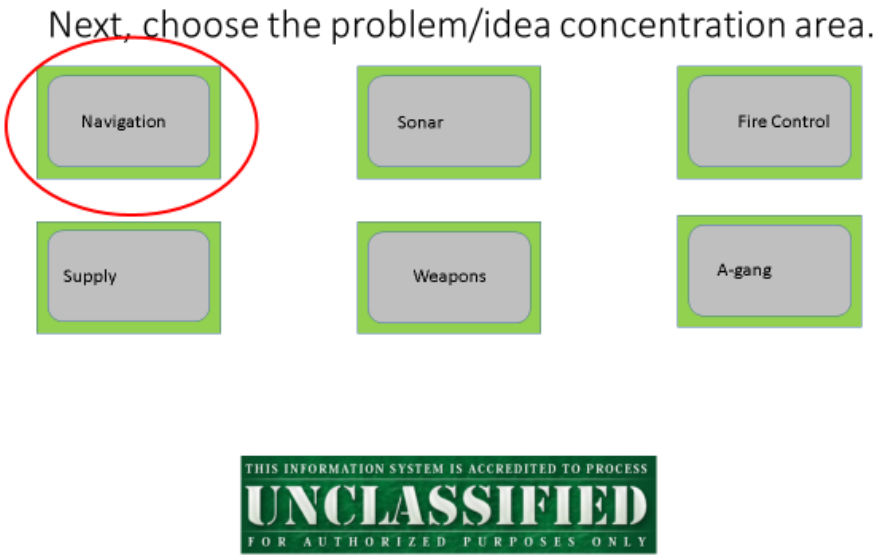

Figure 11. Subpage 2

Figure 12. Dialogue Box

D. SUBMISSION COMMUNICATION PATH

The dialogue box submission will initiate a keyword search of two of the primary functions within ICARS: the historical documents and the innovation database. These functions will be explained in the next section, but the query will search for related work, lessons learned, or challenges encountered by the fleet. The search would also identify any previous innovation attempts or related research. Based on these findings, the individual who submitted the idea will decide whether they want to pursue their innovation further. Having a perspective of previous attempts to solve the problem will also allow the would-be innovator to better asses their own solution.

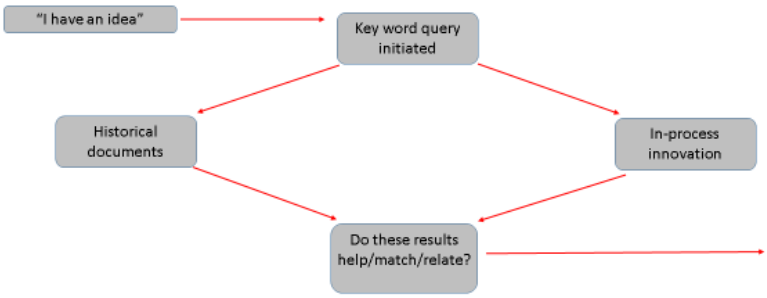

Figure 13. Initial Communication Path

Once the innovator determines that his or her idea is either a new concept or a way to restart a previous or related project, ICARS verifies the individual's contact information then alerts the local IH (see "innovation pathway" below). Innovation Hunters will sit down with the individuals, listen to the pitch, and determine what action should be taken: the idea may be returned to the person for more information, submitted to the primary reviewer for further consideration, or rejected. Every step is logged in ICARS for transparency, to-do lists are transmitted to the innovator, and updates are logged in the database. Once the PR is satisfied, he or she submits the idea to the executive panel who determines its final disposition (see "submission process" below).

