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SYSTEMS ENGINEERING CAPSTONE REPORT

USNA SAIL TRAINING CRAFT ACQUISITION: EFFECTIVE STAKEHOLDER MANAGEMENT THROUGH APPLICATION OF THE SYSTEMS ENGINEERING PROCESS

by

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December 2020

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The United States Naval Academy (USNA) does not possess an effective management plan for the acquisition of the 44-foot Navy sail training craft (STC), which has led to cost overruns and late deliveries. A review of the past acquisitions of the Mark I and Mark II STC revealed a possible effective solution is a stakeholder management plan. This capstone project answers the question of how the USNA might utilize the systems engineering process to develop an effective internal stakeholder management strategy that generates effective and actionable requirements for the acquisition of the next-generation STC while preserving a predictable and timely acquisitions process. Utilizing tools and techniques developed by data collection, this research found the essential elements to a successful stakeholder management plan are to identify, analyze, engage, and monitor stakeholders. These essential elements integrated with techniques used in corporate America, such as managing for stakeholders and the stakeholder circle, can reduce friction and issues within the STC program for the USNA. Identified avenues for future research are utilizing the systems engineering process for the development of structural stakeholder management elements, improving stakeholder management requirements elicitation, and developing stakeholder management plan validation methods.

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EFFECTIVE STAKEHOLDER MANAGEMENT THROUGH APPLICATION OF THE SYSTEMS ENGINEERING PROCESS

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LIST OF ACRONYMS AND ABBREVIATIONS

CCC	Configuration Control Committee
DAG	Defense Acquisition Guidebook
DAS	Defense Acquisition System
DAU	Defense Acquisition University
DoD	Department of Defense
DoDI	Department of Defense Instruction
EMD	Engineering and Manufacturing Development
ESE	Education Support Equipment
ICD	Initial Capabilities Document
IMS	Integrated Master Schedule
MDD	Material Development Decision
MOP	Measure of Performance
MSA	Material Solution Analysis
NAVSEA	Naval Sea Systems Command
O&S	Operations and Support
PEO	Program Executive Office
PMBOK	Program Management Book of Knowledge
PMI	Program Management Institute
PMS	NAVSEA Program Office
P&D	Production and Deployment
STC	Sail Training Craft
TMRR	Technology Maturation and Risk Reduction
USNA	United States Naval Academy

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EXECUTIVE SUMMARY

The U.S. Naval Academy (USNA) requires a framework for the development of Sail Training Craft (STC) requirements among internal stakeholders involved with the acquisition of a new Navy-44 STC. Historically, the acquisition of the Sail Training Craft (STC) at the United States Naval Academy (USNA) has been challenging due to an extensive list of stakeholders, unique requirements, and multi-faceted use. The competing interests of various stakeholders and the corresponding STC requirements resulted in an inefficient and overly competitive process. Additionally, the utilized requirements generation process lacks the formalism necessary to accurately capture stakeholder needs. Accordingly, the USNA sponsor, CDR Todd Greene, has requested assistance to apply a systems engineering process-based approach to stakeholder management for the acquisition of the next generation STC.

The purpose of the project is to apply the systems engineering process to the development of a comprehensive stakeholder management plan to better manage the requirements generation aspect of the acquisition of the United States Naval Academy's STC. The STC project has four primary objectives to complete the recommended stakeholder plan to the project sponsor:

- Explore and identify the applicability of the systems engineering process to stakeholder management.
- Identify methods to assess stakeholder's level of responsibility and impact in the acquisition of the STC.
- Investigate how the application of the systems engineering process can streamline the internal processes of USNA's procurement of the STC.
- Deliver a stakeholder management plan to the project sponsor.

The STC project was initiated with a literature review centered on the STC. The contextual application of STC research guided the literature review to assess the functional nature of the STC and the historical STC requirements. Consequently, the STC findings

and assessments reflected two critical conclusions regarding the STC program. First, the lack of a formalized requirements generation process has frustrated the STC program and caused extensive delays and additional disjointed requirements. Second, the lack of a formalized internal acquisitions management process has enabled conflict among internal and external stakeholders, resulting in significant negative impacts to cost, schedule, and performance.

The research methodology utilizes the systems engineering process to develop an effective stakeholder management plan. Specifically, the Defense Acquisition University (DAU) defines the systems engineering process as a five-step iterative process consisting of: Requirements Analysis, Systems Analysis Control, Functional Analysis, Design Synthesis and Verification and Validation.

Applying the systems engineering process and qualitative research techniques resulted in additional focused literature reviews as part of the research methodology. Requirements analysis collected data through a focused literature review and communication with the program sponsor. Specifically, the literature review focused on the acquisition of the STC Mark I and the STC Mark II. The requirements analysis resulted in a stakeholder objectives hierarchy that identified and prioritized the requirements of a potential solution for a stakeholder management.

Additionally, a separate literature review focused on determining the essential elements of an effective SMP. This literature review was focused on reference stakeholder management sources (the Program Management Book of Knowledge [PMBOK], the Defense Acquisition Guide [DAG] and articles by the Program Management Institute [PMI]) as part of the Systems Analysis and Control portion of the systems engineering process. These essential elements were identified as the activities of identify stakeholders, analyze stakeholders, engage stakeholders, and monitor stakeholders.

Finally, another focused literature review focused on creating an inventory of modern stakeholder management techniques that could potentially form the foundation of a stakeholder management plan. This review was conducted as part of the Functional Analysis portion of the systems engineering process. This inventory of techniques also facilitated the formulation of discrete performance measures by identifying those capabilities that stakeholder management could provide to an organization. These performance measures were developed as part of the Systems Analysis and Control portion of the systems engineering process. A total of 11 techniques were inventoried and from these techniques 17 binary performance measures were identified

The design synthesis portion of the systems engineering process utilized a morphological box to identify and assess potential stakeholder management techniques for the development of a stakeholder management plan. The morphological box identified all the capabilities that a particular inventoried technique provided, thus allowing comparison across techniques based on the supposition that more capabilities is preferred since there are no real costs associated with these capabilities. Evaluation showed that the Stakeholder Circle is the preferred technique for the development of the SMP, partially due to its ease of implementation for non-experts.

Findings and Conclusions

Returning to the research objectives, there was a concerted effort to explore and understand the applicability of the systems engineering process to non-quantitative domains, and how the systems engineering process could lead to more effective processes with better outcomes.

The application of the systems engineering process to the development of a stakeholder management plan for the acquisition of the STC demonstrated the capabilities and limits of the systems engineering process. Requirements analysis necessitates a full and complete understanding of the problem and in doing so sets conditions for a properly scaled and scoped solution. However, the process is obviously less well suited for dealing with the undefined requirements that are simply a part of stakeholder management. The critical analysis that undergirds the systems engineering process is highly valuable in any context and a tailored and deliberate deployment that acknowledges the limitations of the process in certain situations can prove highly effective.

