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THESIS

**A CASE STUDY OF INNOVATION AND CHANGE IN
THE U.S. NAVY SUBMARINE FLEET**

by

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December 2012

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**A CASE STUDY OF INNOVATION AND CHANGE IN THE U.S. NAVY
SUBMARINE FLEET**

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Submitted in partial fulfillment of the
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ABSTRACT

In November of 2011, the United States Navy Submarine Force conducted a revolutionary forum to leverage the technological abilities of the millennial generation in order to further the situational awareness of the sailors in the submarine's control room. To facilitate this effort, a design firm was contracted to help understand the needs of the community and to guide the design sessions of the junior officers and enlisted brought in to generate ideas. The result of the forum was an output of several encouraging new methods for displaying information to understand a submarine's contact much more rapidly. These new displays also dramatically reduce the time required to train new sailors in their operation.

This incident provided an excellent opportunity to investigate the interactions of the Navy, change management and design thinking in the field of information technology. Given the high rate of failure for information technology projects within the Department of Defense, design thinking and change management are examined in this thesis to find possible methods to reduce the losses created by those failures.

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TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	PURPOSE.....	1
B.	BACKGROUND	1
C.	PROBLEM STATEMENT	6
D.	PURPOSE STATEMENT.....	6
E.	RESEARCH QUESTIONS.....	6
F.	RESEARCH METHODS.....	6
G.	PROPOSED DATA, OBSERVATION AND ANALYSIS METHODS	7
H.	POTENTIAL BENEFITS AND LIMITATIONS.....	8
I.	ORGANIZATION OF THE THESIS.....	9
1.	Chapter II: The Nuclear Navy, Change Management and Design Thinking	9
2.	Chapter III: The Events in the Case of TANG	9
3.	Chapter IV: Analysis	10
4.	Chapter V: Conclusion	10
II.	LITERATURE REVIEW	11
A.	INTRODUCTION.....	11
B.	CHANGE MANAGEMENT.....	11
1.	Introduction.....	11
2.	Creating Change	11
a.	<i>Establishing a Sense of Urgency.....</i>	<i>15</i>
b.	<i>Creating the Guiding Coalition.....</i>	<i>16</i>
c.	<i>Developing a Vision and Strategy</i>	<i>16</i>
d.	<i>Communicating the Change Vision</i>	<i>17</i>
e.	<i>Empowering Employees for Broad-Based Action</i>	<i>17</i>
f.	<i>Generating Short-Term Wins.....</i>	<i>18</i>
g.	<i>Consolidating Gains and Producing More Change</i>	<i>18</i>
h.	<i>Anchoring New Approaches in the Culture.....</i>	<i>18</i>
i.	<i>Resistance to Change.....</i>	<i>19</i>
j.	<i>Conclusion.....</i>	<i>20</i>
C.	DESIGN	20
1.	Introduction.....	20
2.	Design vs. Design Thinking.....	21
3.	Design Thinking	22
a.	<i>Innovation</i>	<i>23</i>
b.	<i>Empathy.....</i>	<i>24</i>
c.	<i>The Design Process</i>	<i>25</i>
d.	<i>Failure</i>	<i>33</i>
e.	<i>Morale.....</i>	<i>33</i>
4.	CONCLUSION	34
D.	CONCLUSION	34

III.	CASE STUDY	35
A.	JOSH	35
B.	APL.....	36
C.	THE SUBMARINE.....	37
D.	THE SUBMARINE CULTURE	38
E.	APB ISSUES.....	42
F.	THE WHITE PAPER.....	44
G.	VADM RICHARDSON.....	46
	1. Cold Calls to Industry	51
H.	THE IDEO SHOPPING CART VIDEO.....	54
I.	JOIT TO TANG.....	58
	1. IDEO's Research.....	59
J.	DESIGN THINKING AS A FRACTAL	63
K.	TANG DRY RUN.....	64
L.	THE TANG FORUM	73
M.	TANG OUTPUTS	79
N.	POST-TANG RESULTS.....	82
IV.	ANALYSIS	87
A.	INTRODUCTION.....	87
B.	DISCUSSION	87
	1. Change Management	87
	a. <i>The Change Management Formula</i>	87
	b. <i>Kotter's Eight-Stage Change Process</i>	89
	c. <i>Kotter's Resistance to Change</i>	91
	d. <i>Implications of Change Management</i>	92
	2. Design	92
	a. <i>Empathy</i>	93
	b. <i>Failure</i>	93
	c. <i>Morale</i>	94
	d. <i>Implications of Design Thinking</i>	94
C.	RESEARCH QUESTIONS.....	94
	1. Organizational Dynamics.....	94
	2. Cultural Factors	96
D.	ADDITIONAL ANALYSIS – CHANGE MANAGEMENT VS DESIGN THINKING FOR ORGANIZATIONAL CHANGE	97
E.	CONCLUSION	99
V.	CONCLUSION AND RECOMMENDATIONS.....	101
A.	INTRODUCTION.....	101
B.	RECOMMENDATIONS.....	102
	1. Research.....	102
	2. Acquisitions	103
	3. Education.....	105
C.	CONCLUSION	106
	APPENDIX A: D.SCHOOL BOOTCAMP BOOTLEG	109

APPENDIX B: IDEO’S TANG WORKSHOP PROCESS GUIDE	157
APPENDIX C: IDEO CONVERTING SKEPTICS BRIEF	167
APPENDIX D: TANG WORKSHOP INSIGHTS	171
APPENDIX E: IDEO’S POTENTIAL SUBJECT MATTER EXPERT INTERVIEW GUIDE.....	179
APPENDIX F: IDEO’S WATERFRONT INTERVIEW GUIDE	181
LIST OF REFERENCES	183
INITIAL DISTRIBUTION LIST	191

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LIST OF FIGURES

Figure 1	“In short, we want to go from screens that look like this:”	48
Figure 2	“To screens that look more like this:”	49
Figure 3	Participants working on TANG prototypes.	77
Figure 4	TANG participants working on Predator sketch.....	79
Figure 5	Skit in PVC control room with watch team lead ‘flicking’ information to watch stander.	81

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LIST OF TABLES

Table 1.	A History of IT Investment Performance. After J. Laurenz Eveleens and Chris Verhoef, “The Rise and Fall of the Chaos Report Figures,”2
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LIST OF ACRONYMS

APB	Advanced Processing Build
APL	Applied Physics Lab
BOQ	Bachelor Officer Quarters
CAPT	Captain
CDR	Commander
CEO	Chief Executive Officer
COB	Chief of the Boat
COMSUBFOR	Commander, Naval Submarine Forces
COTS	Commercial Off the Shelf
CSDS 12	Commander, Submarine Development Squadron 12
d.school	The Hasso Plattner Institute of Design at Stanford
DEVRON 12	Commander, Submarine Development Squadron 12
DHS	Department of Homeland Security
DISA	Defense Information Systems Agency
DoD	Department of Defense
DTS	Defense Travel System
ENS	Ensign
FY	Fiscal Year
GAO	Government Accounting Office
HMW	How Might We
HBS	Harvard Business School
JHU	The Johns Hopkins University
JO	Junior Officer
JOIT	Junior Officers Innovation and Technology Forum
LCDR	Lieutenant Commander
LT	Lieutenant
LTJG	Lieutenant Junior Grade
MILSPEC	Military Specification
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
NMCI	Navy-Marine Corps Intranet

NPS	Naval Postgraduate School
NSA	National Security Agency
NUWC	Naval Undersea Warfare Center
OMI	Operator Machine Interface
SME	Subject Matter Expert
TANG	Tactical Advancements for the Next Generation
TI	Technology Insertion
VADM	Vice Admiral

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I. INTRODUCTION

A. PURPOSE

This thesis utilizes the case study method to capture the events leading up to, during and following the Tactical Advancements for the Next Generation (TANG) Forum. TANG is an innovative change effort within the United States Navy's submarine force. The submarine community utilized design thinking with the assistance of an external trusted agent to leverage the innate technological awareness of its junior sailors and officers. This research focuses on the implementation of design thinking and change management within the case by capturing the interpersonal interactions of the primary actors in support of and resistant to the TANG effort.

B. BACKGROUND

The 2000 Report of the Defense Science Board Task Force on Defense Software stated, "The success and failure rate of DoD and commercial systems appears to be equivalent... data regarding performance is difficult to obtain. However, studies reveal appalling performance in both environments."¹ The most common source utilized for these comments is the Standish Group's Chaos Study. These reports group all investigated information Technology (IT) initiatives, whether government or corporate, into one of three categories: successful, challenged, or failed. "Successful" means that the project was completed on schedule and on budget as compared to the initial estimate of the two metrics. "Challenged," means that the project did not meet one or both of the metrics,. A "failed" project is defined as one that was cancelled.² Table 1 represents the results of the Standish Group's reports since 1994.

¹ Defense Science Board, Report of the Defense Science Board Task Force on Defense Software. Federal Report, Washington D.C.: Office for the Undersecretary of Defense for Acquisition and Technology, 2000.

² J. Laurenz Eveleens and Chris Verhoef, "The Rise and Fall of the Chaos Report Figures." *IEEE Software*, (Jan/Feb 2010).

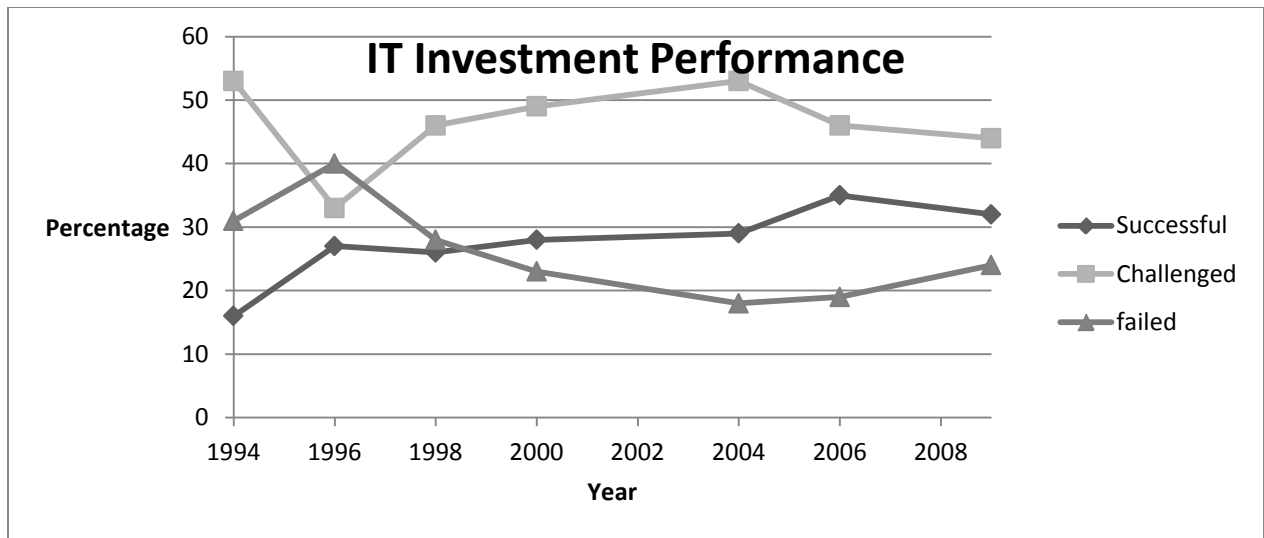


Table 1. A History of IT Investment Performance. After J. Laurenz Eveleens and Chris Verhoef, “The Rise and Fall of the Chaos Report Figures,”

A similar report produced by the Hackett Group showed that approximately 40 percent of IT initiatives are completed either on budget or on schedule. The Hackett Group’s findings failed to discriminate between the metrics of schedule and budget. Due to this binning of statistics and gap in granularity, those IT initiatives that failed outright can be safely assumed to have missed both schedule and budget targets. Absent the raw data, however, the report offers no way to discern which IT initiatives included in the study failed to meet one or both of the targets of schedule and budget.³

The fiscal year (FY) 2008 enacted budget for IT was roughly \$68 billion⁴. A FY08 Government Accounting Office (GAO) report stated that over \$28 billion of those IT investments were “poorly planned” and / or “poorly performing.” The GAO report also stated that 100 percent of the Department of Defense’s (DoD) “major IT projects,” which totaled over \$9.6 billion, were found to be “at risk,” defined by the Office of Management and Budget as “projects requiring attention from oversight authorities and

³ The Hackett Group, “IT Projects Delivered Late and Over Budget.” *Internal Auditor*, (Oct 1998).

⁴ Office of Management and Budget, “Fiscal Year 2009 Information Technology Budget.” *The White House*. April 15, 2009.
http://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/FY09_IT_Budget_Rollout_AprilUpdate.pdf (accessed September 7, 2012).

the highest level of agency management.”⁵ These facts represent a significant threat to nearly one-third of the DoD’s IT budget for the fiscal year.

The budget for FY 2012 provided roughly \$80 billion for federal IT spending.⁶ Included in this spending was slightly over \$37 billion slated for the DoD.⁷ For FY 2013, the President has requested just under \$79 billion for the federal government IT budget, which again included \$37 billion for the DoD’s IT programs.⁸

Given the constraints of the current fiscal environment, these numbers paint a very troubling picture for the Federal Government. When one considers that 40 percent of federal IT programs are considered to be “at risk,” in FY 2012 that translates to \$32 billion of taxpayer dollars being at risk. Since 100 percent of the DoD’s major IT programs are considered to be at risk, the DoD is responsible for the risk to \$11 billion of the taxpayer’s money in both FY2012 and FY2013.

These distressing numbers were a primary catalyst for this researcher’s interest in this thesis project. This research was originally intended to create a change management plan for the introduction of cloud computing into the Department of Defense. The foundation of that thesis was to have been a review of scholarly lessons learned gathered from the implementation of the Navy Marine Corps Internet (NMCI) and an analysis of their applicability to Defense Information Systems Agency’s (DISA) cloud computing

⁵ United States Government Accountability Office, “GAO.gov”. http://www.gao.gov/highrisk/agency/omb/better_it.php (accessed September 23, 2012), and United States Government Accountability Office, “OMB and Agencies Need to Improve Planning, Management, and Oversight of Projects Totaling Billions of Dollars. Testimony Before the Subcommittee on Federal Financial Management, Government Information, Federal Services, and International Security, Committee on Homeland Security and Governmental Affairs, U.S. Senate, Washington, D.C.: United States Government Accountability Office, 2008.

⁶ Vivek Kundra, "Vivek Kundra - FY 2012 Information Technology Budget." The American Council for Technology (ACT) - Industry Advisory Council (IAC). <http://www.actgov.org/knowledgebank/governmentit/Documents/Vivek%20Kundra%20-%20FY%202012%20Information%20Technology%20Budget%2002%2024%2011.pdf> (accessed September 6, 2012).

⁷ Ibid.

⁸ Steven VanRoekel, "FY 2013 IT Budget Overview." The American Council for Technology (ACT) - Industry Advisory Council (IAC). <http://www.actgov.org/knowledgebank/governmentit/Documents/FY2013-IT%20Budget%20Overview%2002-13-12.pdf> (accessed September 6, 2012).

initiative. While conducting research for that area of interest, it was discovered that there is an alarming lack of recorded corporate knowledge regarding information technology change implementations in the DoD. With regards to NMCI, there were only four theses from the Naval Postgraduate School (NPS) that touched on the progress and handling of its implementation. Of those four, only Gregory Taylor's 2006 thesis was focused on capturing lessons learned from NMCI.⁹ External to NPS, a September 2007 case study was created at the request of the Office of the Deputy Assistant Secretary of Defense, Forces Transformation and Resources.

While both of these documents were exceptionally well researched and written, this did not represent the volume of background that this researcher had expected to discover regarding the expenditure of billions of dollars on the second largest Internet in existence. It was surprising to this researcher that an investment costing \$8.8 billion over the initial seven years of the system, and that encountered so many well-known obstacles, including delayed fielding and an inaccurate estimation of the number of applications in use by Navy installations, would be so minimally researched.¹⁰ In an effort to expand the basis for comparison, the research was then broadened to encompass any IT related change effort within the DoD or the federal government. This research did not reveal any great depth in the recorded knowledge of DoD IT endeavors.

In an effort to develop guidance on the matter, this researcher met with a retired Navy Captain that is a current faculty member at NPS. During the discussion, the accounting of numerous IT implementation efforts, their issues and the lessons learned continued for nearly an hour. Over the next couple of weeks, this pattern repeated itself. This discussion highlighted the abundance of corporate knowledge retained by those who have managed or otherwise experienced IT initiatives within the DoD. It also served to

⁹ Gregory S. Taylor, "NMCI: History, Implementation and Change" (master's thesis, Naval Postgraduate School, 2006).

¹⁰ Kenneth L Jordan, "The NMCI Experience and Lessons Learned: The Consolidation of Networks by Outsourcing" Case Study, Washington D.C.: Office of the Deputy Assistant Secretary of Defense Forces Transformation and Resources, 2007.

highlight the complete lack of any scholarly recording of the events for future use and analysis.

Contemporary to this realization, a meeting between an executive at the design firm IDEO, David Haygood, and Professor Frank Barrett of the Naval Postgraduate School brought to light a current and ongoing IT (information display) effort utilizing design thinking within the U.S. Navy's submarine community. Given the opportunity and the timing, a decision was made to conduct case study method research into TANG. TANG presents a particularly innovative, large-scale change effort that is unusual in that it includes input from junior officers and enlisted. It is also an IT driven change that includes implementation of various novel technologies in the Undersea Community. This thesis will explore the lessons that DoD can glean from large scale, participative change in the adoption of new technology.

While it is not practical to capture the intricacies of every IT related effort within the bounds of the DoD, it should be of great benefit to IT managers and the U.S. taxpayers if cases from the services that highlight issues encountered during attempts to innovate were recorded and analyzed. Potentially, the creation of Harvard Business School (HBS) style case studies for use at NPS and other IT decision-maker forums could solve both the problem with capturing the information and serving as a more relatable teaching tool for professors and instructors.

A former junior officer from the submarine community arranged a meeting between current junior officers and young enlisted service-members with a design and innovation team from IDEO. The group's purpose was to use the technological experiences of the younger generation of submariners to help guide and define the future of the community. Throughout the effort, from the design meeting to the implementation, there was a mix of proponents and those who were less enthusiastic that served to present most of the classic change management issues such as: an internal champion, selectivity of the personnel invited to the design exercise, experimentation and prototyping, active and passive resistance and the co-opting of the effort when it appeared to be headed for success.

Given this richness of detail and the recency with which it occurred, this case is optimal for turning into a scholarly case study. Many lessons can be learned with relation to smart management and change implementation. Additionally, the fact that this happened within the last year should mean that the information would be relatively easy to gather from those participants willing to be interviewed by the researcher.

C. PROBLEM STATEMENT

The DoD does not have records of historical technological change implementation. This lack of case study material limits the ability of educators to provide directly relevant material to students in DoD institutions and the ability of IT professionals in the work force to examine cases similar to those they find themselves in routinely.

D. PURPOSE STATEMENT

This research aims to develop an in depth case study of a large-scale change effort involving design thinking, innovation and the implementation of new technology. This case study highlights change related issues that will serve to develop knowledge to assist DoD in future technological change initiatives.

E. RESEARCH QUESTIONS

- What are the organizational dynamics involved in introducing a participative, technological design thinking process within the traditional, bureaucratic setting of DoD?
- What cultural factors facilitate and / or constrain efforts to introduce design thinking in DoD?

F. RESEARCH METHODS

This research was performed using the case study method as described by Carter V. Good in a 1941 article in *The Journal of Educational Research*. The case study is designed to capture all relevant aspects of one specific event or series of events. The case recorded in the study then consists of situations, people, behavior and other factors that are examined

to discover the “causal factors operating.”¹¹ This method is not to be confused with the fields of casework or the case method. Good continues to describe casework as a field related to addressing diagnosed issues including those discovered through a case study. The case method on the other hand is an educational technique in which a case is used as an example to provoke thought and discussion on the part of students. Again, the case method is typically an evolution of information gathered during a case study.¹²

The setting chosen for this research case is the U.S. Navy’s Submarine Community. The Submarine community introduced a participative design process for the purpose of improving technology that facilitates situational awareness in the submarine’s control room. The research method is a case study utilizing ethnographic interviews of key participants involved in the change process. A total of 19 research participants were interviewed along with several discussions with current members of the submarine force in various settings such as during a tour of a submarine that was at the pier during a research visit, at the Officer’s Club and during meals. (see attachment – include numbers by units – two enlisted, two prior enlisted, two junior officers, four civilians with prior junior officer fleet submarine experience, three civilians, two retired senior officers, and four facilitators from IDEO).

G. PROPOSED DATA, OBSERVATION AND ANALYSIS METHODS

The case study method has been in common usage since at least 1930, when Francis N. Maxfield said, “It is becoming generally recognized that in dealing in any practical way with human relationships and adjustments there is considerable advantage in developing a case-study technique.”¹³ Many of Maxfield’s proposals are similar, with different language, when compared to the current work of Robert Stake in *The Art of Case Study Research*.¹⁴ Both authors acknowledge that it is a practical impossibility to

¹¹ Carter V. Good, "Case Study and Case Work." *The Journal of Educational Research* 35, no. 3 (November 1941): 218-220.

¹² Ibid.

¹³ Francis N. Maxfield, "The Case Study." *Educational Research Bulletin*, March 1930.

¹⁴ Robert E. Stake, *The Art of Case Study Research*. Thousand Oaks: SAGE Publications, 1995.

record every aspect of a case. Completeness is relative, and absolute completeness is unattainable.

The authors also agree that perspectives gathered should be crosschecked for validity of generalized sentiments. This was done using Stake's triangulation methods. Finally the authors are in agreement that an important portion of the work of the case study researcher is to add their opinions of what was found, based upon their research and experience, to the record as a form of synthesis of the case. This was done throughout the following case study based on the interviews, both formal and informal, and the literature review conducted.

In order to capture and represent the emotions and motivations of the actors in the case to the best of the researcher's ability, triangulation was used to define pivotal factors in the case. Following Stake the researchers sought multiple perspectives to create a holistic picture of events and did not seek a singular interpretation.¹⁵ Rather efforts were made to include the dilemmas and internal conflicts of the actors, even when these actors reported conflicting interpretations of the same events.

H. POTENTIAL BENEFITS AND LIMITATIONS

As this researcher was conducting research into change planning for the implementation of cloud technology within the DoD it became apparent that there was a lack of historical information regarding Information Technology implementation attempts. Even with respect to the implementation of NMCI, the largest network project in the U.S. government, there were only four case studies on record, and only two of those were academic case studies. This research is an attempt to capture a change effort for follow-on analysis and for use as an educational tool for any and all personnel who will be involved in IT related decision-making, and in this day and age all decision-making is IT related.

¹⁵ Robert E. Stake, *The Art of Case Study Research*. (Thousand Oaks: SAGE Publications, 1995), 108, 110

A case study has limitations. They present a case from several perspectives, but it is impossible to capture the true internal workings of a subject's emotional being with complete accuracy. This can be offset through use of triangulation. Triangulation is an attempt on the part of the researchers to correlate statements and actions of a subject throughout the case to lend credence to an interpretation.

A case study is a representation of one event or series of events. While a case study is by definition limited to one series of events, the lessons to be learned from a rich, detailed case can be generalized by future readers for use in their careers as IT managers and military leaders.

There is a lack of current DoD IT related case study material for use at institutions such as NPS. Given the rate of technological change and the billions of dollars lost in IT investments, this researcher would recommend that all large, possibly ACAT 1, projects and attempts at technological innovation should receive the attention of case study researchers. The availability of more recent materials for use in class might enable students to relate to the material.

I. ORGANIZATION OF THE THESIS

1. Chapter II: The Nuclear Navy, Change Management and Design Thinking

Chapter II will provide a thorough discussion of the literature relevant to this case. In particular, the literature will be examined in three sections. The initial discussion will be of the U.S. Navy's nuclear submarine forces, their history, missions and culture. Section two will cover change management literature with a focus on Professor John Kotter's work. The third and final section will examine the field of design and design thinking, and the growing body of work that supports its use in change management and IT management.

2. Chapter III: The Events in the Case of TANG

Chapter III will consist of a case study built upon the interviews of several submariners, and the civilians that support their community. The details and stories of

those involved will be folded together to form a mostly chronological retelling of the events and emotions involved in the effort.

3. Chapter IV: Analysis

Chapter IV will focus on an analysis of design thinking and change management and how the two compare and contrast as tools for the implementation of IT related change.

4. Chapter V: Conclusion

Chapter V will provide discussion of the research questions and any recommendations. The recommendations will be both those directed at future research and any actions that might be found to be desirable based on this research.

II. LITERATURE REVIEW

A. INTRODUCTION

Given the qualitative nature of case study research, there were few readings known to be of relevance prior to commencement. As the research unfolded, the need to understand various elements of the case, whether people, beliefs or environment, directed the course of literature discovery. Over time, it became clear that this case was a blending of issues involved in change management and design thinking. This literature review was therefore guided by those two fields and will attempt to serve as a basis for further later comparison and contrast during the case study's analysis.

B. CHANGE MANAGEMENT

1. Introduction

Change management is a field of study directed at improving the success rate of the implementation of changes within organizations. There are numerous frameworks for thinking about and planning organizational change. For this research, the focus points were Professor John P. Kotter's works: 1996's *Leading Change* and 2002's *The Heart of Change*, and David Gleicher's change formula as modified by Dannemiller and Jacobs in their 1992 article, *Changing the Way Organizations Change*. Additionally, several other books including Professor Peter Senge's *The Fifth Discipline* were used to broaden the discussion and highlight various aspects of change.

2. Creating Change

An excellent introduction to the concepts underlying change management can be found in practically any writing on David Gleicher's change formula. Kathleen D. Dannemiller and Robert W. Jacobs simplified the formula in 1992¹⁶. The revised formula is:

¹⁶ Kathleen D. Dannemiller and Robert W. Jacobs, "Changing the Way Organizations Change: A Revolution of Common Sense." *Journal of Applied Behavioral Science*, 1992.

$$D \times V \times F > R$$

That is to say that D represents dissatisfaction with the status quo, V represents the proposed vision of the future, F represents the first steps taken toward the vision, and R is the amount of resistance to be overcome.¹⁷ Each of these values is relative with no absolute, objective measure being possible. Examining this change formula mathematically, it becomes apparent that for a change effort to succeed, the product of the dissatisfaction, the vision and the first steps must be greater than the total amount of resistance applied against the change. It is also apparent that if any of the three factors working to create the change is absent, then that side of the equation goes to zero, and the resistance is almost assuredly greater than that.¹⁸ This formula does not guarantee the success of a change effort. The knowledge of the basics required for change to take place does however help frame or focus a discussion on the subject as it regards an organization.

This researcher has not seen it stated explicitly in any work discussing Gleicher's formula, but other books on change highlight the fact that change management is a discussion or analysis of people's behavior.¹⁹ Even in the equation it becomes obvious. The dissatisfaction and the vision are things provided by management or leadership to the members of the organization. The first steps are a plan drawn up by management for the organization's members to follow, and personnel, likely at all levels of the organization, generate the resistance.

In his *Heart of Change*, Kotter further refines his statement that change is an issue of people's behavior by adding that "speaking to people's feelings" is the action that effects the change.²⁰ He puts forth the opinion that people are significantly less likely to alter their behavior when provided with a reasoned analysis aimed at impacting their

¹⁷ Kathleen D. Dannemiller and Robert W. Jacobs, "Changing the Way Organizations Change: A Revolution of Common Sense." *Journal of Applied Behavioral Science*, 1992.

¹⁸ Ibid.

¹⁹ John P. Kotter, *The Heart of Change: Real-Life Stories of How People Change Their Organizations*. Boston, Massachusetts: Harvard Business School Publishing, 2002. Kindle, location 87.

²⁰ Ibid.

thoughts, than if they are “shown a truth that influences their feelings.”²¹ It may be possible to convince someone that something is in his or her best interests with facts, but that is unlikely to create the behavioral change. That requires an emotional connection to the change and the reason for the change. To conclude that line of thought Kotter states, “The flow of see-feel-change is more powerful than that of analysis-think-change.”²² Jonathan Haidt says it well in his book, *The Righteous Mind: Why Good People are Divided by Politics and Religion*, “You can’t make a dog happy by forcibly wagging its tail. And you can’t change people’s minds by utterly refuting their arguments.”²³

Who are these people though? In *Crossing the Chasm*, Geoffrey A. Moore divides technology adopters into five categories based on their personal technology adoption timeline. The spectrum of adoption is distributed along a bell curve. By replacing the phrase technology adoption with change adoption, the same theory may be used to examine the organization’s population with regard to the change effort.

The first group is the “laggards.” The laggards occupy one narrow end of the curve. Laggards are unlikely to ever adopt the new technology until the technology they are currently using is no longer serviceable, if they agree to use any technology at all, and they are forced to make a transition.²⁴ As regards change, these are the people who would never want the organization to change for any reason and will continue the trajectory to obsolescence or bankruptcy.

Next is the “late majority.”²⁵ The late majority occupies the spot on the curve between laggards and the centerline, or the average. This section of the population is

²¹ John P. Kotter, *The Heart of Change: Real-Life Stories of How People Change Their Organizations*. Boston, Massachusetts: Harvard Business School Publishing, 2002. Kindle location 112, 125.

²² Ibid. Kindle location 129.

²³ Jonathan Haidt, *The Righteous Mind: Why Good People are Divided by Politics and Religion*. New York: Pantheon Books, 2012. Kindle page 47.

²⁴ Geoffrey A. Moore, *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers*. HarperCollins Publishers, 1991. Kindle location 353.

²⁵ Ibid. Kindle location 348.

willing to adopt the technology or change, but they do not feel comfortable with what is being presented to them and want to see it proven before they adopt it.²⁶

The third group is termed the “early majority.”²⁷ This group is relatively comfortable with the change, but, guided by caution and practical considerations, they want to see the new technology or change implementation succeed at another organization’s risk before their adoption.²⁸

Fourth is the “early adopter.”²⁹ The early adopter “appreciate(s) the benefits of a new technology,” and they are able to “relate these potential benefits to their other concerns.”³⁰ In the realm of change, these people may not have been part of the team implementing the change, but they realize how this may potentially benefit them in their efforts within the organization.

The final group is the “innovators.”³¹ In Moore’s technology-centric model, the innovators are those who have a passion for technology. “At root they are intrigued with any fundamental advance and often make a technology purchase simply for the pleasure of exploring the new device’s properties.”³² In a change organization, these would be the change leading manager or executive. The individual would be driven by the desire to try the latest ideas or possibilities within their organization’s space.

Where Kotter expands upon the discussion of change management is through providing organizational leadership with an “eight-stage change process” in *Leading Change*.³³ Through discussions with corporate leadership, he has discovered that while the stages may overlap, they need to be kept in sequence in order for them to build upon

²⁶ Geoffrey A. Moore, *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers*. HarperCollins Publishers, 1991. Kindle location 348.

²⁷ Ibid. Kindle location 348.

²⁸ Ibid. Kindle location 343.

²⁹ Ibid. Kindle location 338.

³⁰ Ibid. Kindle location 338.

³¹ Ibid. Kindle location 334.

³² Ibid. Kindle location 338.

³³ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 353.

one another toward the change.³⁴ He then divides the eight stages into three logical groups and goes on to list likely reasons for any organizational resistance.

The first four stages are focused on preparing the change space for the desired new direction. The next three steps are the introduction of the new direction, and step eight is where the newly implemented change is made to become a part of the fabric of the organization itself so that the change might be a lasting one.³⁵

The eight stages of Kotter's change process are:

- Establishing a Sense of Urgency
- Creating the Guiding Coalition
- Developing a Vision and Strategy
- Communicating the Change Vision
- Empowering Broad-Based Action
- Generating Short-Term Wins
- Consolidating Gains and Producing More Change
- Anchoring New Approaches in the Culture³⁶

Additionally, most of the eight stages can be mapped to Gleicher's change formula. Stage one corresponds to the dissatisfaction with the status quo. Stages two through four correspond with the proposed future vision of the organization. Finally, stages five, six and seven are the first steps toward the change.

a. Establishing a Sense of Urgency

The purpose of establishing a sense of urgency is to loosen the grip of complacency upon the organization. As the change formula shows, a sense of dissatisfaction must be developed within the members of the organization. This is what

³⁴ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 403.

³⁵ Ibid. Kindle location 376.

³⁶ Ibid. Kindle location 375.

creates the willingness to be open to a new vision. If the individuals within the organization feel that they are satisfied, they will never embrace a change.³⁷

b. Creating the Guiding Coalition

Wholesale change efforts tend to appear, from external to the organization, as the product of one person. Kotter mentions Lee Iacocca's transformation of Chrysler in the 1980s as an example of the credit for change being laid at the feet of an individual.³⁸ This holds true today as well. With Chrysler's 2009 – 2011 turnaround, the current CEO is being lauded for the turnaround in a 60 Minutes interview.³⁹ The reality of the events is likely much different.

Any leader in the civilian world or within the military must develop a core group of supporters for his change effort. A change vision may not exist yet, but this core group should be comprised of those adventurous "early adopters" that are motivated to improve the organization.⁴⁰

c. Developing a Vision and Strategy

The vision's purpose is to "direct, align, and inspire actions on the part of large numbers of people."⁴¹ This tool should be created by the leader, but preferably with the help of the guiding coalition. As shown in the 1995 Charlotte Beers case from the Harvard Business School, it was the guiding coalition that came together to define the vision of the company's future.⁴² Sometimes the leader only needs to know that a change is required. The collective talent of the organization can be leveraged to define the path from there.

³⁷ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 521-532.

³⁸ Ibid. Kindle location 762.

³⁹ CBS News. *Sergio Marchionne: Resurrecting Chrysler*. March 25, 2012. <http://www.cbsnews.com/video/watch/?id=7403188n> (accessed September 16, 2012).

⁴⁰ Geoffrey A. Moore, *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers*. HarperCollins Publishers, 1991. Kindle location 297.

⁴¹ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 183.

⁴² Steckler, Nicole. "Charlotte Beers at Ogilvy and Mather Worldwide (A)." *Managing Change*. Harvard Business School, 1995. 141-159.

Kotter's rule for corporate visions: "Whenever you cannot describe the vision driving a change initiative in five minutes or less and get a reaction that signifies both understanding and interest, you are in for trouble."⁴³ This clear and simple vision statement should paint the picture of the future for the organization.

d. Communicating the Change Vision

The vision creates its maximum effect when all members of the organization have a common knowledge and understanding of it and embrace it.⁴⁴ Often, organizational leadership will under-communicate the vision they have created for the company.⁴⁵ The day for an average employee is crowded with many other competing inputs. It is not enough to share the vision once or twice and then assume that the entire population of the organization understands the new direction. Another part of vision communication is "leadership by example."⁴⁶ The surest method for undermining the vision is to act in a manner inconsistent with the message being communicated.

e. Empowering Employees for Broad-Based Action

Kotter breaks this down into the removal of four types of "barriers to empowerment" of an organization's employees. The first barriers are structural. Does the structure of the organization prevent the effective actions of the employees as they work to embrace the change?⁴⁷ The second set of barriers is skill related. Have the employees been given the appropriate set of skills and the training they require to make the change?⁴⁸ Thirdly, are systems related barriers. Have the old processes within the organization been altered to reflect the new direction? The example Kotter gives relates to performance evaluation. The company had shifted to a customer-focused organization,

⁴³ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 202.

⁴⁴ Ibid. Kindle location 1270.

⁴⁵ Ibid. Kindle location 1400.

⁴⁶ Ibid. Kindle location 1442.

⁴⁷ Ibid. Kindle location 1548.