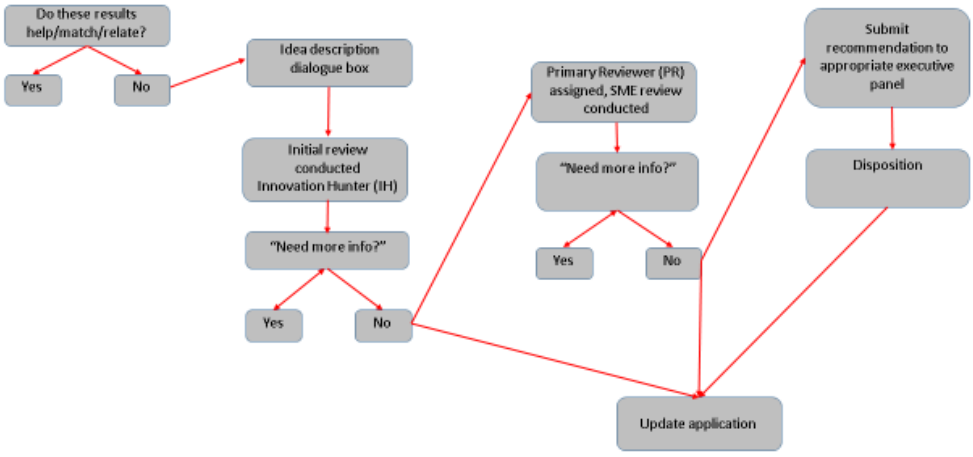

Figure 14. Innovation Pathway

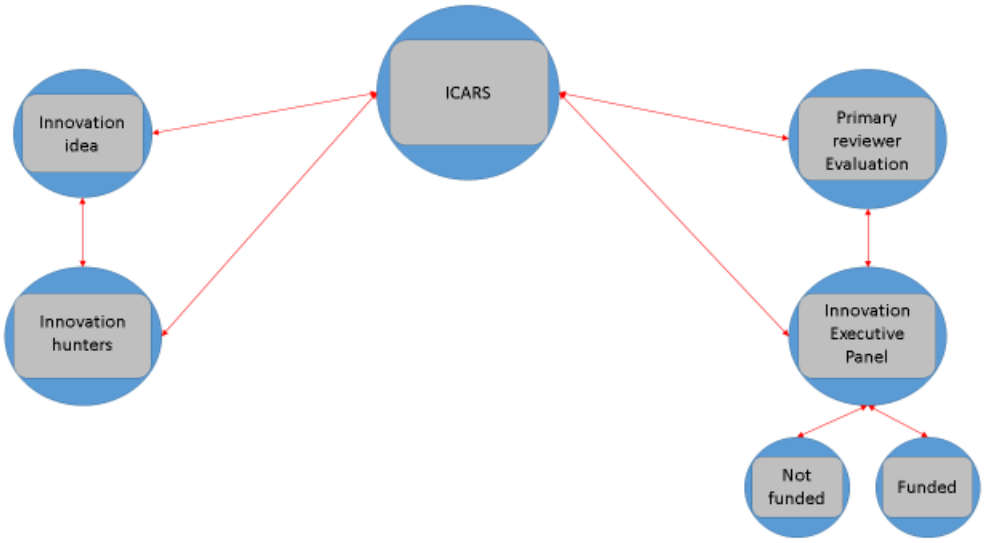

Figure 15. Submission Process

E. COMPONENTS

1. Historical Library

Inside the ICARS program itself, there are four pillars, or database repositories: Historical documents, Innovation database, Fleet & Schoolhouse SME boards, Industry and Research SME boards (Figure 7). The Innovation team has already been addressed, so four of these pillars will now be described in further detail. The first to be discussed are the fleet's historical documents. Official papers like Departure From Specifications (DFS), the various forms of Ship Alterations (SHIPALT), Casualty Reports (CASREP)/Casualty Corrections (CASCOR) provide innovators information regarding technical problems encountered and addressed across the fleet. For instance, the CASREP/CASCOR pairs explain details of a problem and how the crew overcame it. By reviewing problems and how these were resolved or mitigated, patterns may be discernible that inspire innovators to suggest additional courses of action or to design better systems.

This portion of ICARS offers the greatest opportunity to win over middle managers. These individuals operate under tremendous pressure to ensure their specific systems, and by extension their unit, are mission ready. Often, they rely

upon their experience and intuition when technical publications fail to diagnose the root failure. By building this resource, middle managers can explore how other units resolved similar problems. ICARS also encourages collaboration and training by allowing junior officer and enlisted sailors to research problems and suggest remedies based upon previous experience and lessons learned. The ICARS historical database is intended to help middle managers better address problems they encounter in their workspaces while encouraging them to support innovations that address recurring problems fleet-wide.