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I. INTRODUCTION

A. BACKGROUND

Historically, the acquisition of the Sail Training Craft (STC) at the United States Naval Academy (USNA) has been challenging due to an extensive list of disparate stakeholders, unique requirements, and multi-faceted use. The STC is a relatively simple craft, yet has no fewer than 11 identified formal and informal stakeholders, representing both government, public, and private interest (T. Green, email to author, April 23, 2020). In addition to the competing interests from multiple stakeholders, the STC remains subject to the federal acquisitions process.

This project seeks to provide the necessary framework to identify and manage key stakeholders, provide potential actions for the orderly and usable generation of requirements, and align actions in time with the overall acquisitions process. During the summer of 2019, the USNA began the process of producing requirements for the MK III STC, and problems reminiscent of previous acquisitions are beginning to reveal themselves. As the requirements generation process began Commander Todd Greene, USNA, expressed concerns:

> We are falling into the oldest, and most well-traveled, pitfall in government acquisition. We are skipping to step 34, when no one had considered steps 1–33. We didn't have a process, didn't have a plan. It was and still is a recipe to repeat the previous STC acquisition failures. (T. Greene, email to author, April 23, 2020)

Understanding the problem first requires the basic knowledge of all the factors that contribute to the unique consortium of STC stakeholders, as well as their contributions, proximity and relevance to the program, and potential individual authority. Secondly, addressing the problem requires acquiring fundamental knowledge of stakeholder management theory and practice in order to formulate an effective and practical project management strategy for the USNA. Finally, to develop and integrate an effective stakeholder management plan, the USNA needs to remain cognizant of applicable acquisitions processes.

Previous STC acquisitions highlight the need to change existing processes to improve cost and schedule performance. Past programs ran behind schedule and over budget due to unstable requirements and a high number of contract modifications. In speaking with stakeholders from the USNA, the unstable requirements are due multiple injections of requirements from competing stakeholders.

The STC acquisition is a unique United States Naval Academy (USNA), but to the Department of Defense (DoD) the procurement of the STC follows all the same requirements other acquisitions follow. The procurement of the USNA STC falls under the Defense Acquisition System (DAS). This procurement must follow all DoD directives, regulations, and laws for the procurement of goods and services. Previous STCs were procured using the DAS and were procured through the PMS 325 office, which is an entity within PEO Ships under Naval Sea Systems Command (NAVSEA).

The DAS contains many different avenues to procured goods and services. However, typically in the DoD, goods are procured with the framework that is the DoDI 5000.2 framework. This framework follows the following acquisition five-phase process: Material Solution Analysis (MSA) Phase, Technology Maturation and Risk Reduction (TMRR) Phase, Engineering and Manufacturing Development (EMD) Phase, Production and Deployment (P&D) Phase, and the Operations and Support (O&S) Phase. The acquisition process normally begins with an Initial Capabilities Document (ICD) in a Material Development Decision (MDD) to determine if a material solution should be considered. Throughout this entire process, a contracting office will work in parallel with the program office to develop and manage the contracts.

Previous STCs were procured using the PMS 325 office with the traditional use of the acquisition process. As with other DoD acquisitions, the STC acquisition can be tailored to best meet the needs of the stakeholders and the USNA. In order to streamline the acquisitions process in the National Defense Authorization Act for Fiscal Year 2016, the DoD was authorized to use Middle Tier of Acquisition consisting of rapid prototyping which leads to rapid fielding.

In the case of the STC, requirements are addressed and the decision to procure new STCs has been made by the relevant stakeholders. Accordingly, the new STC process begins in the MSA Phase. The project focuses on SM throughout all five phases of the acquisition process with the management of the stakeholders and how information flows from the USNA to PEO Ships.

B. PROJECT OVERVIEW

Naval Academy leadership needs a recommended sequence of events and critical actions to guide the USNA through a successful STC acquisition (T. Greene, email to author, April 23, 2020). An internal management plan would allow decision makers to communicate effectively with the most important stakeholders at the correct time in the acquisitions process. To avoid delays, conflicts and friction, the USNA leadership needs to correctly identify stakeholders and their relevance during the phases of acquisition. Integrating the management plan with the systems engineering process would allow the USNA to correctly align efforts and communicate at the correct time during the acquisition. The STC is a unique acquisition due a mission that benefits many stakeholders. The USNA needs a way to manage the development of the STC while maintaining good working relationships with PEO Ships and the contracting agency and simultaneously avoiding the alienation of key stakeholders.

The project sponsor at the USNA identified historical cost growth as a major concern during previous STC acquisitions. The previous acquisition of the STC, known as the MK II, had an original contract for 24 STCs at a total cost of $16.5 million dollars (T. Greene, email to author, April 23, 2020). After multiple contract modifications, the cost grew to nearly $18 million for only 16 STCs, an increase of $363k per STC on contract. Further problems occurred with late deliveries. The MK II contract required Pearson to deliver the first STC in January of 2005, but the USNA did not receive the first delivery until October 2007 (T. Greene, email to author, April 23, 2020).

Accomplishing the goals and objectives outlined in this report requires knowledge of multiple disciplines. These disciplines include, but are not limited to, the systems engineering process, current management processes used at the USNA and a background on stakeholder management processes. The integration of these disciplines leverages the functional analysis approach to mitigate the risk of increased costs and delayed deliveries.

C. ISSUES IN STC ACQUISITION

Previous STC acquisitions experienced multiple contract modifications, significant cost growth, and late deliveries that often translate to cost growth, as well as lost opportunity costs. There is evidence in the historical record that the difficulties associated with previous STC acquisitions were at least partly the result of a disjointed requirements derivation process, competing stakeholders, and a general lack of unity of effort (Miller, Pedrick, and Schweikert 2009; Nicholson 2020; McCurdy and Bonds 1996). Projects fail due to lack of formal stakeholder management in projects and because of weaknesses in qualitative methods (Aladpoosh, Sharoun, and Saman 2012). During interviews with CDR Todd Greene, USNA project sponsor, shares this belief and requested the development of a plan to manage the diverse group of stakeholders and the overall process in order to avoid the cost growth and late deliveries that have plagued previous STC acquisitions. Currently, the USNA does not employ a stakeholder management strategy for the design, development, and acquisition of the Navy-44 STC. Additionally, the requirements generation process lacks the formalism to accurately capture stakeholder needs. Most significantly the requirement generation process lacks the ability to clearly state the mission requirements and instead relies on a method of "just make it better," as stated in "Development and Initial Review of the Mark II Navy 44 Sail Training Craft":

> The difficulty of incorporating numerous changes in an existing design, led the Superintendent to decide in May 2001 to develop a new design. This expanded the specifications to over 30 pages. (Miller, Pedrick, and Schweikert 2009, 4)

Extant systems engineering method could support the development of a requirements generation process and stakeholder management strategy for the USNA. Developing systems engineering efforts into a quantifiable action plan may guide the Naval Academy in the development of a capability that fills gaps in the current design. Design efforts need to be supported by an aligned stakeholder management strategy bound by mission analysis that identifies capability gaps in the current design.