⁴⁸ Ibid. Kindle location 1610.

but performance was still measured against not making mistakes.⁴⁹ Finally, are the supervisors themselves a barrier to adoption of the change? Are your subordinate leaders acting counter to the new vision and ruining the impression of the entire leadership structure?

f. Generating Short-Term Wins

While guiding the organization toward the future vision, the people within it need to see some concrete results today. Kotter refers to this as “manag(ing) the current reality.”⁵⁰ It maintains the momentum of the change, and it builds credibility in the eyes of those who are still undecided about it.⁵¹ The worthwhile short-term win is defined as one that is visible, unambiguous and obviously related to the change effort underway.⁵²

g. Consolidating Gains and Producing More Change

The resistance to a change effort never dissipates completely.⁵³ A constant pressure is required to keep the change effort progressing until the final results are achieved. Something as simple as celebrating a short-term victory can send the message that no further effort is required and the slide back into the previous way of doing things can begin.⁵⁴

h. Anchoring New Approaches in the Culture

This is a continuation of the previous stage, but it goes beyond the achievement of the desired results. This extends to the point that the results become self-sustaining.⁵⁵ The departure of one individual should not completely derail the change if the organization has internalized the state of being at every level.

⁴⁹ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 1654.

⁵⁰ Ibid. Kindle location 1772.

⁵¹ Ibid. Kindle location 1772.

⁵² Ibid. Kindle location 1817.

⁵³ Ibid. Kindle location 1983.

⁵⁴ Ibid. Kindle location 1983.

⁵⁵ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 2197.

i. Resistance to Change

Working against all of the effort placed into the change of the organization is a constant pressure toward maintaining the status quo that must be overcome, as the change formula indicates, for the effort to succeed. Kotter states that there are forces working against the initial launch of the change implementation, and there are forces working against the effort throughout its life cycle.⁵⁶

In *Heart of Change*, Kotter's four types of behavior that tend to derail the launch of a change effort are: "The first is complacency, driven by false pride or arrogance. A second is immobilization, self-protection, a sort of hiding in the closet, driven by fear or panic. Another is you-can't-make-me-move deviance, driven by anger. The last is a very pessimistic attitude that leads to constant hesitation."⁵⁷

Kotter's eight reasons for resistance throughout the change's life cycle, from *Leading Change*, are:

- Inwardly Focused Cultures
- Paralyzing Bureaucracy
- Parochial Politics
- Low Levels of Trust
- Lack of Teamwork
- Arrogant Attitudes
- Lack of Leadership in Middle Management
- The General Human Fear of the Unknown⁵⁸

The final aspect of resistance to change is that as contentious as the struggle between the innovators and early adopters against the laggards may be, there is no blame. The entire organization works as a system. As Senge points out, there is no

⁵⁶ Ibid. Kindle location 1996.

⁵⁷ John P. Kotter, *The Heart of Change: Real-Life Stories of How People Change Their Organizations*. Boston, Massachusetts: Harvard Business School Publishing, 2002. Kindle location 338.

⁵⁸ John P. Kotter, *Leading Change: Why Transformation Efforts Fail*. 1995. Kindle location 362.

“‘separate other;’ that you and the other person are part of a single system. The cure lies in your relationship with the ‘enemy.’”⁵⁹

j. Conclusion

Change management is an invaluable resource when faced with implementing organizational change. However, it does not guarantee success. It only improves the odds that the effort will be successful. The field also does not actually outline how to create a vision or the steps necessary to implement it in a practical sense. Something else is required to remove the last level of abstraction from the discussion.

C. DESIGN

1. Introduction

In itself, the change management field does not provide any guidance for creating the change. Change management appears to exist at a higher level of abstraction and there is a separate requirement to bring it into practical application. For instance, where it advises to target the feelings of the organization members that might drive their change adoption, it does not provide guidance for how to bring that about. Thankfully, there is a broadening overlap with the field of design and design thinking.

As an example, in the previously mentioned Charlotte Beers change case, Beers assembled a team to build a vision for the company’s future. The details are few, but the description of the meeting in Vienna as putting “a diversity of talents in a climate of disruption” reads like a design session.⁶⁰

As was recommended in the change management discussion of Moore’s *Crossing the Chasm*, wherever the reader of a design or design thinking work encounters the word customer, the words sailor or service member will fit within the context. Similarly,

⁵⁹ Peter M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday, 1990. Kindle page 67.

⁶⁰ Nicole Steckler, "Charlotte Beers at Ogilvy and Mather Worldwide (A)." *Managing Change*. Harvard Business School, 1995. 141-159.

Admiral, Captain or “anyone who assumes a leadership role” may be substituted for CEO or manager.

2. Design vs. Design Thinking

There are currently multiple expectations entwined within the meaning of design. When this researcher first heard the word design mentioned during the course of interviews conducted for this case, the idea conveyed was of people being given a product and then making it look attractive in an effort to sell more units of the product. In his book, *Design-Driven Innovation*, Roberto Verganti states that the general impression of most corporate executives is one of product styling.⁶¹ In other words, after a product is created and engineered, it is then handed over to designers for an appealing image. Verganti then compares that vision of design with a newer, emergent version that is centered on the user’s experience. This version of design is involved from the discussion of what needs to be done all the way through to the final product’s eventual display.

In an effort to clarify, this document will refer to the latter version as “design thinking” in accordance with Tom Brown’s original description from *Change by Design*: “Design thinking relies on our ability to be intuitive, to recognize patterns, to construct ideas that have emotional meaning as well as functionality, to express ourselves in media other than words or symbols.”⁶² Another definition that brings the topic of design thinking into focus comes from Richard J. Boland and Fred Collopy in *Managing as Designing*. They state that, “A good design solution solves many problems, often ones that were not envisioned in its development.”⁶³

Design thinking is a rapidly iterative process. It stands apart from the typical “linear problem-solving” techniques that most military officers have seen used

⁶¹ Roberto Verganti, *Design-Driven Innovation: Changing the Rules of Competition by Radically Innovating What Things Mean*. Boston: Harvard Business Press, 2009. Kindle location 106-107.

⁶² Nigel Cross, *Design Thinking*. New York: Berg, 2011. Kindle location 93.

⁶³ Richard J. Boland, Jr. and Fred Collopy, *Managing as Designing*. Stanford: Stanford University Press, 2004. Kindle location 264.

throughout their careers.⁶⁴ Jeanne Liedtka and Tim Ogilvie in, *Designing for Growth*, contrast the two by describing typical problem-solving processes as problem definition, solution identification and analysis followed by the selection of the “right” choice.⁶⁵ Designers, by contrast, base their solution upon empathy and experimentation.⁶⁶

Professor Senge doesn’t explicitly discuss participative design thinking, but he does highlight the importance of design thinking to an organization. He views the role of a “leader as designer” as being neglected in terms of how organizational leaders view themselves.⁶⁷ Senge recognizes the need for leadership to drive the design of the organization itself with a focus on the interactions of the members of the organization.⁶⁸

Design thinking moves beyond persuading people to purchase or invest based on appearances alone. It is intended to be a framework for tackling any problem, internal or external, faced by the organization. Senge hints at the reason the introduction of design thinking to a modern organization: “It’s just not possible any longer to figure it out from the top, and have everyone else following the orders of the ‘grand strategist.’ The organizations that will truly excel in the future will be the organizations that discover how to tap people’s commitment and capacity to learn at all levels in an organization.”⁶⁹

3. Design Thinking

Liedtka and Ogilvie list three basic “growth lessons” observed from those who have been successful design thinking in their experience. They also list several other “maxims for growth,” of which two are of particular relevance to the DoD. The growth lessons:

⁶⁴ Jeanne Liedtka and Tim Ogilvie, *Designing for Growth*. New York: Columbia University Press, 2011. Kindle location 230.

⁶⁵ Ibid.

⁶⁶ Ibid.

⁶⁷ Peter M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday, 1990. Kindle page 321.

⁶⁸ Ibid.

⁶⁹ Ibid. Kindle page 207.

You don't have to search far and wide to find opportunities. There are opportunities to improve through design in everything we do and what we surround ourselves with."

You don't have to bet big in order to be successful. In fact, big bets often cause failure. Place small bets fast, and learn learn learn.

Speed thrills. Developing a corporate climate that thinks, moves and innovates fast can become addictive and lead to continuous improvements and learning.⁷⁰

The relevant maxims for growth are: 1. "Focus on meeting genuine needs," and 2. "Explore multiple options."⁷¹ The first tip is telling the reader to empathize with the customer or group that the product, process or organization is being designed for. The second is referring to prototyping of several options at once. This is not the same form of prototyping that the DoD performs when procuring major systems through the acquisitions process. This version of prototyping is using inexpensive materials to examine the problem as opposed to building a couple of multi-million dollar weapon systems to compete against one another and be analyzed for failure modes.⁷²

a. Innovation

Before preceding much further, it is necessary to differentiate between design and innovation. Senge describes an innovation as an invention that can be reliably recreated at a practical cost.⁷³ Based on this it can be deduced that design thinking is likely to generate innovation, but an innovation may or may not incorporate design thinking.

All readings on innovation, design and design thinking agree that most established organizations have over time refined themselves into a specialized form for

⁷⁰ Jeanne Liedtka and Tim Ogilvie, *Designing for Growth*. New York: Columbia University Press, 2011. Kindle location 377-399.

⁷¹ Ibid. Kindle location 414-438.

⁷² Ibid. Kindle location 414-438.

⁷³ Peter M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday, 1990. Kindle page 5.

the efficient performance of routine activities.⁷⁴ This is not a fault of the company, but a natural tendency to maximize a cost to benefit ratio.⁷⁵ However, in *The Other Side of Innovation*, the authors argue that this specialization places two parts of the organization into conflict.⁷⁶

The two sides of the organization in conflict for the limited resources of the organization are termed the “performance engine” and the innovators.⁷⁷ These are similar in concept to James March’s “exploitation” and “exploration,” respectively.⁷⁸ In both cases, one segment of the organization is focused on maintaining the efficient and profitable daily operations while the other segment is attempting to find new products or processes. Additionally in both cases, the two are portrayed as in conflict and competing for organizational resources. Multiple sources agree that the typical organization is not adept at continuously refining the balance of the exploration and exploitation over time.⁷⁹ If this argument is accepted, then leadership must assume responsibility for providing the balance of the two.

b. Empathy

If modern design thinking is framed around creating an experience for the user, the natural extension if this is a need to empathize with the group that the product or process is intended for. Liedtka and Ogilvie go as far as to say that, “Design starts with empathy, establishing a deep understanding of those we are designing for.”⁸⁰ These two

⁷⁴ Vijay Govindarajan and Chris Trimble, *The Other Side of Innovation: Solving the Execution Challenge*. Boston: Harvard Business School Publishing, 2010. Kindle location 347, 356.

⁷⁵ Ibid. Kindle location 358.

⁷⁶ Ibid. Kindle location 358-359.

⁷⁷ Ibid. Kindle location 356, 398.

⁷⁸ James G. March, "Exploration and Exploitation in Organizational Learning." *Organizational Science*, 1991: 71-87.

⁷⁹ Vijay Govindarajan and Chris Trimble, *The Other Side of Innovation: Solving the Execution Challenge*. Boston: Harvard Business School Publishing, 2010. Kindle location 418. and Roger L. Martin, *The Design of Business: Why Design Thinking Is the Next Competitive Advantage*. Boston: Harvard Business Press, 2009. Kindle location 389 – 391.

⁸⁰ Jeanne Liedtka and Tim Ogilvie, *Designing for Growth*. New York: Columbia University Press, 2011. Kindle location 194.

are not alone. Several other works on design mention empathy and give it a central position in their design philosophies.

Tim Brown, CEO and President of IDEO, describes empathy as the primary difference between what design thinkers do and academic efforts. In his words, “We are not trying to generate new knowledge, test a theory, or validate a scientific hypothesis—that’s the work of our university colleagues and an indispensable part of our shared intellectual landscape. The mission of design thinking is to translate observations into insights and insights into products and services that will improve lives.”⁸¹

In *Wired to Care*, Dev Patnaik, describes empathy as “seeing the world as it really is.”⁸² That seems unlikely to be the case. But, empathy is a matter of putting yourself in someone else’s frame of reference and trying to understand how they experience their reality. Therefore, it is unlikely that the observer is actually seeing the world the way it is, but perhaps seeing it through the eyes of those they are designing for is a more relevant goal.

c. The Design Process

There are numerous versions of the design process. For this discussion, and due to its free availability at the Hasso Plattner Institute of Design at Stanford, also known as d.school, website, the focus will primarily be upon their *Bootcamp Bootleg*⁸³. *The Bootleg* serves to bring together most of the design process elements from the other readings mentioned. Where necessary, other design works will be used to expand on the theme.

The Bootcamp Bootleg lists five phases of their design process. They start with “empathize,” and move through “define,” “ideate,” and “prototype” to conclude

⁸¹ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 627.

⁸² Dev Patnaik and Peter Mortensen, *Wired to Care: How Companies Prosper When They Create Widespread Empathy*. San Mateo: FT Press, 2009. Kindle location 569.

⁸³ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

with testing. Several other design readings either explicitly add or imply the existence of another phase that appears to belong prior to empathize phase.⁸⁴

(1) The Brief. Prior to the empathic investigation of the project, a brief is delivered to the designers. The brief primarily consists of goals and constraints. The goals appear to be relatively straightforward, but from speaking to several designers, they typically require some examination and change over time.⁸⁵ The reason for this is that a customer arrives with a set goal for the design effort. It is often necessary to remove that initial request or problem to a higher level of abstraction. For instance, “How do we improve aluminum can recycling on Wednesdays?” might become, “How do we increase awareness of recycling opportunities?”⁸⁶ Stanford’s d.school and Tim Brown in *Change by Design*, describe these questions as “How might we” questions or “HMWs.”⁸⁷ Thus the brief itself is a living thing to be remade as events demand.

In *Design Thinking*, Nigel Cross describes his thoughts on a brief by explaining that this looseness in the brief is to allow the designers to define the problem as they are attempting to solve it.⁸⁸ The brief is also not to be considered a concrete set of requirements or specifications for the final product. Cross relays a statement from an interview conducted with the architect Richard MacCormac about design, “Often in competitions the winning scheme is the one that tells the client something that they never knew before ... something that is terribly important to them and was not in the brief.”⁸⁹

⁸⁴ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 293. and Nigel. Cross, *Design Thinking*. New York: Berg, 2011. Kindle location 256.

⁸⁵ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

⁸⁶ "IDEO Design Thinking Simulation at Naval Postgraduate School." Monterey, CA, April 27, 2012.

⁸⁷ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle page 184.

⁸⁸ Nigel Cross, *Design Thinking*. New York: Berg, 2011. Kindle location 256.

⁸⁹ Ibid.

The brief should also be neither too restrictive nor too broad.⁹⁰ Constraints are a helpful necessity, but with too many the options for creative ideas are reduced.⁹¹ If there are too few constraints, the ideas may not be applicable to the problem.⁹² Examples of constraints include cost, size and weight, but might just as easily refer to a type of technology or a portion of a customer base. Alternatively, the brief could aim to utilize something internal to the organization as the constraint, such as the size of the sleeping quarters aboard a ship.⁹³

(2) Empathize. The empathize phase is more commonly referred to as observation, but in both cases the goal is the same.⁹⁴ Tom Kelley, IDEO's General Manager, emphasizes in *The Art of Innovation*, that it is necessary to focus the designer's empathy toward the actual user for the product or process.⁹⁵ This can be difficult considering that unless the design project is something internal to the organization funding the project, those sought out to empathize with are not likely to be the ones paying for the project.⁹⁶

Peter Senge best describes what is being sought through this empathize phase. It is probable that the best insight to be gleaned from the research will be something small. "Small changes can produce big results –but the areas of highest

⁹⁰ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 310.

⁹¹ Ibid. Kindle location 293, 310.

⁹² Ibid. Kindle location 310.

⁹³ Ibid. Kindle location 293.

⁹⁴ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012). and Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 621. and Richard J. Boland Jr and Fred Collopy, *Managing as Designing*. Stanford: Stanford University Press, 2004. Kindle location 3536. and Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 138.

⁹⁵ Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle page 25.

⁹⁶ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 556.

leverage are often the least obvious.”⁹⁷ He goes on to describe a systems thinking version of leverage that is appropriate to the styles of insight sought by designers. Senge discusses that the obvious methods for creating an impact on a project are unlikely to create the desired effect. However, in his words, “...small, well-focused actions can sometimes produce significant, enduring improvements, if they’re in the right place.”⁹⁸ The ultimate goal is to find the point at which the maximum effort may be applied to produce the greatest effect for the customer’s user experience.⁹⁹

(3) Define. The define stage is what IDEO has referred to in interviews as generating insights.¹⁰⁰ It is what is done with all of the information, feelings and emotions gathered during the research and empathize portion of the design thinking process. Seldom can the user describe what is missing or required to perform their job in the form of a complete solution. It is typically necessary to synthesize the inputs of the users into a couple of insights.

These insights are then used to guide the “point of view” of the design sessions.¹⁰¹ This point of view serves to define the focus of the design on the needs of the user. This vision should also serve as an inspiration to the design team and be the source of the “How might we” questions used to generate the brainstorming in the next phase.¹⁰²

⁹⁷ Peter M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday, 1990. Kindle page 63.

⁹⁸ Ibid. Kindle page 63.

⁹⁹ Ibid. Kindle page 63.

¹⁰⁰ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012). and David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

¹⁰¹ Ibid.

¹⁰² Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

(4) Ideate. This has been more generically referred to as brainstorming. The goal is to create a large base of ideas from which to later choose.¹⁰³ In the words of two-time Nobel Prize winning chemist Linus Pauling, “To have a good idea, you must first have lots of ideas.”¹⁰⁴ Tom Kelley calls brainstorming “the idea engine of IDEO’s culture.”¹⁰⁵ The previously mentioned HMWs are also used to focus brainstorming sessions, and IDEO has seven self-explanatory rules for the sessions.¹⁰⁶

- Defer Judgment
- Encourage Wild Ideas
- Build on the Ideas of Others
- Stay Focused on Topic
- One Conversation at a Time
- Be Visual
- Go for Quantity¹⁰⁷

Occasionally, before starting a brainstorming session, it might be helpful to loosen up the participants in the brainstorming.¹⁰⁸ During the research, this was expanded by a practical example of asking participants to create a list of technologies with the expected potential to contribute to a design solution.¹⁰⁹ Tom Kelley provides guidance for four situations when the time spent warming a group up is worth the commensurate time lost for brainstorming. “When the group has not worked together

¹⁰³ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 852.

¹⁰⁴ Ibid. Kindle location 855.

¹⁰⁵ Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 738.

¹⁰⁶ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

¹⁰⁷ This list is taken from the Bootcamp Bootleg, but it correlates with several other readings and interviews. The rules are similar in nature with the addition of one step, “Headline” – used to mean ‘only describe the idea, sketch it briefly and keep the session moving to maintain the flow of ideas.’

¹⁰⁸ Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 790.

¹⁰⁹ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

before. When most of the group doesn't brainstorm frequently. When the group seems distracted by pressing but unrelated issues.”¹¹⁰

There are two additional pieces of guidance for a successful brainstorming, or ideation, session and a list of things to be avoided or risk limiting the options created. Multiple sources recommend sketching as a method to contribute an idea during brainstorming.¹¹¹ Nigel Cross refers to these brainstorming sketches as “temporary, external store for tentative ideas” to help the designer examine and convey more complete ideas where words might not be sufficient.¹¹² The second idea is that a typical brainstorming session should be limited to sixty minutes due to the mental exertion required by the activity.¹¹³

It should be apparent from the descriptions that the brainstorming is a relatively free process with some guidelines and constraints to ensure a relevant set of outputs to choose from later. Tom Kelly provides a convenient list of things to avoid in order to maximize the potential of an ideation session. “Six Ways to Kill a Brainstormer”¹¹⁴

- The Boss Gets To Speak First
- Everybody Gets A Turn
- Experts Only Please
- Do It Off-Site
- No Silly Stuff
- Write Down Everything¹¹⁴

¹¹⁰ Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 790.

¹¹¹ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. page 81, and Nigel Cross, *Design Thinking*. New York: Berg, 2011. Kindle location 216.

¹¹² Nigel Cross, *Design Thinking*. New York: Berg, 2011. Kindle location 216.

¹¹³ Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 734.

¹¹⁴ Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 848 – 868.

Once a field of ideas has been created, the ideas are then grouped according to function or some other metric.¹¹⁵ Depending on the number of ideas in a group, it might be necessary to form them into sub-groups.¹¹⁶ After the ideas are grouped, it is necessary to select the most popular ideas from the group, and some form of voting typically does this.¹¹⁷

(5) Prototyping. The prototyping phase is about bringing the ideas selected from brainstorming into a more physical setting.¹¹⁸ The designers feel this is more engaging and creates an environment in which it is easier to envision the potential solution and how it may be altered to better meet the needs of the brief; it also enables decision making about such things as which features are relevant.¹¹⁹

Prototyping additionally serves as a method of reducing risk.¹²⁰ This is the same school of thought that DoD has used for project management for years, but done at a much earlier point. The difference is that this is done in order to engage the imagination through tactile interaction with a very low cost, low risk form of possible solutions. In this way, the project is defined through experimentation at low cost. This is in accordance with research that has shown that investment in the requirements and design phases of software can reduce the costs of error correction after delivery by a factor of 100.¹²¹ Through this physical manifestation of the ideas from brainstorming,

¹¹⁵ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

¹¹⁶ Ibid.

¹¹⁷ Ibid. and Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle page 10.

¹¹⁸ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

¹¹⁹ Thomas Kelley with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 1456.

¹²⁰ Richard J. Boland, Jr. and Fred Collopy, *Managing as Designing*. Stanford: Stanford University Press, 2004. Kindle location 3541-3542.

¹²¹ Barry Boehm and Victor R. Basili, "Software Defect Reduction Top 10 List." *Software Management*, January 2001: 135-137.

those participating in the prototyping are now capable of providing feedback on an experiential basis as compared to logical descriptions of a capability.¹²²

These early prototypes are intended to be created and evaluated quickly and cheaply.¹²³ The point is to gain the benefits previously mentioned without creating emotional “overinvestment” on the part of the designer or design participant.¹²⁴ As described by Tim Brown, this rapid build and discard or move forward methodology guards against the risks associated with a poor idea moving forward and increases the chances of discovering new opportunities at a minimal cost.¹²⁵

Prototyping has even been done in this inexpensive fashion in the field of software engineering. In *Change by Design*, Brown mentions having seen “software interfaces mocked up with Post-it notes long before a line of code was written.”¹²⁶ This has been demonstrated recently by the events of this case study and can be seen by viewing the YouTube video for the TANG Forum.¹²⁷

(6) Testing. The testing phase is, in the literature, perhaps the least represented part of the design thinking phase. Most of the excitement generated in design thinking readings revolves around the brainstorming and prototyping phases. In essence though, those phases continue throughout the process. Testing is another opportunity to observe the user in action with the prototype.¹²⁸ It is an opportunity to brainstorm about how to conduct the test itself, and then prototype the test if desired. It is

¹²² Richard J. Boland, Jr. and Fred Collopy, *Managing as Designing*. Stanford: Stanford University Press, 2004. Kindle location 3541-3542.

¹²³ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 1147.

¹²⁴ Ibid. Kindle location 1147-1148.

¹²⁵ Ibid. Kindle location 1148.

¹²⁶ Ibid. Kindle location 1173.

¹²⁷ Submarine Development Squadron 12. *Tactical Advancements for the Next Generation*. January 11, 2012. <http://www.youtube.com/watch?v=i9kxffGWU8M> (accessed September 1, 2012).

¹²⁸ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

also a method for developing feedback on the prototypes and then iterating them based on the feedback.¹²⁹

d. Failure

Another significant feature of design thinking is its tolerance for failure. According to Tim Brown, one of IDEO's philosophies is "fail early to succeed sooner."¹³⁰ This acceptance of the inevitable consequence of the risks associated with any acquisition is, in the opinion of the researcher, one of the bigger differences between design thinking and the common analysis decision-making. This failure though is not the kind of big failure experienced as the congressional cancellation of a major acquisitions program. This is the failure of numerous ideas in the very early phases of development to help with requirements definition and project design. These failures are experienced at the very outset of the program and are cost effective forms of experimentation and iteration to an eventual output. As Professor Frank Barrett states in his book, Yes to the Mess, this acceptance of failure can often become "the pathway to discovery, especially in highly experimental and innovative cultures."¹³¹

e. Morale

There are two additional aspects of design thinking and the design thinking process noted during the course of investigation. Both aspects relate to the morale of designers and participants as noted by researchers. First, Dev Patnaik highlights his belief that the process of building empathy creates a sense of enjoyment in the workplace.¹³²

¹²⁹ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

¹³⁰ Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009. Kindle location 228.

¹³¹ Frank J. Barrett, *Yes to the Mess: Surprising Leadership Lessons from Jazz*. Boston: Harvard Business Review Press, 2012. Kindle location 887.

¹³² Dev Patnaik and Peter Mortensen, *Wired to Care: How Companies Prosper When They Create Widespread Empathy*. San Mateo: FT Press, 2009. Kindle location 2790.

Second, Tom Kelley, states what should be obvious but is often overlooked in military units: “When people feel special, they’ll perform beyond your wildest dreams.” Along these lines, Kelley’s company throws large end-of-year parties and allows its employees to play “hooky” from time to time.¹³³

4. CONCLUSION

Design, as is stated in the Bootcamp Bootleg, is difficult to convey in print.¹³⁴ The Bootleg, available freely from the d.school website, makes an excellent starting point for a design effort. Having observed a demonstration design session, it would appear to be when facilitated by those used to the process, but either way, design needs to be attempted and learned experientially. Having partaken in demonstration versions of the design thinking process, this researcher finds the process to be a potential answer to the problems plaguing DoD acquisitions whether it be a major weapons system or to design the interface for the household goods shipment website. In particular, that website could do with some design thinking.

D. CONCLUSION

Based on the literature reviewed and the case research conducted, there exists an excellent fit between the items of significance in the fields of change management and design thinking and the case that was researched. Lessons extracted from this case by an individual or group of readers are generalizable to other organizations even as this case was selected based upon specific points that serve to highlight relevant points of change management and design thinking.

¹³³ Thomas Kelle with Jonathan Littman, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001. Kindle location 1214.

¹³⁴ Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).

III. CASE STUDY

A. JOSH

In the summer of 2010, a young former naval submarine officer and current employee of Johns Hopkins University Applied Physics Lab (APL), Josh Smith, was looking for a way to capitalize on the knowledge he had developed as a fleet submariner and tactics instructor. Now, Smith was specifically interested in using the balance of experience and open-mindedness of junior officers (JOs), “Lieutenants and below,” and enlisted, “First Class (Petty Officers) and below,” to guide nuclear submarine technology acquisition efforts in the Navy.¹³⁵ Josh described his reasons for the white paper:

There were a few reasons that motivated me to write the whitepaper, but none more important than the desire to create an environment where junior officers and operators could collaborate around ideas to make their lives on board the submarine better. During my time in the Navy as a JO, I witnessed some great instances of innovation both at the senior and junior level on the boat. These events were indicators of a powerful potential that could really change the submarine force. When junior officers and operators feel like they can make a difference and have a voice, their energy and motivation is intensified. My fellow JOs had some fantastic ideas that could greatly influence the quality of life, efficiency, and productivity of their divisions, the wardroom, and themselves. Without an outlet to express or try out these ideas, most concepts would stay within a group of 1 or 2. If it was a radical change to a process, it would require senior level involvement which is great, but also comes with another level of paperwork, convincing, socialization, etc...where the question is asked, “Is this worth going through all of the wickets to pitch my idea? What if it’s a dumb idea? Will I lose credibility?” The paper was my way of articulating what an environment would look like where junior officers and operators could collaborate openly and without fear of failure in front of their superiors. Also, if a few on one boat could make a big difference, then a group from multiple boats could collaborate and make something truly amazing. Giving this demographic a voice was my top motivation for the concept.

¹³⁵ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

Another aspect is that the Navy invests a significant amount of money and time to train these officers and sailors to become the top performing warfighters in the submarine force. Their knowledge, insight, and ideas are an untapped resource if they leave the Navy after their first sea tour. Many of my counterparts were leaving the submarine force to take jobs in Corporate America or enrolling in business or law school. How could the submarine force tap into this knowledge and idea base before they leave the Navy? Some of my friends included ideas for improvement in their “letter of resignation” from the Navy, but where do those ideas go?

B. APL

The Applied Physics Lab is a “not-for-profit center for engineering, research and development” university laboratory division of The Johns Hopkins University located in Laurel, MD. The APL has a long history, since 1942, of assisting the U.S. military with complex and important research. Stemming from the requirements of World War II, a series of research laboratories, including APL, were created by the government in conjunction with acclaimed universities. The Laboratory’s most impactful contribution, an improved proximity fuse for anti-aircraft shells, would subsequently be judged one of the leading technological contributions to the war effort.¹³⁶

The Laboratory currently conducts research on behalf of over 600 programs. Sponsors for this research include the Departments of Defense (DoD) and Homeland Security (DHS), the National Aeronautics and Space Administration (NASA), and the National Security Agency (NSA) to help guide the direction of future development based upon “research, engineering, and analytical problems.”¹³⁷ As an example, APL has handled the launch of 64 spacecraft for NASA.¹³⁸ For the U.S. Navy’s submarine

¹³⁶ The Johns Hopkins University Applied Physics Lab, *About APL*.
<https://www.jhuapl.edu/aboutapl/default.asp> and <http://www.jhuapl.edu/aboutapl/heritage/default.asp>
(accessed September 1, 2012).

¹³⁷ Ibid.

¹³⁸ The Johns Hopkins University Applied Physics Lab, *Our Work*.
<https://www.jhuapl.edu/ourwork/civilspace/default.asp> (accessed September 1, 2012).

community, this is manifested in the undersea warfare realm by providing unbiased opinions regarding development investments¹³⁹.

C. THE SUBMARINE

The submarines referred to in this thesis are the Navy's fast attack boats. These boats are significantly smaller than the ballistic missile submarines nicknamed 'boomers.' This size difference is largely driven by their respective missions. A fast attack is required to be sleeker and faster in order to find, trail and destroy an enemy submarine. The boomer on the other hand is largely expected to stay deep, stay quiet and stay unlocated in order to be able to perform its strategic missile launch role.¹⁴⁰

Size constraints are probably the defining aspect of life aboard a submarine as viewed by an outsider. Every aspect of the boat is confining. Within minutes a visitor will be squeezing themselves sideways in order to allow others to pass in a passageway. Shoulders brush both sides of a passageway in the wide spots. The control room does not allow for many people to be in motion at any one time except through the coordination that can only come from long experience sharing the circumstances with your crew.

The sleeping accommodations, "racks," are so small as to appear incapable of containing an adult human being, and these racks are occasionally required to be shared such that one person has it while another is on duty. When the first person comes off of duty, it is then his turn to sleep in the rack that is likely still warm from the previous sailor. This tradition is known by submariners as 'hot racking.'

In other cases, the sailor or officer may be moved from his rack to accommodate ship-riders, those who are aboard the ship to observe a trial or test for instance. In that case, the relocated sailor is likely to find him or herself sleeping on a narrow mattress, the same over-small ones in their regular rack, but with a difference. These overflow berthing

¹³⁹ The Johns Hopkins University Applied Physics Lab, *About APL*. <https://www.jhuapl.edu/aboutapl/default.asp> and <http://www.jhuapl.edu/aboutapl/heritage/default.asp> (accessed September 1, 2012).

¹⁴⁰ Anonymous, interview by Thomas Hall. *Offline Group Discussion with Submarine Officers* (August 24, 2012).

racks are located in the torpedo room, underneath a rack of torpedoes, and they are pushed together with no separation. The good news, as relayed by a Lieutenant, was that on the occasions he had slept there, “I was so tired, because the boat was so busy, that I slept like a baby for 18 hours after I got off watch.”¹⁴¹ The overall feeling of the spaces is closer to *Das Boot* than the overly spacious depiction of the ballistic missile submarine depicted in *Crimson Tide*.

D. THE SUBMARINE CULTURE

From a blending of interviews, discussions and readings, this researcher’s perspective shifted to share the opinions of those within the community as they described themselves. The community is structured in a typical military hierarchy. Salutes were rendered as required and without fail. There is no shortage of bravery or courage in the organization.¹⁴² These are not fearful technocrats.

All sources agreed that there is a rigid adherence to the rules of nuclear power in the boat’s engineering department. This procedural rigidity was imbued into the submariners as part of the nuclear power training regimen. Every potentiality has a written procedure to deal with it.¹⁴³ All orders are repeated back verbatim.¹⁴⁴

Most submariners independently, without the researchers having mentioned it, identified these “competing cultures” as their defining cultural artifact. One submariner referred to this split as the source of “creeping-nukism.” Creeping-nukism was mentioned by multiple interviewees, and was defined as the encroachment of the rigid, procedural culture of the aft portion of the boat, the reactor and engineering spaces, upon the forward half of the boat, the control and weapons area. These two flavors are referred

¹⁴¹ Tim Manke, interview by Thomas Hall. *Guided Tour of Submarine in Groton, CT* (August 24, 2012).

¹⁴² Sherry Sontag and Christopher Drew, *Blind Man's Bluff: The Untold Story of American Submarine Espionage*. New York: Public Affairs, 1998. Stories throughout *Blind Man's Bluff* of courageous and heroic actions of nuclear submariners.

¹⁴³ Alex Flemming, *Making a Submarine Officer: A Story of the USS San Francisco (SSN-711)*. New York: ACF Consulting Services, 2011. Kindle locations 528-532, 534-537.

¹⁴⁴ *Ibid.*

to as the “for” and “aft” portions of the boat. Creeping nuke-ism, it was felt, was the result of the first half of an officer’s first fleet tour being spent in the engineering department where the zero defect mentality and stringent procedural compliance were absolute. After being qualified in the engineering spaces, officers are moved to the “forward half” of the boat to gain experience on the weapons systems and qualify as the Officer of the Deck, the commanding officer’s direct representative in charge of the safe navigation of the vessel. It was a stated concern of several interviewees that many officers found it difficult to make the transition from the world of procedural compliance they faced “back aft” to the unscripted environment of the control room “up forward.”

During the first year and a half or so of a JOs initial sea tour after reactor training, the officer is assigned to the engineering department to continue developing their knowledge of the reactor without interruption. After the completion of this first half of their tour, the officer moves to the forward section of the boat to gain experience with the navigation and tactical functions of the boat. Once an officer moves forward in the second half of their first tour though, there is a need to be more dynamically flexible to meet the requirements of an unscripted world. Here there develops a split between those who excel in the more academic environment of the reactor and those thrive on the irregularity of driving a vessel in three dimensions with none of the visual cues a surface ship’s crew has the benefit of. This split was attributed to both types of submarines, fast attack and boomer.¹⁴⁵

From both sides of the fore and aft cultural divide came opinions of the junior personnel, both officer and enlisted, as developing “pockets of innovation.” It was felt that from time to time, a good idea would come forward, but the requirements to enact that idea, whether administrative, engineering or operational in nature, became insurmountable obstacles.

¹⁴⁵ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012). Multiple interview sources - Cultural references will remain anonymous due to subjective nature and sensitivity of the material.

One of the humorous community specific roles that this researcher had come upon previously with submariners served with that appeared during this research was:

the ‘Finite Happiness Theory’ of life on a submarine. There is only so much happiness on a submarine at any time, and it is not enough for everybody. The only way to get this happiness is to take it from someone else, in the form of prodding or practical jokes, or just plain yelling at them. You hold on to this happiness for a little while, until someone takes it from you.”¹⁴⁶

Similar to most other U.S. military groups, the submarine community is a highly hierarchical organization where command and control flows along the Navy’s rank structure. The senior person onboard the boat is typically the Commanding Officer, a Navy Commander (CDR). The Commanding Officer is typically on his fourth sea tour, with roughly seven or eight deployments worth of experience. There are routinely to be found however, all manner of higher-ranking officers such as the Commodore for the Squadron, a Captain (CAPT) senior to the Commanding Officer with previous submarine command experience, or an Admiral.