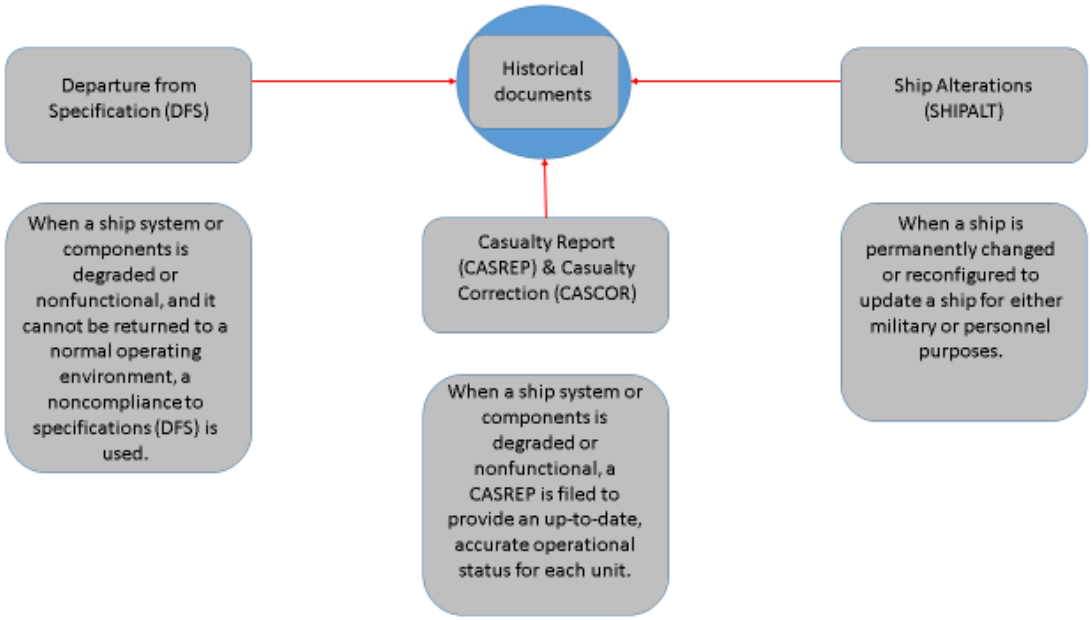

Figure 16. ICARS – Historical Documents Explanation, Part 1

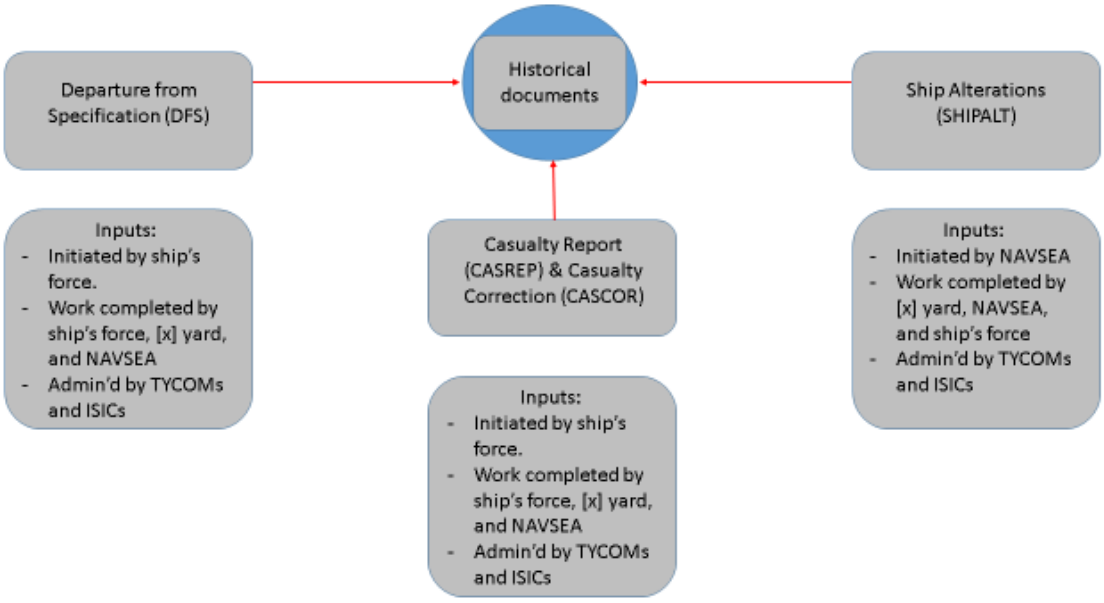

Figure 17. ICARS – Historical Documents Explanation, Part 2

2. Innovation Database

The second pillar in ICARS to discuss is the collection, organization, and presentation of past and present innovation initiatives that emerged primarily through throughout the formal and informal Navy Innovation Network (NIN). This database will consist of past attempts and ongoing projects, a description of desired project outcomes, a log of what has and has not worked in each case, message boards for each project, and points of contact for those interested in contributing to the innovation effort or in seeking further information.