D. PROBLEM STATEMENT

The United States Naval Academy (USNA) does not currently possess an effective management plan for the regular acquisition of the 44-foot Navy Sail Training Craft (STC). Historically, the lack of an effective management plan has created significant delays, conflicts, and friction with the overall STC acquisitions process. An effective management solution requires a multi-faceted approach that seamlessly aligns with, and substantively supports, the Naval acquisitions process. Specifically, an effective solution must:

- Identify stakeholder management techniques to include their interests, motivations, and any existing hierarchies.

- Inventory and recommend effective stakeholder management tools, processes, or procedures applicable to those identified stakeholders.

- Identify the acquisitions process or range of possible processes for procuring the STC.

- Integrate identified stakeholder management tools into a comprehensive management plan that is compatible with the identified range of acquisitions processes.

E. AIM AND OBJECTIVES

1. Aim

The project aim is to apply the systems engineering process in the development of a comprehensive stakeholder management plan to better structure execution of the acquisition of the United States Naval Academy's STC.

2. Objectives

- Explore and identify the applicability of the systems engineering process to stakeholder management.
- Identify methods to assess stakeholder's level of responsibility and impact in the acquisition of the STC.

- Investigate how the application of the systems engineering process can streamline the internal processes of USNA’s procurement of STC.
- Deliver a stakeholder management plan to the project sponsor.

II. LITERATURE REVIEW

A. LITERATURE REVIEW PURPOSE

A review of relevant literature of the STC serves two distinct purposes:

- It looks to understand the current state of research regarding the STC and the history of the acquisitions of STC vessels.
- It acts as a foundational element of the research methodology by providing fundamental knowledge of the STC.

Accomplishing both tasks necessitated a multi-part structure to the review of literature. First, it requires understanding all those factors that contribute to the unique consortium of STC stakeholders, and then research into the dynamics that exist between them. As the review of literature is integrated as part of the research methodology, it must complement the research question. In this regard, the review of literature must clearly define what the STC is, from the point of view of all stakeholders, and assess the current state of STC related research.

Several key assumptions were made in designing the STC literature review. First among these is that the niche nature of the STC could potentially lead to a relatively small pool of available resources. Secondly, any information regarding the STC, historical and current, would prove useful, either in providing a contextual understanding of the STC or in understanding the relationships, motivations, and interests of identified potential stakeholders. Thirdly, due to the changing nature of federal acquisitions through time, sources older than 30 years would not be particularly relevant for understanding the acquisition of the STC but may be of use in placing the STC in appropriate historical and cultural context. These assumptions collectively led to the decision to conduct a literature review that was deliberately broad to capture as much information as possible.

Specific attention was devoted to the areas of STC history and STC acquisition requirements as these topics were believed to correspond to the minimum areas of knowledge required to properly understand the roles, both functional and cultural, of the

STC, and necessary to understand the processes, frustrations, or issues faced by previous STC acquisitions.

B. HISTORY OF THE STC

Articles related to the history of the STC often fell into the subcategories of historical involvement with training, or previous processes for requirements generation and STC acquisitions. As such, these articles provided necessary context for the cultural and academic role of the STC and how this role influences or impacts the requirements generation process.

Articles found on the history of the STC involvement in Naval training give an insight to why the STC exist and its use in the training of Navy officers. A recurring observation is how deeply entrenched sail training is to the Navy and Naval culture. The education and training offered at the U.S. Naval Academy are viewed as key factors in the professionalization of the Naval officer corps prior to the Civil War (Hunter 2006).

Overall, this history is important as general background on the STC in order to form a baseline in the research. Understanding the STC's typical uses and the historical training program conducted with the STC will drive future stakeholder management techniques. Hunter's article (2006) provides a comprehensive summary of the historical involvement with the Naval Academy education program. The young officers were evaluated before and after these training cruises, and those failing to show progress were dismissed. Summer cruises on the STC is a continued tradition of older experienced officers training midshipmen in not only the physical operations of the ship, but also teamwork and routine (Hunter 2006). These observations explain the disproportionate degree of involvement by senior leaders and former senior leaders.

For the past 50 years the STC has played a role in training midshipmen and the STC is a key concept to gaining experience (Mason 2017, 1). Mason goes on to note there is very little that has changed in the STC or the mission. This is an important observation moving forward as it is likely that the mission of the new STC will have very few changes as well. Historically the appearance over the years has not changed as all previous Navy 44 have looked very similar (Mason 2017).

The history of vessels and processes of acquisition give insight to who in the past were the influential stakeholders. McCurdy and Bonds (1996) explain that the initial stakeholders were the Naval Academy Sailing Squadron. This is relevant to any recommendations regarding methods in the stakeholder management process as it allows for the differentiation among identified stakeholders. Knowing how stakeholders have changed and evolved throughout history shows how the STC program and USNA have also evolved.

Previously, senior leadership's direct involvement in the development of the STC happened early and often in the development process. According to Bonds (1996), the development for the original Navy 44 began with a simple request to identify requirements for a new training craft (91). This provides critical insight into the informal genesis of the original STC requirement and could prove useful in future stakeholder analysis. McCurdy and Bonds further describe the process, providing insight into the processes used in the past STC acquisitions. Moving forward this adds value to know how the Navy operates and what has worked, or not worked, in previous procurement processes.

Further, McCurdy and Bonds described previous requirements development processes as including the Superintendent of the Naval Academy, and a directed study on the sailing program. The study group asked questions about what the sailing program was now, and where did the program need to go in the future (McCurdy and Bonds 1996, 96). McCurdy and Bonds explicit identification of the top leadership, the superintendent of the Naval Academy and Captain, as important stakeholders further define critical stakeholders and outlines the fractured nature of the STC acquisition process. Use of study groups by the USNA indicates additional stakeholders or at least potential stakeholders to consider for recommended processes or deliverables, and indicates the existence of some rudimentary stakeholder management attempts.

Miller, Pedrick, and Schweikert's 2009 article, "Development and Initial Review of the Mark II Navy 44 Sail Training Craft" describes the strategy and struggles of the current Mark II STC. The authors detailed the struggles that the Mark II STC faced and provide information regarding key stakeholders. The stakeholders mentioned believed they had the authority to approve key design decision and to give authority to others for design decisions. Miller, Pedrick, and Schweikert's study reveals how mission requirements have not changed since McCurdy and Bonds in 1989, but specifications have increased. This is a potential indicator of a broken requirements generation process, micromanagement, or both.

Miller, Pedrick, and Schweikert's 2009 study is useful since it provides insight to what to possibly expect from the next, from inception to delivery. The previous generation the Mark II, took 14 years to field and had issues with funding. Some stakeholders even called for a new design that directly impacted design times and construction (Miller, Pedrick, and Schweikert 2009). They also identified other stakeholders that had input in the design and that must be considered as part of the requirements generating process. Miller, Pedrick, and Schweikert explained that while NAVSEA has the funding, the USNA desired full control over all decisions. This is important when creating a stakeholder management plan to know that there may be friction between the stakeholders. This stakeholder friction is an issue identified by articles and requires consideration in any stakeholder management recommendations.