The second in command of the boat is the Executive Officer who is a Lieutenant Commander (LCDR) on his third sea tour. The Department Heads billets are filled by second tour Lieutenants (LT), and the Division Officer billets are manned by Ensigns (ENS) just out of their initial training. The Ensigns will most likely receive two promotions during their first tour including from ENS to Lieutenant Junior Grade (LTJG) and then to LT shortly before they rotate to their first shore tour.

The enlisted part of the crew consists of the Chief of the Boat (COB) who is the senior enlisted representative to the Commanding Officer. There are also Department and Divisional Chiefs whose role is to assist their officer counterpart and supervise the work and training of the junior enlisted. Serving within these divisions, is the vast majority of the crew – the most junior sailors on the boat.

¹⁴⁶ Alex Flemming, *Making a Submarine Officer: A Story of the USS San Francisco (SSN-711)*. New York: ACF Consulting Services, 2011. Kindle locations 960-965.

Added to those factors, the nuclear submarine community has rooted in its origins a drive to maintain an absolute, zero defect, safety posture with respect to its boat's nuclear reactor systems.¹⁴⁷ These individuals see their mission as "do no harm" with respect to the boat's control systems. In other words, nothing should be allowed to circumvent requirements to ensure the continued absolute safe operation of the boat and its systems. This sentiment is difficult to argue, but a couple of those interviewed during this research referred to this as another face of the creeping nuke-ism of the submarine culture.¹⁴⁸

Several interviewees described this fore and aft cultural divide. "You hate the guys back aft...until someone else (outside the crew) says something about them."¹⁴⁹ This submarine force wide split factored into the decision to focus TANG on the forward half, the sonar and tactical systems. It would have been next to impossible to make this happen in the engineering and reactor spaces according to those interviewed for this research. The safety requirements drive the process for enacting changes to be too time consuming for an agile response to technological improvements. With a naval reactor safety record of zero reactor related incidents, the methods have proven effective.

The APB

The Navy's nuclear submarine fleet had been running a pair of programs in tandem to deliver technological progress aboard the boats. The software and algorithm updates were handled under the umbrella of the Advanced Processing Build (APB), and hardware updates by Technology Insertions (TI). The system was originally organized so that updates were to take place annually. Due to concerns from the fleet about maintaining readiness and qualifications, it was slowed to every other year. One year would be an APB and the next would be a TI. These improvements would be fielded in the two-year interim on those boats that came in for a scheduled shipyard period during that time.

¹⁴⁷ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

¹⁴⁸ Ibid.

¹⁴⁹ Ibid. The portion within parentheses added by researcher for clarity.

The as-is method for addressing an increase in capabilities has been referred to by some interviewees as ‘knob-ology.’ Knob-ology is not an uncommon term in the naval service and is most commonly used to refer to technology development efforts. When a new capability is added to a system, there is often not a complete reworking of the system to fully integrate the functionality. Instead a new knob, an electronic potentiometer at one time, would be installed on an available piece of surface area. Later knob-ology manifested itself through the addition of new pages of software, or worse yet, one software function hidden on a page of unrelated software functions.¹⁵⁰

Given the number of submarines in the fleet, their deployment and yard schedules, the fleet would be comprised of a mixture of three or more hardware and software combinations at any one time. This leads to an unmanageable number of locations for a new sailor to look for a specific piece of functionality in the field of ‘knobs.’ It was also therefore possible for a sailor to leave a boat that was outfitted with six-year-old equipment for three years of shore duty. He would then return to sea aboard a boat with technology that is a decade newer. These users found themselves asking questions like, “How do I X?” or “Where is functionality to do Y?” and “Why can’t the symbol to take a picture look like the symbol on my iPhone?”¹⁵¹

E. APB ISSUES

The last question came up during a story of a recent TI that incorporated “radical changes to the interface.” Lieutenant Josh Hausbach was at sea familiarizing himself with a new console and trying to figure out which button would bring up a geographic plotting (geo-plot), or mapping, of the boat and other contacts being tracked by the watch team.

There was a little button at the bottom, and it’s got a ‘G’ on it. I’m sitting there, and I’m clicking on it, and I’m like “Why is the geo-plot not coming up?” Cause I see a ‘G,’ and I think geo-plot. And finally after sitting there

¹⁵⁰ Anonymous, interview by Thomas Hall. *Offline Group Discussion with Submarine Officers* (August 24, 2012). Result of several off-line discussions on the subject of issues relating to lack of design thinking application to current systems.

¹⁵¹ Josh Hausbach, interview by Thomas Hall. *TANG Thesis Research Interview* (August 23, 2012).

and pushing it for 30 or 40 times, I notice up at the top that it says ‘frame grab,’ and it has a date-time stamp on it. And it’s right now. I click it again, and it changes. “Oh, that’s the take a picture button!” So, through this process of feeding back to the APB folks, the very next software iteration Andy Leal went to the engineers, and took his phone. “Do you see this camera button on here? Turn this ‘G’ into the iPhone camera button.” And now, if you want to take a picture... you push the camera button.¹⁵²

In 2009 and 2010, the control room technology update discussion had turned to “when is enough... enough?” Fleet commanding officers and some senior leaders felt that the processing power and algorithms currently at sea were capable of meeting the fleet’s operational requirements. The desire was to allow the fleet to standardize on one version of the boat’s systems and possibly save money.

The acquisition professionals within the submarine community pointed out that this idea was unfeasible. The submarine community has long been a customer of commercial off the shelf technology (COTS). With the rate of change and obsolescence within the technology industry, the cost of parts that are a decade out of date in the civilian world, if they’re even available, is exorbitant.¹⁵³ A COTS acquisition strategy does provide some advantages however. COTS systems are typically significantly cheaper than a comparable military specification (MILSPEC) system.¹⁵⁴ It also allows the submarine community to be more agile in response to threats and vulnerabilities of competitive nation’s military hardware.¹⁵⁵ COTS systems had also been deemed to be cheaper for maintaining current simulators as of APB 07 than maintenance costs associated with the legacy simulators.¹⁵⁶

¹⁵² Josh Hausbach, interview by Thomas Hall. *TANG Thesis Research Interview* (August 23, 2012). A geo-plot is a digital chart representation of the boat’s geographic position.

¹⁵³ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

¹⁵⁴ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

¹⁵⁵ Ibid.

¹⁵⁶ Ibid.

There were also historical concerns over the durability of COTS systems given their unhardened nature as compared to mil spec systems. Vice Admiral (VADM) Richardson later addressed this concern with an illustrative story, “With a submarine hitting a submerged seamount at greater than 25 knots, the only piece of COTS equipment damaged, on a boat full of COTS gear, was a display that was damaged by a sailor thrown by the collision... We can’t be on the leading edge of technology. We’re one or two generations back where the technology is more reliable.”¹⁵⁷

There had also been problems with the APB process along the way. There was one APB version with enough software issues that a staffer would provide the commanding officer with the message he would need to send as soon as he put to sea in order to create a demand signal for the required fixes. Other builds had failed to pass their operational testing.¹⁵⁸

F. THE WHITE PAPER

In an effort to promote a different approach to solving the problems facing the U.S. Navy’s submarine forces, Smith created and distributed within APL a white paper recommending that the Navy capitalize on the open-minded condition of more junior officers (JOs) and sailors within the fleet. His white paper, titled “Junior Officer Watch Team Innovation Conference,” and dated 1 June 2010, stated that:

We have already observed younger sailors and officers’ success with new capabilities and technology during countless sea tests and Watch Section Task Analysis events.. Their dependence on “the way we’ve always done it” does not exist; instead it is replaced with an open mind and a desire to learn something new. Why is it that when new installments of the Madden Football Game are released with a different look and feel, you don’t hear complaints amongst the gaming community? (Instead, there is enthusiasm

¹⁵⁷ Navy Warfare Development Command, *Junior Leader Innovation Symposium*. June 6, 2012. <https://www.nwdc.navy.mil/ncoi/jlis/Junior%20Leader%20Innovation%20Symposium%20Videos/Forms/AllItems.aspx> (accessed September 9, 2012).

¹⁵⁸ Josh Hausbach, interview by Thomas Hall. *TANG Thesis Research Interview* (August 23, 2012).

and anticipation of the new version.) The gamer can usually adjust to these new controls and is up and running before the end of the day.¹⁵⁹

The paper went on to suggest that the use of the junior members of the crew would allow the submarine community's future requirements to be defined by the watch team as a whole.¹⁶⁰ This paper would later evolve into audience and support to form the Tactical Advancements for the Next Generation Forum that would involve the work of countless individuals to bring together technology industry leaders with 27 junior sailors and officers, meeting in San Diego, CA, in November of 2011, in order to create a more intuitive experience within the confines of a submarine.

The paper was generally well received within APL, but found little traction outside of the organization. In the opinion of Bill Mahoney, an APL contractor, "Narrowband hadn't changed in years. I thought it was great. Best idea I'd ever heard. We needed to work on Operator Machine Interface (OMI), but the group was working on 'knob-ology.'"¹⁶¹ OMI is the portion of systems engineering in the acquisitions process that aims to promote usability of equipment.

John Stapleton, Director of Technology Strategy for APL's submarine advanced development programs, agreed that the idea of using junior personnel was a good idea, saying that, "The submarine community has a corporate history of forward thinking."¹⁶² There were several other similar statements including an offline discussion specifically making mention of Admiral Hyman G. Rickover, the Father of the Nuclear Navy. In that discussion, the submariners around the table described him, reverently as an innovative engineer and a man who broke the rules whenever required to make progress that he saw as invaluable for his Navy and his country. First and foremost on the list of Rickover's

¹⁵⁹ Joshua D. Smith, Brad Wolf, Don Noyes and Mandy Natter, "Junior Officer Watch Team Innovation Conference." White Paper, Johns Hopkins University Applied Physics Lab, 2010.

¹⁶⁰ Ibid.

¹⁶¹ Bill Mahoney, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).

¹⁶² John Stapleton, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).

courageous and innovative actions in the face of strong opposition was his decision to “place the first nuclear reactor inside a submersible pressure hull.”¹⁶³

By way of innovation comparison, in Walter Isaacson’s biography of Steve Jobs, Jobs is credited with either revolutionizing or reimagining seven industries.¹⁶⁴ In Theodore Rockwell’s collection of tales regarding Rickover, this researcher counted up 12, or 13 depending on one’s personal opinion, aspects of modern life that admiral had a lasting impact on. The list includes: recruitment and training, shipbuilding, the materials industry, planning and budgeting, manufacturing, military construction projects, operating procedures and manuals, the electric utility industry, large equipment manufacturing, radiation and safety standards, technical information handling – dissemination and declassification, radiological engineering. The debated 13th field is education.¹⁶⁵

There were also pockets of resistance to the idea throughout the Navy, the APB development group, and, to a lesser extent, within APL itself. This use of junior personnel for developing weapons systems did not mesh with the way business was typically conducted within DoD. These pockets of resistance would turn into a recurring theme within the effort to bring the conference about.

G. VADM RICHARDSON

Vice Admiral John M. Richardson graduated from the U.S. Naval Academy in 1982 and has since earned three Master’s Degrees from the Massachusetts Institute of Technology (MIT), Woods Hole Oceanographic Institute, and the National War College. The admiral previously served on the staff of the Chief of Naval Operations and as a naval aide to the President. The admiral’s four command tours, including his current role as Commander, Naval Submarine Forces (COMSUBFOR), were USS Honolulu

¹⁶³ Anonymous, interview by Thomas Hall. *Offline Group Discussion with Submarine Officers* (August 24, 2012).

¹⁶⁴ Walter Isaacson, *Steve Jobs*. New York: Simon & Schuster, 2011. Kindle location 275.

¹⁶⁵ Theodore Rockwell, *The Rickover Effect: How One Man Made a Difference*. Lincoln, NE: iUniverse, Inc., 2002. Kindle location 111, 103, 91, 84, 33, 136, 146, 163, 172, 184, 197, 219, and 298.

(SSN 718), Commodore of Submarine Development Squadron 12 (CSDS 12 or DEVRON 12) in Groton, CT, and most recently serving in a dual-hatted position as Commander, Submarine Group Eight and Commander, Submarines, Allied Naval Forces South.¹⁶⁶

As fortune would have it five months after Josh published his white paper, VADM Richardson took over the position of COMSUBFOR for the Navy. During the weeks leading up to his assumption of command, Richardson met with the CEO of Google, at the company's Mountain View, CA headquarters. An anecdote, as relayed by Scott Tupper at a few removes from the origin of the story, about the meeting describes it as follows: During the meeting, Admiral Richardson was asked what problems he was having. The admiral responded with a specific need. Twenty minutes later a developer had returned with complete and functional app meeting the admiral's needs¹⁶⁷. The admiral would subsequently be quoted as saying that with no training "he could get up to speed on what was happening using Google Earth in less than three hours," and that submarine systems should capitalize on these types of commercial technologies to reduce training requirements and speed a sailor's development of tactical situational awareness.¹⁶⁸

In May of 2011, Admiral Richardson spoke to the Submarine Technology Symposium held in Laurel, MD, at APL. He posed to the group a comparison between an iPad and the way the submarine community handles contact management. He asked why the community "builds things foreign to our customers."¹⁶⁹ Richardson stated that the younger sailors are familiar with systems like the X-Box, iPhones and iPads, and asked

¹⁶⁶ United States Navy, *Admiral John M. Richardson Biography*.
<http://www.navy.mil/navydata/bios/navybio.asp?bioID=440> (accessed September 14, 2012).

¹⁶⁷ Scott Tupper, interview by Thomas Hall. (September 10, 2012). This is cited as the initial source, but throughout this research an effort was made to achieve triangulation and confirmation of statements based on the recollection of individuals.

¹⁶⁸ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

¹⁶⁹ Navy Warfare Development Command. *Junior Leader Innovation Symposium*. June 6, 2012.
<https://www.nwdc.navy.mil/ncoi/jlis/Junior%20Leader%20Innovation%20Symposium%20Videos/Forms/AllItems.aspx> (accessed September 9, 2012).

why the military should disregard that previous training in favor of retraining the users on less intuitive systems.¹⁷⁰

The Admiral's Motivation and Direction

On a post-TANG blog, the admiral posed the problem as follows, to include figures 1 and 2 and their captions:

Most Sailors entering the Navy can pick up a smartphone and handle it like an ace. They are familiar with the icons and display modes of the new apps and games that deliver a tremendous amount of complexity in an intuitive interface and system design. We want to bring that into our combat systems and take advantage of all the experience and “training” that our Submariners have when they first arrive.



Figure 1 “In short, we want to go from screens that look like this:¹⁷¹“

¹⁷⁰ Scott Tupper, interview by Thomas Hall. (September 10, 2012).

¹⁷¹ Vice Adm John M. Richardson, USN, “TANG” – A Vision for the Future. January 17, 2012. <http://comsubfor-usn.blogspot.com/2012/01/tang-vision-for-future.html> (accessed September 1, 2012).

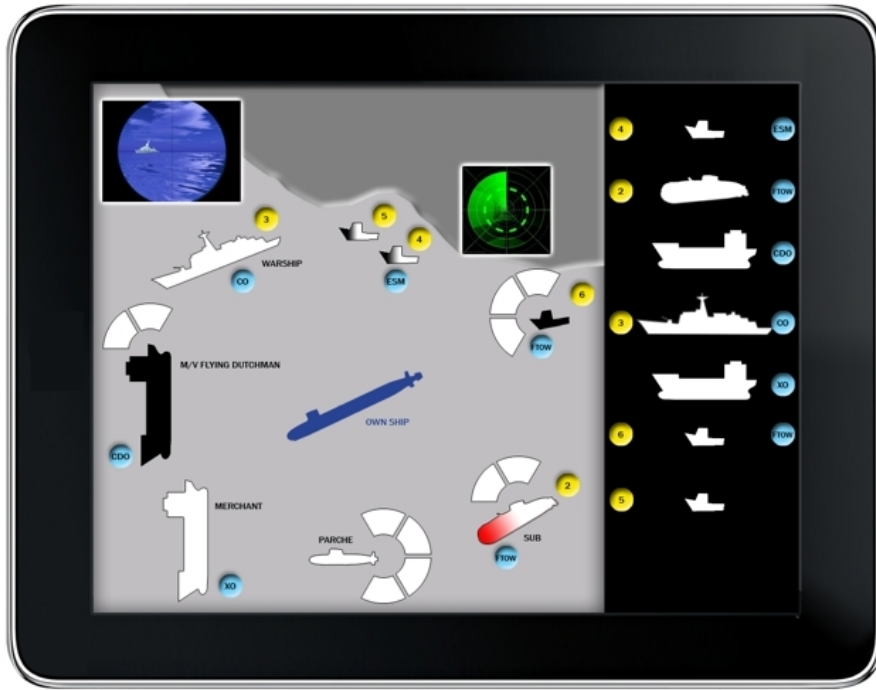


Figure 2 “To screens that look more like this:¹⁷²“

Around the same time, Richardson posed the problem of leveraging this free “training” of the “millennial generation” of sailors and officers.¹⁷³ This idea resonated with CAPT William Merz, the current Commodore of DEVRON 12, the job previously held by Admiral Richardson. The mission of DEVRON 12 is to develop, evaluate and disseminate tactics to the fleet.¹⁷⁴

¹⁷² Vice Adm John M. Richardson, USN, “TANG” – A Vision for the Future. January 17, 2012. <http://comsubfor-usn.blogspot.com/2012/01/tang-vision-for-future.html> (accessed September 1, 2012).

¹⁷³ Navy Warfare Development Command, *Junior Leader Innovation Symposium*. June 6, 2012. <https://www.nwdc.navy.mil/ncoi/jlis/Junior%20Leader%20Innovation%20Symposium%20Videos/Forms/AllItems.aspx> (accessed September 9, 2012). The term “training” as used to mean the group’s gaming experience was attributed to VADM Richardson by numerous interviewees, and was used by the admiral in a keynote speech to the Junior Leader Innovation Symposium on 6 June 2012. The term “millennial generation” or “millennials” is usually attributed to Neil Howe and William Strauss, from their book, “Millennials Rising: The Next Great Generation,” to describe those born between 1982 and 2000.

¹⁷⁴ United States Navy, *Commander, Submarine Group Two*. <http://www.public.navy.mil/subfor/csg2/Pages/SubmarineDevelopmentSquadronTwelve.aspx> (accessed September 22, 2012).

Commodore Merz scheduled a meeting with the submarine force's development community to discuss methods of leveraging the millennials.¹⁷⁵ John Stapleton, Pete Scala, the Integrated Weapon System Advanced Development Director, and Scott Tupper delivered Josh Smith's white paper to the Commodore as an option to meet the admiral's challenge.¹⁷⁶ The plan had already moved to incorporate the entire watch team.¹⁷⁷

The watch team is composed of JOs and enlisted Fire Control Technicians and Sonar Technicians. The Fire Control Technicians are responsible for the maintenance and operation of combat control and tactical computer systems. The Sonar Technicians are responsible for developing sonar tracks to aide in safely navigating the boat and engaging enemy vessels.

The name for the event was still JOIT however until a better name could be arrived at. By all accounts, the admiral liked the proposal, and along with a few other ideas ordered that DEVRON 12 and APL move ahead with the idea. The admiral also recommended that an effort be made to develop the involvement of large private organizations such as Microsoft, Adobe, Cisco and Google.¹⁷⁸

Based on Richardson's orders and recommendations, the APL personnel, Josh Smith and Don Noyes, started planning for a Junior Officers Innovation and Technology (JOIT) Forum. The forum was to use a format that would eventually be adopted for use at TANG. The plan was for several smaller teams guided by facilitators to brainstorm and then rapidly and inexpensively prototype their ideas. The prototype artists were originally to have been provided by APL or to have been hired separately. To create an air of excitement and purpose, the JOIT planning team discussed the wearing of civilian attire,

¹⁷⁵ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

¹⁷⁶ Ibid.

¹⁷⁷ Ibid.

¹⁷⁸ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

gift bags, command coins and a social hour to get the participants familiar with one another prior to the forum.¹⁷⁹

1. Cold Calls to Industry

To facilitate APB innovation and leverage American industry capabilities, a series of “cold calls” to representatives of industry leading corporations was planned. The proposed list of corporations to approach via a cold call included: 3M, Google, Microsoft (with a focus on their touch table) and EA Sports, a sports video game developer. The group also considered attempts to connect with universities such as Penn State, Carnegie Mellon and MIT.¹⁸⁰ Josh and the team planning the forum at APL already had connections with Sonalysts, General Dynamics, and Lockheed Martin that would be leveraged after the forum.¹⁸¹

The first call was to Corning, a maker of glass products including a multi-touch surface glass. This call lead Corning to connect APL, the APB, and those working to set the innovation forum up with a much larger network of potential supporters for the forum. During the initial conversation, the APL representative, B.M., was told that his timing was excellent. Wendell Weeks, the CEO of Corning, had told Paul Tompkins, his Director of Commercial Technology, to “Go find something patriotic to do.”¹⁸² An added benefit of the introduction to Corning was the idea of “fast following.”¹⁸³ A term they defined as being agile with respect to time, and rapidly correcting an organization’s technology investments to track or follow changes being made by the technological leaders.¹⁸⁴

¹⁷⁹ Joshua D. Smith, *JOIT Forum Initial Planning Meeting Notes*. Laurel, MD, June 16, 2011.

¹⁸⁰ Ibid.

¹⁸¹ Ibid.

¹⁸² John Stapleton, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).

¹⁸³ Ibid.

¹⁸⁴ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

While intended to support the APB, this and other cold calls would lead to direct support for the forum, soon to have its name changed to TANG Forum. That word, forum vice conference, was actually a key consideration. It was felt by the TANG Forum supporters that forum was much more inclusive by nature than a conference would be. In a conference, the emphasis is not on participation – “a parade of briefs.”¹⁸⁵ This was not intended to induce spectatorship. This was to be experiential. Unfortunately, at this point, even with the backing of the admiral, TANG was still far from a certainty.¹⁸⁶

The unexpectedly positive results of this first call built confidence within the ranks of the forum supporters. Their next call was to Microsoft to see if they would be interested in working with the APB developers and participating in the TANG Tech Expo. The company immediately said yes. This and several other follow-on technology demonstrations served to awaken the team to what Josh, Don and John eventually took to calling, “the art of the possible.”¹⁸⁷ That term would go on to be embraced and appreciated by all those who came into contact with the forum. It was told to the researchers by several interviewees that these expos, along with the design process itself, helped to ignite a fire of imagination within the participants.

In the end, several large technology companies would support the forum. Microsoft, InDepth Engineering Solutions and METRON, an engineering and scientific consultancy respectively, agreed to participate in the TANG Forum. VADM Richardson described the financial impacts for a company like Microsoft for their participation with the APB and TANG in his post-TANG brief to the Junior Leader Innovation Symposium:

It’s round-off noise to these companies... Corning hosted a seminar at Stanford. We didn’t have any solutions, but the submarine community did have a pretty interesting problem for them, if they wanted to help us solve it. As I said they were all pretty eager to help... Microsoft spent 8.6 billion dollars last year on R&D. IBM, Cisco and Google spent billions and billions, and they’re willing to share the results with us...

¹⁸⁵ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

¹⁸⁶ Ibid.

¹⁸⁷ John Stapleton, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).

In contrast, the admiral described the DoD as not having “a blank slate or an unlimited budget. We have to concentrate on those ideas that provide the biggest bang for the buck.”¹⁸⁸ None of the companies involved asked for or expected anything in return for their participation. Obviously, Microsoft and the other industry participants in TANG were not in this to pad their bottom lines.

While John Stapleton was conducting cold calls to the technology industry, another APL executive offered to connect those working to coordinate TANG with an individual in the technology industry. This was a person known to have exceptional skills at managing innovation. Importantly, he was a known quantity because the APL executive had worked with him previously.

The individual was former Walt Disney Imagineer and Executive, Dr. Eric Haseltine. Haseltine met with Josh and the rest of the APL team at the Washington Navy Yard. Josh told this researcher that Haseltine’s answer was, “You want to have guys prototype things fast and see what works and fail often so that you can figure out what is the right solution... You need to tap into industrial design or industrial engineering, and he dropped IDEO’s name and said, ‘You really need to get in touch with these guys.’”¹⁸⁹

IDEO

IDEO is a “global design consultancy” that seeks to “create impact through design.”¹⁹⁰ While IDEO does work on products and their design, the core of their work and their philosophy is to utilize “design thinking” to create human-centered, innovative answers to needs and support for behaviors. Their approach to design is based on empathy with, and ethnographic research into, the culture of the group they are designing

¹⁸⁸ Navy Warfare Development Command, *Junior Leader Innovation Symposium*. June 6, 2012. <https://www.nwdc.navy.mil/ncoi/jlis/Junior%20Leader%20Innovation%20Symposium%20Videos/Forms/AllItems.aspx> (accessed September 9, 2012).

¹⁸⁹ Bill Mahoney, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).

¹⁹⁰ IDEO, *About IDEO*. <http://www.ideo.com/about/> (accessed September 3, 2012).

for, and they strive to make their process more personal through this as opposed to a running systems discussion.¹⁹¹

H. THE IDEO SHOPPING CART VIDEO

As a first step, Josh Smith and John Stapleton searched the Internet. The first video result returned is a 1999 ABC Nightline clip in which the IDEO design team is challenged to update the ubiquitous shopping cart using the company's design thinking process.¹⁹² Josh and John showed the video to nearly every member of their portion of APL's Undersea Warfare Business Area. IDEO Partner David Haygood sums up the opinions of the video in an e-mail to Professor Frank Barrett of the Naval Postgraduate School, "Almost EVERYBODY loves the Nightline video and sees tons of applicability for their situation." He goes on to say, "There is a thread thru this whole case about overcoming adversity. This is just one anecdote. As you have seen, almost everybody loves the Nightline video and sees tons of applicability for their situation. This reaction is extremely rare." Haygood, whose corporate bio includes, among other things, serving as a "U.S. Army Combat Photographer in Vietnam, leading chapel services in a maximum security prison, and swimming from Alcatraz to San Francisco" serves as the "point of contact for government and public policy programs" described the negative reaction as he had heard it, "the design opportunity was nearly derailed by the video."¹⁹³

The usual reaction to the shopping cart video is along the lines of what Josh Smith and Don Noyes had experienced, "When Don and I watched the video, we were intrigued by how much was accomplished in one full day and the process at which the research, brainstorming, and prototyping was conducted."¹⁹⁴ John Stapleton had one of the

¹⁹¹ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

¹⁹² IDEO, *Shopping Cart Concept for IDEO: Redesign of the Shopping Cart for ABC's Nightline*. <http://www.ideo.com/work/shopping-cart-concept> (accessed September 3, 2012).

¹⁹³ David Haygood, interview by Professor Frank Barrett. *Video Story?* (September 5, 2012), and IDEO. *IDEO People*. <http://www.ideo.com/people/david-haygood> (accessed September 5, 2012).

¹⁹⁴ David Haygood, interview by Professor Frank Barrett. *Video Story?* (September 5, 2012).

stronger reactions to the video. In an effort to shift his self-described negative mindset based on the video, he called Bill Mahoney. This is the phone call as recollected by John:

I really don't know what these IDEO guys are going to do for us, and we need for this TANG thing to work. Look at the shopping cart video. Name one grocery store you've been to that has adopted that design. Safeway and Giant haven't. Even trend-setting stores like Whole Foods and Wegman's use regular old shopping carts. Why? Well, it's like George [another TANG plankholder] explained to me. A regular shopping cart has stood the test of time and is very robust - a large basket on wheels can do all sorts of big and small jobs. The IDEO shopping cart is very specialized for shoppers who want a few small items here and there. And where do you put the kids? Also, the notion that the IDEO team comes in as outsiders, with no subject matter expertise, to help a team think outside the box, just doesn't hold up for the shopping cart example. Everyone has used a shopping cart and everyone is a subject matter expert, including the IDEO team. So why do we think IDEO is really who they say they are?"¹⁹⁵

Why was John so skeptical of IDEO's suitability? He later stated that this skepticism likely evolves from his test and analysis engineering background. John also pointed out the similarity of this trait to the balance between ship's safety and risk that the nuclear submarine crews he works to support must strike in order to conduct their missions, and that "It is an essential skill for those purposes, but as IDEO helped us understand, it isn't particularly helpful at the onset of an innovation effort."¹⁹⁶ This reaction to an anthropology heavy design process is much less surprising in light of remarks made by IDEO's General Manager, Tom Kelly, at Creativity World Forum 2008 in which he stated that it took him a while to get used to the presence of the anthropologists that arrived en masse at IDEO in 1991.¹⁹⁷

¹⁹⁵ John Stapleton, interview by Thomas Hall. *How Shopping Cart Almost Killed TANG?* (September 5, 2012).

¹⁹⁶ David Haygood, interview by Professor Frank Barrett. *Video Story?* (September 5, 2012).

¹⁹⁷ Thomas Kelley, *Tom Kelley at the Creativity World Forum 2008: Helping Organizations to Innovate Through Design*. December 1, 2008. http://www.youtube.com/watch?v=VeXO1gQJ__M (accessed September 5, 2012).

Bill Mahoney's response during the phone call, as told by John, "He told me to get out of my dark place and make it work. And I did, probably mostly because I wanted to support Josh."¹⁹⁸ John was now going to give IDEO an opportunity to impress, but was clearly still skeptical of their participation.

Mahoney then placed the cold call to IDEO's New York office. The result was a trip to APL by David Haygood for a face-to-face meeting to discuss what APL and the submarine forces were looking for.¹⁹⁹ What followed was a larger meeting with Haygood, Josh Smith, Bill Mahoney and John Stapleton to set a tentative schedule and start work on getting approval to hire IDEO and issue their designers the required clearances on 16 August 2011. The results of this meeting were profound for Stapleton. In his words, "We had a great first meeting with IDEO. They were completely unpretentious, they were very confident about what they could and couldn't do, very willing to learn about our problem space, and very interested in a partnership that played to everyone's strengths."²⁰⁰ Stapleton had seen the potential of the contributions that IDEO could make and was now a convert. He later became one of the most vocal supporters, not just of TANG, which he had always supported, but now also of IDEO's design thinking involvement. The issue of the shopping cart video did receive more discussion however. John Stapleton and Josh Smith subsequently pointed out to David Haygood that a video of IDEO conducting their design process for a more technical customer might have made the comparison easier to draw for APL.²⁰¹

While this coordination was ongoing, Admiral Richardson was continuing to make his push for innovation and leveraging the talents that the millennials show up to boot camp and officer candidate school with. These coordination efforts however, were at such an early stage that they were proceeding without the formal backing of the admiral. It was all happening so fast that the Admiral had not yet heard about the involvement of

¹⁹⁸ David Haygood, interview by Professor Frank Barrett. *Video Story?* (September 5, 2012).

¹⁹⁹ Bill Mahoney, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).

²⁰⁰ David Haygood, interview by Professor Frank Barrett. *Video Story?* (September 5, 2012).

²⁰¹ Ibid. and Stapleton, John, interview by Thomas Hall. *How Shopping Cart Almost Killed TANG?* (September 5, 2012).

IDEO or the rapid progress of industry partners supporting the forum.²⁰² This left him unaware that there were new developments in the innovation effort he was fostering for a period. The admiral embraced the IDEO effort immediately upon hearing of it, but possibly due to this temporary disconnect, the proponents of the forum would meet with resistance throughout the process.

Dissatisfaction

The fleet had long been anxious about the changes put forth every other year by the APB process. The APB program had initially been releasing new systems annually from APB99–04.²⁰³ The submarine commanders felt that they were left with the responsibility of having to train sailors on systems that the training community within the submarine forces could not keep up with. The training community focused on the newer systems on the boats, but there were typically at least three different systems to be found at the waterfront at any one time. Over time, the APB came to agree with the commander's feelings on the issue, and they began to consider where the balance lie between technological advancement and proficiency of the watch teams.²⁰⁴ To rectify this issue, several releases were skipped, and starting with APB 09, the program released updates biannually and a COTS based trainer was incorporated into the APB to ensure trainer currency.²⁰⁵

These feelings would carry over to TANG as well, and they manifested in several manners. Criticisms revolved around, “What good outputs do you expect from a bunch of JOs and enlisted?”²⁰⁶ This researcher was unable to discuss this sentiment directly with any of the resisters. Several interviewees put forth that quote as having come from

²⁰² Bill Mahoney, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).

²⁰³ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²⁰⁴ Josh Hausbach, interview by Thomas Hall. *TANG Thesis Research Interview* (August 23, 2012). While it is traditional for vessels belonging to the U.S. Navy to be referred to as ships, the submarine forces refer to their vessels as boats, and thus will be referred to as such by the author.

²⁰⁵ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²⁰⁶ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

multiple unnamed sources of resistance. This researcher feels that quotes of that nature likely stemmed from a perceived threat to the speakers' position or sense of identity.

At least two of those who did not fully support the initiative, did so out of a stated sense of caution. That cautious nature is a product of their “do no harm” safety mantra. This then is the “creeping nuke-ism” in action.²⁰⁷

Others felt that this type of innovation effort would not be a good fit for the corporate climate of the submarine forces given the need to meet stringent engineering requirements aboard the boats. Almost to a man, these people would over time become converts and even serve as evangelists for the program. As meetings were held to train subject matter experts for the forum, more people would be invited to the IDEO led brainstorming sessions. The typical reaction to seeing the design thinking process in action live was an enthusiastic embrace of the design initiative and the conversion to design advocate.²⁰⁸

Advocates for TANG would have to confront these feelings of dissatisfaction along the path to the forum and in order to bring the forum's outputs to the fleet. One thing that most participants of this research agree on however is that none of the resisters were malicious or had other than the best intentions and needs of the Navy at heart. It was a situation viewed from numerous perspectives that provoked differing reactions based on the realities of each individual in question.

I. JOIT TO TANG

No one interviewed knows exactly when it happened, but at some point between 16 June and 17 August 2011, the name was changed from JOIT Forum to TANG forum due to leadership with the name. Commodore Merz of CSDS 12 came up with a new

²⁰⁷ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

²⁰⁸ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012), and Stapleton, John, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012). Stated by two interviewees that converted to supporters of the program and by several who saw the change in opinion of the individuals.

name: TANG.²⁰⁹ The new name served two purposes aside from simply replacing JOIT. The new name encompassed the enlisted participation that the old name failed to address. The TANG moniker also provided the forum with a historical connection for the participants. The USS Tang (SS-306) was a highly decorated submarine during World War II. During the boat's five deployments, it was credited with sinking 33 enemy ships.²¹⁰ The new name just made sense and added to the experience for all participants.

On 17 August, Josh Smith had a conversation with a Microsoft representative at which the company formally agreed to deliver a presentation of new possibilities during a "technology expo" for the TANG Forum, and on 20 September, their schedule was finalized.

1. IDEO's Research

On 1 September 2011, the clearances were received for IDEO's team of designers to participate in TANG. Typically, an IDEO design team must develop the brief they are given by a client to a higher level of abstraction. For instance, in an exercise given to a class at NPS, the initial request was to "get people to recycle their plastic bags." This was then changed to a more abstract "raise community awareness of recycling opportunities." This was not required for TANG. The brief given to IDEO was that the submarine community wanted to improve the situational awareness of the watch team. Situational awareness in this context was with regard to the location and type of sonar contacts being tracked by the boat's control room watch team. VADM Richardson provided the constraint. He wanted to leverage the innate technological knowledge of the young people.²¹¹

From 7–9 and 14–16 September, IDEO conducted research interviews, toured Lockheed Martin observing APB11 testing, and received a tour of a nuclear submarine.

²⁰⁹ Joshua D. Smith, interview by Thomas Hall. *TANG Thesis Research Interview* (September 13, 2012).

²¹⁰ Vice Adm John M. Richardson, USN, "TANG" – *A Vision for the Future*. January 17, 2012. <http://comsubfor-usn.blogspot.com/2012/01/tang-vision-for-future.html> (accessed September 1, 2012).