In order to accomplish this, existing project/idea data from the various NIN need to be uploaded into a database and formatted. The resulting Innovation database would enable innovators to build upon what others have learned in the past (through trial and error). This dynamic, living Innovation database would then be maintained by the Innovation team.

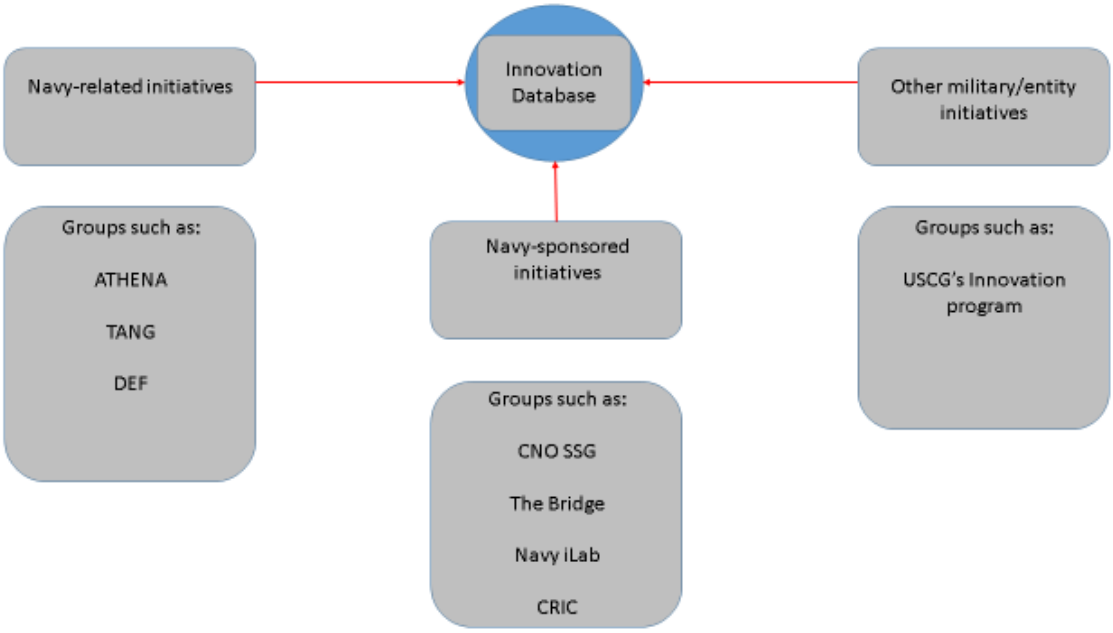

Figure 18. ICARS – Innovation Database

3. Fleet and Industry SMEs

The third and fourth pillars in ICARS to discuss are the Fleet & Schoolhouse SME boards and Industry and Research SME boards. These databases contain listings, attributes, and contact information for both fleet and civilian subject matter experts. These subject matter experts represent years of experience and a depth of knowledge in their respective fields. They are both sources of information and conduits for innovation development and implementation.