C. STC REQUIREMENTS

An understanding of STC requirements generation is necessary before any analysis into the subject. There is a key difference between developing an individual requirement, and the total STC requirement generation process. The ability for the Naval Academy to analyze, fully understand and quantify the mission objectives is key to develop requirements for the next generation STC. The reviewed literature shows there has been research into ways to improve the design of the STC at the component level. However, there needs to be further analysis into functional requirements (does the system perform as intended) and performance requirements (how does the system perform). It is important that the traditional requirements development process is applied to the STC as it would be to any other DoD system.

Generally, the prevailing trend regarding STC requirements seems to be based off incremental improvement of individual craft components. However, there is a considerable gap in findings on the justification of these requirements. It is clear that the STC has a unique mission and the offshore sail training program uses a designed and built craft that occupies a niche for the United States Navy and the rest of the sailing world (Miller, Pedrick, and Schweikert 2009). The unique mission set drives its requirements, but there is no standardization of requirements that are currently used. Typically, the requirements generation process produces multiple artifacts capturing requirements development. Examples of such artifacts from include (AcqNotes 2020):

- Requirements tracing.
- Capability development tracking and management (CDTM) Tool.
- Feasibility assessment.
- Requirements checklist.
- Joint capability area attributes.
- Joint service specifications guides (JSSG).
- Standardization.
- Requirement types.
- Requirements allocations.
- Requirements development sequence.
- Requirements evaluation.

None of these reports, or any functional equivalents, were found that outlined STC requirements generated from the Naval Academy leadership. This is indicative of a need for further research in the area of requirements generation as it relates to the STC. Documentation regarding requirements was found from generally two sources: PEO Ships PMS325I, and anecdotal accounts of mission sets.

The scope of the PEO specifications report explains the specification is for the construction of the 44’ Naval Academy MK II Sail Training Craft (STC). It goes on to describe the hull, mechanical, electrical, environmental, logistical, personnel, and verifying requirements for the STC are established within" (PEO Ships 2004). These specification references only include industry and statutory requirements consistent in sailing craft construction. There are no references made to mission requirements or any further analysis to Naval Academy requirements. The STC's principal characteristics and operational environment are described in the PEO report, and this is a good indication that the Naval Academy had some communication with the PEO with the purpose to develop STC requirements. Therefore, the assumption would be that some degree of analysis was applied to new design efforts.

Other accounts of requirements for the STC are not in the form of quantifiable research, but from anecdotal publications. *Practical Sailor* described the STC as "a sailboat intended to cruise and race and endure the wear and tear of 20 years in the water" (Nicholson 2020, 1). These requirements are not in doubt as to their validity; however, the methodology of the validation is in question. These requirements need to have some method to tie or trace them back to stakeholders and quantify their application to the STC from a USNA perspective.

There is a considerable gap in the findings related to the justification of requirements. Clearly, the Navy 44 has a unique mission set that spans more than half a century, the offshore training program serves a very peculiar purpose at the Naval Academy (Miller, Pedrick, and Schweikert 2009). The unique mission set drives the requirements put forth from a number of stakeholders. Unfortunately, these stakeholders seem to have a lack of structure in how requirements are generated and communicated. Finding consensus on the development of the Navy 44 Mk II project was challenging and difficult, described as "at times seemingly navigated by bureaucrats in a rowing shell with no coxswain to guide them" (Nicholson 2020, 1).

Mission requirements are identified in the current research and noted mission requirements include: "Safe for novices, low maintenance (high durability in an intensive training environment), offshore capability for trips to Bermuda with a semi-skilled crew of ten, and favorable treatment under existing rating rules" (Miller, Pedrick, and Schweikert

2009, 3). These stated requirements will be hard to quantify or evaluate, and subjective interpretation can lead to confusion in the design process.

It appears some suitability analysis was performed, but not quantified well. Miller, Pedrick, and Schweikert's (2009) articles says the STC sails 250 days in a typical training year. "Eventually, the annual cost of repairs and replacement of equipment, together with associated down time, would become substantial" (Miller, Pedrick, and Schweikert (2009). There clearly needs to be some analysis into maintainability, reliability, sustainability, and availability that need to be quantified. This analysis needs to be done for threshold and objective requirements to be clearly defined.

Most significant of note is that the requirement generation process lacks the ability to clearly state the mission requirements and instead relies on a method of "just make it better," as stated in "Development and Initial Review of the Mark II Navy 44 Sail Training Craft":

> Recommendation #1 was to reuse the existing M&R design. The Configuration Control Committee (CCC) continued to develop the detailed specifications for all parts of the design over the next three years. With the development of the IMS rule and advanced computer modeling, the late 90's saw a significant improvement in the understanding of sailboat design. This, combined with the loss of tooling for the M&R Navy 44 and the difficulty of incorporating numerous changes in an existing design, led the Superintendent to decide in May 2001 to develop a new design. This expanded the specifications to over 30 pages. (Miller, Pedrick, and Schweikert 2009, 4)

The extant research supports additional efforts into the development of an internal requirements generation process for the USNA. Systems engineering efforts into a quantifiable action plan would assist the Naval Academy to successfully develop a capability that fills gaps in the current design. Statements described in the article is that a Navy Captain passed down the rudder order

D. FINDINGS AND ASSESSMENTS FROM STC LITERATURE REVIEWS

The unique nature of the STC is reflected in its history and system requirements. The requirements demanded of the STC, or the difficulty in defining them, is also clear throughout the craft's history. The literature provides two critical insights into this persistent issue. First, at least some of the structural dynamics that drive the current friction related to the acquisition of the STC have existed for decades. Additionally, there is not currently an effective, formalized process to capture internal requirements that may be traced to functions and integrated into the acquisitions process. The history of ad hoc requirements generation, with no subsequent linkage to a functional need has led to significant frustration and delay in recent acquisitions.

In assessing the overall strength of the literature available regarding the STC, it is decidedly mixed. As expected, there was not a significant amount of volume of literature available on the STC due to its limited appeal as a research topic. However, the literature that was available proved to be informative, and valuable. Additionally, the information that was not there proved just as valuable in some cases as the information that was available. This is particularly true in the case of STC requirements and requirements generation. The lack of documentation with regard to these elements may reasonably be attributed to a lack of an effective process to generate and capture internal requirements.