²¹¹ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

During the same period, the IDEO team refined their interview methodology, and provided training to those selected as subject matter experts (SMEs – spelled out by IDEO and CSDS 12 personnel, but said as a word by most of the Navy participants) on the IDEO method of brainstorming. It was agreed on by those interviewed that IDEO’s interview methods were effective. One of those interviewed stated, “You got me to talk about a lot of stuff.”²¹² Others stated during interviews for this research that the IDEO researchers would let a lull in conversation continue. Each individual then felt compelled to comment to fill the conversational void.²¹³

One of the goals of the research was to make observations regarding the way in which the submariners interacted with their systems and to make note of any quotes that seemed especially telling about the human aspects of the submarine forces and their systems. Dan Soltzberg, who lead the research, stated that the specifics of each interview were “similar to jazz improv” and therefore difficult to reconstruct in specific detail, but the purpose was to

understand what was working for people in the current context of their experiences in the sub force, and what was not working. To understand these points, we uncover people’s actions, motivations, the technological and spatial context in which they’re working, the immediate interpersonal dynamics of their work, and factors of the larger organization such as training that might impact their experience. While we go into our research interviews with a structured set of questions, the actual interviews are similar to jazz improv in that we maintain a high degree of flexibility around both topics and methods. We will often follow the conversation where it leads, as our goal is to discover factors we didn’t necessarily go into the conversation knowing to look for. ²¹⁴

²¹² David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²¹³ Anonymous, interview by Thomas Hall. *Offline Group Discussion with Submarine Officers* (August 24, 2012).

²¹⁴ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

The observations and quotes obtained during the research were then evaluated to refine future interviews and to uncover insights into which needs design thinking could be applied to in order to support the watch team.²¹⁵

The following are some examples of quotes the IDEO team took down during their research:

- “I know the information exists, but I don’t know how to get at it.”
- “If the system was smart enough to know what I need and don’t need, I would be happy. “
- “Drill down as I need/want to (through the track data).”
- “I’d like to have some history of those things I’ve learned (regarding training).”²¹⁶

From this, the IDEO team developed the following observation, “Info is everywhere; it’s hard to pull it all together. There’s no common format. Need to be able to see partial layers, not everything.”²¹⁷

Selecting SMEs

During this early phase, a second crucial portion of IDEO’s ethnographic research work involved conducting interviews to determine an individual’s suitability to be a SME for TANG. IDEO, APL and DEVRON 12 gave serious consideration to which people were suitable for the job. The SME would be more than just a source of engineering knowledge for the design sessions. The SME was responsible, with the help of IDEO facilitators, for guiding the design thinking process of the TANG participants toward a personal and human discussion, and away from a systems discussion. They needed to be able to do that without interfering with the brainstorming sessions unnecessarily or in a heavy-handed manner.²¹⁸ Several of the SMEs later said that the hardest part was “holding (their) thoughts and ideas while facilitating.”²¹⁹

²¹⁵ Ibid.

²¹⁶ IDEO, *TANG Workshop Insights Memo*. Palo Alto, 2011.

²¹⁷ Ibid.

²¹⁸ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²¹⁹ Ray Rowland, interview by Thomas Hall. *TANG Thesis Research Interview* (August 24, 2012).

Lieutenant Tim Manke, a TANG attendee, described the SME's role as "a matter of finding the right question to ask, and then asking it based on "How might we's." Equally important according to Manke was creating an environment in which the participants were made comfortable with asking silly questions without repercussions.²²⁰

Rumors of sailors and JOs being interviewed for a chance to shape the future of the submarine community filtered down to the waterfront in Groton, CT. LT Josh Hausbach sought out the source of these rumors in an effort to learn more. Hausbach would eventually serve as a TANG SME.

The design team was specifically looking for people they considered "T-shaped."²²¹ In an interview, Dan Soltzberg described the IDEO version of T-shaped as being someone with a deep knowledge of at least one subject, a broad base of more generalizable knowledge and experience, and a sense of empathy that the person could bring to bear on the human-centric nature of any design issue.²²²

During the SME selection process, there was one person who did not appear to fit the T-shaped description. The individual was a prior enlisted submariner now that now worked as a civilian supporting the submarine community in several areas. Those conducting the interview felt he was quiet, withdrawn and negative about the process.²²³ When interviewed later as part of this research, he said, "I'm not an idea generation person. I can take someone else's ideas and work with them and make them better, but I don't really come up with new ideas." Those feelings likely colored his interactions during the interviews. Interestingly, during the course of the rest of the interview, this researcher and a co-researcher took note of at least three very original and intelligent

²²⁰ Tim Manke, interview by Thomas Hall. *TANG Thesis Research interview* (August 23, 2012).

²²¹ The term T-shaped appears in Tim Brown's, "Change By Design," on page 27, where he says that the phrase originates from McKinsey and Company. This researcher was unable to track down a direct reference, but a Forbes.com article elaborates that it originates from McKinsey and Company internal discussions of prospective employees. <http://www.forbes.com/sites/andyboynton/2011/10/18/are-you-an-i-or-a-t/> (accessed September 4, 2012).

²²² David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²²³ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

ideas that this individual had recently developed. The ideas were helping to transform training for the betterment of the submarine forces. It appears that the individual had just never thought of himself as an innovator before, and was uncomfortable with the role.²²⁴

J. DESIGN THINKING AS A FRACTAL

Throughout the process, IDEO used their design thinking methodology in a fractal fashion to develop the design sessions they were supporting at TANG. In a group interview with the IDEO design team that worked with the TANG participants to facilitate design thinking, David Haygood, Dave Blakely, Dan Soltzberg, and Peter Macdonald, the team's internal planning processes were discussed. They indicated that at each point where the plan for TANG pivoted or altered, the team relied upon the same design thinking process that they provided to the submarine forces customers. When it came to designing the design sessions for TANG, there was a brainstorming session followed by selection and prototyping.²²⁵

The IDEO team brought this approach with them to several planning meetings in an APL basement office where the activities for the three days of the TANG Forum were laid out. Two people attended the first meeting from APL, Josh Smith and Don Noyes, along with two people from IDEO, Dave Blakely and Dan Soltzberg. The use of the design thinking process in this initial planning meeting surfaced good themes for investigation at TANG, but also served to convince Josh and Don of the value that IDEO was capable of bringing to the submarine community. From this meeting onward, Josh and Don would bring in more people to the planning meetings to spread the experience with IDEO.²²⁶

²²⁴ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

²²⁵ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²²⁶ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

K. TANG DRY RUN

With any first run exercise or event, there are likely to be problems encountered and issues to be resolved. Using the same design thinking process, it was decided to stage a dry run to serve as a prototype. The dry run would hopefully surface any of those likely problems and issues while there was still time for them to be dealt with. The dry run would be held in Groton, CT given its convenient location for the Commodore and DEVRON staff and many of the SMEs. It also provided a ready source of participants for the prototype event.

On 20 September 2011, nine officers and sailors were recruited from the boats at the waterfront. The goal was to conduct a small-scale experiment with the proposed design session by asking the nine dry run participants to brainstorm, prototype, and generally go through the design thinking process.²²⁷ Initially, most of the participants were skeptical of the exercise. They had received no prior notice of the event, nor were they told by their commands what to expect. One especially grim individual arrived thinking he was there to help write a tactical manual.²²⁸ There were several comments along the lines of “What can we do?” and “Nobody will listen to us.”

By the end of the event, most of the participants were converts who had enjoyed the process and felt they had positively contributed to the session. The person that arrived expecting to rewrite a tactical manual was quoted as saying, “This is way cool, how can I participate and be selected,” on his way out.²²⁹ The IDEO design team took note of the outputs and held onto them in the event that those ideas, or some that they had developed

²²⁷ IDEO, "TANG Weekly Report: Week of 17 Oct 2011." Planning and Progress Report, 2011.

²²⁸ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²²⁹ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

in their own brainstorming sessions, might be needed to seed the brainstorming session of the TANG Forum in November.²³⁰

One element of the dry run was a graphic of the Virginia control room layout and a tape outline of the spatial constraints that any prototyped idea would have to conform to as stated by VADM Richardson. Richardson explained these limits during a subsequent keynote address to a Junior Leader Innovation Symposium in June of 2012. His stated constraint was that the submarine would not grow in size. The hatches would not grow in size. If the system did not fit down an existing hatch or into the volume of current submarine hulls, then it did not meet his requirements.²³¹

Based on the results of the dry run, it was decided by IDEO and APL that a more substantial version of the model would be required. In the lead up to TANG, IDEO constructed an outline model of a Virginia class nuclear submarine to guide the participant's design thinking based on constraints.²³²

Another element of the dry run was the plenary room. Given the level of interest by Admiral Richardson and the Commodore, it was expected that others would want to observe the process. The plenary room was there for those who wanted to observe the IDEO led dry run from another room so as to not disturb the junior personnel during the design session. There was an audio and video feed into the room so that the observers could follow along with the brainstorming and prototyping throughout the day. Sources vary as to whether the plenary room was much used during the dry run, but it was

²³⁰ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012), and Smith, Joshua D. and Donald Noyes. *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²³¹ Navy Warfare Development Command, *Junior Leader Innovation Symposium*. June 6, 2012. <https://www.nwdc.navy.mil/ncoi/jlis/Junior%20Leader%20Innovation%20Symposium%20Videos/Forms/AllItems.aspx> (accessed September 9, 2012).

²³² David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012), and Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012. The PVC piping mock up of the control room is visible on the YouTube video at <http://www.youtube.com/watch?v=i9kxffGWU8M> (accessed September 1, 2012).

decided to have a more substantial plenary room capacity for TANG in any event.²³³ The more substantial version of the room was to be run as a fully active and engaged process for the senior leadership in attendance. This was done due to the IDEO team's impression that it would be easier for the leadership group to develop a sense of what was going on in the design room and where the eventual outputs came from if they took part in the process.²³⁴

Several other changes were proposed based on the results of the dry run. It was recommended that after the first day design session, that the SMEs and facilitators guide the participants toward a focus on the boat's displays rather than wholesale control room reconfiguration. TANG participants would be provided with a better selection of prototyping tools and aides for demonstrating what the equipment was and how it should behave to the SMEs. The design team also decided that the structure of the control room mock-up could be used as a stage for the groups of TANG participants to perform skits in support of their prototype's functionality.²³⁵ Finally, the dry run allowed the design facilitators and SMEs to refine the questions used to guide the design process for TANG.²³⁶

The dry run was deemed a success. It had served as an excellent low-cost experiment in which the APL and IDEO coordinators of TANG were able to test most of their design session ideas, the agenda, the way in which the spatial constraints were displayed and the manner of involvement of interested observers.²³⁷ A further benefit

²³³ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012), and Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²³⁴ Dan Soltzberg, interview by Thomas Hall. *TANG Thesis Research Interview* (November 4, 2012).

²³⁵ IDEO, "TANG Weekly Report: Week of 17 Oct 2011." Planning and Progress Report, 2011.

²³⁶ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²³⁷ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012), and Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

was brought about by the similar training and experience levels of the dry run participants to the proposed participants for TANG.

Another significant benefit of the dry run came from the brainstorming output. Because the participants in the dry run were similar to the participants for TANG, the IDEO/APL team gained a subjective understanding of how the team would respond to synthesis, brainstorming, and prototyping activities. This allowed the team to tune the workshop materials for TANG.

Possibly the biggest benefit was that once again, the majority of those who might have otherwise been resistors were persuaded by what they saw that the design thinking process could work for their community. This is effectively shown by their desire to participate in the actual TANG event in November.²³⁸ As mentioned previously, even a naturally creative person like Ray Rowland, who was described by Don Noyes as “He does a lot of stuff really out of the box, some very crazy display concepts. They called him the mad scientist,” had concerns about the IDEO process²³⁹. Don ultimately convinced him through his conduct of the dry run session. Don had served as the facilitator during the dry run; Don simply stuck to IDEO’s brainstorming rules and insisted that the participants did too.²⁴⁰ These recent converts to the design thinking cause were given IDEO’s version of a command coin. The brass coins read, “Brainstorm Qualified.”²⁴¹

Even after conversion some of the new supporters required further proof. They wanted to know WHY it worked. “It works, we grant you that...explain to me why.”²⁴² The IDEO team had never had anyone ask that question before, so they returned to their

²³⁸ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012), and Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

²³⁹ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

²⁴⁰ Ray Rowland, interview by Thomas Hall. *TANG Thesis Research Interview* (August 24, 2012).

²⁴¹ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²⁴² David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012). The interviewees attributed the quote to an anonymous source.

offices and compiled academic research that showed why it worked.²⁴³ Thus prepared, they not only gave it to those who had asked, they kept it on hand to provide to those who were certain to ask for it during TANG.²⁴⁴

In a post-dry run conversation, one of the facilitators stated that the one day, eight-person event “exceeded my expectations.” The individual also felt that despite the fact that the eight people had come into the event without any previous introduction to design thinking or what they would be doing that day, they had come up with a wealth of ideas, and that he was confident that there would be “no shortage of ideas for TANG itself.”²⁴⁵ From IDEO’s perspective, “Ideas are endless; there is no scarcity.” They also saw little difference in the way they needed to engage the nuclear navy as compared to other large scale, hierarchical organizations. While they felt it was a more technical realm with very smart group of clients, their design thinking approach is more concerned with achieving an understanding of the humans involved in the process. The one difference that stood out for the IDEO team was clean up at the end of the day. Corporate clients “are usually checking their watch by five o’clock,” but the sailors and officers “cleaned up in two-point-five minutes and were ready to go.”²⁴⁶

Selecting Participants

In the background throughout this period, Commodore Merz and the DEVRON 12 staff were working to select the right participants from the fleet for the forum. The Commodore and the APL staff had agreed that the DEVRON should select their own participants. Their goal was to develop a good cross section of the submarine community for the event. The result:

Another little funny side story, we sent out the request to get junior officers. One squadron came back and said, “All my junior officers are too

²⁴³ Ibid. The key piece of evidence was: Anita Williams Wooley, et al., “Evidence for a Collective Intelligence Factor in the Performance of Human Groups,” *Science* 330 no. 6004 (October 2010).

²⁴⁴ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012),

²⁴⁵ Scott Tupper, interview by Thomas Hall. (September 10, 2012).

²⁴⁶ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012),

busy, but I can give you my department heads.” I am like; “That doesn’t make any sense. Why would your department heads have more free time than your junior officers? We don’t want anybody. Thank you very much.” But that is the culture. Don’t send the JOs. Next. So the good cross-section from across the fleet... We did have two Petty Officers 3rd Class nominated. For a commodore of a squadron, a captain to think that his Petty Officer 3rd Class is the most creative and dynamic and innovative guy in the squadron, that is a big deal. So when the names came in and DEVRON picked them, he is like; “We have got an FT 3.” I am like, “He has to come. I have to see who this guy is.” Who was he? He was the guy with the hat on in the video, the guy with the glasses from Super Bad. So all walks of life with that one. So we had two FT 3s and I started asking myself, “When is it anytime that a 3rd Class gets heard on anything to change the future? Ever?”

One SME, summed it up, “I don’t want someone who hasn’t been to sea, because then you don’t understand what the physical problem is out there. But, I did want young kids, because you can look at my daughter with an iPhone. Those came out just a few years ago, it seems, and it’s amazing what she can do with it, how quick she can figure it out. So, I wanted the young kids... And, it’s also possible that I felt like when I was a lieutenant, back in APB ‘98, I had lots of ideas, and there was no way to gain traction.”²⁴⁷

One of the ‘young kids’ at TANG was a young Petty Officer Second Class from the *USS Virginia*. The Petty Officer had been told by his commanding officer that he was selected for the forum specifically because he “questions everything.” The Petty Officer said he experienced immediate jealousy onboard the boat over a week in sunny San Diego. He also said that the jealousy was even greater when he, upon his return, described to his shipmates what he had been doing there and “how much fun I had.”²⁴⁸

The Run Up to TANG

During the four weeks between the dry run and TANG’s opening remarks, the TANG team, including APL, DEVRON, IDEO and the SMEs, worked to refine their requirements for a successful TANG, their insights to focus the TANG brainstorming

²⁴⁷ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

²⁴⁸ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

sessions and the overall agenda. The IDEO design team uncovered nine insights into the submarine force's needs based on their ethnographic research. These nine insights were then grouped into three "clusters." For instance, the second cluster was, "Building Shared Understanding," and within that cluster the first insight was, "The majority of incidents stem from a breakdown in shared mental model." Each insight has one quote that highlights the relevance of the insight. In this case, the quote, from a Sonar Technician, was, "All the info's in there, but we're not doing a good job of getting it out there onto the surfaces."²⁴⁹ Based on the insights report, Dan Soltzberg, a designer from the IDEO team, was told, "You guys came in, and in two weeks articulated what we've been trying to articulate for a decade."²⁵⁰

Josh Smith and Don Noyes, used this interim period for most of the logistics of getting officers and enlisted to San Diego and coordinating the rooms and busses. Given the level of effort required to make TANG happen, most of those interviewed referred to this as Josh and Don's project. Scott Tupper said, "Josh was the ringleader on this."²⁵¹

A week prior to the start of TANG, on 1 November 2011, Commodore Merz sent an e-mail to the selected participants for TANG. The e-mail started with, "Hello TANG participants!" The Commodore then congratulated them for being selected to participate in the inaugural TANG forum, stated that he was looking forward to speaking with them, his motivations for supporting TANG, and then explained what the participants could expect the following week in San Diego. The e-mail told the participants that they would receive a technology demonstration by Microsoft and other industry leaders to help define the "art of the possible." Finally, the Commodore concluded with four thoughts for the selected participants,

- Next week will be unlike any military event you've been through before.
- Next week there are no wrong answers.

²⁴⁹ IDEO, "TANG Weekly Report: Week of 17 Oct 2011." Planning and Progress Report, 2011, and IDEO. *TANG Workshop Insights Memo*. Palo Alto, 2011.

²⁵⁰ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²⁵¹ Scott Tupper, interview by Thomas Hall. (September 10, 2012).

- Next week there are no uniforms.
- Next week is about new ideas.

No clearer message that they were in for something different could have been sent to the participants prior to their arrival.²⁵²

On 6 November 2011, Dan and Peter from IDEO drove into San Diego from Palo Alto carrying IDEO's toolkit for the event. The toolkit included everything that the facilitators and SMEs would need during the three-day forum. On Monday, as David Haygood and Dave Blakely arrived, the IDEO team worked to assemble the PVC pipe control room mock-up, rearranged the furniture of the Submarine Learning Center Detachment, San Diego, and distributed the ever-present Post-It notes. Afterward, they met up with the TANG SMEs and participants that evening for a round of introductions and a social hour.

Much thought had been given to the design of the conduct of the forum, too. San Diego's Gaslamp Quarter had been chosen for quartering to give the forum a sense of occasion and to charge the minds of the participants to expect big things from the trip. Since they were staying in the Gaslamp, no rental cars were provided. The thinking was that, "There is plenty of entertainment right there. It reduces the potential for DUIs to zero, and the lack of rental costs covers the difference in hotels and the cost of the busses."²⁵³

At the airport, there were "Welcome" signs pointing to the TANG bus pick-up where the busses were waiting to take the participants to their hotel. The Hilton. TANG was designed to be an experience. That is what IDEO's version of design is about. According to Josh, every time a sailor was dropped off at the hotel, he heard,

"Are you kidding me?' I am like, 'The BOQ (Bachelor Officer Quarters) was packed, so we couldn't put you in there.' Although some people—this gets to the dynamics, the people when we were trying to set this thing up were like, "Just put them out in the BOQ down by 32nd Street, on down

²⁵² CAPT William R. Merz, USN, *Welcome to TANG!* November 1, 2011.

²⁵³ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

there with the local guys.” What is the experience they are going to have of the whole forum? They are part of the team from the minute they get off the plane. They matter. One of the comments was when we were dropping them off on the way out they said, “You guys are awesome. You thought of everything.”²⁵⁴

The participants were told not to pack a uniform. They would be in civilian clothes for the duration in order to “break out of the sub culture.” This was done to remove the barriers to the effective flow of communication that the rank structure of most any military unit would otherwise impose.

If you are a fast attack guy, think Hunt for Red October, the USS Dallas, they do the cool missions off the coast or whatever, blah, blah, blah. Then there is a boomer guy. So it is like Crimson Tide, where they go and they hide and they don’t want to talk to anybody. Their mission is important, but there are a lot of dynamics if you are a fast attack guy and a boomer guy. So we didn’t want that to happen. So with the civilian clothes you don’t look at how many ribbons you have and whatever, so no judgment there. Makes the enlisted guys and the officers collaborate more because they are all just in civilian clothes. And, it’s comfortable. Some guy with a hat, best dressed, hands down, guy with the funky hat.

This was all done outside of the Defense Travel System (DTS) to reduce the burden to the participant. The junior sailor or officer was only responsible for arriving in San Diego.²⁵⁵

That evening at the introductions, the participants were given patches corresponding to World War II submarines and divided into teams according to which boat they wore the patch of. Each participant was also given a TANG “command coin” similar to what a commanding officer presents a sailor with at the end of a tour aboard a naval vessel. These coins were highly coveted by the recipients, with numerous senior officers requesting them as well. What most didn’t know is that the Navy and APL supply systems would not approve the purchase of command coins for the forum. Josh Smith paid for the coins out of his own pocket with no reimbursement. This was all done

²⁵⁴ Ibid.

²⁵⁵ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

in the name of creating the appropriate experience for the TANG participants, and the story is this:²⁵⁶

Now the funny thing about the coin was Commodore Merz, he saw the coin because his right hand man is like, (Commodore:) “So, I should have brought something for these guys.” (Executive Assistant:) “You mean like this coin?” (Commodore:)”He’s like where did this come from?” (Executive Assistant:) “Josh bought them.” He (the Commodore) goes, calls back east, has his chief of staff overnight all of his coins from his command and the next day he goes and hands them out... awesome. So people get it. You just have got to inspire them and say “Yes this is important.” Spend the money out of my own pocket. People chipped in to help cover it, which is fine, and even if they didn’t it would be fine. Because when I hand that coin to that petty officer, he is like, “This is awesome.” Now everyone wants a coin and I am out of coins, but you know it matters. They matter, and that is the big thing. And they even said that they actually have a voice and that they matter.

L. THE TANG FORUM

On the morning of 7 November 2011, TANG kicked off with a Video Teleconference message from VADM Richardson to the TANG participants to urge them to take part in the brainstorming to come as a way to facilitate the submarine force’s fast following of industry technology.²⁵⁷ Commodore Merz provided guidance as well. He instructed the JOs and sailors not to look at the mundane aspects like reliability. Instead, he directed that they think big.²⁵⁸

The Tech Expo was held by industry leading corporations such as Microsoft and by current APB developers such as METRON and InDepth Engineering on current and emerging technologies. A warm-up exercise was held to get the participants thinking about these tools and what they knew from their own experience that might be useful in the control room. Each of the three groups was given a board and told, “Tell us what technologies you are aware of for interactions and things like that. So they started talking

²⁵⁶ Ibid. Material in parentheses added for clarity.

²⁵⁷ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²⁵⁸ Ray Rowland, interview by Thomas Hall. *TANG Thesis Research Interview* (August 24, 2012).

about pico projectors and of course iPads and iPhones and Kinect and all that stuff was brought up by each room.”²⁵⁹ Based on these thoughts, the groups were then asked HOW these technologies might be incorporated into the control room. That’s when they were given a set of seven rules by the IDEO design team.

- Defer Judgment
- Encourage Wild Ideas
- Build on the Ideas of Others
- Stay Focused on Topic
- One Conversation at a Time
- Be Visual
- Go for Quantity

These are IDEO’s seven rules for brainstorming, and each person present, SMEs and participants alike, was given a copy of the rules on a wallet-sized card. These rules are painted on the walls of every office space in IDEO’s headquarters in Palo Alto, CA, but these are not to be confused with rules for life in general. When asked, Dan Soltzberg stated that “Every design session requires judgment be applied at the right points... and eventually the quantity needs to be controlled.”²⁶⁰ These then are the rules only for the brainstorming portion of a design session.

The purpose of brainstorming is to develop a divergence of ideas to generate possibilities. Dan likened the “different mental construct required during divergence” to a “sci-fi film...you have to suspend disbelief for a while.” The first two rules create a fertile breeding ground for the session’s participants. The third rule uses the traditional improvisational (improv) “Yes, and...” rule. Nothing kills brainstorming like the word no. That comes later. In this stage, say “yes” to what a previous person said, “and...” build upon the idea to fashion a newer better idea. Ideas are put forth by sketching them onto Post-it notes, supported by a quick, one to two line verbal description and placed

²⁵⁹ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²⁶⁰ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

onto the board. Regardless of the merit, someone should then be able to work with that sketch to produce his or her own sketch, and the cycle continues in the improv manner.²⁶¹

These rules had an impact upon the SMEs and participants. Months later, individuals we interviewed either had their IDEO issued brainstorming card in their wallet or said it was tacked to a wall in their office for ready reference. The APL personnel in particular said that they now used this process as part of every business meeting.²⁶²

Given the heavy reliance on Post-it notes, it is not surprising that IDEO instructed facilitators and participants on a particular manner for removing a note from a stack. If a note is peeled from a corner, the result is a note with a curled corner that is less likely to stick. Instead, it was recommended that a Post-it be removed from its stack by pulling down from the center of the bottom of the note.²⁶³ Each person then gets an opportunity to promote his or her idea to the crowd.²⁶⁴

Another lesson directed the participants as to how the Post-its were to be used. Every time a new group attempts to brainstorming, IDEO conducts training on how to use a Post-it. As described by Dan, there are three ways to use a Post-it. “This is good. This is better. This one is the best. And the good one has an idea on it. The better one has an idea written really big in Sharpie, and the best one has the name of the idea and a sketch.”²⁶⁵ Partially this is to make the Post-it easier to read from across the room, but

²⁶¹ Ibid, and Smith, Joshua D, interview by Thomas Hall. *TANG Thesis Research Interview* (September 13, 2012).

²⁶² Joshua D. Smith, interview by Thomas Hall. *TANG Thesis Research Interview* (September 13, 2012).

²⁶³ "IDEO Design Thinking Simulation at Naval Postgraduate School." Monterey, CA, April 27, 2012. This was demonstrated in a sidebar conversation with an anonymous participant during the simulation.

²⁶⁴ Joshua D. Smith, interview by Thomas Hall. *TANG Thesis Research Interview* (September 13, 2012).

²⁶⁵ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

the sketch also enables other participants to “really quickly ‘grok’” what the creator intended.²⁶⁶

The participants were described as “initially quiet and reserved.” They may have started slow, but by the end of the three days, they would “want to keep going,” and “Every idea lead to five more ideas in their heads.” It was “the first time they felt like they had control over the future of their systems.”²⁶⁷

The field of ideas is then grouped logically, possibly along functional lines, and then the groups are subdivided again along similar lines. From this divergent set of ideas, the group then works toward convergence. The best ideas were selected by the participants from the broad field of ideas generated during brainstorming. This was accomplished through voting. Each participant was given a set number of adhesive voting dots with which to choose from the field of candidate ideas. The handful of ideas with the most voting dots on them were then the starting point for another round of brainstorming to refine those ideas. According to Dave Blakely, IDEO’s Director of Technology Strategy, “The Navy guys were hilariously good at brainstorming.”²⁶⁸

At the conclusion of this brainstorming session, the process was repeated until a couple of ideas had been selected for prototyping as an advancement of the original sketch. The prototypes were made of inexpensive items such as dry erase markers, foam core boards, cardboard boxes, tape and hot glue as shown in Figure 3. As the prototype was made refinements were added, unnecessary parts discarded. Finally, from among the prototypes the most viable were chosen to go forward into experimentation.

²⁶⁶ Ibid, “Grok” is from Robert A. Heinlein’s, “Stranger in a Strange Land,” and is defined in the book as follows: “‘Grok’ means to understand so thoroughly that the observer becomes a part of the observed-to-merge, blend, intermarry, lose identity in group experience.”

²⁶⁷ Scott Tupper, interview by Thomas Hall. (September 10, 2012).

²⁶⁸ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).



Figure 3 Participants working on TANG prototypes.

During this first day, senior leadership was watching from the plenary room that had been tested during the dry run. Based on the number of leaders asking, “Why don’t I get to do this?” during the dry run and the changes made to include the observers in the process, IDEO’s David Haygood sat in on the plenary room sessions and, along with Josh Smith, lead the observers through the full brainstorming and prototyping process.²⁶⁹ This senior session was briefing, brainstorming, selecting and prototyping to develop a tool, plan or business process for implementing the ideas brought forth by the junior personnel at TANG.²⁷⁰

The day ended, as would the next two, with skit based demonstrations of prototypes to the TANG Forum meeting as a whole.²⁷¹ At the end of the first day, most of the SMEs and facilitators felt that the ideas has been too systems and reliability centric. According to attendees, Commodore Merz addressed the gathering, and told them

²⁶⁹ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012), and Joshua D. Smith, and Donald Noyes. *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

²⁷⁰ Ibid.

²⁷¹ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

not to look at reliability, but to instead think big.²⁷² By this he was understood to mean that he was looking for new innovations to help with tactical situational awareness aboard the boats, and not interested in the engineering of the systems that would come later in the development process.

The participants were bussed back to their hotel in the Gaslamp Quarter of San Diego. That evening, three junior sailors were eating pizzas when inspiration struck. While looking at the pizza and puzzling over a group of control room displays for fire control and sonar data that did not work together to provide track information in one location, the idea for a sliding wedge of information to be displayed came to him. Over the course of the next several hours, the IDEO process was used on numerous cocktail napkins and a pizza box with a SME, Ray Rowland, who had joined them at the table. By the end of the night, it had been given a name. It was called Predator due to the similarity its appearance shared with the wrist display the alien wore in the 1987 Arnold Schwarzenegger action film of the same name.

The next morning, the idea was presented to the group as a whole as shown in Figure 4. Word filtered back to VADM Richardson, who was so impressed with the idea that he requested a working prototype of the display.²⁷³ Ray called back to his software prototype in Groton, CT, to get him working on the project.²⁷⁴

²⁷² Ray Rowland, interview by Thomas Hall. *TANG Thesis Research Interview* (August 24, 2012).

²⁷³ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

²⁷⁴ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.



Figure 4 TANG participants working on Predator sketch.

TANG continued that Wednesday with a schedule change. APL and IDEO arrived at the change based on a quick brainstorming session the evening prior. The change meant that the three groups, which had been divided up with JOs in one group, Sonar Technicians in another and Fire Control Technicians in the third, would remain that way until Thursday now.²⁷⁵ It was felt that the teams were making such good progress that it was best not to disturb the momentum.

In the end, the facilitators did not need to seed the groups with ready-made topics for brainstorming. An incredible amount of ideas were created at every brainstorming session.

M. TANG OUTPUTS

By the end of the final day of TANG, four ideas had grabbed attention. The first was the Predator display that drastically reduced the time and mental effort required to achieve a 90 percent solution on a new track. The second was a 360-degree continuous multi-touch display representation of the periscope's image that numerous people liked, but was finally determined to not work within the size constraints of the submarine. Third

²⁷⁵ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

was an idea to use Microsoft X-Box controllers to operate the submarine's periscope instead of the more costly and complex system currently in use. This new system is being incorporated into the process for APB approval and makes use of the millennial generation's experience with game system controllers to reduce training time for the periscope system.

The fourth idea was Adaptive and Embedded Training, and it appears to be headed for the fleet as well. According to some participants, roughly 80 percent of the displays in the control room are required to be on a particular screen at any given time. The idea that came from TANG was to use the other screens for training while on watch. The training, of whichever sort was required by the particular sailor, would be based on prior mission recordings, and the training completed would be recorded as a score in the same way that a video game will save a score when you exit. That score would then degrade over time as currency or proficiency was lost, and the score could travel with the sailor from one command to another. This is a revolutionary idea to speed up the training process through the use of time and systems that would otherwise be claimed, but possibly underutilized.

TANG concluded with skits performed by the JOs and sailors using the PVC pipe control room as their stage. One demonstration was of a tablet-based messaging system. To represent the messages being 'flicked' from one screen to another, a sailor would snap a Post-it out of his hand, and another sailor across the control room would reveal one he had palmed at the same time. The IDEO team loved that touch.²⁷⁶

²⁷⁶ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

These skits were useful to demonstrate the watch team integration role of the new ideas. Josh's description of watching the skits was, "They would act it out and say this is how I want to do this. So it is in a physical space, you can build off of the idea and we can all visualize what they are trying to do." Figure 5 shows this spatial mock up.



Figure 5 Skit in PVC control room with watch team lead 'flicking' information to watch stander.

VADM Richardson received the software-based prototype that he had requested on Friday. The prototype development was a quick course in component reuse. The quick development was made possible in the main by the fact that most of the software required already existed due to Ray's efforts to engage the current systems aboard the boats.²⁷⁷ The only real coding required was for Ray's very talented developer to take a previously linear graph and now wrap it around a central point.

²⁷⁷ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

Ray Rowland had been creating these tools for years, but he and his supporters could find no traction for them. Ray's computer has been described as "the logical equivalent of the warehouse at the end of Indiana Jones and the Raiders of the Lost Arc."²⁷⁸ Unfortunately, they were ideas with no stakeholders. Now, the submarine community itself had created the demand signal for these tools. Ray rapidly transformed the prototype into one capable of running real system data, and within 12 weeks, Predator had been prototyped to the level required for testing for inclusion in APB 13.²⁷⁹

The senior officers, managers and engineers from the plenary room design session also presented a deliverable on the final day. It was a mobile innovation lab, and they put just as much energy into their pitch as the JOs and sailors. It was delivered to the accompaniment of a rap. The product was a "Pimp My Submarine" truck with tools for design thinking for the fleet.

N. POST-TANG RESULTS

David Haygood had one post-TANG concern based on his years of experience with bringing design thinking to large organizations. He used the British term "Mind the Gap." This term came into British usage in the 1960s and referred to the gap between the London Underground train and the platform for waiting passengers. To IDEO, it refers to the point at which their contract ends and an organization assumes responsibility for maintaining the momentum. If the change hasn't been given enough time and management, it is all too easy for the organization to backslide into their old ways and processes. "Without a persistent voice, something might die on the vine."²⁸⁰ There is hope in this case. David feels that "Josh has now created a large pool of champions for

²⁷⁸ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²⁷⁹ Ibid.

²⁸⁰ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

design thinking within the org, but need to connect and maintain the connection between the top and the bottom of the org.”²⁸¹

Ray Rowland also personally supports this feeling. “Shortly after TANG I thought to myself, ‘At some point this has to stop, right? At some point I have to go back to work. But then I realized it was engrained in our processes and it works.’”²⁸²

Josh and Don maintain contact with as many TANG participants and facilitators as possible. They try to monitor the use of design thinking going forward from TANG, and in return keep the participants apprised of how Predator and Embedded Training are progressing in the APB / TI world.²⁸³ Josh and Don are also working on plans to conduct TANG with JOs and junior enlisted every two years.²⁸⁴

TANG outputs were also included in a follow on program to TANG developed by Josh and Don. This new event was called, Concept User Experience Events. During a Concept User Experience Event, one of the concepts being tested by Lockheed was a web browser supported version of the X-Box controller operated periscope concept from TANG.²⁸⁵ Young sailors with no knowledge of TANG or the concept and prototype were given a chance to use the system.

They gave them no training what so ever. ‘Just sit in front of it. You know what a periscope does right? Because you’re a submarine guy. Start playing with it.’ So, they started playing with it and clicking. They gave them fifteen minutes, I think. Then after the fifteen minutes, they started asking them questions like, ‘I want you to do this?’ or, ‘I want you to tell me how many contacts there are,’ or, ‘What are they doing?’ interacting with it... But what was neat was that through this process...something like 70 percent of the operations they did with no training what-so-ever. Afterward, they gave them, no-kidding, ten minutes or less of training to

²⁸¹ David Haygood, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).