In the Fleet and Schoolhouse database would be the military personnel who teach in the schoolhouses, train and evaluate the fleet at the Afloat Training Groups and at the squadron, work at the maintenance facilities, and in the various Warfare Centers and Naval research facilities. On the civilian side, these are technical experts from industry partners with vast experience in the both the Defense industry and the private sector.

Having registered with ICARS administrators, SMEs can either choose to contribute to innovations already posted, or offer solutions for others to pursue.

These SMEs could also be selected to serve as a primary reviewer for specific projects.

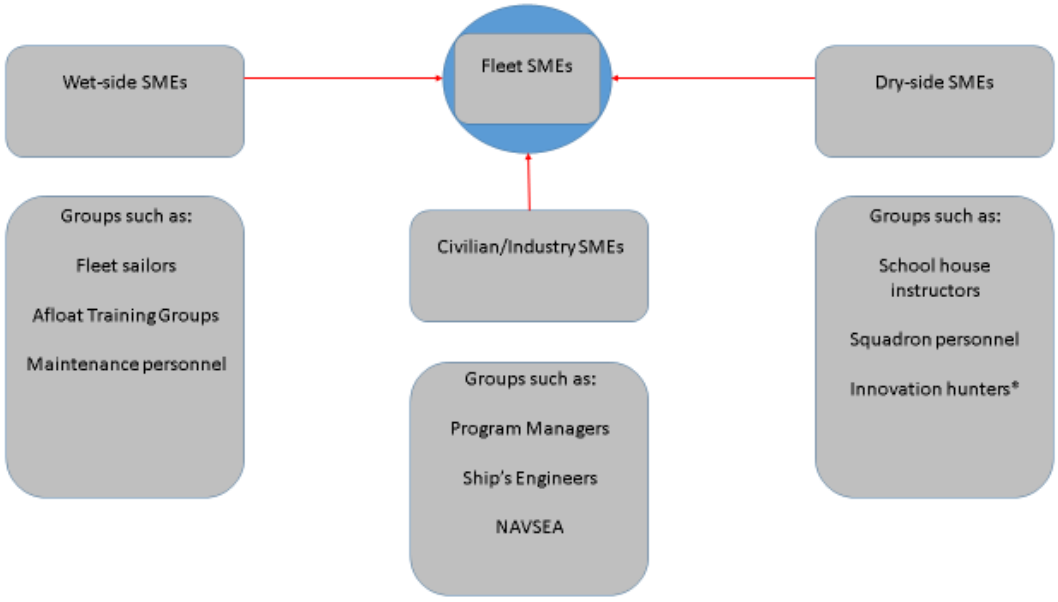

Figure 19. ICARS – Fleet SMEs

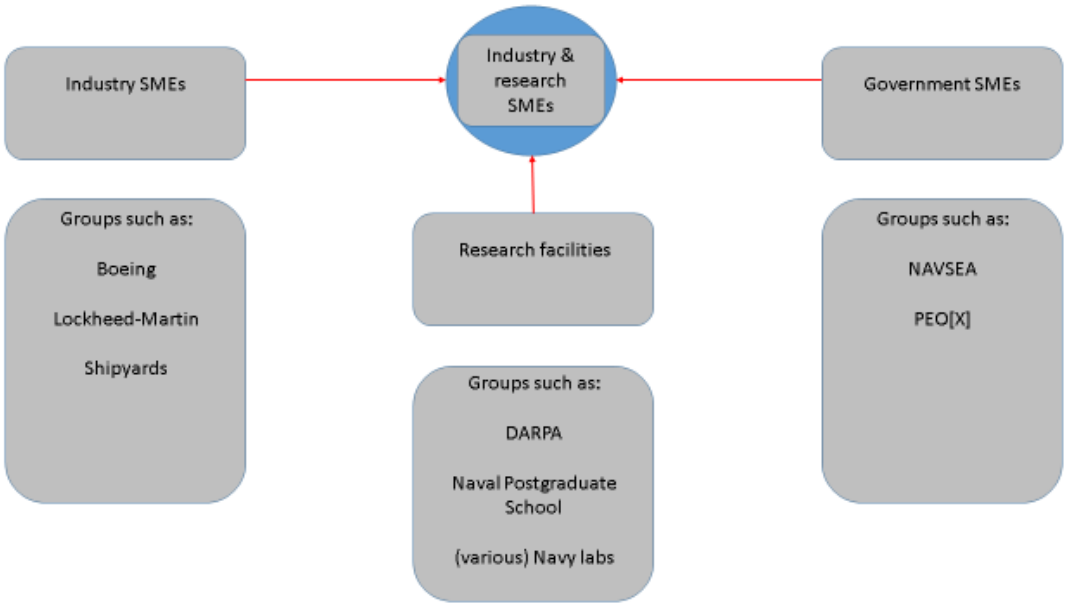

Figure 20. ICARS – Industry SMEs

F. CONCLUSION

Today's sailors routinely demonstrate that they want to make the Navy better, and when given the opportunity, their ideas have improved the quality of life for those affected. Unfortunately, these innovators are stymied by the current inefficient, and sometimes convoluted, process; disinterested middle managers who either will not help or actively block efforts; and an archaic compensation system that discourages inventors from submitting ideas. Additionally, the service's current risk-adverse, zero-defect mentality stifles potential innovators for fear of failure. In order for the Navy to encourage this new generation of sailor to offer their concepts, the current systems and mindsets need overhauled.

ICARS will assist the Navy's innovation attempts through a multitude of facets. First, it more effectively bridges together individuals and clusters within the network of the Navy's Innovation Network by providing a dedicated, structured, and organized path for innovators throughout the fleet to submit, inspire, and contribute ideas. Second, it will provide middle managers a dedicated troubleshooting and situational awareness resource that will reduce unit downtime, technical consultation time and expenses, and improve research and training opportunities. Finally, it provides the opportunity to expand beyond the Navy to allow innovators from all branches of service to interact and contribute, benefiting all of DoD.

1. Recommendations and Future Research

a. ICARS

The first recommendation is to design, test, and field ICARS. In order to do this, the program itself needs to be coded to operate inside the NIPR and SIPR platforms. For the unclassified version, building a VPN access port will also need to take place.

Big data collection and storage will also need to be addressed, as will system architecture to support machine learning and keyword search algorithms.