Additionally, the history of the STC itself, as well as the history of STC acquisitions, lend significant support to the need to apply a systems engineering approach to the development of an internal acquisitions management process for the Sail Training Craft, specifically a stakeholder management plan. Typically, the Naval acquisitions process would be sufficient for the procurement of such a vessel. However, as previously noted, the STC is more than simply a 44-foot sloop to the USNA, and to the Naval Officers that trained on it. Due to these factors, there are significant stakeholders outside the traditional acquisitions process that seek to influence and shape the acquisition. This dynamic is compounded by the quantity of individuals and organizations that are served by the STC and thus desire input into its ongoing development. While stakeholder involvement is generally considered a positive development, when left unmanaged and unorganized, it can negatively impact the cost, schedule, and ultimate performance of the acquisition. Armed with an effective management plan for internal USNA stakeholders, future STC acquisitions should require less time and result in the delivery of a craft more responsive to stakeholder needs.

III. METHODOLOGY

The utilization of the systems engineering process to develop an effective stakeholder management plan as the system of interest provides a structure for the overall research effort. This framework delineates the desired outcomes or outputs that should be satisfied by the research methods. The systems engineering process is commonly defined as consisting of five distinct but interrelated steps (Defense Acquisition University [DAU] 2001):

- Requirements analysis.
- Systems analysis control.
- Functional analysis.
- Design synthesis.
- Verification and validation.

The process steps are distinct, but they are also iterative and interactive. However, for the purposes of this project, the steps were applied sequentially. Each step of the systems engineering process identifies the desired outputs necessary for the succeeding step (Figure 1).

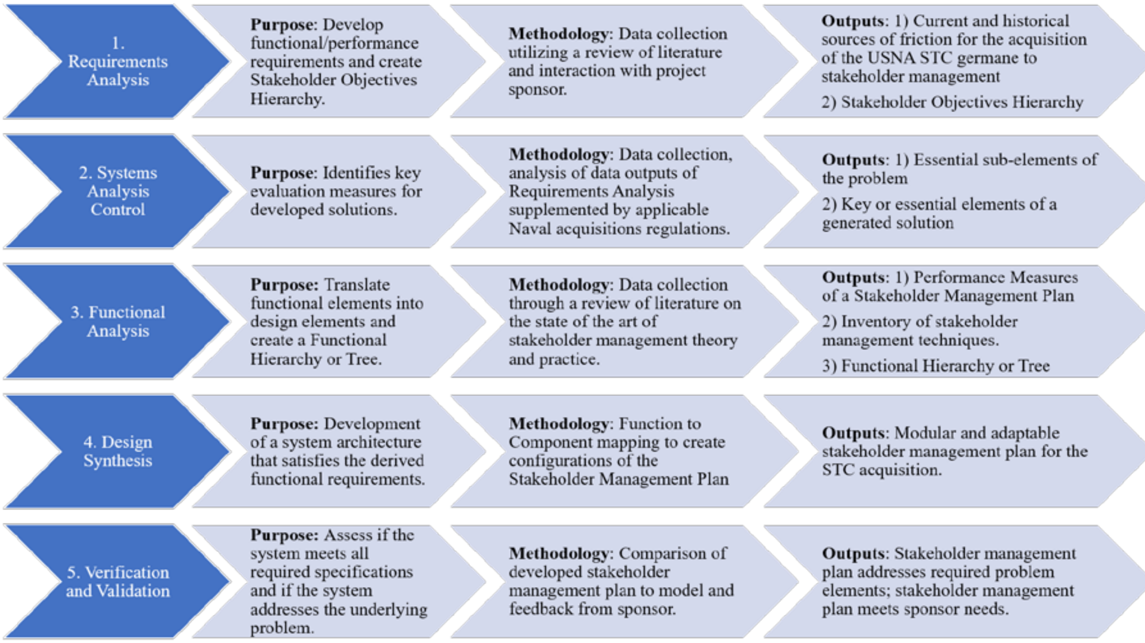

Figure 1. The Systems Engineering Process

The systems engineering process begins with Requirements Analysis with the intent to accurately identify and develop system requirements that define what the system must do (DAU 2001). For the STC problem set, Requirements Analysis will utilize a data collection methodology consisting of a focused literature review in conjunction with the project sponsor. The literature review will focus on the history of the STC, with particular attention to the nature of issues or friction points associated with previous acquisitions. The project sponsor will be utilized as a contemporary data source to provide insight into nature of the current STC acquisitions effort. The output of Requirements Analysis is an identification of those sources of friction to the STC acquisition process that are germane to the field of stakeholder management. An analysis of the data collected from the reviewed literature and the project sponsor should clearly identify *what* issues a stakeholder management plan should address. Furthermore, these objectives should be developed hierarchically with relative priorities assessed.

Following Requirements Analysis is Systems Analysis and Control. Systems Analysis and Control serves many purposes within the scope of project management. However, for the purposes of the research problem at hand, the focus will be the outputs of identifying essential sub-elements of the problem and the development of key evaluation measures for a developed solution. The research method utilized to accomplish this will be data collection via a literature review focused on identifying the required elements of an effective stakeholder management plan. Specifically, the review will focus on stakeholder management reference sources to identify consensus elements of a stakeholder management plan. These identified elements will form the necessary components of the stakeholder management plan developed for the STC (Figure 2). As Requirements Analysis focused on finding *what* a potential solution must do, Systems Analysis and Control will develop metrics or indices to evaluate potential solutions with regard to the stated requirements.

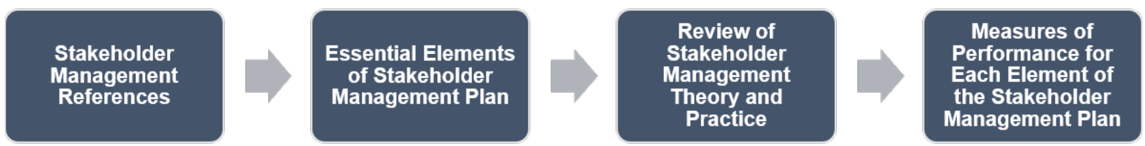

Figure 2. Development of Evaluative Metrics and Indices

At the conclusion of the Systems Analysis and Control is the Functional Analysis step. The purpose of Functional Analysis, sometimes referred to as Functional Analysis and Allocation (DAU 2001). The step of Functional Analysis defines the system to be developed in functional terms, translating the *what* of the requirements analysis into a collection of *how*, and further develops these elements into hierarchical groupings comprised of supporting sub-functions (DAU 2001). For the present problem, this will consist of using a focused literature review for data collection, and subsequently inventorying that collected data. The literature review will examine stakeholder management theory and practice over the preceding 15 years. The literature review will serve two purposes regarding Functional Analysis. First, this data will identify performance attributes of those stakeholder management elements identified during Systems Analysis and Control. In this manner, the review will provide performance measures for each functional element, with more effective methods necessarily performing a greater number of measures and providing greater value. Secondly, the literature review will also focus on identifying contemporary stakeholder management techniques, practices, and methods. Once identified these techniques will be analyzed and inventoried based on any explicit statements regarding to purpose, scope, scale, or environment. These attributes will also serve to associate the method with a supported essential element of stakeholder management plans. On completion, the identified essential elements, supporting performance measures, and inventories methods will form a morphological box that supports the identification of stakeholder management plans that possess all of the essential elements and provide maximum value to the project sponsor (Table 1). The key outputs of this step are an identification of the functional measures of those stakeholder management plan elements previously identified during Systems Analysis and Control, and an inventory of current and relevant stakeholder management techniques available for application to the STC problem set.