²⁸² Ray Rowland, interview by Thomas Hall. *TANG Thesis Research Interview* (August 24, 2012).

²⁸³ Ibid.

²⁸⁴ Joshua D. Smith and Donald Noyes, *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).

²⁸⁵ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

make sure that they could get up to 100 percent, and every one of them, five sailors over five days, got 100 percent on the test after the training. This is rewarding, and the fun thing is that these things are all defined, and we haven't paid one coder one dime to start developing the system yet. When you read the systems engineering and program management books, they all say it's 10 times the savings if you identify the requirements up front vice later. So... we should save 10-X because I already know what the display should look like. We've already received the feedback of little tweaks to make it that much better. So when we no-kidding build the display, which will start here in the next month, five months from now when we test it with sailors and the real system connected I'm feeling pretty good about how it will be received.²⁸⁶

Several months after TANG, in February of 2012, Microsoft flew several APL and APB personnel out to Redmond, WA, for a follow up meeting to discuss TANG's results at no cost to APL or the U.S. government. In May of 2012, Microsoft, Adobe, Google, Metron, InDepth, Sedna and the Naval Undersea Warfare Center (NUWC) participated in the Submarine Technology Symposium.²⁸⁷ The symposium is an annual event that brings together the submarine community with industry to broker discussion of technology issues within the fleet.²⁸⁸ This represents the first time ever that the symposium had commercial industry representation. Adobe, Cisco, Corning, Google and Microsoft are all now part of the TANG Tech Team. The APL team maintains its close ties with the industry leading technology companies that supported TANG.

The TANG participants have done their part to carry design thinking into the fleet. While underway, a cable onboard a submarine snapped when a sailor bumped into it. The normal response tends to be that a Chief tells someone in his shop how it should be done. In this case a TANG participant, a Petty Officer, gathered together his division-mates and walked them through the design process. He started off by giving them a brief with a constraint: "Reconnect the cable with a guard to protect it." They brainstormed to diverge into a bigger decision space. He ran them through the selection process. He gave

²⁸⁶ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

²⁸⁷ Joshua D. Smith and Donald Noyes, *Email with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

²⁸⁸ The Johns Hopkins University Applied Physics Lab, *Sub Tech Symposium*. <http://www.jhuapl.edu/sts/> (accessed September 8, 2012).

them Velcro, Plexiglas and lock wire to prototype their fix. Finally, the repair was put in place. The Petty Officer said he heard several sailors saying, “This is actually kind of fun,” about brainstorming and prototyping. Ray Rowland described it like this, “The magic is in the prototype. It’s the kindergarten thing. Working and thinking with the hands.” At the time of this writing, the submarine community was planning to implement the guard created by the Petty Officer’s division-mates across the fleet.²⁸⁹

Admiral Richardson has since transferred to take command of Naval Reactors. This is an excellent position from which to guard over this fledgling movement for which he created the environment necessary to thrive.

²⁸⁹ Anonymous, interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).

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IV. ANALYSIS

A. INTRODUCTION

In this chapter the TANG case study will be analyzed with regard to its relationship to the fields of change management and design thinking in order to determine how they enable organizational change. This in turn will allow for conclusions regarding the organizational dynamics and cultural factors impacting the adoption of design thinking techniques within the DoD.

Additional analysis will be presented beyond that answering the initial research questions. The additional analysis is aimed at exploring the relationship between the two fields in an effort to establish how they might best be utilized to support one another. For use as comparison cases two HBS cases will be referenced: “Charlotte Beers at Ogilvy & Mather Worldwide (A)” and “First National City Bank Operating Group (A).”²⁹⁰ These cases will be used along with the TANG case to highlight the differing uses of change management and design thinking on organizational change.

B. DISCUSSION

1. Change Management

The TANG case presents an excellent opportunity to create discussion of change management. The aspects of creating and managing change can be discussed from the perspective of Gleicher’s change formula as modified by Dannemiller and Jacobs, and most of Professor Kotter’s work on change including the eight stages of change, and some of his eight reasons for resistance to change.

a. The Change Management Formula

With the previously discussed change formula being applied to the TANG case, the values of dissatisfaction with the status quo, vision of the future, and resistance

²⁹⁰ Nicole Steckler, "Charlotte Beers at Ogilvy and Mather Worldwide (A)." *Managing Change*. Harvard Business School, 1995. 141-159, and John A. Seeger, Jay W. Lorsch and Cyrus F. Gibson. "First National City Bank Operating Group (A)." Boston: Harvard Business School, 1974.

to change vary over the course of the case. The value for first steps taken is fixed on the other hand.

The dissatisfaction value differs depending on the perspective it is approached from. VADM Richardson, Don Noyes and Josh Smith had each experienced dissatisfaction with the current state of technology in the submarine community. Over time, the admiral, Josh and Don were able to convince numerous individuals of the possibility of improvement through a different change effort, and thus the portion of the value for dissatisfaction produced by this group may be viewed as increasing over time.

On the other hand, the crews and commanders of fleet submarines had been dissatisfied with the speed and difficulties involved in previous attempts to implement change efforts and could therefore be said to desire the maintenance of the status quo. This group has not seen, in the main, the TANG outputs that are being incorporated into future APBs with the exception of those who participated in the event itself. Their effect on the overall dissatisfaction with current systems across the fleet is unknown at this point. The portion of the dissatisfaction value will then be assumed to have remained constant. With these two portions comprising the whole of the dissatisfaction, the net change is an increase in the organization's dissatisfaction with the current tactical systems.

The vision for the future was initially laid down by Josh and Don in the white paper circulated within APL. When VADM Richardson stated a desire to improve the use of the knowledge, experience and capabilities that sailors develop prior to their entry into the submarine fleet, this provided the ability for Josh and Don's vision to move forward and become the guide for the development community with respect to the use of junior personnel in technological change. With the support of the admiral, Commodore Merz and decision makers within APL the strength of the vision was communicated to all those impacted. The value therefore is viewed by this researcher as steadily increasing over time with the increase in the number of advocates for the vision.

During the course of TANG, the first steps may be considered the events leading up to TANG and the forum itself. Several aspects of those events contributed to

the relative value contributed by the first steps toward change. Given the amount of thought that went into the selection of participants, the number of people that came to believe in the design thinking approach and the use of junior personnel in the forum, the positive outcomes of meetings with industry and the usable and relevant nature of the outputs of TANG that are currently being implemented into future APBs the results of these first steps are viewed as highly successful and of solid value.

The individuals resistant to change during the events leading up to the TANG Forum were largely converted into supporters by the process itself. A few interviewees maintained some degree of concern about the impact upon the safety of the boat created by the implementations of the new systems. For the most part, their perspective was to reserve judgment until it was known how the TANG output systems performed during testing. Fleet personnel aboard the boats are largely unaware of the systems and their feelings on the matter will likely remain unknown until nearer to the implementation of the ideas as part of an APB. Overall, the relative value of the resistance to change decreased over time.

The end result of evaluating TANG against the equation over time was a building momentum for the forum. Of course the relative values involved in this equation are constantly in flux. If the focus is removed from the vision or if the fleet never eventually sees the first step successes, then the forces for change may be overcome by the amount of resistance, which never completely goes to zero. Even in this simplistic analysis, it is apparent that a change effort needs continuous effort to steward the implementation toward the goal.

b. Kotter's Eight-Stage Change Process

Kotter's first stage is establishing a sense of urgency, and this correlates well with the change formula's creating a sense of dissatisfaction with the status quo. It also includes an aspect of momentum though. TANG does an excellent job of highlighting both the previously mentioned dissatisfaction, and the sense of urgency and momentum. The submarine community had experienced dissatisfaction with the rate of

previous change, but not in a manner that necessarily aided the adoption of this case's new methods for defining the direction of future systems. At every opportunity to press the change forward though, Josh and Don engaged with supporters and detractors in an effort to broaden the base of support and build momentum.

The second stage is the creation of a guiding coalition for the change. Josh, Commodore Merz and VADM Richardson all worked to build a coalition from their differing positions within the hierarchy. In many cases the early adopters required a bit of convincing that this change attempt was relevant to the submarine community, but with an advocacy born of participation these early adopters served as supporters to those creating the change, spread the message to those they encountered, helped to define the forum and helped to refine the vision.

Developing a vision and strategy, the third stage, took place throughout the case. Initially there was Josh's white paper, but it lacked the pull from the submarine community to move it forward. Then with the direction from VADM Richardson to leverage the knowledge of the junior sailors and JOs, the discussion was opened a larger audience. Over time, the vision changed to include design thinking and capitalizing on the research and development investments of American industry in the forum. Even the name of the event underwent an overhaul in order to better communicate the vision of the event.

As discussed in the case, numerous personnel worked to communicate the change vision to the nuclear submarine forces as suggested in Kotter's stage four. Josh's white paper again factors in at this point to communicate a change vision up the chain of command. The Admiral has gone on record on several occasions to emphasize his desire the leverage the experience technological experience of junior sailors. Everyone interviewed for this research was fully aware of the admiral's goal of maximizing the use of the millennial generation's innate abilities. While it is never possible to overstate the vision for a change, it appears that this vision has been made widely known.

The process of the design sessions at TANG was stage five: empowering employees for broad-based action. It was shown how the experience created by the

TANG team changed the perceptions of the participants from wondering how they could hope to be taken seriously to leaving with the knowledge that they had contributed to the future of their community. The support and involvement of the admiral and commodore served to highlight to the participants that they and their efforts were important to the community as a whole.

The fact that three of the four primary concept outputs of TANG are being designed and tested for inclusion in upcoming APBs stands as likely proof of short term wins, which is Kotter's sixth stage. It is still too early to determine the success or failure of TANG as an early win, but the level of interest and apparent value of the conceptual outputs can be pointed to as such for now.

Proponents of TANG cannot over emphasize these wins though, and the level of effort must be maintained in order to secure future victories. This is the focus of stage eight: consolidating gains and producing more change. There is currently an executive version of TANG scheduled for early 2013. If this event is well received and leads to more innovations for the fleet, these future wins are what allow the change to fully take root in the fabric of the organization.

Stage eight, anchoring new approaches in the culture, is another stage for which it is too early to reach a conclusion. This stage may take several years if it is ever reached. It is possible it might take longer than that for the proponents to become aware of whether the change ultimately succeeded or not.

c. Kotter's Resistance to Change

The research indicates that the sources of resistance to change include an apparent low levels of trust in the proposed change based on previous experience and the general fear of the unknown as manifested by the concern for the change's impact upon the boat's safety. There are several other reasons for resistance that appear to be excluded from possibility such as paralyzing bureaucracy based on the multi-level agreement on the change from within the hierarchy. Lack of leadership in middle management and lack of teamwork also appear to be excluded from the reasons for resistance. The remaining

three reasons, inwardly focused cultures, parochial politics and arrogant attitudes, were not expressed by anyone as having come from themselves, but there are possible undertones of them in the case. There is one underlying trend that recurred in most interviews regarding the change resistance.

The interviewees felt that there was no single person or group upon which the blame for resistance could or should be placed. This is directly in line with Senge's point in the literature review that "there is no blame."²⁹¹ All involved in the change effort, whether designer, contractor or sailor are part of the same system. Each participant in the events of and surrounding TANG felt that what they were doing was the best for the organization.

d. Implications of Change Management

As was expected in the proposal to conduct this thesis research, this case served to highlight the vast majority of points relevant to a change management case. From this perspective, capturing the details of this case at an early stage should serve to further develop the body of cases that may be referenced by future researchers and DoD IT leadership to aide in technological change implementations.

2. Design

The previous section sought to describe the relationship between TANG and change management. In this section the relationship between TANG and design thinking will be examined. The TANG case highlights the meaning of design thinking through the forum's focus upon the end user's experience to solve problems facing the boat's watch team. TANG also points to the value of the inclusion of the end users as opposed to relying upon Senge's "Grand Strategist" to create the desired results for the organization. Most importantly, this case may be used to examine all of the previously discussed primary focus points of design thinking including empathy, the design process, tolerance of failure and organizational morale.

²⁹¹ Peter M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday, 1990. Kindle page 66.

Each of the six phases of design thinking as laid out in the Bootcamp Bootleg and added to by this researcher is demonstrated in the TANG case. The first five phases, the brief, empathize, define, ideate and prototyping, are all discussed in detail in the case. This is due to the central nature of the efforts and involvement of a design company in the design of the forum and its conduct. Most obvious examples of testing the ideas generated and prototyped occur after TANG itself as part of the evaluation and implementation of the concepts into follow on APBs, but throughout the prototyping phase testing is conducted to evaluate the prototypes and to build on the successes and failures of each preceding generation.

a. Empathy

The concept of empathy is a central tenet of design thinking. TANG exhibits this idea of making an effort to relate to the reality experienced by the user through IDEO's research and the development of their insights into the issues of importance to the watch team. Even Josh's efforts to create a sense of importance for the participants can be tied back to empathy. The TANG team, through their empathy with junior officers and sailors, worked to create an experience that everyone could enjoy and take pride in.

b. Failure

The tolerance for failure discussed in design literature is shown in the TANG case in the environment of the forum. While the military and the DoD are not currently organizations with an exceptional amount of tolerance for failure, the TANG team did its utmost to create an environment within the setting of TANG, both during and after hours, where the participants felt comfortable putting forward their ideas. These ideas were put forth with the expectation that regardless of the face value of the idea, it would be built upon and expanded by subsequent participant inputs.

c. Morale

The relationship between design thinking and morale is also to be found in the TANG case. Every participant interviewed enjoyed his time working on TANG and appears to have carried that enthusiasm with them back to their regular duties. Additionally, the TANG team's efforts to impart a sense of "specialness" to the event appears to have motivated the participants to engage in and give their utmost to the design sessions. This argument can be substantiated by the potential value of TANG's outputs, the fact that participants were continuing to design after the day's official events were concluded and from the statements of participants upon arrival as compared to their statements during and after the forum.

d. Implications of Design Thinking

The TANG case provides an excellent source of material for a conversation of design thinking and its potential value to the DoD at all levels and especially as it pertains to the acquisitions of ever more complicated technological systems.

C. RESEARCH QUESTIONS

This research sought to determine which organizational dynamics and underlying cultural phenomena were involved in the introduction of design thinking to the hierarchical bureaucracy of the DoD. Several aspects of the organization came to be known as significant to the integration of the participative design thinking effort with regards to dynamics and culture.

1. Organizational Dynamics

Examining the dynamics against Gleicher's change formula, there are several aspects on both sides of the equation. The resistance side of the organizational dynamic appears to be comprised primarily of internal resistance due to three factors. The first factor is the prior bad experience fleet commanders had known with the APB process. This, in turn, was brought about by the technical difficulties in at least one build and by

the difficulties of training crews across differing versions of software and hardware in the fleet. The second factor is the probable sense of disconnect among mid level leadership due to their lack of inclusion in the initial version of TANG as primary participants. The third organizational dynamic that produced resistance was the presence of doubt as to the need for a new method of innovation and the suitability of design thinking to serve as that method. In particular this new attempt at including the junior sailors and officers was one in which they were not familiar with and had no control over. This factor, more than the previous two, represents a threat to an individual's sense of self and their personal identity.

Of the three resistance related organizational dynamics, this represents what is possibly the most dangerous threat to the success of the change effort. It is significantly easier to logically determine which members of the population might fall into the groups impacted by the first two factors. This final factor is capable of including anyone. It is also likely that if the individual is not comfortable with his or her place within the changing organization, they might be less inclined to discuss their true motivation for any actions that might run counter to the change effort.

Fortunately, there were an even greater number of factors within the organization working to push the change effort forward. First and foremost, there was support from all levels of the submarine force. Obviously VADM Richardson and Commodore Merz supported the change effort. Less obviously, APL leadership supported effort. If Josh Smith and Don Noyes had not been given the creative freedom to look outside of the organization for new solutions, the design thinking effort could not have gotten off the ground.

Importantly, this support from all levels continued and was reemphasized routinely throughout the effort to date. The change effort met with resistance as any change would have, but leadership maintained the pressure to leverage the innate abilities of junior sailors and officers. Without this, it would have been easy for resistance to point to a lack of leadership interest in the program.

Not only were sources of resistance countered with a continuous push for the change by leadership, but also they were actively engaged in the process in an effort to reduce the level of resistance offered. In most cases it appears that the engagement created advocates from those who might otherwise have remained resistant to the process. The effects may not be permanent for all, but are more positive than the results of not engaging at all.

Another aide to navigating the organizational dynamics of the DoD was the presence of an experienced and credible outsider to guide the design sessions. Based upon a history of successful design projects and experience with process design in large hierarchical organizations, leadership found itself able to place a degree of trust in IDEO. This outside assistance is what lent credibility, in the eyes of service members, to the concepts involved in design thinking such as saying yes to any idea voiced in a brainstorming session.

The final positive organizational dynamic driving the effort to utilize design thinking in the submarine force was the enthusiastic reaction of the majority of the personnel that encountered the process. This interaction of the dynamics within the DoD organization with the design thinking process created advocates that then went on to push the effort further. As seen in the case, very few of those who participated in a design thinking session did not embrace the process, and all of those who took part in TANG poured their energies into the forum.

2. Cultural Factors

Similar to the organizational dynamics, elements within the culture of the submarine community work for and against the effort to implement design thinking within the organization. On the side of those elements working to constrain the move to incorporate design thinking is the procedurally rigid indoctrination that all officers in the organization go through early in their careers. This is by no means meant to portray that as other than necessary or positive to the safety of the boat and its sailors, but this nature

would tend to argue against the incorporation of new methods of innovation that have not been tested in such unforgiving environments previously.

Another possible cultural element that was examined to determine whether or not it was working against the utilization of design thinking was the highly engineering centric nature of the organization. Engineering is not anathema to design thinking. When working on a product or on certain business processes engineering is an inherent part of the design process. In the end, there was no evidence to suggest that this engineering focus in any way reduced the effectiveness of the design thinking process or constrained its introduction to the organization. It is even likely that the level of engineering knowledge and experience of the participants enabled them to better incorporate the technologies presented to them at the art of the possible demonstrations provided by industry.

Working to facilitate the inclusion of design thinking were the highly intelligent and motivated junior sailors and officers utilized as participants in the forum. These participants have training and experience aboard the boats solving dynamically complex problems. Giving them design thinking as a tool appears to have served to further enable their abilities. Another benefit of utilizing submariners was the empathy that those who are currently working with and on the systems in the fleet have for their fellow sailors. They share the problems and concerns of the whole population and can surface those issues during the design sessions.

The fact that design thinking has so far been successfully employed within what is possibly the most engineering centric and procedurally rigid communities within the DoD bodes well for its adoption throughout the whole.

D. ADDITIONAL ANALYSIS – CHANGE MANAGEMENT VS DESIGN THINKING FOR ORGANIZATIONAL CHANGE

This case has served to capture a large percentage of the factors involved in both change management and design thinking. It has therefore also served to bring to light the one glaring difference this researcher sees between the two fields. As stated in the

literature review, the area of change management does an excellent job of providing a number of frameworks within which to look at the problems that must be overcome in order for an organization to successfully implement a change. Change management it seems exists at least one level of abstraction above any effort to realistically employ the ideas within the field.

In the First National City Bank case from Harvard, the change proponents appear to have followed the guidance from most of Kotter's stages of change. The one specific point at which this researcher feels that case's success or failure hinged was upon the talents of the singular figure of John Reed, the vice president of the group within the bank being studied in the case. Reed was single-handedly responsible for the direction of his group. He sought the advice and feedback of his guiding coalition, but the ideas were largely generated by Reed.

In the Charlotte Beers case, Beers takes her coalition to a meeting in Vienna. The invitation was via a letter to her likely supporters that laid out her plan for the meeting and what she expected from them. Once there, she engaged her group in a discussion of the issues the company was facing and asked for inputs on the organization's way forward. A few months later, the group produced a list of 22 issues that needed to be addressed. This process could be viewed as similar to the brief, research, selection of participants and ideation of the design process demonstrated by TANG.

From that point forward, the two stories, Beers and TANG, appear to part ways given the lack of obvious prototyping and testing. On the other hand, the divergence offered up in the 22 issues given to her led to the selection of, or convergence to, three key strategies. From that point forward, the rest of the case may be viewed as a continuous cycle of prototyping the implementation of the strategies, testing and gathering feedback from the organization and customers.

On one further note, the entire process Beers led focused on what value Beer's company could deliver to its customers. The Beers case, it turns out, offers another excellent example of design thinking in practical application even if that was not the

method of the day. After the experience of investigating, recording and analyzing TANG, it appears that this is the critical difference in the two cases.

Both cases are examples of exceptional managers leading successful changes, but Reed at First National was the sole source of change innovation while Beers relied on the cumulative power of a de facto design team to create her vision and strategy for success. While there is no guarantee of success from any change effort, it appears to this researcher that the Beers methodology would have a greater chance of being successfully repeated by subsequent organizations.

The key to creating that repeatability for future change managers is knowledge of both change management and design thinking. Change management provides a means to understanding the problem, but it is design thinking that provides a practical solution to harness the experience and insights of a larger group in the creation of a change management plan. This involvement in the creation in turn furthers their involvement and emotional connection to the success of the project.

The practical and readily applicable nature of design thinking can be seen in the story of the Petty Officer utilizing the design process while underway aboard his boat and the numerous participants and SMEs who continue to use design thinking in their daily work functions. Design thinking can be applied to any problem regardless of the scale. This requires some effort to ensure that the problem is viewed from the correct perspective so as to not limit the discovery or to be too broad as to diminish the focus, but it can be done. Design can be used at each stage of the more abstract change process to create practical solutions leveraging the talents of the many.

E. CONCLUSION

The events leading up to TANG and during the forum serve as excellent examples of the important teaching points of a change management case. Similarly, the elements of design thinking are also present in the case, and should be included in any effort to discuss change management as a valid, relevant and dynamic tool to create lasting change

at each of Kotter's eight stages. While change management exists at a remove of one level of abstraction, design thinking can serve as the bridge to implementation.

V. CONCLUSION AND RECOMMENDATIONS

A. INTRODUCTION

The purpose of this research effort was to record the events surrounding the TANG Forum held by the U.S. Navy's nuclear submarine community. Additionally, the material was analyzed for its fit within the fields of change management and design thinking in an effort to determine if this case brought forth any overlap or differentiation of the two fields. During the course of the research numerous potential areas for further research or possible incorporation into other areas of the DoD were observed.

Based on the readings, interviews and analysis, design thinking is an excellent fit for the DoD. Given its fractal nature, it can be used at all levels of the organization to examine dynamically and detail complex problems in order to create valid solutions based on the knowledge and experience of those most involved – the end users. This case does an excellent job of highlighting how design thinking can be best implemented and how it serves to remove the level of abstraction present in change management.

Based upon the previous review of the literature and this analysis, change management appears to indicate that change must be driven from the top of an organization. Following this model, leadership is most likely the initiator of change via an issued command and is certainly necessary to support change, especially if the change is significant. On the other hand, the design literature proposes a different model and suggested that innovation not only can be highly participative, but also needs to involve several diverse voices in order to be successful.

This case study demonstrates that these two paradigms – the paradigm of change management and the paradigm of design thinking – are not contradictory or exclusive, that in fact major change can involve both the design high-involvement process and top down driven change. More importantly, in terms of the field of organizational theory this case suggests that high-participation change can occur in the context of a highly

bureaucratic structure. Commitment to bureaucracy and the chain of command does not drive out bottom-up change processes.

B. RECOMMENDATIONS

1. Research

Four key opportunities for further research were noted over the course of this investigation. First, there was a widespread feeling of distrust within the fleet regarding new technological changes that had been brought onto the boats in the fleet. None of the concept outputs of TANG have arrived in the fleet yet, but word of the forum has likely filtered across the boats by now given the participation of VADM Richardson and Commodore Merz. It could be of value to future change efforts to analyze the relationship between the support of leadership and the positive reaction of TANG participants to the opinions of members of the fleet in both leadership and user roles. Specifically, are current members of the fleet more or less likely to embrace a change created through the design thinking process versus the more conventional methods of development?

Second, it is recommended that someone attend and develop a case study of the TANG to be held in February of 2013. This could be of benefit since the researcher would be able to capture the majority of the event live to better detail the case. It would also serve to evaluate whether the design thinking initiative now at work in the submarine community has possibly gained another small win along its path to becoming part of the fabric of the organization. A third value could be had in the comparison of the outputs of the two forums. Does one version of the forum, junior personnel or senior personnel, provide more technological intuition to the process? Does this confirm or disconfirm the notion of millennials as being more ready to adapt to new technological initiatives?

Third, if design thinking were to be implemented by a group within DoD, the individuals within the group would of necessity work to empathize with members of other sub-cultures within the DoD. To facilitate this interaction, and possibly guide the insights of the design team, it would be beneficial to conduct ethnographic research into

the many expected sub-cultures of the DoD. Without this type of research, it is too likely that the design team members would be guided by their personal biases of other cultures. It is possible that none of the sub-cultures is all that different from any other, but each sub-organization within the whole of DoD indoctrinates its members to believe themselves separate from the rest. Ethnographic research would not be objective by its nature, but it would provide an outsider's perspective on the topic.

Finally, every large-scale acquisition program and change effort should be chronicled for use by later researchers. As stated, there is little documented material on the largest IT investment in the DoD's history, NMCI. There is less recorded material on smaller initiatives. Most of the knowledge is relayed through stories from one individual to another. Given the rate of failure of IT projects within the DoD, these lessons learned need to be captured and disseminated more widely.

2. Acquisitions

In today's fiscally constrained environment, it was highly probable that there would be several recommendations regarding the acquisitions of information technology within DoD. There are five recommendations concerning acquisitions, but each of these recommendations may be viewed as having a research component as well. Each of these acquisitions related recommendations should, if implemented, be seen to have a requirement to have case study research conducted during its implementation in order to chronicle the fit of the change to the organization. This would not only serve future researchers, but current decision makers as they lead the changes.

None of the components of design thinking is in opposition to the current rules for acquisitions. The process helps to define requirements that are never fully understood, but could always be better understood. The prototyping and testing phases could also contribute to the avoidance of expensive failures at later stages. It costs more to thoroughly design a product up front, but as shown those costs are more than offset by the cost of late stage rework on a project or program.

First, efforts should be made to include design thinking in other areas of the DoD. As systems become more complex the presence and involvement of current users, as opposed to user representatives, could help define the requirements of new systems or be used to refine legacy systems. This should be done in order to establish the fit of design thinking to the DoD. It should not however be done on a single acquisitions program that may fail or succeed without regard to the contribution of design thinking. If design thinking were implemented on several programs, its value could be measured objectively in the aggregate or subjectively through interviews and case study.

Second, the DoD should seek to promote the involvement of industry leading companies in these design sessions for smaller scale items. Corporate America has proven itself to be willing to participate in the future of the DoD; their participation supports the availability of the markets they depend upon for their goods and this researcher believes that most Silicon Valley companies are currently demonstrating a desire to help the nation. Their research and development dollars could serve to improve the art of the possible for DoD. Additionally, the expected value of DoD purchases in these smaller count systems means that they have no expectation of real financial gain or reimbursement. The DoD is no longer the primary source of innovation. We need to be the fast followers of other's innovation. Therefore, there is no conflict between their participation and acquisition rules.

Third and related to the previous recommendation, this researcher has increasingly felt that design and modern methods of software engineering such as spiral and agile development have much in common with design thinking. This relationship, if any, should be explored in order to maximize the benefits of both the development methods and design thinking as the percentage of functions performed by software continues to rise dramatically and approaches 100 percent. There already exists some discussion on the relationship of the two topics, but this researcher has seen nothing to indicate its application to DoD or federal acquisition programs.

Fourth, as mentioned in the ethnographic research recommendation, the creation of a design thinking team internal to DoD could serve to guide major acquisition

programs and to possibly advise on programs that are struggling to meet requirements. This design team should be created after an investigation of the relationship between what a design team could do for acquisitions as compared to the more common Integrated Project Team approach. Additionally, a good source for initial members of the team would be those who had previously been involved in TANG either as participants or SMEs.

The final acquisitions related recommendation concerns prototyping. As a minimum, the low cost, low risk version of prototyping espoused in design thinking literature should be adopted in acquisitions programs. Contractors obviously create prototypes of components and systems that are then tested by designated test groups and user representatives. Instead, the end users should be involved in the creation of these cheap prototypes and their testing in order to avoid the increased cost of prototypes that are overinvested in that in turn leads to later stage adjustments and higher costs.

3. Education

Several opportunities to increase awareness of the benefits of design thinking became obvious during this research. The implementation of design thinking is similar to the implementation of any other organizational change. It must be worked into the fabric of the organization over time. One of the earliest and most impactful opportunities is during attendance at DoD educational institutions.

At a minimum each management curriculum offered within the DoD should have a design course introducing the concepts. To support the concepts, a design thinking simulation could be conducted similar to the one provided during a change management class at NPS by IDEO.

Similarly, most simulations aimed at preparing students for the issues they will be faced with in their future leadership roles are designed around a contentious premise. As examples, the ORGsimONE from Trigon, a German development consultancy, does an excellent job of demonstrating the internal friction and resistance to change within an

organization.²⁹² The Massachusetts Institute of Technology's Sloan School of Management created the "Beer Game" which is similar in nature.²⁹³ Both of these simulations create the tension of disparate organizations or units within an organization as they attempt to balance the optimization of the unit against the optimization of the whole. A simulation designed around design thinking, as mentioned, already exists. One with a military centric focus could serve to focus the participants in the same way that many students find a military change case study more relatable than the corporate equivalent.

Finally, it is recommended that a teaching case study of the style used in support of the case method at Harvard Business School be created from the information compiled within this case study. The educational case studies discussed in the analysis chapter of this thesis were incredible tools for gaining insight on the part of the students in change management courses. Unfortunately, few educational case studies exist with a military focus. Many students have stated that this hampered their ability to relate to the situations discussed. The creation of an educational case study based upon TANG should better allow students to internalize the lessons to be learned from the case and supporting materials for change management and design thinking.

C. CONCLUSION

This case has served to record the events of the TANG Forum for posterity and to build a basis for the comparison of change management theory and the field of design thinking. As with any change, TANG was faced with opposition and resistance. Through the application of change management and design thinking principles, the TANG team was able to, as of the writing of this thesis, apply enough pressure to overcome the opposing force of resistance to change.

²⁹² Trigon, *ORGsimONE Business Simulation Game*. 2012.
http://www.trigon.at/en/_trigonSpecials/planspiele/beratungsangebot/orgsimone.php?sub1=17&sub2=131
(accessed October 5, 2012).

²⁹³ Peter Dizikes, *The Secrets of the System*. May 2, 2012.
<http://web.mit.edu/newsoffice/2012/manufacturing-beer-game-0503.html> (accessed October 28, 2012).

The primary take away of this research is that design thinking is an acceptable and effective tool for bringing the more abstract guidance of change management into practical application for an organization. It appears that the design thinking process may be used at any level of an organization to approach any problem, but the process's full potential requires much more investigation and experimentation.

Some new approach is required to create the lasting change in the manner in which DoD acquires new technology. Given the growing percentage of IT in every investment DoD makes, and the historical failure rate of IT investments, it only makes sense that something else capable of combining the current acquisition system, component reuse and architecture be examined. These are the keys to stewardship of limited tax dollars, and design thinking ties them all together.

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APPENDIX A: D.SCHOOL BOOTCAMP BOOTLEG



Check this out – It's the d.school bootcamp bootleg.

This compilation is intended as an active toolkit to support your design thinking practice. The guide is not just to read – go out in the world and try these tools yourself. In the following pages, we outline each mode of a human-centered design process, and then describe dozens of specific methods to do design work. These process modes and methods provide a tangible toolkit which support the seven mindsets – shown on the following page – that are vital attitudes for a design thinker to hold.

The bootleg is a working document, which captures some of the teaching we impart in “design thinking bootcamp,” our foundation course. An update from the 2009 edition, we reworked many of the methods based on what we learned from teaching and added a number of new methods to the mix. The methods presented in this guide are culled from a wide range of people and organizations who have helped us build the content we use to impart design thinking. Think of this guide as a curation of the work of many individuals, who hail both from the d.school and also from other far-reaching areas of the design world. We thank all the people who have contributed to the methods collected in this guide.

This resource is free for you to use and share – and we hope you do.

We only ask that you respect the Creative Commons license (attribution, non-commercial use). The work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/>

We welcome your reactions to this guide. Please share the stories of how you use it in the field. Let us know what you find useful, and what methods you have created yourself – write to: bootleg@dschool.stanford.edu

Cheers,
The d.school



SHOW DON'T TELL

Communicate your vision in an impactful and meaningful way by creating experiences, using illustrative visuals, and telling good stories.



FOCUS ON HUMAN VALUES

Empathy for the people you are designing for and feedback from these users is fundamental to good design.

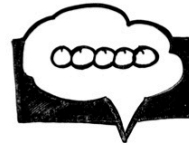
CRAFT CLARITY

Produce a coherent vision out of messy problems. Frame it in a way to inspire others and to fuel ideation.



EMBRACE EXPERIMENTATION

Prototyping is not simply a way to validate your idea; it is an integral part of your innovation process. We build to think and learn.



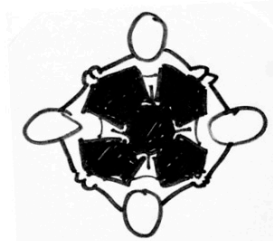
BE MINDFUL OF PROCESS

Know where you are in the design process, what methods to use in that stage, and what your goals are.



BIAS TOWARD ACTION

Design thinking is a misnomer; it is more about doing that thinking. Bias toward doing and making over thinking and meeting.

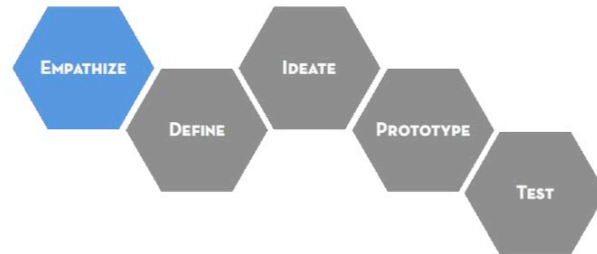


RADICAL COLLABORATION

Bring together innovators with varied backgrounds and viewpoints. Enable breakthrough insights and solutions to emerge from the diversity.

D.MINDSETS

MODE EMPATHIZE



WHAT is the empathize mode

Empathy is the foundation of a human-centered design process. To empathize, we:

- **Observe.** View users and their behavior in the context of their lives.
- **Engage.** Interact with and interview users through both scheduled and short 'intercept' encounters.
- **Immerse.** Experience what your user experiences.

WHY empathize

As a human-centered designer you need to understand the people for whom you are designing. The problems you are trying to solve are rarely your own—they are those of particular users; in order to design for your users, you must build empathy for who they are and what is important to them.

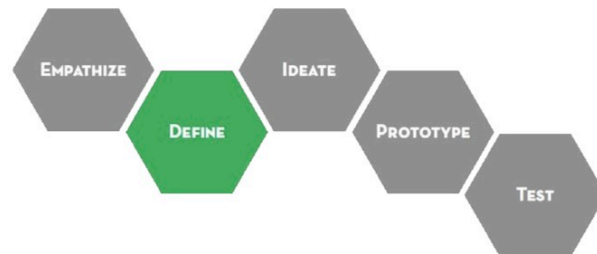
Watching what people do and how they interact with their environment gives you clues about what they think and feel. It also helps you to learn about what they need. By watching people you can capture physical manifestations of their experiences, what they do and say. This will allow you to interpret intangible meaning of those experiences in order to uncover insights. These insights will lead you to the innovative solutions. The best solutions come out of the best insights into human behavior. But learning to recognize those insights is harder than you might think. Why? Because our minds automatically filter out a lot of information in ways we aren't even aware of. We need to learn to see things "with a fresh set of eyes" – tools for empathy, along with a human-centered mindset, is what gives us those new eyes.