After this build is completed and ICARS is fully integrated in the fleet, expanding access to the rest of the DoD might ensure higher-level support and broader, more diverse collaboration, resulting in combinatorial innovation.

b. Innovation Leadership

In order to encourage innovation, Navy leaders should incentivize rather than punish responsible risk-taking to offset the current risk-averse culture that has developed over time. Navy leaders at all levels (from major commands to work-centers) need to encourage and incentivize innovative thinking, and this includes a willingness to take reasonable risks.

c. Future Research

ICARS has the potential to revolutionize the Navy's innovation efforts, and as the Navy rolls it out, new qualitative and quantitative research opportunities will present themselves. Specifically, future researchers can observe and evaluate the program's implementation. There is also an opportunity to conduct a cost-benefit analysis of the ideas presented versus the total investment. Finally, once the program is completely fielded, evaluating it at the five-year point will offer a realistic analysis of ICARS' effectiveness and level of use.

Determining the number and type of patents that result from ICARS and the Innovation process is a second area to explore. Previous patent research was limited to USMC personnel and resulted in a sample size too small to offer a statistically significant outcome (Bladen, 2016). By expanding it to either DoN or all of DoD, there is a higher likelihood of receiving significant results.

Finally, a thorough evaluation of how junior personnel perceive their Command's willingness to encourage their contributions to innovation should be quantitatively and qualitatively measured. The case studies cited in the Literature Review demonstrated that junior sailors were often reluctant to voice a different point of view. Questions regarding command support for inclusive innovation should be incorporated into the Command Managed Equal Opportunity (CMEO) surveys.

LIST OF REFERENCES

Adams, D., Cares, J., Morash, B., Nofi, A., Siordia, A., & Soldow, D. (2017, April 18). *The Navy's innovation problem. Proceedings Magazine*.

Baker, T. (2015). *Athena 7*. Retrieved February 24, 2018, from http://www.secnav.navy.mil/innovation/HTML_Pages/2015/05/AthenaProject7.htm

Bladen, S. (2016). *Do military personnel patent?* (Master's thesis). Retrieved from https://calhoun.nps.edu/bitstream/handle/10945/51648/16Dec_Bladen_Shane.pdf?sequence=1

Bock, L. (2015). *Work rules!: Insights from inside Google that will transform how you live and lead*. London: John Murray.