Table 1. Stakeholder Management Essential Elements and Measures of Performance

Essential Elements of a Stakeholder Management Plan									
	STAKEHOLDER IDENTIFICATION			STAKEHOLDER ANALYSIS			STAKEHOLDER ENGAGEMENT		
Measures of Performance:	Formal and Informal	Internal and External	Legitimate and Illegitimate	Assess Urgency	Assess Interest	Assess Impact	Degree of engagement	Type of engagement	Length of engagement

Following Functional Analysis is Design Synthesis. Design Synthesis is the development of a physical architecture, or multiple architectures, which satisfies those stated requirements derived from the decomposition of the functional analysis (DAU 2001). Applying this to the STC, the desired output is a modular and adaptable stakeholder management plan for the STC acquisition that is compatible with the Naval acquisitions process and timeline. As there could be multiple options that satisfy these criteria, potential solutions will be evaluated to determine the solution or solutions that are best suited for the STC problem set. The research methodology employed will center around a modified grounded theory approach. Those elements identified as critical or essential to an effective stakeholder management plan as part Systems Analysis and Control will form the baseline stakeholder management plan for the STC, in that it identifies the minimal components that an acceptable solution must possess. This baseline will then be modified and tailored by aligning specific stakeholder management techniques with the STC acquisition based on those measures of performance identified during Functional Analysis through the use of a morphological box (Table 2). Each developed solution will be assessed utilizing the criteria previously identified, with those methods addressing more measures of performance being assesses as preferable or more effective. Lastly, the stakeholder management plan will be sequenced to the Naval acquisitions process to fully support the STC acquisition.

Table 2. Example Stakeholder Management Morphological Box

Essential Elements of a Stakeholder Management Plan									
	STAKEHOLDER IDENTIFICATION			STAKEHOLDER ANALYSIS			STAKEHOLDER ENGAGEMENT		
Measures of Performance:	Formal and Informal	Internal and External	Legitimate and Illegitimate	Assess Urgency	Assess Interest	Assess Impact	Degree of engagement	Type of engagement	Length of engagement
Method A	✓		✓	✓	✓	✓			
Method B	✓	✓		✓	✓	✓			
Method C	✓		✓	✓		✓			
Method D							✓	✓	

The final step of the systems engineering process is Verification and Validation. This step assesses two distinct attributes of the designed system:

- Verification assesses if the system meets specifications.
- Validation assess if the specifications describe the problem owner's requirements (DAU 2001).

To verify that the stakeholder management plan developed for the STC meets specification, the plan will be evaluated using the key evaluation metrics developed as part of Systems Analysis and Control. This evaluative method will not only allow for a discrete evaluation of the developed stakeholder management plan but will also ensure deliberate decision making regarding potential functional trade-offs in the planning process. Validation of the stakeholder management plan will consist of a two-tiered approach, structural and functional. From a structural standpoint, the stakeholder management plan is validated by tracing a discrete plan element to a requirement generated as part of the Requirements Analysis. The stakeholder management plan may be functionally validated through an exit process with the project sponsor and as well as feedback from its eventual use. These activities will aid in answering the question of if the stakeholder management plan was properly developed and if a stakeholder management plan was the appropriate solution.

IV. ANALYSIS

A. REQUIREMENTS ANALYSIS: STC LITERATURE REVIEW

The requirements analysis phase of the systems engineering process determines what a proposed system must do and what capabilities deficits or performance gaps are to be addressed (DAU 2001). With regard to the stakeholder management plan (SMP), requirements analysis was accomplished via a two-pronged data collection approach consisting of a focused systematic literature review and dialogue with the project sponsor. On conclusion, requirements analysis should produce a stakeholder objectives hierarchy that identifies and prioritizes the requirements of a potential solution for a SMP. Further, in the current case, requirements analysis should also tacitly confirm or deny the assumption that a stakeholder management plan is an appropriate potential solution to the identified problem or problems.

1. Literature Review Methodology

A general literature review was conducted as an initial effort for this project. The requirements analysis literature review is a subset of the general literature review. However, there were several assumptions made prior to conducting the general literature review. First, it was assumed that the niche nature of the STC would limit the relevant literature available, especially the availability of any research-based literature related to the STC. Secondly, for the purposes of a general literature review, any information regarding the STC, both historical and current, could prove useful, either in providing a contextual understanding of the STC or in understanding the relationships, motivations, and interests of identified potential stakeholders. These assumptions collectively led to the decision to create a literature review methodology that was deliberately as broad to capture as many data sources as possible. The general methodology consisted of the following steps:

1) Drafting of broad keyword search terms to include common variants of key terms (i.e., Navy 44 is a common referent for the STC).
2) Application of the identified search terms to academic search engines.

3) Retrieval of all sources corresponding to the conducted search. Only clearly irrelevant items were excluded at this point.
4) Elimination of sources with a publication age greater than 35 years.
5) Content based review of all retrieved sources for relevancy. As part of the general literature review, those sources which discussed the history, requirements, and performance of the STC was included, as were sources including seamanship.

While this methodology was adequate for a general literature review, more rigorous and focused examination of the literature was required to properly generate requirements for SMP development in accordance with the systems engineering process. To narrow the scope, the requirements analysis literature review would focus only on those sources relating to the acquisition of post-World War II STC. This would limit the analysis to the acquisition of the Mk I STC during the 1980s and the acquisition of the Mk II STC in the early 2000s. While this narrow focus resulted in a far smaller source pool, those sources that remained were highly relevant and informative. For each acquisition, there was a comprehensive account of the process from design to delivery authored by participating individuals. This level of detail, access, and comprehensiveness offset the relatively small sample size available. The applied analysis consisted of constructing a general narrative of development for each craft, and identifying the drivers of friction in each process.

2. Analysis: The Mark I STC Acquisition

The acquisition of the Mark I STC began in 1981 when Captain Ned Shuman, Commanding Officer of Naval Station Annapolis and Commodore of the USNA Sailing Squadron, asked Captain John Bonds to begin developing the requirements for a craft to replace the Luder’s Yawls (McCurdy 1987; McCurdy and Bonds 1989). Figure 3 summarizes the acquisition timeline.