Engaging with people directly reveals a tremendous amount about the way they think and the values they hold. Sometimes these thoughts and values are not obvious to the people who hold them. A deep engagement can surprise both the designer and the designee by the unanticipated insights that are revealed. The stories that people tell and the things that people say they do—even if they are different from what they actually do—are strong indicators of their deeply held beliefs about the way the world is. Good designs are built on a solid understanding of these kinds of beliefs and values. Engage to:

- Uncover needs that people have which they may or may not be aware of
- Guide innovation efforts
- Identify the right users to design for
- Discover the emotions that guide behaviors

In addition to speaking with and observing your users, you need to have personal experience in the design space yourself. Find (or create if necessary) experiences to immerse yourself to better understand the situation that your users are in, and for which you are designing.

MODE DEFINE



WHAT is the define mode

The define mode is when you unpack and synthesize your empathy findings into compelling needs and insights, and scope a specific and meaningful challenge. It is a mode of “focus” rather than “flaring.” Two goals of the define mode are to develop a deep understanding of your users and the design space and, based on that understanding, to come up with an actionable problem statement: **your point of view**. Your point of view should be a guiding statement that focuses on specific users, and insights and needs that you uncovered during the empathize mode.

More than simply defining the problem to work on, your point of view is your unique design vision that you crafted based on your discoveries during your empathy work. Understanding the meaningful challenge to address and the insights that you can leverage in your design work is fundamental to creating a successful solution.

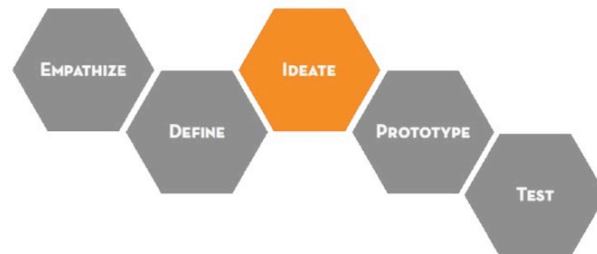
WHY define

The define mode is critical to the design process because it explicitly expresses the problem you are striving to address through your efforts. In order to be truly generative, you must first craft a specific and compelling problem statement to use as a solution-generation springboard.

As a test, a good point of view (POV) is one that:

- Provides focus and frames the problem
- Inspires your team
- Provides a reference for evaluating competing ideas
- Empowers your team to make decisions independently in parallel
- Fuels brainstorming by suggesting “how might we” statements
- Captures the hearts and minds of people you meet
- Saves you from the impossible task of developing concepts that are all things to all people
- Is something you revisit and reformulate as you learn by doing
- Guides your innovation efforts

MODE IDEATE



WHAT is the ideate mode

Ideate is the mode during your design process in which you focus on idea generation. Mentally it represents a process of “going wide” in terms of concepts and outcomes—it is a mode of “flaring” rather than “focus.” The goal of ideation is to explore a wide solution space – both a large quantity of ideas and a diversity among those ideas. From this vast depository of ideas you can build prototypes to test with users.

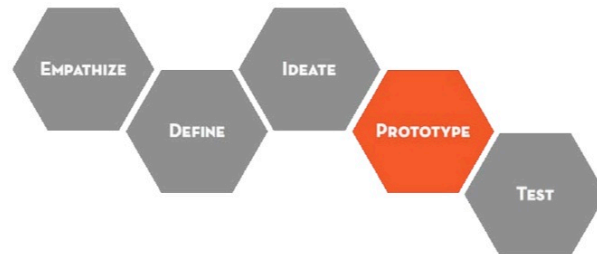
WHY ideate

You ideate in order to transition from identifying problems into exploring solutions for your users. Various forms of ideation are leveraged to:

- Step beyond obvious solutions and thus increase the innovation potential of your solution set
- Harness the collective perspectives and strengths of your teams
- Uncover unexpected areas of exploration
- Create fluency (volume) and flexibility (variety) in your innovation options
- Get obvious solutions out of your heads, and drive your team beyond them

Regardless of what ideation method you use, the fundamental principle of ideation is to be cognizant of when you and your team are generating ideas and when you are evaluating ideas – and mix the two only intentionally.

MODE PROTOTYPE



WHAT is the prototype mode

Prototyping is getting ideas and explorations out of your head and into the physical world. A prototype can be *anything* that takes a physical form – be it a wall of post-it notes, a role-playing activity, a space, an object, an interface, or even a storyboard. The resolution of your prototype should be commensurate with your progress in your project. In early explorations keep your prototypes rough and rapid to allow yourself to learn quickly and investigate a lot of different possibilities.

Prototypes are most successful when people (the design team, the user, and others) can experience and interact with them. What you learn from those interactions can help drive deeper empathy, as well as shape successful solutions.

WHY do we prototype

Traditionally prototyping is thought of as a way to test functionality. But prototyping is used for many reasons, including these (non-mutually-exclusive) categories:

- **Empathy gaining:** Prototyping is a tool to deepen your understanding of the design space and your user, even at a pre-solution phase of your project.
- **Exploration:** Build to think. Develop multiple solution options.
- **Testing:** Create prototypes (and develop the context) to test and refine solutions with users.
- **Inspiration:** Inspire others (teammates, clients, customers, investors) by showing your vision.

Many of the goals of prototyping are shared across all four of the above categories.

We prototype to:

Learn. If a picture is worth a thousand words, a prototype is worth a thousand pictures.

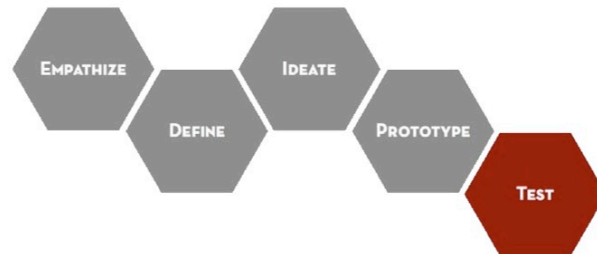
Solve disagreements. Prototyping is a powerful tool that can eliminate ambiguity, assist in ideation, and reduce miscommunication.

Start a conversation. A prototype can be a great way to have a different kind of conversation with users.

Fail quickly and cheaply. Creating quick and dirty prototypes allows you to test a number of ideas without investing a lot of time and money up front.

Manage the solution-building process. Identifying a variable to explore encourages you to break a large problem down into smaller, testable chunks.

MODE TEST



WHAT is the test mode

Testing is the chance to refine our solutions and make them better. The test mode is another iterative mode in which we place our low-resolution artifacts in the appropriate context of the user's life. Prototype as if you know you're right, but test as if you know you're wrong.

WHY test

To refine our prototypes and solutions. Testing informs the next iterations of prototypes. Sometimes this means going back to the drawing board.

To learn more about our user. Testing is another opportunity to build empathy through observation and engagement—it often yields unexpected insights.

To test and refine our POV. Sometimes testing reveals that not only did we not get the solution right, but also that we have failed to frame the problem correctly.

METHOD

ASSUME A BEGINNER'S MINDSET



WHY assume a beginner's mindset

We all carry our experiences, understanding, and expertise with us. These aspects of yourself are incredibly valuable assets to bring to the design challenge - but at the right time, and with intentionality. Your assumptions may be misconceptions and stereotypes, and can restrict the amount of real empathy you can build. Assume a beginner's mindset in order to put aside these biases, so that you can approach a design challenge afresh.

HOW to assume a beginner's mindset

Don't judge. Just observe and engage users without the influence of value judgments upon their actions, circumstances, decisions, or "issues."

Question everything. Question even (and especially) the things you think you already understand. Ask questions to learn about how the user perceives the world. Think about how a 4-year-old asks "Why?" about everything. Follow up an answer to one "why" with a second "why."

Be truly curious. Strive to assume a posture of wonder and curiosity, especially in circumstances that seem either familiar or uncomfortable.

Find patterns. Look for interesting threads and themes that emerge across interactions with users.

Listen. Really. Lose your agenda and let the scene soak into your psyche. Absorb what users say to you, and how they say it, without thinking about the next thing you're going to say.

METHOD

WHAT? | HOW? | WHY?

concrete		emotional
WHAT (what are they doing in the photo?)	HOW (how are they doing it?)	WHY (why are they doing it this way? Take a guess!)
-little girl picking root vegetables	-she's smiling, even though it looks bigger than her, it looks fun	-somehow it's been made into a game...gardening is fun...getting messy is fun to her?
		

WHY use What? | How? | Why?

During observation mode, What? | How? | Why? is a tool that can help you drive to deeper levels of observation. This simple scaffolding allows you to move from concrete observations of the happenings of a particular situation to the more abstract potential emotions and motives that are at play in the situation you're observing. This is a particularly powerful technique to leverage when analyzing photos that your team has taken into the field, both for synthesis purposes, and to direct your team to future areas of needfinding.

HOW to use What? | How? | Why?

Set-up: Divide a sheet into three sections: What?, How?, and Why?

Start with concrete observations:

What is the person you're observing doing in a particular situation or photograph? Use descriptive phrases packed with adjectives and relative descriptions.

Move to understanding:

How is the person you're observing doing what they are doing? Does it require effort? Do they appear rushed? Pained? Does the activity or situation appear to be impacting the user's state of being either positively or negatively? Again, use as many descriptive phrases as possible here.

Step out on a limb of interpretation:

Why is the person you're observing doing what they're doing, and in the particular way that they are doing it? This step usually requires that you make informed guesses regarding motivation and emotions. Step out on a limb in order to project meaning into the situation that you have been observing. This step will reveal assumptions that you should test with users, and often uncovers unexpected realizations about a particular situation.

METHOD

USER CAMERA STUDY



WHY do a user camera study

In empathy work, you want to understand your users' lives, and specific tasks within the context of their lives. A User Camera Study allows us to understand a user's experience by seeing it through their eyes. It will also allow you to understand environments to which you might not normally have access.

HOW to do a user camera study

1. Identify subjects whose perspective you are interested in learning more about.
2. Briefly explain the purpose of the study, and ask if they would be willing to take photographs of their experiences. Get permission to use images they take.
3. Provide a camera to your subject and instructions such as: "We would like to understand what a day in your life feels like. On a day of your choosing, take this camera with you everywhere you go, and take photos of experiences that are important to you." Or you could try: "Please document your [morning routine] experience with this camera." Or, "Take pictures of things that are meaningful to you in your kitchen." Frame your request a little broader than what you believe your problem space might be, in order to capture the surrounding context. Many insights can emerge from that surrounding space.
4. Afterwards, have your subject walk you through the pictures and explain the significance of what they captured. Return to a good empathetic interviewing technique to understand the deeper meaning of the visuals and experience they represent.

METHOD

INTERVIEW PREPARATION



WHY prepare for an interview

Time with users is precious, we need to make the most of it! While we always must allow room for the spontaneous, blissful serendipity of a user-guided conversation, we should never abdicate our responsibility to prepare for interviews. Especially in following up with users (after testing, etc.), it is imperative to plan your interviews. You may not get to every question you prepare, but you should come in with a plan for engagement.

HOW to prepare for an interview

Brainstorm questions

Write down all of the potential questions your team can generate. Try to build on one another's ideas in order to flesh out meaningful subject areas.

Identify and order themes

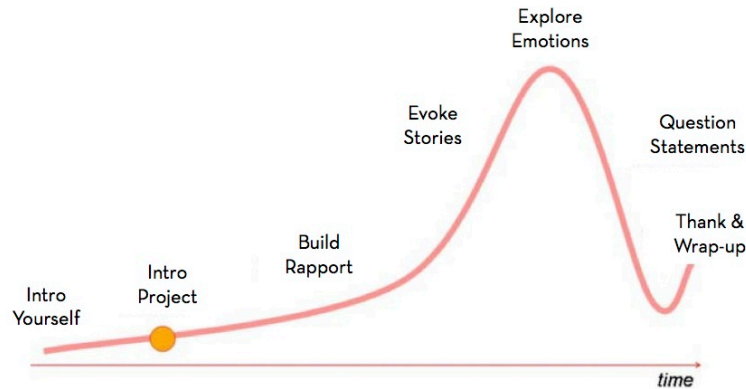
Similar to "grouping" in synthesis, have your team identify themes or subject areas into which most questions fall; once you've identified the themes of your question-pool, determine the order that would allow the conversation to flow most naturally. This will enable you to structure the flow of your interview, decreasing the potential for hosting a seemingly-scattershot interaction with your user.

Refine questions

Once you have all the questions grouped by theme and order, you may find that there are some redundant areas of conversation, or questions that seem strangely out of place. Take a few moments to make sure that you leave room in your planning to ask plenty of "why?" questions, plenty of "tell me about the last time you ___?" questions, and plenty of questions that are directed at how the user FEELS.

METHOD

INTERVIEW FOR EMPATHY



WHY interview

We want to understand a person's thoughts, emotions, and motivations, so that we can determine how to innovate for him or her. By understanding the choices that person makes and the behaviors that person engages in, we can identify their needs and design for those needs.

HOW to interview

Ask why. Even when you think you know the answer, ask people why they do or say things. The answers will sometimes surprise you. A conversation started from one question should go on as long as it needs to. **Never say "usually" when asking a question.** Instead, ask about a specific instance or occurrence, such as "tell me about the last time you ____"

Encourage stories. Whether or not the stories people tell are true, they reveal how they think about the world. Ask questions that get people telling stories.

Look for inconsistencies. Sometimes what people say and what they do are different. These inconsistencies often hide interesting insights.

Pay attention to nonverbal cues. Be aware of body language and emotions.

Don't be afraid of silence. Interviewers often feel the need to ask another question when there is a pause. If you allow for silence, a person can reflect on what they've just said and may reveal something deeper.

Don't suggest answers to your questions. Even if they pause before answering, don't help them by suggesting an answer. This can unintentionally get people to say things that agree with your expectations.

Ask questions neutrally. "What do you think about buying gifts for your spouse?" is a better question than "Don't you think shopping is great?" because the first question doesn't imply that there is a right answer.

Don't ask binary questions. Binary questions can be answered in a word; you want to host a conversation built upon stories.

Only ten words to a question. Your user will get lost inside long questions.

Only ask one question at a time, one person at a time. Resist the urge to ambush your user.

Make sure you're prepared to capture. Always interview in pairs. If this is not possible, you should use a voice recorder—it is impossible to engage a user and take detailed notes at the same time.

METHOD

EXTREME USERS



WHY engage with extreme users

Designers engage with users (people!) to understand their needs and gain insights about their lives. We also draw inspiration from their work-arounds and frameworks. When you speak with and observe extreme users, the needs are amplified and their work-arounds are often more notable. This helps you pull out meaningful needs that may not pop when engaging with the middle of the bell curve. However, the needs that are uncovered through extreme users are often also needs of a wider population.

HOW to engage extreme users

Determine who's extreme

Determining who is an extreme user starts with considering what aspect of your design challenge you want to explore to an extreme. List a number of facets to explore within your design space. Then think of people who may be extreme in those facets. For example, if you are redesigning the grocery store shopping experience you might consider the following aspects: how groceries are gathered, how payment is made, how purchase choices are made, how people get their groceries home, etc. Then to consider the aspect of gathering groceries, for example, you might talk to professional shoppers, someone who uses a shopping cart to gather recyclables (and thus overloads the cart), product pullers for online buyers, people who bring their kids shopping with them, or someone who doesn't go to grocery stores.

Engage

Observe and interview your extreme user as you would other folks. Look for work-arounds (or other extreme behaviors) that can serve as inspiration and uncover insights.

Look at the extreme in all of us

Look to extreme users for inspiration and to spur wild ideas. Then work to understand what resonates with the primary users you are designing for.

METHOD

ANALOGOUS EMPATHY



WHY use analogous empathy

During empathy work, analogies can be a powerful tool for developing insights that aren't obvious in a direct approach. Analogous needfinding spaces can offer up inspiration, a way to get unstuck, a fresh perspective on a space, or a useful work-around when direct observation is difficult.

HOW to use analogous empathy

Identify specific aspects of the space that you're interested in

Get your team together to talk about what aspects of the empathy space you're exploring are particularly interesting. If you're looking at hospitals, for example, you may be focusing on extreme time pressures, very high stakes decisions or perhaps long wait times. Look for spaces that are tangential to your design challenge, but share enough attributes that there may be insight cross-over.

Brainstorm opportunities for analogous spaces

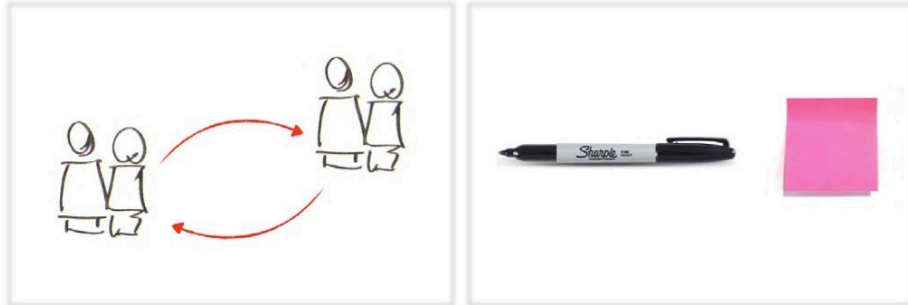
If, for example, you think customer service is an important aspect of the space you're looking at, brainstorm places you might go to find particularly strong (or weak) customer service. You may also want to brainstorm specific people you could interview about these analogous spaces, or how you might do a quick observation.

Make an analogous inspiration board

Saturate a space with photos and quotes from your analogous space; this can help the team share inspiration, or bring in the analogous insight later in the process.

METHOD

STORY SHARE-AND-CAPTURE



WHY story share-and-capture

A team share serves at least three purposes. First, it allows team members to come up to speed about what different people saw and heard in the field. Even if all the team members were present for the same fieldwork, comparing how each experienced it is valuable. Second, in listening and probing for more information, team members can draw out more nuance and meaning from the experience than you may have initially realized. This starts the synthesis process. Third, in capturing each interesting detail of the fieldwork, you begin the space saturation process.

HOW to story share-and-capture

Unpack observations and air all the stories that stick out to you about what you saw and heard during your empathy fieldwork. Each member in the group should tell user stories and share notes while other members headline quotes, surprises, and other interesting bits - one headline per post-it. These post-its become part of the team's space saturation, and can also be physically grouped to illuminate theme and patterns that emerge (See "Saturate and Group" method card). The end goal is to understand what is really going on with each user. Discover who that person is and what that person needs in regard to your problem space.

METHOD

SATURATE AND GROUP



WHY saturate and group

You space saturate to help you unpack thoughts and experiences into tangible and visual pieces of information that you surround yourself with to inform and inspire the design team. You group these findings to explore what themes and patterns emerge, and strive to move toward identifying meaningful needs of people and insights that will inform your design solutions.

HOW to saturate and group

Saturate your wall space (or work boards) with post-its headlining interesting findings (see “Story Share-and-Capture”) plus pictures from the field of users you met and relevant products and situations.

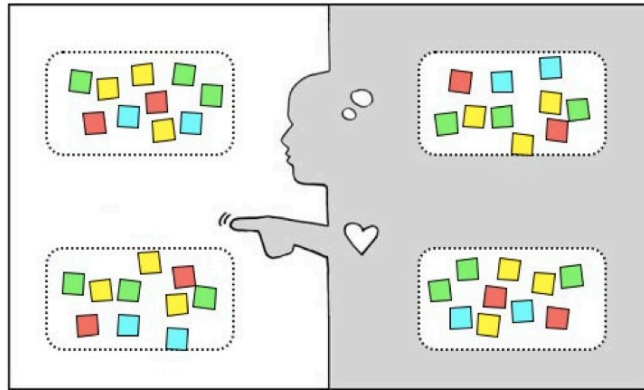
In order to begin to synthesize the information, organize the post-its and pictures into groups of related parts. You likely have some ideas of the patterns within the data from the unpacking you did when producing the notes. For example, you may have seen and heard many things related to feeling safe, and many things regarding desire for efficiency. Within the group of ‘safety’, go beyond the theme and try to see if there is a deeper connection that may lead to an insight such as “Feeling safe is more about who I am with than where I am”. Maybe there is a relation between groups that you realize as you place items in groups – that safety is often at odds with users’ desire for efficiency. Try one set of grouping, discuss (and write down) the findings, and then create a new set of groups.

The end goal is to synthesize data into interesting findings and create insights which will be useful to you in creating design solutions.

It is common to do the grouping with post-its headlining interesting stories from fieldwork. But grouping is also useful to think about similarities among a group of products, objects, or users.

METHOD

EMPATHY MAP



WHY use an empathy map

Good design is grounded in a deep understanding of the person for whom you are designing. Designers have many techniques for developing this sort of empathy. An Empathy Map is one tool to help you synthesize your observations and draw out unexpected insights.

HOW to use an empathy map

UNPACK: Create a four quadrant layout on paper or a whiteboard. Populate the map by taking note of the following four traits of your user as you review your notes, audio, and video from your fieldwork:

- SAY:** What are some quotes and defining words your user said?
- DO:** What actions and behaviors did you notice?
- THINK:** What might your user be thinking? What does this tell you about his or her beliefs?
- FEEL:** What emotions might your subject be feeling?

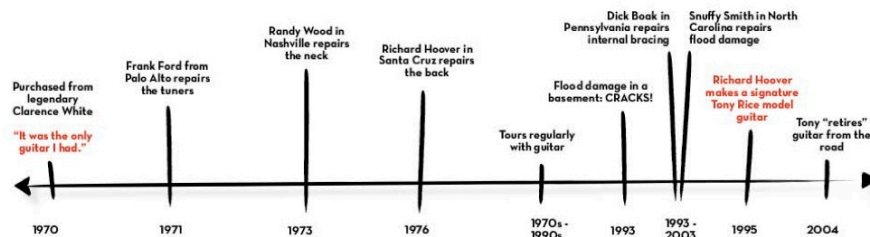
Note that thoughts/beliefs and feelings/emotions cannot be observed directly. They must be inferred by paying careful attention to various clues. Pay attention to body language, tone, and choice of words.

IDENTIFY NEEDS: "Needs" are human emotional or physical necessities. Needs help define your design challenge. Remember: Needs are *verbs* (activities and desires with which your user could use help), not *nouns* (solutions). Identify needs directly out of the user traits you noted, or from contradictions between two traits - such as a disconnect between what she says and what she does. Write down needs on the side of your Empathy Map.

IDENTIFY INSIGHTS: An "Insight" is a remarkable realization that you could leverage to better respond to a design challenge. Insights often grow from contradictions between two user attributes (either within a quadrant or from two different quadrants) or from asking yourself "Why?" when you notice strange behavior. Write down potential insights on the side of your Empathy Map. One way to identify the seeds of insights is to capture "tensions" and "contradictions" as you work.

METHOD

JOURNEY MAP



WHY use a journey map

To gain empathy for a person or understanding of one's process through an experience, consider the details of that process to illuminate areas of potential insights. Creating a journey map is an excellent way to systematically think about the steps or milestones of a process. A journey map can be used for your own empathy work, or to communicate your findings to others.

HOW to use a journey map

Create diagrams that capture multiple observations, e.g. a map of a user's day, a map of a user's experience, or a map of how a product moves through space and time (from manufacturing to store shelf to user's hands). Consider a process or journey that is relevant, or even tangential to, your problem space. For example, you could consider your user's morning breakfast routine. You could capture every event of one person's exercise in a month – and consider who she was with, where she came from, where she exercised, and where she went afterwards. Or perhaps you are developing a dating service website; you could document every communication between two people before the first date. One important concern is to be comprehensive within the variables you choose to capture. (Don't overlook the opening of the window shades in the morning breakfast routine.) What seems meaningless, could actually be the nugget that develops into a stunning insight. You can create a journey map based on observation and interview – or you might ask a user to draw a journey map and then explain it to you.

Organize the data in a way that makes sense: a timeline of events, a number of parallel timelines that allows for easy comparison, a series of pictures, or a stack of cards. Then look for patterns and anomalies and question why those themes or events occurred. Push yourself to connect individual events to a larger context or framework. It is often the pairing of an observation with the designer's knowledge and perspective that yields a meaningful insight.

METHOD

COMPOSITE CHARACTER PROFILE



Franklin

- 38 years old
- Divorced
- 2 kids
- Diabetic
- Free-clinic care-giver
- Has extreme tendencies in consumption and preparation of food.
- Balances his health and that of others, favoring the health of others.

WHY use a composite character profile

The composite character profile can be used to bucket interesting observations into one specific, recognizable character. Teams sometimes get hung up on outlying (or non-essential) characteristics of any of a number of particular potential users, and the composite character profile is a way for them to focus the team's attention on the salient and relevant characteristics of the user whom they wish to address. Forming a composite character can be a great way to create a "guinea pig" to keep the team moving forward.

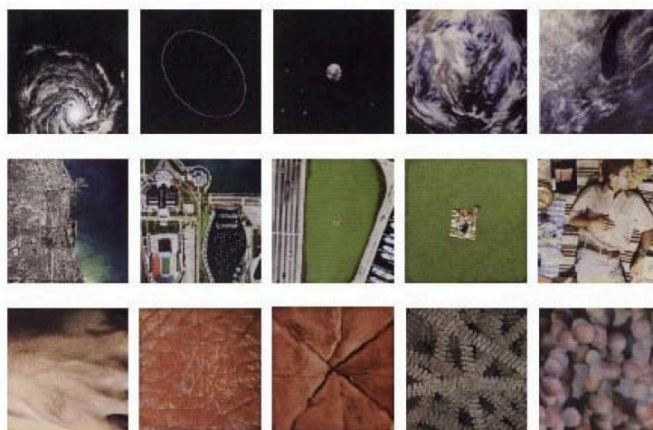
HOW to use a composite character profile

The composite character profile is a synthesis method whereby the team creates a (semi)-fictional character who embodies the human observations the team has made in the field. These might include "typical" characteristics, trends, and other patterns that the team has identified in their user group over the course of their field work.

In order to create a composite character profile, a team needs to have unpacked its field observations and saturated its team space. After this is done, a team should survey across the individual users it encountered in the field to identify relevant dimensions of commonality and/or complementarity - these dimensions could be demographic information, strange proclivities and habits, or sources of motivation, to name only a few. After several dimensions of commonality have been identified, list these features of the user; if there are any dimensions of complementarity (those which may not be shared by all users, but are interesting to the team and not necessarily mutually exclusive), the team should add these as well. Last, give your character a name, and make sure every member of the team buys into the identity and corresponding characteristics that the team has created.

METHOD

POWERS OF TEN



WHY use powers of ten

Powers of Ten is a reframing technique that can be used as a synthesis or ideation method. It allows the design team to use an intentional approach to considering the problem at varied magnitudes of framing.

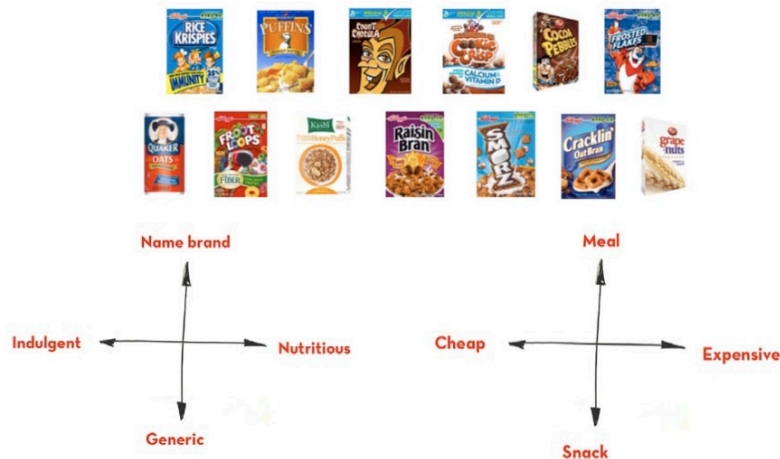
HOW to use powers of ten

The concept of Powers of Ten is to consider one aspect over increasing and decreasing magnitudes of context. Let's take two examples to illustrate how Powers of Ten could be used during a design process:

POWERS OF TEN FOR INSIGHT DEVELOPMENT: In this example, imagine you are designing a checkout experience, and you are trying to understand a user's motivation and approach to an aspect of her life. You are thinking about how she makes buying decisions. You made the observation that she read a number of customer reviews before making a purchase and are developing an insight that she values her peers' opinions when making purchases. Consider what her behavior might be for buying various items over a wide range of costs, from a pack of gum, to a pair of shoes, to a couch, to a car, to a house. Capture this in writing. Probe for nuances in your insight and see where it breaks down. Perhaps this could develop into a framework, such as a 2x2 (see the 2x2 Matrix method card).

POWERS OF TEN FOR IDEATION: During brainstorming groups idea generation lulls from time to time. One way to facilitate new energy is to use Powers of Ten. Continue with your brainstorming topic, but add a constraint that changes the magnitude of the solution space. "What if it had to cost more than a million dollars to implement?," "What about under 25 cents?," "What if it was physically larger than this room?," "Smaller than a deck of cards?," "Had no physical presence?," "Took more than four hours to complete the experience?," "Less than 30 seconds?," "More power to you."

METHOD 2X2 MATRIX



WHY use a 2x2 matrix

A 2x2 matrix is a tool to scaffold thinking and conversation about your users and problem space. Use it during your synthesis process to help you think about relationships between things or people. The hope is that insights or areas to explore more deeply will come out from using a 2x2. 2x2 matrices are also a great way to visually communicate a relationship you want to convey.

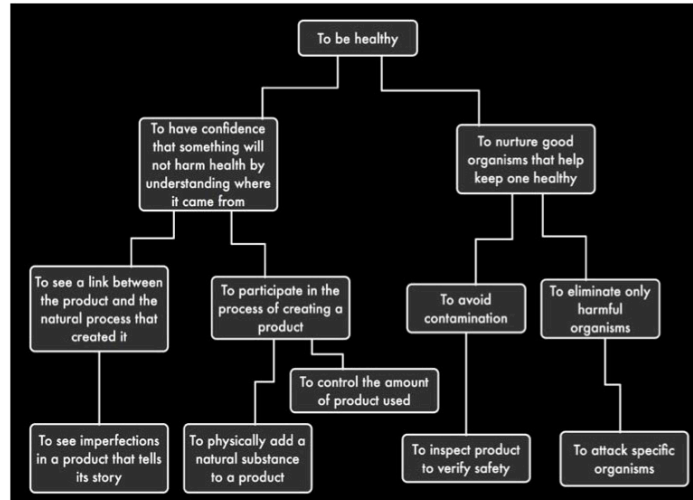
HOW to use a 2x2 matrix

Pick two spectra (one on each axis), draw a 2x2 matrix, and plot items in the map. The items could be product, objects, motivations, people, quotes, materials - any group of things that would be useful to explore. Put opposites on either end of each axis. For example, you might place different people on a matrix of passion for their career (low-to-high) vs. technology adoption (early-adopter-to-late-adopter). Look for relationships by seeing where groups start to form. See what quadrants are very full or empty; where does the assumed correlation break down? The discussion that is spurred by trying to place items on the matrix is often more valuable than producing the map itself. You may need to try a number of combinations of spectra to get one that is meaningful and informative. Try some combinations, even if you are not sure which is right - the first attempts will inform the ones to follow.

One common use for a 2x2 matrix is a competitive landscape. In this case, an empty quadrant could signal a market opportunity (or a very bad idea).

METHOD

WHY-HOW LADDERING



WHY why-how ladder

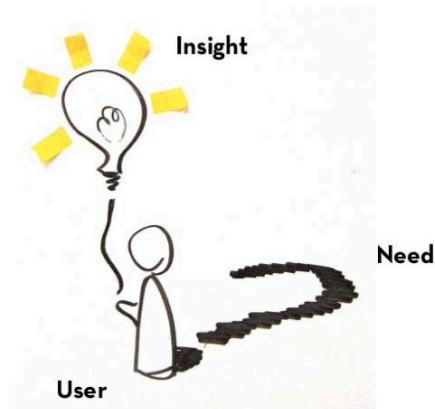
As a general rule, asking 'why' yields more abstract statements and asking 'how' yields specific statements. Often times abstract statements are more meaningful but not as directly actionable, and the opposite is true of more specific statements. That is why you ask 'why?' often during interviews – in order to get toward more meaningful feelings from users rather than specific likes and dislikes, and surface layer answers. Outside an interview, when you think about the needs of someone, you can use why-how laddering to flesh out a number of needs, and find a middle stratum of needs that are both meaningful and actionable.

HOW to why-how ladder

When considering the needs of your user, start with a meaningful one. Write that need on the board and then ladder up from there by asking 'why'. Ask why your user would have that need, and phrase the answer as a need. For example, "Why would she need to see a link between a product and the natural process that created it?" Because she 'needs to have confidence that something will not harm her health by understanding where it came from'." Combine your observations and interviews with your intuition to identify that need. Then take that more abstract need and ask why again, to create another need. Write each on the board above the former. At a certain point you will reach a very abstract need, common to just about everyone, such as the 'need to be healthy'. This is the top of that need hierarchy branch. You can also ask 'how' to develop more specific needs. Climb up ('why?') and down (how?) in branches to flesh out a set of needs for your user. You might come up to one need and then come back down. In the previous example, you climbed up to the 'need to understand where a product came from'. Then ask 'how' to identify the 'need to participate in the process of creating a product'. There will also be multiple answers to your 'whys' and 'hows' – branch out and write those down. The result (after some editing and refining) is a needs hierarchy that paints a full picture of your user or composite user. Alternatively, you can use this tool to hone in on one or two particularly salient needs.

METHOD

POINT-OF-VIEW MADLIB



WHY use a POV madlib

A point-of-view (POV) is your reframing of a design challenge into an actionable problem statement that will launch you into generative ideation. A POV Madlib provides a scaffolding to develop your POV. A good POV will allow you to ideate in a directed manner, by creating How-Might-We (HMW) questions based on your POV (see “Facilitating Brainstorms”). Most of all, your POV captures your design vision – your responsibility and opportunity as a designer is to discover and articulate the meaningful challenge.

HOW to use a POV madlib

Use the following madlib to capture and harmonize three elements of a POV: user, need, and insight.

[USER] needs to [USER'S NEED] because [SURPRISING INSIGHT]

Use a whiteboard or scratch paper to try out a number of options, playing with each variable and the combinations of them. The need and insight should flow from your unpacking and synthesis work. Remember, ‘needs’ should be verbs, and the insight typically should not simply be a reason for the need, but rather a synthesized statement that you can leverage in designing a solution. Keep it sexy (it should intrigue people) and hold the tension in your POV.

For example, instead of “A teenage girl needs more nutritious food because vitamins are vital to good health” try “A teenage girl with a bleak outlook needs to feel more socially accepted when eating healthy food, because in her hood a social risk is more dangerous than a health risk.” Note how the latter is an actionable, and potentially generative, problem statement, while the former is little more than a statement of fact, which spurs little excitement or direction to develop solutions.

METHOD

POINT-OF-VIEW ANALOGY

You don't want to miss this!

30-40 Thousand LPs @ \$1.00 each!

Doubles \$2.00

Triples & Box Sets \$3.00

Rock, Soul, Jazz, Blues, Folk, Classical, International, Original Cast & Soundtrax, Country, Lounge, Childrens, etc.

CHECK OUT OUR NEW \$5 RECORD STORE IN PLANET MIX!

ALSO, 1,000s of CDs, DVDs & Books ...VHS & Cassettes!

No Parking in Record Man Lot. There is plenty of parking across the street on Diller & Franklin and around the corner.

Sale starts at 8:00am.

All Credit & Debit cards are accepted.

WHY use a POV analogy

A point-of-view (POV) is your reframing of a design challenge into an actionable problem statement that will launch you into generative ideation. A POV Analogy can be a concise and compelling way to capture how you define the design challenge (your POV!). A good analogy will yield a strong directive of how you go about designing the final solution.