Bonomo, B. (2017, December 21). *Tall vs. flat hierarchy: Organizing your business for impact*. Retrieved February 24, 2018, from http://clarityconsultants.com/blog/tall-vs-flat-hierarchy-organizing-your-business-for-impact/

Cannon, C. (2014). *A case study of project ATHENA: Tactical level technological innovation aboard the USS Benfold* (Master's thesis). Retrieved from https://calhoun.nps.edu/handle/10945/44532

Commander, U.S. Pacific Fleet. The bridge. Retrieved November 07, 2017, from http://www.cpf.navy.mil/the-bridge/

Cross, R., & Prusak, L. (2002, June). *The people who make organizations go*. *Harvard Business Review.* Retrieved from https://hbr.org/2002/06/the-people-who-make-organizations-go-or-stop

DEF. About. Retrieved February 01, 2018, from https://defenseentrepreneurs.org/about/

Denning, P., Dunham, R., & Brown, J. (2012). *The innovator's way. Essential practices for successful innovation*. Cambridge: The MIT Press.

Eriksen, C. (2015). *On creativity: A case study of military innovation* (Master's thesis). Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/1008922.pdf

Fisher, P. (2018, January 09). Opinion: Don't ignore bad policy and the 'indolent chiefs mess'. *Navy Times.* Retrieved February 09, 2018, from https://www.navytimes.com/news/your-navy/2018/01/09/opinion-dont-ignore-bad-policy-and-the-indolent-chiefs-mess/

Fleet Forces Command. (2017). *Joint Fleet maintenance manual.* Norfolk, VA.

Google. (2018). Google search. Retrieved from https://www.google.com/search?q=submit%2Ban%2Bidea%2Bto%2Bgoogle&ie=utf-8&oe=utf-8&client=firefox-b-1.

Granovetter, M.S. (1973). *The strength of weak ties*. *American Journal of Sociology 78*(6): 1360–1380.

Hall, J. (2013, September 01). *10 barriers to employee innovation. Retrieved* from https://www.forbes.com/sites/johnhall/2013/04/29/10-barriers-to-employee-innovation/#37fd09ec117dhttp://www.navy.mil/navydata/testimony/safety/sullivan031029.txt

IDEO U. *Design thinking*. Retrieved February 24, 2018, from https://www.ideou.com/pages/design-thinking

Integrated Publishing, Inc. *Casualty report system*. Retrieved from http://www.tpub.com/gunners/274.htm

Johnston, K. & Featherstone, R. (2014). *A case study of introducing innovation through design* (Master's thesis). Retrieved from https://calhoun.nps.edu/handle/10945/41398

Kadushin, C. (2004). *Basic network concepts*. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwi-lovAyojaAhUV6WMKHaxbCo0QFggpMAA&url=https%3A%2F%2Fsites.google.com%2Fsite%2Fshancook2%2FBasic_Network_Concepts1.pdf&usg=AOvVaw0QVh0TinuM6PEi56fmMjEx

Kadushin, C. (2012). *Understanding social networks: Theories, concepts, and findings.* New York: Oxford University Press.

Kluckhuhn, C. (2008). *An examination of four successes in the Coast Guard's innovation program and implications for innovation within homeland security* (Master's thesis).Retrieved from https://calhoun.nps.edu/bitstream/handle/10945/4216/08Mar_Kluckhuhn.pdf?sequence=1

Kolinger, J. (2017, May 09). *Importance of span of control & organizational structure*. Retrieved February 24, 2018, from https://www.orgchartpro.com/span-of-control-and-organizational-structure/

Kossiakoff, A., & Sweet, W. N. (2006). *Systems engineering: Principles and practices.* New Delhi: J. Wiley-India.