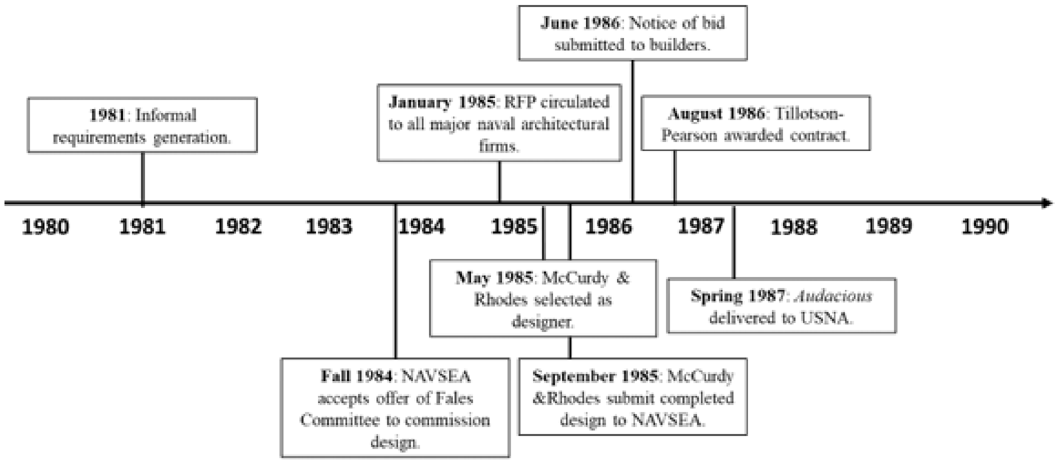

Figure 3. Timeline of the Mark I Acquisition

The USNA would not receive the first Mark I STC until the spring of 1987 when the *Audacious* was delivered for trial evaluations before the remaining craft would be delivered (McCurdy 1987; McCurdy and Bonds 1989). This journey from requirements generation to system delivery was significant in that it provides tangible insight into the operating dynamics internal to the USNA as well as those between the USNA and other peer or higher organizations such as NAVSEA. The issues encountered during the acquisition may be attributed to the lack of a formal process to identify, generate, and document requirements, a lack of consensus among internal stakeholders, and to the dual-purpose nature of the STC itself.

While the requirements generation for what would become the Mark I STC began in 1981, the acquisition did not officially commence until 1984 when an offer was made to NAVSEA to have the Fales Committee at the USNA commission a design for the next generation Sail Training Craft (McCurdy 1987; McCurdy and Bonds 1989). From that point in 1984, there were relatively few acquisition related issues and the first craft was delivered three years later in 1987. This essentially amounts to 3 years of requirements generation to update an existing capability. Some portion of this extended period was likely due to the informal nature utilized in the information and requirements generation process. The requirements generation process for the Mark I essentially consisted of Capt. Bonds asking all those individuals connected with sailing at the USNA a series of memorized questions and then collating the answers (McCurdy and Bonds 1989). While this proved to ultimately be effective, it was by no means efficient and did not allow for the dynamic exchange of information which often proves fruitful when identifying and developing requirements. The trade-off in the utilization of an informal process versus a formal process is one of efficiency. While there are circumstances where an informal process may be preferable, more formal processes provide more predictable timelines and overall less time.

The Mark I STC acquisition was also slowed by a lack of consensus among key internal stakeholders at the USNA. This too was likely at least partly the result of the informal and closed nature of the requirements process during the initial stages. While an informal process allows the collection of information discretely, a more formal process allows the open establishment of a common goal or vision among stakeholders. This potentially saves both time and facilitates the alignment of key stakeholders earlier in the overall process. This is lack of unity of effort is apparent in the early Mark I STC acquisition as the process is being driven by the Commanding Officer of Naval Station Annapolis who also serves as the Commodore of the Sailing Squadron, but the record is silent on the direct involvement of the USNA Superintendent or the Fales Committee until at least 1983 (McCurdy and Bonds 1989). The direct engagement and involvement of these key stakeholders earlier in the process could have set conditions for greater internal communications and allowed for simultaneous engagement with key external stakeholders such as NAVSEA. It should also be noted that under the modern budgeting process, there is direct fiscal benefit to providing earlier notice of a multi-million acquisition that may be forthcoming.

Finally, the dual-purpose nature of the STC also contributed to an extended and time-consuming requirements generation timeline. The STC is expected to perform both as a reliable and sturdy training craft, but still acquit itself well in a race (McCurdy and Bonds 1989). These two expectations often create direct conflict. The weight and sturdiness of benefit to new sailors only slows more experienced racers. This often led to friction among competing requirements, and additional time used to sort out the primary purpose. This is again an area where an early introduction of a more formalized methodology of engagement and requirements development could be beneficial. By facilitating more robust and frequent communication, it is possible that a degree of requirements friction could have been resolved prior to the documentation process.

An examination of the Mark I STC acquisition reveals several sources of friction and inefficiency that impacted the acquisition process. An acquisition that seeks to minimize the likelihood of encountering similar issues should incorporate practices and strategies that directly address these issues. As such, these issues become de facto requirements for any potential solution.

- Facilitate iterative, formal, and purpose driven engagements between all stakeholders that are clearly documented.
- Clearly establish the purpose, goals, roles, and responsibilities of all parties in order to promote unity and economy of effort.

3. Analysis: The Mark II Acquisition

Like the Mark I STC acquisition, the Mark II STC also faced multiple issues that directly impacted the cost and schedule of the acquisition. Discussions regarding the replacement of the Mark I STC began informally in 1996 (Miller, Pedrick, and Schweikert 2009). Figure 4 summarizes the Mark II acquisition.

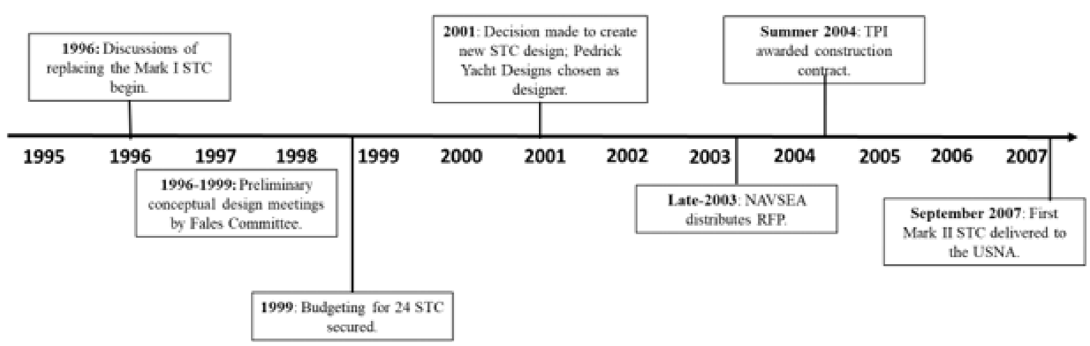

Figure 4. Timeline of the Mark II Acquisition

While the USNA intended to simply re-use the McCurdy and Rhodes Mark I design which had performed so admirably in the preceding years, they were unable to and were forced to commission a new design (Miller, Pedrick, and Schweikert 2009). Additionally, the events of September 2001 further delayed the project for a year and a half (Miller, Pedrick, and Schweikert 2009). The first Mark II design craft was delivered to the USNA in September of 2007, for a total project duration of 11 years (Miller, Pedrick, and Schweikert 2009). Even accounting for delays attributable to the unforeseen events of 2001, 11 years is a significant amount of time for a relatively simple craft that was accompanied by substantial specifications and performance data. An examination of the acquisition reveals that a large portion of this extended schedule is likely the result of specific acquisitions decisions that inadvertently created cascading negative consequences. Specifically, the decision to utilize an extremely detailed specification coupled with the decision to utilize Educational Support Equipment (ESE) funding versus standard procurement dollars to fund the Mark II acquisition (Miller, Pedrick, and Schweikert 2009). These issues are in addition to more mundane issues of stakeholder alignment and issues of communication, similar to those that plagued the Mark I STC acquisition.