HOW to use a POV analogy

Use concise analogies to distill ideas. Metaphors and similes can encapsulate your insights in a rich picture. Discover metaphors from the work you do in synthesizing information, and looking at analogies between your user's situation and other areas.

For example, one metaphor from industry is:

"Personal music player as jewelry,"

which provides the directive for creating the iPod. Looking at the headset as jewelry, rather than simply speakers, allows the designer to create a product that users will enjoy as a projection of themselves, rather than merely a utilitarian device. You can imagine this could have been seeded by an insight about how a user views her music collection - that "her identity is linked to the bands she listens to, and her relationships are bolstered by shared music taste."

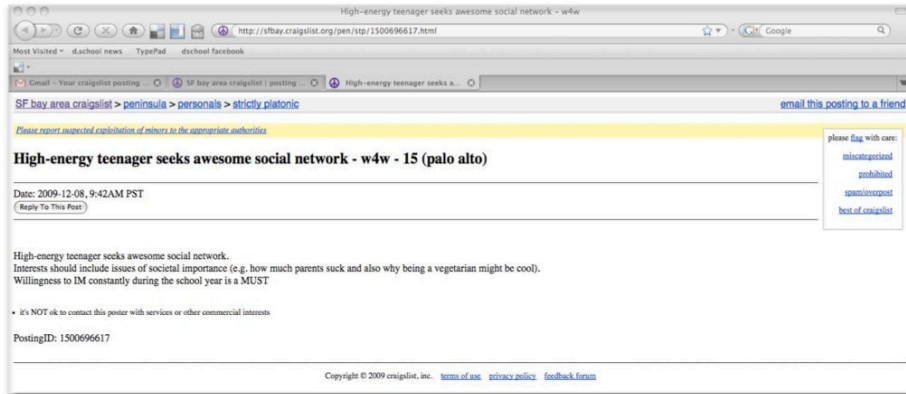
A metaphor can also be embedded into a more comprehensive POV.

For example you may create the following POV:

"A works-hard-plays-hard young professional needs to be motivated at work with a job that is more like a first-person-shooter than Tetris."

METHOD

POINT-OF-VIEW WANT AD



WHY use a POV want ad

A point-of-view (POV) is your reframing of a design challenge into an actionable problem statement that will launch you into generative ideation. A POV Want Ad can be a good way to express your distilled findings in an intriguing format. The want ad format tends to accentuate a specific user, and her important character traits.

HOW to use a POV want ad

Embed your user, his or her need, and your insights within the format of a want ad. This way of expressing a POV is often more playful and nuanced than the simple USER+NEED+INSIGHT madlib, but should still have a clarity about how you have reframed the problem.

Try this format:

Descriptive characterization of a user,
followed by "seeks" an ambiguous method to meet an implied need,
plus additional flavor to capture your findings.

For example: "High-energy teenager seeks awesome social network. Interests should include issues of societal importance (e.g. how much parents suck and also why being a vegetarian might be cool). Willingness to IM constantly during the school year is a MUST!"

METHOD

CRITICAL READING CHECKLIST

Critical Reading Checklist

- 1.) What's the point?
- 2.) Who says?
- 3.) What's new?
- 4.) Who cares?

WHY use a critical reading checklist

The Checklist is a tool used to determine whether a team has arrived at a meaningful, unique Point of View (POV). The original "Critical Reading Checklist" tool was developed by David Larabee, of the Stanford School of Education, and repurposed in the context of a design process to evaluate POVs.

Use this Checklist to ensure that your team's POV is valid, insightful, actionable, unique, narrow, meaningful, and exciting. While this method is not in itself sufficient to address the deficiencies of a POV, it is a great tool to think through and evaluate the usefulness of the POV.

HOW to use a critical reading checklist

We ask ourselves four basic questions about our Point of View:

1. **What's the point?** – What is your team's angle?
 - What is your team's framework in stating a POV?
 - Is it User-centered, Need-based, and Insight-driven?
2. **Who says?** – How valid is your team's POV?
 - Is your position supported by findings from users?
 - Is it a distillation of findings? Is this applicable outside of one colorful interview?
3. **What's new?** – What is the value-add of your POV?
 - Have you articulated your findings in a new way?
 - Are they placed in the context of a user?
 - If your POV doesn't feel new, try being more specific.
4. **Who cares?** – How is your POV significant?
 - Your team should be excited at this point!
 - Is this work worth doing? *If not, ask yourself why?*
 - Reframe/rephrase until you get it right.

METHOD

DESIGN PRINCIPLES

Invite multiple audiences
Extend nature of classes
Diversify learning opportunities
Encourage diversity of students
Extend contact beyond physical walls

Houses your things
Showcases your work
Allows access to unique people and resources
Nurtures a community

WHY use design principles

Design principles are strategies to solve a design challenge independent of a specific solution. You, as the designer, articulate these principles, translating your findings – such as needs and insights – into design directives. These principles give you a format to capture abstracted, but actionable, guidelines for solutions, and communicate your design intentions to others.

HOW to use design principles

Develop a list of statements – using imperative phrasing – that outlines essential guidelines to create successful design solutions. The guidelines should distill your understanding of the design space and user. That is, you define what would be the meaningful challenge to solve, based on your empathy work, and then create the design principles to outline what's necessary to achieve that success.

You develop design principles in a number of ways. You can translate your point of view, needs, and insights into design principles by stating your findings in terms of solutions rather than the user, while maintaining the focus on the user-centered needs and insights you discovered. For example, a user's "need to feel instrumental in creating a gift" could become a design directive that the solution should "involve the user in creating the final gift outcome." You can also back out design principles from potential solutions that you and users find compelling. Ask yourself what aspects of the solution resonated with users, and those aspects may be abstracted and formed into design principles.

Design principles should be independent of a specific solution – i.e. useful guidelines regardless of the particular solution. However, it is helpful to identify the broad solution context to help you develop design principles. For example, you may know that you are designing a physical space – that would help you understand how to phrase your principles. In another case, you might know you are creating a gift – but not know whether it will be physical, digital, or experiential. Still, that context would allow you articulate the meaningful principle mentioned above to "involve the gift-giver in creating the final outcome."

METHOD

"How Might We" QUESTIONS

How Might We...?

WHY create how might we questions

"How might we" (HMW) questions are short questions that launch brainstorm. HMWs fall out of your point-of-view statement or design principles as seeds for your ideation. Create a seed that is broad enough that there are a wide range of solutions but narrow enough that the team has some helpful boundaries. For example, between the too narrow "HMW create a cone to eat ice cream without dripping" and the too broad "HMW redesign dessert" might be the properly scoped "HMW redesign ice cream to be more portable." It should be noted, the proper scope of the seed will vary with the project and how much progress you have made in your project work.

HOW to generate how might we questions

Begin with your Point of View (POV) or problem statement. Break that larger challenge up into smaller actionable pieces. Look for aspects of the statement to complete the sentence, "How might we..." It is often helpful to brainstorm the HMW questions before the solutions brainstorm. For example, consider the following POV and resulting HMW statements.

USER	+	NEED	+	INSIGHT
An overworked husband	(needs)	to feel good about recycling		When things pile up he feels behind. And ultimately the big pile on the curb feels more like generating waste than doing good

1. How to reduce the size of the recycling pile?
2. How to make the husband feel good about a big pile?
3. How to reduce the amount of work involved in gathering all the house piles?
4. How to eliminate overflowing recycling bins?
5. How to make the husband feel ahead of the game?
6. How to make the husband feel less overworked?
7. How to make recycling feel less like waste?

METHOD

STOKE



WHY stoke

Stoke activities help teams loosen up and become mentally and physically active. Use stoke activities when energy is wavering, to wake up in the morning, to launch a meeting, or before a brainstorm.

HOW to stoke

Do an activity that gets your creativity going and increases your team members' engagement with each other. A good stoke activity not only increases energy but also requires each person to actively engage, listen, think, and do. For example, when playing Pictionary you must watch a teammate drawing, listen to other teammates guessing the answer (allowing you to build on those ideas), think of what the answer might be, and call out guesses yourself. Keep the activity brief (5-10 minutes) and active so you can jump into your design work after. Many improv games are good stoke activities. Try one of these:

Category, category, die! Line folks up. Name a category (breakfast cereals, vegetables, animals, car manufacturers). Point at each person in rapid succession, skipping around the group. The player has to name something in the category. If she does not, everyone yells "die!!" and that player is out for the round.

Sound ball Stand in a circle and throw an imaginary ball to each other. Make eye contact with the person you are throwing to, and make a noise as you throw it. The catcher should repeat the noise while catching, and then make a new noise as he throws to next person. Try to increase the speed the ball travels around the circle. Add a second ball to the circle to increase each person's awareness.

"Yes, Let's" Everyone walk around the room randomly, and then one person can make an offer: "Let's act like we're all at a cocktail party," "Let's be baby birds," or "Let's act like we don't understand gravity." Then everyone should shout in unison the response, "Yes, let's" and proceed to take the directive by acting it out. At anytime someone else can yell out the next offer. The answer is always, "Yes, let's!"

METHOD

BRAINSTORMING



One Conversation at a Time

Encourage wild ideas

Go for Quantity

Be Visual

Headline!

Stay on Topic

Build on the Ideas of Others

Defer Judgement -
NO Blocking

WHY brainstorm

Brainstorming is a great way to come up with a lot of ideas that you would not be able to generate by just sitting down with a pen and paper. The intention of brainstorming is to leverage the collective thinking of the group, by engaging with each other, listening, and building on other ideas. Conducting a brainstorm also creates a distinct segment of time when you intentionally turn up the generative part of your brain and turn down the evaluative part. Brainstorming can be used throughout a design process; of course to come up with design solutions, but also any time you are trying to come up with ideas, such as planning where to do empathy work, or thinking about product and services related to your project – as two examples.

HOW to brainstorm

Be intentional about setting aside a period of time when your team will be in “brainstorm mode” – when the sole goal is to come up with as many ideas as possible, and when judgment of those ideas will not come into the discussion. Invest energy into a short period of time, such as 15 or 30 minutes of high engagement. Get in front of a whiteboard or around a table, but take an active posture of standing or sitting upright. Get close together.

Write down clearly what you are brainstorming. Using a How-Might-We (HMW) question is a great way to frame a brainstorm (e.g. HMW give each shopper a personal checkout experience?). (See more on the “How Might We” Questions” method card.)

There are at least two ways to capture the ideas of a brainstorming:

1. Scribe: the scribe legibly and visually captures on the board ideas that team members call out. It is very important to capture every idea, regardless of your own feelings about each idea.
2. All-in: Each person will write down each of his or her ideas as they come, and **verbally share it** with the group. It is great to do this with post-it notes, so you can write your idea and then stick it on the board.

Follow and (nicely) enforce the brainstorming rules – they are intended to increase your creative output.

METHOD

FACILITATE A BRAINSTORM



WHY facilitate a brainstorm

Good facilitation is key to a generative brainstorm. You brainstorm to come up with many, wide-ranging ideas; a good facilitator sets the stage for the team to be successful doing this.

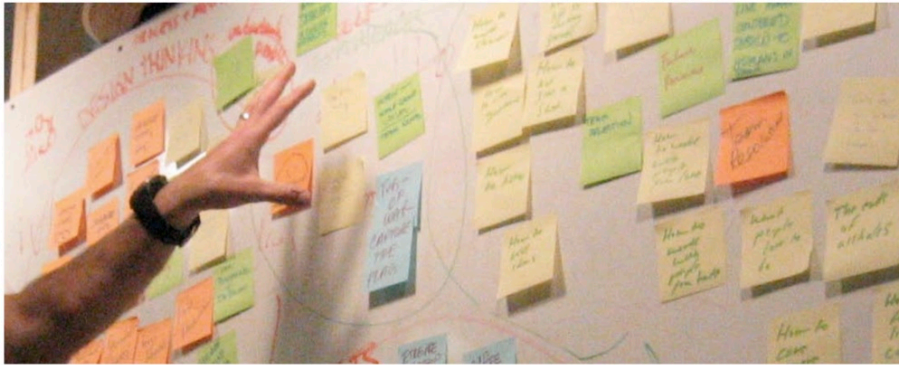
HOW to facilitate brainstorm

ENERGY – As the facilitator it is your task to keep the ideas flowing. Perhaps the most important aspect of a successful brainstorm is the seed question that you are brainstorming about (see the “How Might We” method card for more information). During the brainstorm keep a pulse on the energy of the group. If the group is slowing down or getting stuck, make an adjustment. Create a variation to the “How-might-we?” (HMW) statement to get the group thinking in another direction (prepare some HMW options ahead of time). Or have a few provocative ideas in your back pocket that you can lob in to re-energize the team.

CONSTRAINTS – Add constraints that may spark new ideas. “What if it had to be round?” “How would superman do it?” “How would your spouse design it?” “How would you design it with the technology of 100 years ago?” Additionally you can create process constraints. Try putting a time limit on each how-might-we statement; shoot for 50 ideas in 20 minutes.

SPACE – Be mindful about the space in which you conduct a brainstorm. Make sure that there is plenty of vertical writing area. This allows the group to generate a large number of potential solutions. Strike a balance between having a footprint that is big enough for everyone, but also is not so large that some people start to feel removed. A good rule of thumb is that all members of the group should be able to reach the board in two steps. Also, make sure each person has access to sticky notes and a marker so they can capture their own thoughts and add them to the board if the scribe cannot keep up with the pace. (See more about scribing on the “Brainstorming” method card.)

METHOD SELECTION



WHY brainstorm selection is important

Your brainstorm should generate many, wide-ranging ideas. Now harvest that brainstorm, so those ideas don't just sit there on the board. Harvesting is straight forward for some brainstorms (pick a couple of ideas), but when ideating design solutions give some thought to how you select ideas. Carry forward a range of those ideas, so you preserve the breadth of solutions and don't settle only for the safe choice.

HOW to select

In the selection process, don't narrow too fast. Don't immediately worry about feasibility. Hang on to the ideas about which the group is excited, amused, or intrigued. An idea that is not plausible may still have an aspect within it that is very useful and meaningful.

Different selection techniques can be used, including these three:

1. Post-it voting - each team member gets three votes and marks three ideas that he or she is attracted to. Independent voting allows all team members to have a voice.
2. The four categories method - the method encourages you to hang onto those crazy but meaningful ideas. Elect one or two ideas for each of these four categories: the rational choice, the most likely to delight, the darling, and the long shot.
3. Bingo selection method - like the four categories method, this is designed to help preserve innovation potential. Choose ideas that inspire you to build in different form factors: a physical prototype, a digital prototype, and an experience prototype.

Carry forward multiple ideas into prototyping. If an idea is so far out there that it seems pointless to test, ask yourselves what about that solution was attractive, and then test that aspect or integrate it into a new solution.

METHOD

BODYSTORMING



WHY bodystorm

Bodystorming is a unique method that spans empathy work, ideation, and prototyping. Bodystorming is a technique of physically experiencing a situation to derive new ideas. It requires setting up an experience - complete with necessary artifacts and people - and physically "testing" it. Bodystorming can also include physically changing your space during ideation. What you're focused on here is the way you interact with your environment and the choices you make while in it.

We bodystorm to generate unexpected ideas that might not be realized by talking or sketching. We bodystorm to help create empathy in the context of possible solutions for prototyping. If you're stuck in your ideation phase, you can bodystorm in the context of a half-baked concept to get you thinking about alternative ideas. Designing a coffee bar? Set up a few foam cubes and "order" a coffee! Bodystorming is also extremely useful in the context of prototyping concepts. Have a couple concepts you're testing? Bodystorm with both of them to help you evaluate them. Developing any sort of physical environment demands at least a few bodystorms.

HOW to bodystorm

This is a straight-forward method, but one that is only useful if you fully engage with it. Get physical! If you are trying to ideate in the context of hospital patients, try walking through the experience to come up with new ideas. If you are designing products for the elderly, rub some Vaseline on your glasses to view the world through older eyes. Bodystorm by moving around and becoming aware of the physical spaces and experiences related to your solutions. Pay close attention to decision-making directly related to your environment and related emotional reactions. Dig into the "WHY"!

METHOD

IMPOSE CONSTRAINTS



WHY impose constraints

It is a bit counterintuitive, but imposing constraints with intention can actually increase your creative potential. Try it: Think of as many white things as you can in ten seconds. Now think of white things in your kitchen. Did the more constrained prompt spark more ideas?

HOW to impose constraints

There are many times throughout the design process when imposing constraints can help you be a more successful designer. However, being conscious of what filters you place on your design process, and when, is very important. Imposing a specific constraint on your idea generation is different than rejecting ideas because of pre-conceived notions of what you are trying to make.

Three areas where imposing constraints can be useful are in ideation, in prototyping, and with time:

IDEATION: During a brainstorm, or when you are ideating with a mindmap, temporarily add a constraint. This constraint might be “What if it were made for the morning?” or “How would McDonald’s do it?”. Keep this filter on the ideation for as long as it is useful. (For more, see the “Facilitate a Brainstorm” card.)

PROTOTYPING: In prototyping, particularly in early stages, you build to think. That is, you reverse the typical direction – of thinking of an idea and then building it – to using building as a tool to ideate. You can increase the output of this process by imposing constraints. Constrain your materials to push toward faster, lower resolution prototypes and increase the role of your imagination. Developing a checkout service? Prototype it with cardboard, Post-its and a Sharpie. Making a mobility device? Do it with cardboard, Post-its and a Sharpie. Designing an arcade game? Cardboard, Post-its, Sharpie.

Additionally, as with brainstorming, put constraints on the solution itself.

How might you design it . . . for the the blind? Without using plastic? Within the space of an elevator?

TIME: Create artificial deadlines to force a bias toward action. Make two prototypes in an hour. Brainstorm intensely for 20 minutes. Spend three hours with users by the end of the weekend. Develop a draft of your point-of-view by the end of the hour.

METHOD

PROTOTYPE FOR EMPATHY



WHY prototype for empathy

It is common practice to test prototypes with users to evaluate solutions, but you can also gain empathy through prototyping, exposing different information than simple interviewing and observation might. Of course, whenever you test with a user you should consider both what you can learn about your solution and what you can learn about the person – you can always use more empathetic understanding.

But you can also develop prototypes or create situations specifically designed to gain empathy, without testing a solution at all (or even having a solution in mind). This is sometimes called “active empathy” because you are not an outside observer, you are creating conditions to bring out new information. In the same way a solution prototype helps you gain understanding about your concept, an empathy prototype helps you gain understanding about the design space and people’s mindsets about certain issues.

HOW to prototype for empathy

These empathy prototypes are often best used when you have done some work to understand the design space, and want to dig deeper into a certain area or probe an insight you are developing. Think about what aspect of the challenge you want to learn more about. Then discuss or brainstorm ways you might investigate that subject. You can create prototypes for empathy to test with users or with your design team.

Some ideas:

- Have your user draw something (for example, draw how you think about spending money, or draw how you get to work) and then talk about it afterward.
- Create a game that probes issues you want to explore (for example, you could make a simple card game which forces users to make choices related to your design challenge).
- Simulate an aspect of what users are going through to better understand it yourself (for example, if your users plant seeds while carrying a baby, get a sling and carry ten pounds while planting seeds).

METHOD

PROTOTYPE TO TEST



WHY prototype to test

Prototyping to test is the iterative generation of low-resolution artifacts that probe different aspects of your design solution or design space. The fundamental way we test our prototypes is by letting users experience them and react to them. In creating prototypes to test with users you have the opportunity to examine your solution decisions as well as your perception of your users and their needs.

HOW to prototype to test

Think about what you are trying to learn with your prototypes, and create low-resolution objects and scenarios which probe those questions. Staying low-res allows you to pursue many different ideas you generated without committing to a direction too early on. The objective is not simply to create a mock-up or scale model of your solution concept; it is to create experiences to which users can react. Bring resolution to the aspects that are important for what you are trying to test, and save your efforts on other aspects. You also need to think about the context and testing scenario you will create to get meaningful feedback. It is not always the case that you can just hand an object to someone on the street and get real feedback. Test in the context that your solution would actually be used (or approximate the important parts of that context). For example, if you are creating a consumer food storage system, let users test it in their kitchens at home - some of the nuanced but important issues will only emerge there.

Some tips for prototyping to test:

Start building. Even if you aren't sure what you're doing, the act of picking up some materials (paper, tape, and found objects are a good way to start!) will be enough to get you going.

Don't spend too long on one prototype. Move on before you find yourself getting too emotionally attached to any one prototype.

Build with the user in mind. What do you hope to test with the user? What sorts of behavior do you expect? Answering these questions will help focus your prototyping and help you receive meaningful feedback in the testing phase.

ID a variable. Identify what's being tested with each prototype. A prototype should answer a particular question when tested.

METHOD

TESTING WITH USERS



WHY test with users

Testing with users is a fundamental part of a human-centered design approach. You test with users to refine your solution and also to refine your understanding of the people for whom you are designing. When you test prototypes you should consider both their feedback on your solution and use the opportunity to gain more empathy. You are back in a learning and empathy mode when you engage users with a prototype.

HOW to test with users

There are multiple aspects to be aware of when you test with users. One is your **prototype**, two is the **context and scenario** in which you are testing, three is **how you interact** with the user during testing and four is how you **observe and capture** and consider the feedback.

In regard to the first two aspects, you need to test a prototype in a context that give you the best chance for meaningful feedback; think about how the prototype and the testing scenario interact. If the prototype is a scenario, think about how to find the proper people (i.e. users relevant to your point-of-view) and get them in the right mindset so that you get genuine feedback.

Roles

During the testing itself, use intentional team roles, as you would with empathy work:

Host: You help transition the user from reality to your prototype situation and give them the basic context they need to understand the scenario (don't over-explain it, let the user discover through the experience).

As the host, you will also likely be the lead questioner when the time comes.

Players: You often need to play certain roles in the scenario to create the prototype experience.

Observers: It is very important to have team members who are solely observers, watching the user experience the prototype. If you don't have enough people to run the prototype and observe, videotape the testing.

Procedure

Use a deliberate procedure when you test.

1. Let your user experience the prototype. Show don't tell. Put your prototype in the user's hands (or your user in the prototype) and give just the minimum context so they understand what to do. Don't explain your thinking or reasoning for your prototype.

2. Have them talk through their experience. For example, when appropriate, as the host, ask "Tell me what you are thinking as you are doing this."

3. Actively observe. Watch how they use (and misuse!) what you have given them. Don't immediately "correct" what your user tester is doing.

4. Follow up with questions. This is important; often this is the most valuable part of testing. "Show me why this would [not] work for you." "Can you tell me more about how this made you feel?" "Why?" Answer questions with questions (i.e. "well, what do you think that button does").

METHOD

PROTOTYPE TO DECIDE



WHY prototype to decide

Often during the design process, it's unclear how to proceed forward, particularly when a team reaches a fork in its decision tree. A prototype can frequently resolve team disagreements and help a team decide which design direction to pursue without having to compromise. The best way to resolve team conflicts about design elements is to prototype and evaluate them with users. Making and evaluating a prototype can be the best way to inform design decisions. If an idea has been prototyped and passes muster with the group, it's a good sign that the idea is worth pursuing further.

HOW to prototype to decide

Staying as low-resolution as possible, develop models of potential design candidates. Be sure to distill the design problem down to discrete elements so you can isolate and be mindful of the variable you are testing. Then try out the prototypes within your team, outsider peers, or, even better, take your prototypes to users and get their feedback.

METHOD

IDENTIFY A VARIABLE



WHY identify a variable

Identifying a variable you want to test helps you understand what kind of prototype you are going to create. Most prototypes should not simply be mock-ups of a solution you have in mind. Instead, create prototypes – which may not look like or wholly represent your solutions at all – that help you learn about specific aspects of your solution or mindsets of your users. When you identify a variable you can save energy in not creating all the facets of a complicated solution, and, more importantly, the results of testing with users will often be more conclusive and nuanced.

Incorporating too many variables into one prototype can water down the feedback you'll get from your users – what was it were they responding to? You might never find out. Identifying a variable also gives you the opportunity to create multiple prototypes, each varying in the one property. Giving a user tester a choice and the ability to make comparisons often results in more useful feedback because that person is encouraged to promote one option over another (rather than a less useful “I like it” response you might get with one prototype).

HOW to identify a variable

Prototype with a purpose; think about what you are trying to learn by making a prototype. Identify one variable to flesh out and test with each prototype you build. Bring resolution to that aspect of the prototype. Remember a prototype doesn't have to be, or even look like the solution idea. You might want to know how heavy a device should be. You can create prototypes of varied weight, without making each one operable. In another example, you may want to find out if users prefer getting delivery or picking up themselves – you may not even need to put anything in the box to test this.

METHOD

USER-DRIVEN PROTOTYPING



WHY create a user-driven prototype

Whenever you engage a user with a prototype, you are trying to better understand him and perhaps his reaction to your solution-in-progress. Often with prototypes, we ask the user to experience something we created, and we gain insight by observing their reaction and by talking to them about the experience. The intention with a user-driven prototype is to gain understanding by watching the user create something, rather than try something that you developed.

The value of a user-driven prototype is that different assumptions and desires are revealed when the user is asked to create aspects of the design, rather than just evaluate or experience the prototype. The goal is not to take what they made and integrate it into your design, but rather to understand their thinking and perhaps reveal needs and features that you may not have thought of.

User-driven prototypes are often useful in early empathy work, as a way to facilitate a different kind of conversation. User-driven prototypes are also useful after you have determined the context and form-factor of your solution, to help think about some of the features and details of that solution.

HOW to create a user-driven prototype

The approach to creating a user-driven prototype is to set up a format for your users to create something which leads to your understanding of how they are thinking. As an example, if you were creating a website to allow users to create custom t-shirts, a traditional early-stage prototype might be a mock-up of the webpage with the features and buttons that you think might be appropriate. A user-driven prototype could be to give your user a blank piece of paper and ask her to draw what she thinks the features should be. You might provide a light scaffolding to get her going, such as a piece of paper with boxes in the layout of a possible website, and then ask her to create the content for those boxes. Of course, there is an entire spectrum of how much you provide and how much you ask your user to create. You need to find the balance, depending on your project progress, for a prototype that is scaffolded enough that the user feels that she can be generative, but open enough that you learn outside of your own biases and assumptions.

Other examples of user-driven prototypes include: asking a user to draw something ("draw how you think about going to the doctor"), to make an object with simple materials ("make a bag for diapers and baby supplies, using this paper and tape"), or to compile things ("tear out pictures from these magazines that represent your ideal mall shopping experience").

:: 38 :: photo: flickr/ivt-ntnu



METHOD

WIZARD OF OZ PROTOTYPING



WHY create a Wizard-of-Oz prototype

You use a Wizard-of-Oz prototype to fake functionality that you want to test with users, thus saving you the time and resources of actually creating the functionality before you refine it through testing. Just like the small man behind the curtain faked the power of the wizard of oz, your design team can fake features that you want to test. Wizard-of-Oz prototypes often refer to prototypes of digital systems, in which the user thinks the response is computer-driven, when in fact it is human controlled.

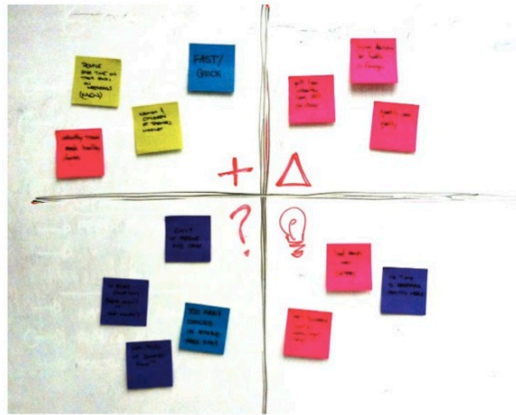
HOW create a Wizard-of-Oz prototype

Creating a Wizard-of-Oz prototype starts with determining what you want to test or explore. It is often the case that you want to test something that requires great effort to create, like coding a digital interface, but you need to learn more before it makes sense to invest that effort. Figure out how to fake the functionality you need to give the user an authentic experience from their viewpoint. Often leveraging existing tools can be very powerful: Twitter, email systems, Skype, instant messengers, Powerpoint to fake a website, projectors, computer screens repurposed in a new skin, etc. Combine tools such as these with your human intervention behind the scenes, and you can create a realistic prototype. The concept can certainly be extended beyond the digital realm, to create physical prototypes. For example, you could prototype a vending machine without creating the mechanics and use a hidden person to deliver the selected purchases.

A good example of a wizard-of-oz prototype is from the company Aardvark. Aardvark connects people with questions with people best-qualified to answer via a digital interface over the internet. To create the network and algorithm to do this would require significant coding, but the team wanted to test user's reaction to the interface well before the coding was completed. They used an instant messaging system and a team of people behind the scenes to physically reroute questions and answers to the right people. The result is they learned a lot and developed their concept notably without investing coding resources.

METHOD

FEEDBACK CAPTURE GRID



WHY use a feedback capture grid

Use a feedback capture grid to facilitate real-time capture, or post-mortem unpacking, of feedback on presentations and prototypes – times when presenter-critiquer interaction is anticipated. This can be used either to give feedback on progress within the design team or to capture a user's feedback about a prototype. You use the grid because it helps you be systematic about feedback, and more intentional about capturing thoughts in the four different areas.

HOW to use a feedback capture grid

1. Section off a blank page or whiteboard into quadrants.
2. Draw a plus in the upper left quadrant, a delta in the upper right quadrant, a question mark in the lower left quadrant, and a light bulb in the lower right quadrant.

It's pretty simple, really. Fill the four quadrants with your or a user's feedback. Things one likes or finds notable, place in the upper left; constructive criticism goes in the upper right; questions that the experience raised go in the lower left; ideas that the experience or presentation spurred go in the lower right. If you are giving feedback yourself, strive to give input in each quadrant (especially the upper two: both "likes" and "wishes").

METHOD

STORYTELLING



WHY storytelling over other forms of communication

It seems stories are hard-wired into our psyche. People have been passing information along via storytelling for as long as humans have had a rich language to draw from. Stories are a great way to connect people with ideas, at a human level. A well-told story – focused on sharing pertinent details that express surprising meaning and underlying emotions – effects the emotions and the intellect simultaneously.

HOW to design a story

What's the point? Know what you intend to convey both narratively and emotionally. You should be able to describe the essence of the transformation of your character in one sentence & the tone of the story in a couple of words. Be able to articulate the emotional tone in a couple of words.

Be Authentic: Stories are more powerful when they include a little bit of you. Honest expression is stronger and more resonant than cliché.

Character-Driven: Characters are a great vehicle through which to express deep human needs and generate empathy and interest from your audience. Focus on character.

Dramatic Action: Your story should have 3 components: Action, Conflict, and Transformation.

Action: What is the character trying to do? What actions are they taking to achieve it?

Conflict: What is in her way? What questions linger beneath the surface?

Transformation: What is the big insight? How do the action & conflict resolve?

Details: "Behind all behavior lies emotion." What details can you share about your character and their situation that will suggest the emotions that lie beneath?

Design Process is a Built in Story: Use what you've learned during the design process.

Empathy maps well to Character. Needs map to Conflict, Insights + Solutions map to Transformation.

METHOD

SHOOTING VIDEO



WHY video

Video is a powerful medium for communicating ideas, insights & stories. Planning ahead, but staying open to possibility will give you the best chance of stumbling on a magical moment. Know what you are trying to do and be aggressive about communicating it in the frame. If it's not in the frame, it doesn't exist.

HOW to shoot video

Tips:

Direct Attention:

1. Know your intention. What are you trying to highlight? How do you want it to feel?
2. Bias toward tight framing.
3. Figure Ground: Get a good contrast between the subject & the background.
4. Be conscious of light sources & shadows on your subject.
5. Follow the rule of thirds, frame off-center.

Plan to Improvise: Know what you want, be flexible about how you get it.

1. Plan Ahead: Storyboard out your idea. Iterate!
2. Get Lucky: Follow your curiosity on the day of your shoot.
3. Overshoot! Get more than you think you need! More stuff gives you more options when editing. Longer takes allow you some wiggle room for transitions.

Audio is Important!!! Remember the 2 rules:

1. Mic close to the subject.
2. Point away from (undesired) noise.

METHOD

VIDEO EDITING



WHY video, why quick editing

Video is a powerful medium for communicating ideas, insights and stories; editing can make or break a video: the story is supported or undermined by the way a video is sequenced, paced, & scored. Editing can also be very time consuming so how you work is important in maintaining progress.

HOW to edit quickly & create compelling videos

Tips:

Make rough cut of the whole film then go into details. Iterate.

Keep it simple; avoid superfluous animated transitions.

Shorter is almost always better.

Sound is more important than picture.

Cut early: when in doubt, edit shorter cuts.

Critical eye: don't fall in love with it.

Choose a style that works with quick cuts – don't get swallowed up by the mechanics.

Music is very powerful: use it wisely.

METHOD

I LIKE, I WISH, WHAT IF



WHY use I Like, I Wish, What if

Designers rely on personal communication and, particularly, feedback, during design work. You request feedback from users about your solution concepts, and you seek feedback from colleagues about design frameworks you are developing. Outside the project itself, fellow designers need to communicate how they are working together as a team. Feedback is best given with I-statements. For example, "I sometimes feel you don't listen to me" instead of "You don't listen to a word I say." Specifically, "I like, I wish, What if" (IL/IW/WI) is a simple tool to encourage open feedback.

HOW to use I Like, I Wish, What if

The IL/IW/WI method is almost too simple to write down, but too useful not to mention. The format can be used for groups as small as a pair and as large as 100. The simple structure helps encourage constructive feedback. You meet as a group and any person can express a "Like," a "Wish," or a "What if" succinctly as a headline. For example you might say one of the following:

"I like how we broke our team into pairs to work."

"I wish we would have met to discuss our plan before the user testing."

"What if we got new team members up to speed with a hack-a-thon?"

The third option "What if..." has variants of "I wonder..." and "How to..."

Use what works for your team.

As a group, share dozens of thoughts in a session. It is useful to have one person capture the feedback (type or write each headline). Listen to the feedback; you don't need to respond at that moment. Use your judgment as a team to decide if you want to discuss certain topics that arise.