Krackhardt, D. (1997). Informal networks: The company knowledge*. In Knowledge in organisations* (pp. 37-49). doi:10.1016/b978-0-7506-9718-7.50006-8

Krackhardt, D., & Stern, R. N. (1988). Informal networks and organizational crises: An experimental simulation. *Social Psychology Quarterly*, 51(2), 123. doi:10.2307/2786835

Lynch, J. (2017). *DEF in the news*. Retrieved from https://defenseentrepreneurs.org/inspire/def-dispatch-17-oct-2017/

Maslov's triangle. (2011). Retrieved from http://www.21stcentech.com/wp-content/uploads/2011/10/maslow.jpg

Mason, Derek R. (2009). *A comparative analysis between the Navy standard workweek and the work/rest patterns of sailors aboard U.S. Navy cruisers.* (Master's thesis). Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a514116.pdf

McLeod, S. (2017). Maslow. https://www.simplypsychology.org/maslow.html

McRaven, W. (2017, September 15). *DEF annual conference welcome speech.* Speech presented at DEF Annual Conference, Austin, TX.

Meehan, C. *Flat vs. hierarchical organizational structure*. Retrieved from http://smallbusiness.chron.com/flat-vs-hierarchical-organizational-structure-724.html

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation*. San Francisco: Jossey-Bass.

Mohan, M. (2013). *Ambiguity aversion in the front-end of innovation*. Stillwater, OK: Oklahoma State University

Mullen, M. (2018). *Secretary of the Navy's guest lecture*. Lecture presented in Naval Postgraduate School, Monterey.

Navy Innovation Network (NIN). (2016, December). Charter. Retrieved from http://www.secnav.navy.mil/innovation/Documents/2016/12/NIN_Charter.pdf

Neal. (n.d.).Naval quotes. Retrieved November 07, 2017, from http://www.subsim.com/index.php?itemid=10902

Network. (n.d.). Retrieved from http://www.dictionary.com/browse/networkNNGroup.com.

NNGroup.com. (n.d.). *Design Thinking 101*. Retrieved February 23, 2018, from https://www.nngroup.com/articles/design-thinking/

Porter, W. (2017). *Final Technical Report* NPS-N097-A. Naval Postgraduate School, Monterey.

Pike, J. (n.d.). *Fleet Modernization Program*. Retrieved from https://www.globalsecurity.org/military/systems/ship/fmp.htm

Research Methodology. *Exploratory research*. Retrieved from https://research-methodology.net/research-methodology/research-design/exploratory-research/

Schein, E. H. (2016). *Can learning cultures evolve?* Retrieved from https://thesystemsthinker.com/can-learning-cultures-evolve/

Science Daily. *Confirmation bias*. Retrieved from https://www.sciencedaily.com/terms/confirmation_bias.htm

SECNAV. (2018). *Centers of innovation*. Retrieved from http://www.secnav.navy.mil/innovation/Pages/centers.aspx

Singh, K. (2008). *Quantitative social research methods*. Thousand Oaks, CA: SAGE.

Smith, J. (2013). *Tactical Advancements Next Generation (TANG)*. Undersea Warfare, 51, 8-20. Retrieved from http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/PDF/USW_Summer_2013.pdf

Stacey, R. D. (1995). The science of complexity: An alternative perspective for strategic change processes. *Strategic Management Journal 16*(6): 477–495. doi:10.1002/smj.4250160606

Study.com. *Exploratory research definition*. https://study.com/academy/lesson/exploratory-research-definition-methods-examples.html

SUBSAFE program. (2003). Testimony of Rear Admiral Paul E. Sullivan, U.S. Navy Deputy Commander for Ship Design before the House Science Committee. Retrieved from http://www.navy.mil/navydata/testimony/safety/sullivan031029.txt

U.S. Navy. (2007). *Cash awards for military personnel for suggestions, inventions, scientific achievements and disclosures*. Washington, DC: Author.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. New York, NY: Cambridge University Press.

Yin, R. (2009). *Case study research: Design and methods*. Thousand Oaks, CA: SAGE.

Zimmerman, Brooke. (2008). *Integrating monetary and non-monetary reenlistment incentives utilizing the combinatorial retention auction mechanism (CRAM)* (Master's thesis). Retrieved from https://calhoun.nps.edu/handle/10945/33968.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California