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APPENDIX B: IDEO'S TANG WORKSHOP PROCESS GUIDE

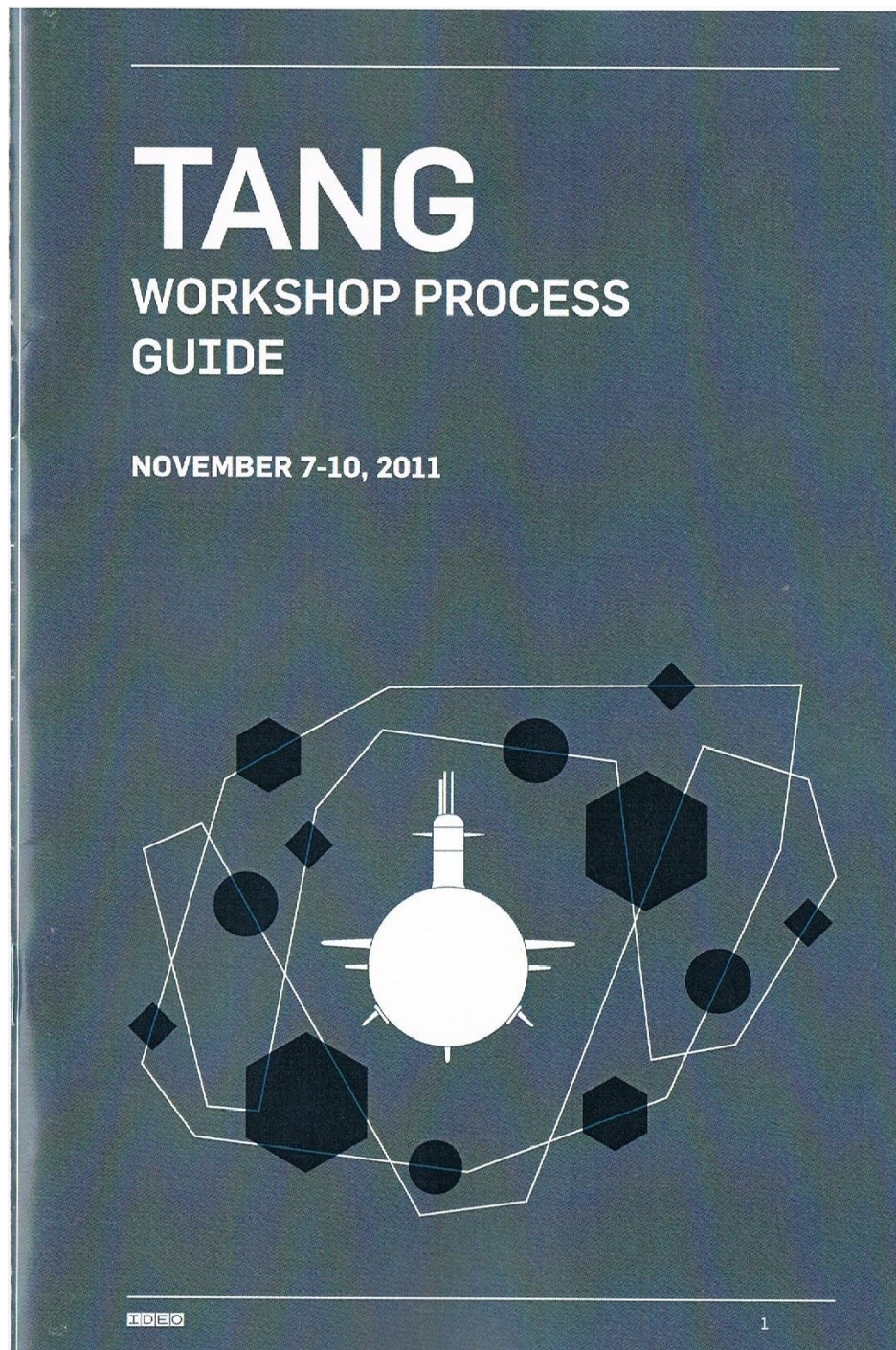


TABLE OF CONTENTS

PROCESS PG.4

INNOVATION PG.5

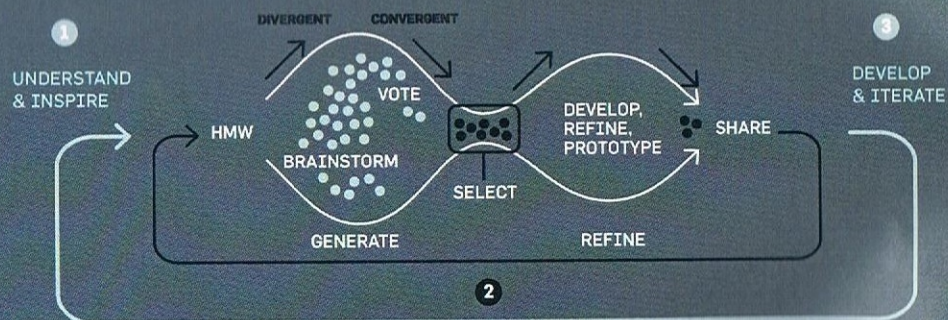
BRAINSTORMING PG.6

PROTOTYPING PG.8

PROCESS

The Design Thinking Process

- 1 Understand the users and context of the system being designed.
- 2 Use this knowledge to generate a diversity of potential solutions at a low level of resolution .
(focus of TANG workshop)
- 3 Explore the solution directions that show greatest promise and feasibility. #



INNOVATION

The innovation process can help you approach problem solving in new ways. Each phase consists of activities to help you create innovative and human-centered solutions.

These activities are described in detail on the pages that follow.

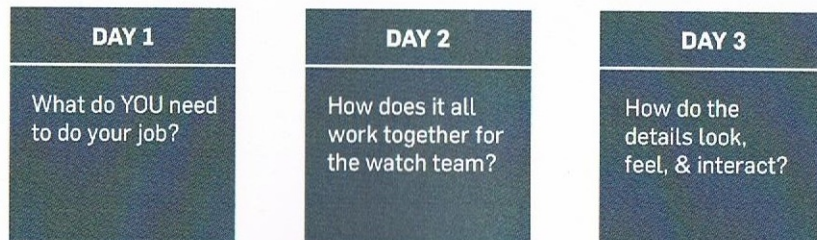
The 3 Days of TANG

GOALS

GENERATE A MULTITUDE OF IDEAS TO SUPPORT:

- More Effective Collaboration
- Streamlined Operations
- Reduced Learning Curve
- Ability to Manage Increased Information Load
- Leveraging of New Technologies

STRUCTURE



BRAINSTORMING

We've found that conducting a great
brainstorm requires energy, discipline,
and focus.

THE 7 RULES OF EFFECTIVE BRAINSTORMING

1. **Defer judgement**

There are no bad ideas at this point! There's plenty of time to judge later.

2. **Encourage wild ideas**

It's the wild ideas that often provide the breakthroughs. It is always easy to bring ideas down to earth later.

3. **Build on the ideas of others**

Think "and" rather than "but."

4. **Stay focused on the topic**

You get better quality output if everyone is disciplined.

5. **One conversation at a time**

That way all of the ideas can be heard and built upon.

6. **Be visual**

Try to engage the left and the right sides of the brain. A simple drawing will make it easier to remember later.

7. **Go for quantity**

Set an outrageous goal and surpass it!

PROTOTYPING

Prototyping is a great way to communicate a concept to your team with minimal investment. Prototypes allow you to identify quickly what may need to be refined.

Using any materials you have available, quickly assemble forms or interactions to represent your idea.

Create a representation that tests for specific questions and makes sense for your idea.

- **If it's a tool, build a rough object.**
- **If it's an interface, draw it with layers to show how it changes.**
- **If it's a new process, draw a map of the steps or act out how each step would happen.**
- **If your idea is a new role, create a job description or a uniform. Role-play how that new role might impact your customers or colleagues.**

Solicit feedback from others.

What did you like?

What questions do you have?

What suggestions for improvement?

Refine your prototype based on this feedback.

Stuck? Try thinking through each of these potential system elements:

- **PROCESS**
- **TOOLS**
- **SPACE**
- **ROLES**

PROTOTYPING CON'T.

1. Building to think

Prototypes are tools used both to validate ideas and to help us generate them. Prototypes force us to think about how someone would interact with our concept.



2. Rough & rapid

Prototypes are exploratory, not precious. They should be built as quickly and cheaply as possible.



3. Answering questions

It is essential to know what question a prototype is being used to answer: whether it's around desirability, usefulness, usability, viability, or feasibility.



Prototyping might be...

- **SKETCHES**
- **STORYBOARDS**
- **PHYSICAL MODELS**
- **ENACTMENTS / ROLEPLAYS / SKITS**
- **DIAGRAMS**
- **SPACES**
- **VIDEOS**
- **ANYTHING THAT REALIZES AND COMMUNICATES YOUR IDEA**

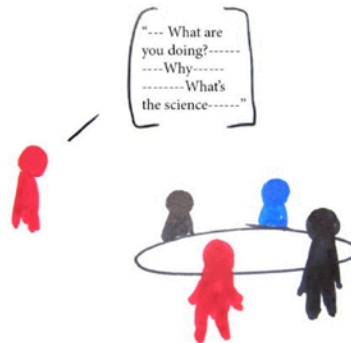
IDEO

11

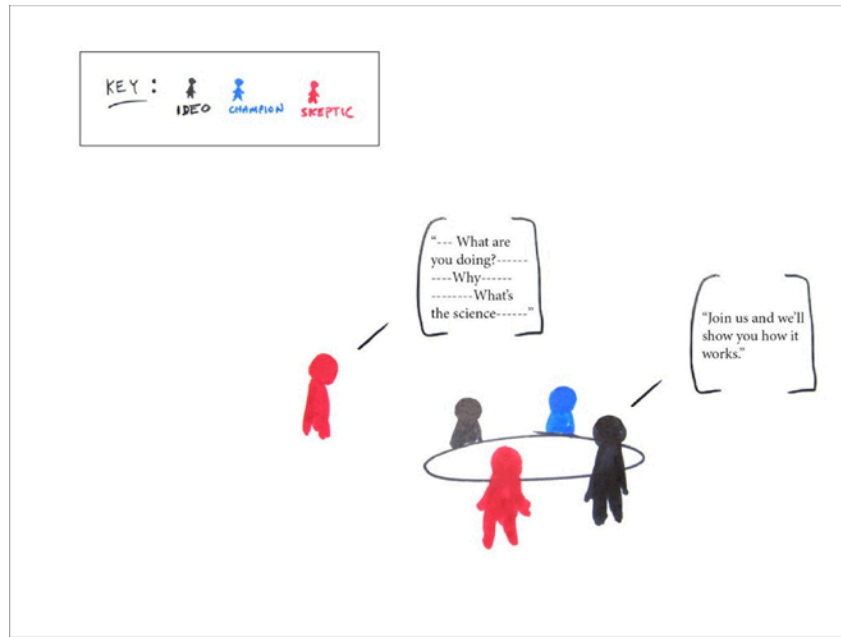
APPENDIX C: IDEO CONVERTING SKEPTICS BRIEF

Converting Skeptics

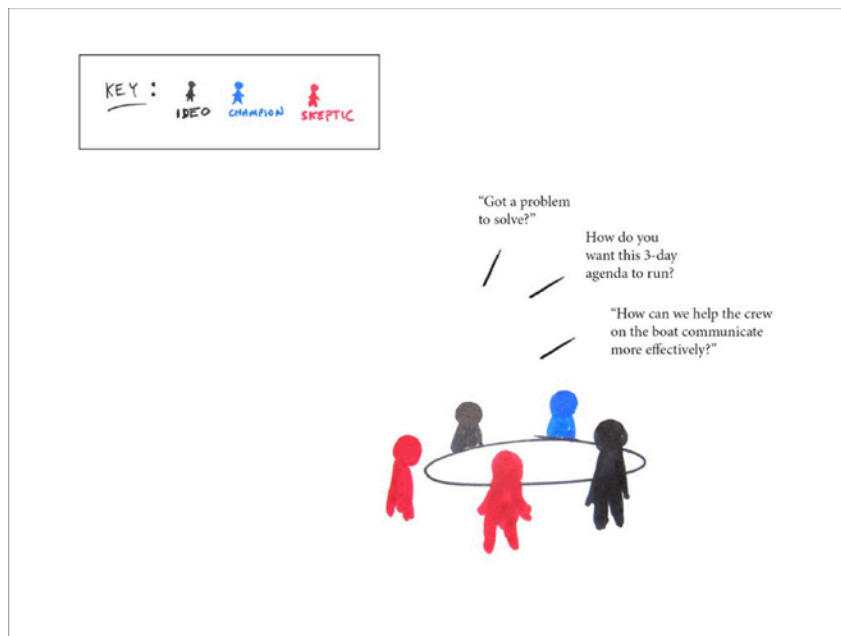
a.k.a. Viral Consulting,
a.k.a. Saving the World with Post-its



Our clients at the US Navy were hardcore skeptics; they wanted to know not just that our approach works, but why!



Each time a new skeptic appeared, we had them join us for a quick experience.



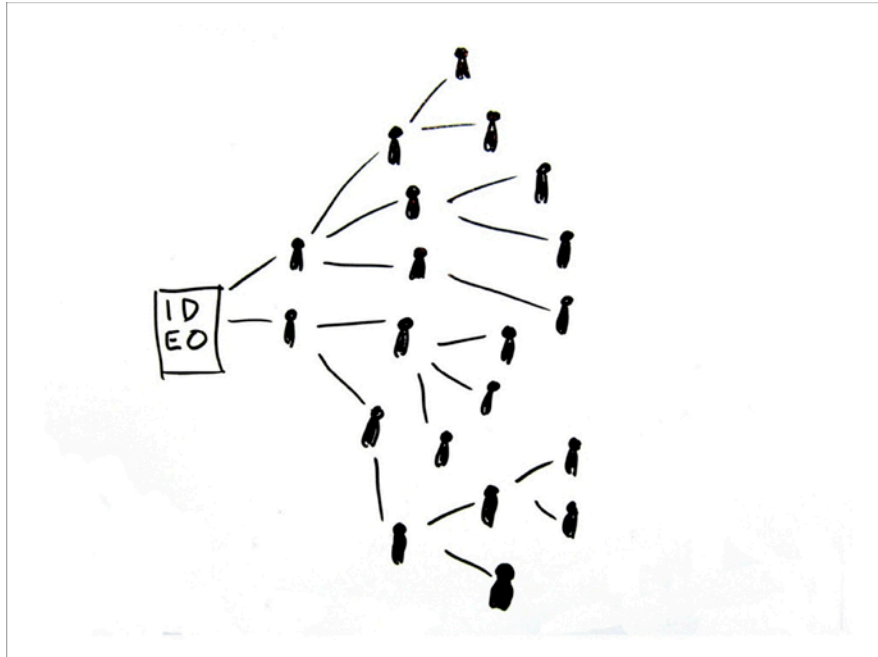
We conducted almost every discussion on this project as a collaborative brainstorm with our clients.



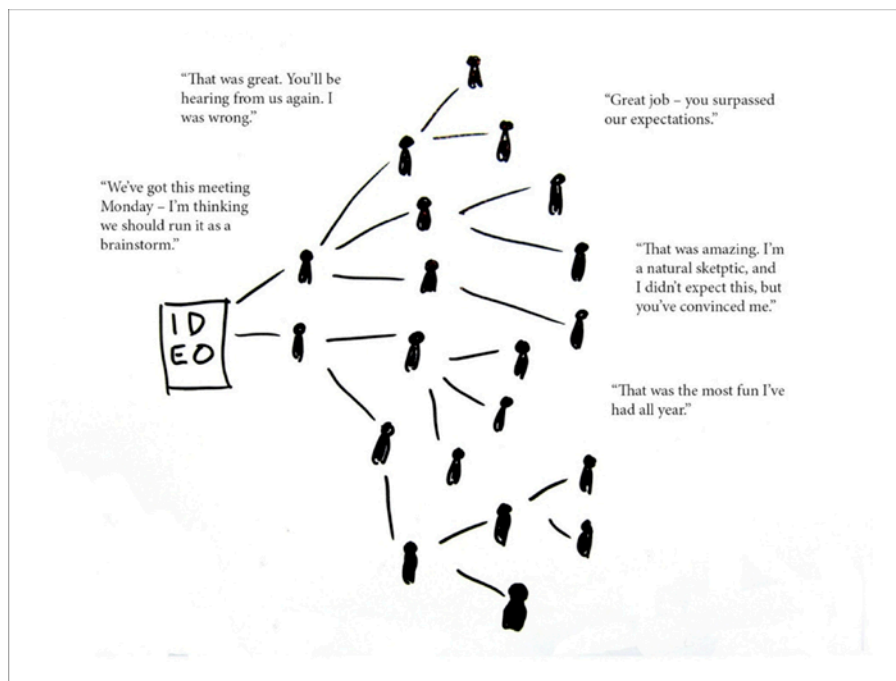
We didn't just expect them to be able to function in this new way. We taught them the rules and rhythms of our style of brainstorming. For example: write/draw your idea first, then put it up--not the other way around--to keep the flow going and avoid lengthy sessions of talking that don't create any tangible output.



The wow! experience of quickly and energetically addressing difficult questions turned skeptics into champions.

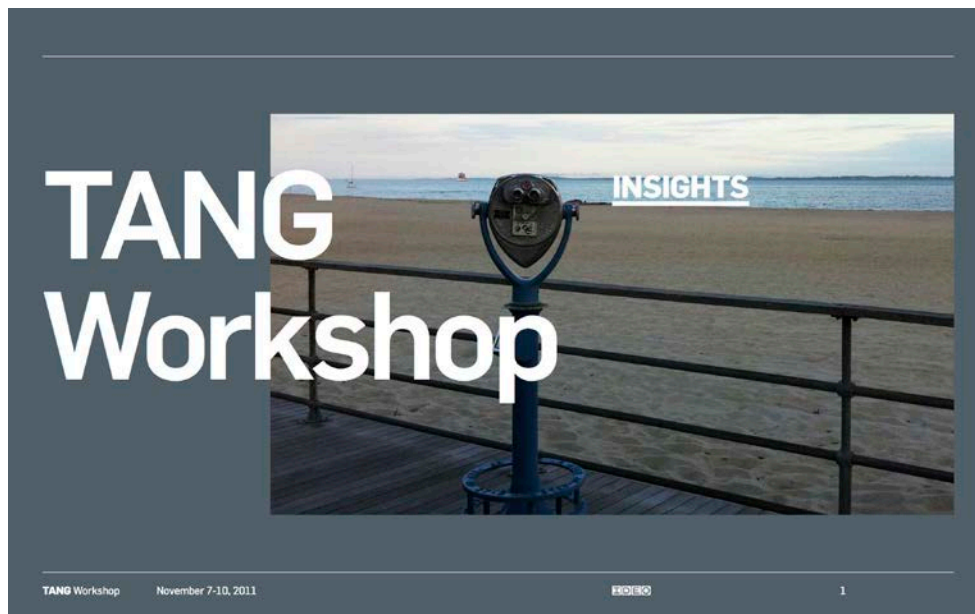


These champions became our allies, and helped spread support through the organization for what we were doing.



By the end of the project, we had turned "haters" at the top levels of the US Navy-- Commodores and Admirals--from skeptics into champions for a generative approach to solving problems.

APPENDIX D: TANG WORKSHOP INSIGHTS



OUR RESEARCH PROCESS

To better understand the needs of sailors, IDEO conducted in-depth interviews, sub visits, briefings with SMEs, and initial brainstorming with waterfront personnel.



TANG Workshop November 7-10, 2011



2

Insights

We synthesized 9 insights from our research into 3 clusters.

- ● ● **1. FLOW & INTEGRATION**
- ● ● **2. BUILDING SHARED UNDERSTANDING**
- ● ● **3. SYSTEMS THAT ENABLE**



FLOW & INTEGRATION

**Processes and information flows
need to support multidirectional
communication.**

"That serial process of going through checklists breaks
down when things get intense."

— **Junior Officer**

FLOW & INTEGRATION

Watch teams need to be able to shift rapidly back and forth between specialized solo tasks and collaborative work.

"In high contact density situations, people get left behind, and we stop correlating."

— **Officer**

FLOW & INTEGRATION

Lack of integration and consistency across the various combat systems make collaboration and information sharing more difficult.

"Everybody puts out their own tech manual. Not even all the parts of our system talk together."

— **Sonar**

BUILDING SHARED UNDERSTANDING

The majority of incidents stem from a breakdown in shared mental model.

"All the info's in there, but we're not doing a good enough job of getting it out there onto the surfaces."

— Sonar

BUILDING SHARED UNDERSTANDING

Team dynamics should encourage the communication and resolution of conflicting information.

"At the end of the day, it's not like "this guy didn't do well." It's like "our section didn't do well.""

— Sonar

Challenges and limitations of putting STs and FTs next to each other in the control room point to the need for hardware, software, and workflow changes to support a new collaborative model.

"They've moved everyone into one space, but how much have things changed?"

– Officer

There are already many useful tools built into the systems, but not everyone knows how to get to them and how to use them.

"To learn this new tool, guys have to break this other habit that they've had to work hard to learn. And they're getting tested on things we don't actually use."

– **Fire Control/Sonar/Junior Officer**

SYSTEMS THAT ENABLE

Sailors with a strong knowledge of fundamental principles are able to “challenge the systems” and perform better in difficult situations.

“The newer systems are doing all the work, so there's too much reliance—the base knowledge is lost. With strong fundamentals, I get better results faster.”

— **Sonar**

SYSTEMS THAT ENABLE

Greater synchronization between training experiences, system builds, and at-sea operations would make it easier for sailors to focus on the most important knowledge and skills.

“I went to (Boat X), and nothing I was taught in A-school applied.”

— **Fire Control**

Insights

FLOW & INTEGRATION

1. Processes and information flows need to support multidirectional communication.
2. The majority of incidents stem from a breakdown in shared mental model.
3. Team dynamics should encourage the communication and resolution of conflicting information.

BUILDING SHARED UNDERSTANDING

4. Watch teams need to be able to shift rapidly back and forth between specialized solo tasks and collaborative work.
5. Lack of integration and consistency across the various combat systems make collaboration and information sharing more difficult.
6. There are already many useful tools built into the systems, but not everyone knows how to get to them and how to use them.

SYSTEMS THAT ENABLE

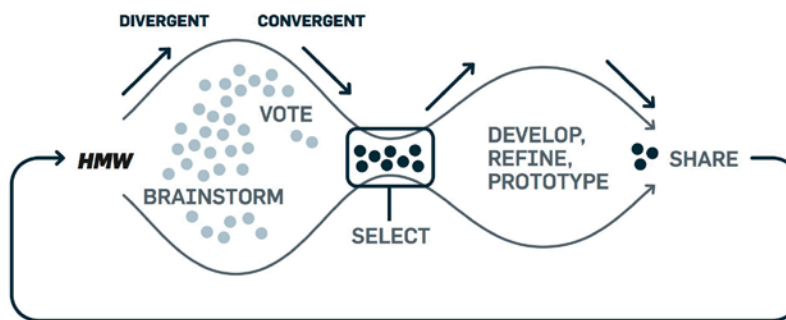
7. Sailors with a strong knowledge of fundamental principles are able to "challenge the systems" and perform better in difficult situations.
8. Greater synchronization between training experiences, system builds, and at-sea operations would make it easier for sailors to focus on the most important knowledge and skills.
9. Challenges and limitations of putting STs and FTs next to each other in the control room point to opportunities for hardware, software, and workflow changes to support a new collaborative model.

CHALLENGES BECOME OPPORTUNITIES

By asking **HOW MIGHT WE...** we turn the challenges posed by research insights into opportunities for design.



HOW MIGHT WE help sailors learn every day?



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APPENDIX E: IDEO'S POTENTIAL SUBJECT MATTER EXPERT INTERVIEW GUIDE

-----SME INTERVIEW GUIDE-----

1. Intro--quick bio
2. About us...
3. About our project: We are helping APL plan and conduct a workshop to drive innovation around technology and communication on the subs. We are focusing on human needs as a primary inspiration point.

Do you have any thoughts on this?

4. What is going well that you think new development should build on?
 - Technology:
 - Human Systems/processes:
 - Other:
5. What keeps you up at night? Any ideas about how you would like to see that addressed?
6. What do you think is most frustrating to the guys on the subs?
7. Where do you see shipboard operations and technology going in the next 5 years?
8. If you could wave a magic wand at a sub, what would you make happen?

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APPENDIX F: IDEO'S WATERFRONT INTERVIEW GUIDE

Waterfront Interview Guide

1. Intro--quick bio: Please tell us a little about yourself.
 - Navy history
 - Role/rank
 - Home/family/hobbies
2. A bit about IDEO...
3. About our project: We are helping plan and conduct a workshop to drive innovation around technology and communication on the subs. We are focusing on human needs as a primary inspiration point.

[Any thoughts on this?]
4. What attracted you to submarines?
5. What do you like about being on a sub? (look for stories)
6. What do you find frustrating? (look for stories)
7. What is going well that you think new development should build on?
 - Technology
 - Human Systems/processes
 - Other
8. If you could change anything, what would you change?
 - Hardware
 - Software
 - Team dynamics
 - Experience
 - Other
9. What do you find yourself asking for from others?
10. What are the communications that happen outside the digital/electronic systems?
 - Verbal
 - Written
 - Other
11. What keeps you up at night? Any ideas about how you would like to see that addressed?
12. What are the differences between operating in a training module and

operations at sea?

13. How can sub systems support continuous improvement of human performance?
14. Where do you see shipboard operations and technology going in the next 5 years?
15. If you could wave a magic wand at a sub, what would you make happen?

LIST OF REFERENCES

- Anonymous, interview by Thomas Hall. *Offline Group Discussion with Submarine Officers* (August 24, 2012).
- . Interview by Thomas Hall. *TANG Thesis Research Interviews* (August 2012).
- Barrett, Frank J. *Yes to the Mess: Surprising Leadership Lessons from Jazz*. Boston: Harvard Business Review Press, 2012.
- Benamati, John & Albert L. Lederer. “Rapid Information Technology Change, Coping Mechanisms, and the Emerging Technologies Group.” *Journal of Management Informations Systems*, 2001: 183–202.
- Boehm, Barry and Victor R. Basili. “Software Defect Reduction Top 10 List.” *Software Management*, January 2001: 135–137.
- Boland, Richard J. Jr and Fred Collopy. *Managing as Designing*. Stanford: Stanford University Press, 2004.
- Brown, Tim. *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. Harper Collins, 2009.
- CAPT William R. Merz, USN. *Welcome to TANG!* November 1, 2011.
- CBS News. *Sergio Marchionne: Resurrecting Chrysler*. March 25, 2012.
<http://www.cbsnews.com/video/watch/?id=7403188n> (accessed September 16, 2012).
- Cross, Nigel. *Design Thinking*. New York: Berg, 2011.
- Dannemiller, Kathleen D. and Robert W. Jacobs. “Changing the Way Organizations Change: A Revolution of Common Sense.” *Journal of Applied Behavioral Science*, 1992.
- Defense Science Board. *Report of the Defense Science Board Task Force on Defense Software*. Federal Report, Washington D.C.: Office for the Undersecretary of Defense for Acquisition and Technology, 2000.
- Dizikes, Peter. *The Secrets of the System*. May 2, 2012.
<http://web.mit.edu/newsoffice/2012/manufacturing-beer-game-0503.html>
(accessed October 28, 2012).
- Eveleens, J. Laurenz and Chris Verhoef. “The Rise and Fall of the Chaos Report Figures.” *IEEE Software*, Jan/Feb 2010: 30–36.

- Flemming, Alex. *Making a Submarine Officer: A Story of the USS San Francisco (SSN-711)*. New York: ACF Consulting Services, 2011.
- Good, Carter V. "Case Study and Case Work." *The Journal of Educational Research* 35, no. 3 (November 1941): 218–220.
- Govindarajan, Vijay and Chris Trimble. *The Other Side of Innovation: Solving the Execution Challenge*. Boston: Harvard Business School Publishing, 2010.
- Haidt, Jonathan. *The Righteous Mind: Why Good People are Divided by Politics and Religion*. New York: Pantheon Books, 2012.
- Hasso Plattner Institute of Design at Stanford. "Bootcamp Bootleg." *The d.school*. <http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf> (accessed September 9, 2012).
- Hausbach, Josh, interview by Thomas Hall. *TANG Thesis Research Interview* (August 23, 2012).
- Haygood, David, interview by Professor Frank Barrett. *Video Story?* (September 5, 2012).
- Haygood, David, Dave Blakely and Dan Soltzberg, interview by Professor Frank Barrett and Thomas Hall. *Designers at IDEO* Palo Alto, CA, (August 29, 2012).
- Hornstein, Henry. "Using a Change Management Approach to Implement IT Programs." *Ivey Business Journal Online*, 2008: N/A.
- IDEO. *About IDEO*. <http://www.ideo.com/about/> (accessed September 3, 2012).
- . "IDEO Design Thinking Simulation at Naval Postgraduate School." Monterey, CA, April 27, 2012.
- . *IDEO People*. <http://www.ideo.com/people/david-haygood> (accessed September 5, 2012).
- . *Shopping Cart Concept for IDEO: Redesign of the Shopping Cart for ABC's Nightline*. <http://www.ideo.com/work/shopping-cart-concept> (accessed September 3, 2012).
- . "TANG Weekly Report: Week of 17 Oct 2011." Planning and Progress Report, 2011.
- . *TANG Workshop Insights Memo*. Palo Alto, 2011.

- Isaacson, Walter. *Steve Jobs*. New York: Simon & Schuster, 2011.
- Jordan, Dr. Kenneth L. *The NMCI Experience and Lessons Learned: The Consolidation of Networks by Outsourcing*. Case Study, Washington D.C.: Office of the Deputy Assistant Secretary of Defense Forces Transformation and Resources, 2007.
- Kelley, Thomas with Jonathan Littman. *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*. New York: Random House Digital, Inc., 2001.
- Kelley, Thomas. *Tom Kelley at the Creativity World Forum 2008: Helping Organizations to Innovate Through Design*. December 1, 2008.
http://www.youtube.com/watch?v=VeXO1gQJ__M (accessed September 5, 2012).
- Kotter, John P. *Leading Change: Why Transformation Efforts Fail*. 1995.
- . *The Heart of Change: Real-Life Stories of How People Change Their Organizations*. Boston, Massachusetts: Harvard Business School Publishing, 2002.
- Kundra, Vivek. “Vivek Kundra - FY 2012 Information Technology Budget.” *The American Council for Technology (ACT) - Industry Advisory Council (IAC)*.
<http://www.actgov.org/knowledgebank/governmentit/Documents/Vivek%20Kundra%20FY%202012%20Information%20Technology%20Budget%2002%2024%2011.pdf> (accessed September 6, 2012).
- Lawrence, Paul R. “How to Deal With Resistance to Change.” *Harvard Business Review*, May/June 1954: 3.
- Legris, Paul and Pierre Colletette. “A Roadmap for IT Project Implementation: Integrating Stakeholders and Change Management Issues.” *Project Management Journal*, Dec 2006: 64–75.
- Liedtka, Jeanne and Tim Ogilvie. *Designing for Growth*. New York: Columbia University Press, 2011.
- Long, Suzanna & David G. Spurlock. “Motivation and Stakeholder Acceptance in Technology-Driven Change Management: Implications for the Engineering Manager.” *Engineering Management Journal*, 2008: 30–36.

- Mahoney, Bill, interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).
- Manke, Tim, interview by Thomas Hall. *Guided Tour of Submarine in Groton, CT* (August 24, 2012).
- . interview by Thomas Hall. *TANG Thesis Research interview* (August 23, 2012).
- March, James G. “Exploration and Exploitation in Organizational Learning.” *Organizational Science*, 1991: 71–87.
- Martin, Roger L. *The Design of Business: Why Design Thinking Is the Next Competitive Advantage*. Boston: Harvard Business Press, 2009.
- Maxfield, Francis N. “The Case Study.” *Educational Research Bulletin*, March 1930.
- Moore, Geoffrey A. *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers*. HarperCollins Publishers, 1991.
- Navy Warfare Development Command. *Junior Leader Innovation Symposium*. June 6, 2012.
<https://www.nwdc.navy.mil/ncoi/jlis/Junior%20Leader%20Innovation%20Symposium%20Videos/Forms/AllItems.aspx> (accessed September 9, 2012).
- Office of Management and Budget. “Fiscal Year 2009 Information Technology Budget.” *The White House*. April 15, 2009.
http://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/FY09_IT_Budget_Rollout_AprilUpdate.pdf (accessed September 7, 2012).
- Patnaik, Dev and Peter Mortensen. *Wired to Care: How Companies Prosper When They Create Widespread Empathy*. San Mateo: FT Press, 2009.
- Rockwell, Theodore. *The Rickover Effect: How One Man Made a Difference*. Lincoln, NE: iUniverse, Inc., 2002.
- Rowland, Ray, interview by Thomas Hall. *TANG Thesis Research Interview* (August 24, 2012).
- Seeger, John A, Jay W. Lorsch and Cyrus F. Gibson. “First National City Bank Operating Group (A).” Boston: Harvard Business School, 1974.
- Senge, Peter M. *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday, 1990.
- Smith, Joshua D. and Donald Noyes. *E-mail with Microsoft Word document clarifying several points with respect to TANG*. September 16, 2012.

- . *TANG Brief to Professor Frank Barrett's Change Management Class* (August 17, 2012).
- Smith, Joshua D., Brad Wolf, Don Noyes and Mandy Natter. "Junior Officer Watch Team Innovation Conference." White Paper, Johns Hopkins University Applied Physics Lab, 2010.
- Smith, Joshua D. *JOIT Forum Initial Planning Meeting Notes*. Laurel, MD, June 16, 2011.
- . interview by Thomas Hall. *TANG Thesis Research Interview* (September 13, 2012).
- Soltzberg, Dan, interview by Thomas Hall. *TANG Thesis Research Interview* (November 4, 2012).
- Sontag, Sherry and Christopher Drew. *Blind Man's Bluff: The Untold Story of American Submarine Espionage*. New York: Public Affairs, 1998.
- Stake, Robert E. *The Art of Case Study Research*. Thousand Oaks: SAGE Publications, 1995.
- Stapleton, John, interview by Thomas Hall. *How Shopping Cart Almost Killed TANG?* (September 5, 2012).
- . interview by Thomas Hall. *TANG Thesis Research Interview* (August 8, 2012).
- Steckler, Nicole. "Charlotte Beers at Ogilvy and Mather Worldwide (A)." *Managing Change*. Harvard Business School, 1995. 141–159.
- Submarine Development Squadron 12. *Tactical Advancements for the Next Generation*. January 11, 2012. <http://www.youtube.com/watch?v=i9kxffGWU8M> (accessed September 1, 2012).
- Taylor, Gregory S. *NMCI: History, Implementation and Change*. Master's Thesis, Monterey: Naval Postgraduate School, 2006.
- The Hackett Group. "IT Projects Delivered Late and Over Budget." *Internal Auditor*, Oct 1998: 14.
- The Johns Hopkins University Applied Physics Lab. *About APL*.
<https://www.jhuapl.edu/aboutapl/default.asp> and
<http://www.jhuapl.edu/aboutapl/heritage/default.asp> (accessed September 1, 2012).

- . *Our Work*. <https://www.jhuapl.edu/ourwork/civilspace/default.asp> (accessed September 1, 2012).
- . *Sub Tech Symposium*. <http://www.jhuapl.edu/sts/> (accessed September 8, 2012).
- Trigon. *ORGsimONE Business Simulation Game*. 2012.
http://www.trigon.at/en/_trigonSpecials/planspiele/beratungsangebot/orgsimone.php?sub1=17&sub2=131 (accessed October 5, 2012).
- Tupper, Scott, interview by Thomas Hall. (September 10, 2012).
- United States Government Accountability Office. *GAO.gov*.
http://www.gao.gov/highrisk/agency/omb/better_it.php (accessed September 23, 2012).
- . *OMB and Agencies Need to Improve Planning, Management, and Oversight of Projects Totaling Billions of Dollars*. Testimony Before the Subcommittee on Federal Financial Management, Government Information, Federal Services, and International Security, Committee on Homeland Security and Governmental Affairs, U.S. Senate, Washington, D.C.: United States Government Accountability Office, 2008.
- United States Navy. *Admiral John M. Richardson Biography*.
<http://www.navy.mil/navydata/bios/navybio.asp?bioID=440> (accessed September 14, 2012).
- . *Commander, Submarine Group Two*.
<http://www.public.navy.mil/subfor/csg2/Pages/SubmarineDevelopmentSquadronTwelve.aspx> (accessed September 22, 2012).
- VanRoekel, Steven. “FY 2013 IT Budget Overview.” *The American Council for Technology (ACT) - Industry Advisory Council (IAC)*.
<http://www.actgov.org/knowledgebank/governmentit/Documents/FY2013-IT%20Budget%20Overview%2002-13-12.pdf> (accessed September 6, 2012).
- Verganti, Roberto. *Design-Driven Innovation: Changing the Rules of Competition by Radically Innovating What Things Mean*. Boston: Harvard Business Press, 2009.
- Vice Adm John M. Richardson, USN. “TANG” – *A Vision for the Future*. January 17, 2012. <http://comsubfor-usn.blogspot.com/2012/01/tang-vision-for-future.html> (accessed September 1, 2012).
- Wooley, Anita Williams, Christopher F. Chabris, Alex Pentland, Nada Hashmi and Thomas W. Malone, “Evidence for a Collective Intelligence Factor in the Performance of Human Groups,” *Science* 330 no. 6004 (October 2010).

Yin, Robert K. *Case Study Research: Design and Methods*. Thousand Oaks: Sage Inc., 2009.

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