The decision to utilize a detailed specification for the development of the Mark II STC was a result of multiple factors. First, the utilization of a detailed specification is common practice within the Naval acquisition community (Miller, Pedrick, and Schweikert 2009). Additionally, the use of a detailed specification was seen as a solution to the oppositional requirements of lower life-cycle costs (i.e., higher initial costs) while employing a lowest-cost acquisition strategy (Miller, Pedrick, and Schweikert 2009). The specification utilized for the Mark II STC often specified particular makes and models of components (PEO Ships 2004). While this was most often done to decrease life-cycle costs, it can often have unintended consequences during the acquisition phase (Miller, Pedrick, and Schweikert 2009).

The specification of highly specific makes and models of components meant that any deviation from this necessitated a change order for the builder, even if the specified part of component is simply not available. Occurrences such as this accounted for more than half of the total change orders associated with the STC Mark II acquisition (Miller, Pedrick, and Schweikert 2009). The impact of this is exacerbated when there is not an effective communications process to quickly process those change orders that are generated. This led to increased delays as the builder awaits government authorization, which can in turn lead to further change orders, creating a vicious cycle of change and delay (Miller, Pedrick, and Schweikert 2009).

In a perfect storm for the Mark II STC acquisition, communications between the designer, the builder, and the government were highly frustrated as NAVSEA policy at the time prohibited direct exchanges between the builder and the designer (Miller, Pedrick, and Schweikert 2009). While these impacts are directly traceable back to the decision to utilize a highly detailed specification, the key question is if the benefits of the highly detailed specification are worthwhile and its negative impacts should be mitigated or were the benefits achievable via an alternative means altogether. Such determinations can be made internal to the acquisition process if a properly scaled and formalized approach is used. Specifically, the record would seem to indicate that more clearly defined roles for PEO Ships, the USNA in general, and the Fales Committee specifically would have been beneficial. PEO Ships was placed in the unique position of spending the Fales Committee funding for a design while simultaneously abdicating its role as the primary driver of requirements due a lack of familiarity with small craft acquisitions (Miller, Pedrick, and Schweikert 2009). An early formal agreement regarding roles, responsibilities, and authorities would have created uncomfortable, but productive conversations. These engagements could lead to a more critical examination of specification framing, the long-term impacts of choices, and a quantifiable analysis of alternatives. A key example would be quantifying the functional difference between a detailed specification requiring a particular make and model of a component to preserve compatibility for maintainability reasons versus a performance specification that merely required such compatibility.

Just as the decision to utilize a highly detailed specification in the development of Mark II acquisition led to unintended consequences, so did the decision to utilize ESE funding. Seeking to acquire some degree of funding certainty for the STC, the USNA decided to utilize ESE funding, which could not be shifted before arriving to the USNA, versus traditional acquisition funding, which could easily be shifted prior to arriving to the actual Mark II STC acquisition (Miller, Pedrick, and Schweikert 2009). However, unintended consequences would once again lead to a more costly and time-consuming acquisition. Unlike acquisition funding, ESE funds are not allocated with any expectation of costs increasing as they are typically used for low-value, short-term contract (Miller, Pedrick, and Schweikert 2009). Some very simply analysis would have revealed the ill-advised nature of this decision.

Even the best-managed acquisitions experience some degree of costs growth, with the average for multi-year ship building being 10–15% (Miller, Pedrick, and Schweikert 2009). With no budget for cost growth, the Mark II STC would be forced to wait until the following fiscal year to authorize certain design changes (Miller, Pedrick, and Schweikert 2009). This not only lead to delays as fabrication awaiting funding, but also increased costs as contractor delay and disruption charges ballooned to four times the technical budget (Miller, Pedrick, and Schweikert 2009). The interaction between these delays fostering additional change orders as specified parts became unavailable cannot be overlooked.

Despite the well-meaning intention of ensuring reliable funding for a timely Mark II STC acquisition, the decision to utilize ESE funding had the total opposite result. The acquisition was over-budget and well over-schedule. There are tangible reasons that acquisition funding sources are used for acquisitions. The USNA would be better served by leveraging informal assets to influence the acquisition process versus utilizing non-acquisition dollars for the STC procurement. While an approach utilizing informal assets may not be successful, it will not directly increase costs or schedule. Further, utilizing non-traditional acquisition funding sources is demonstrated to offer no guaranteed benefit and may prove extremely costly. A process that incorporates the informal resources (social connections, previous positional or institutional experiences) of both the USNA and the Fales Committee could potentially provide significant return in the form of funding probability and amount. Based on this a potential acquisition approach could include an inventorying of the informal and social resources internally available to the USNA and Fales Committee that could potentially benefit the STC acquisition.

In addition to the difficulties discussed previously, the Mark II STC acquisition was also confronted with multiple communications related issues. Most prominent were issues stemming from a lack of clarity as to the proper responsible party. The design process was described as a “multi-headed Hydra” as multiple stakeholders articulated competing requirements (Miller, Pedrick, and Schweikert 2009, 6). The designer further stated that understanding the fundamental requirements of the STC was frustrated due to a lack of unity among the various stakeholders (Miller, Pedrick, and Schweikert 2009). These comments merit some degree of discussion as two distinct issues may be conflated in these observations. Undoubtedly, there was some degree of competing guidance to the designer from the many stakeholders, and to some degree this was due to a lack of a formal internal requirements generation process. A process that would have articulated the purpose of the STC clearly prior to engaging outside parties. All that being said, some degree of requirements competition must be attributed to the dual-purpose nature of the STC itself. This same conflict was seen during the Mark I STC acquisition. But rather than offering this dual nature as an explanation for the resulting communications challenges, it is further evidence for the need for a more formal and comprehensive internal process to facilitate requirements generation. Such a process would offer a unity of voice and effort to engaged third parties and create greater understanding of selected trade-offs for the USNA's internal stakeholders. A simple example is related to the deck plan for the Mark II STC. Civilian sail craft at the time were consolidating the sail controls to as few winches as feasible (Miller, Pedrick, and Schweikert 2009). The USNA, however, deliberately chose to avoid this in support of the sail training mission of the craft, despite it being preferred from a racing perspective (Miller, Pedrick, and Schweikert 2009). When such deliberate decisions are communicated openly to all stakeholders, it can create a greater shared understanding of purpose. This, in turn, should reduce conflicting voices and foster greater institutional unity.

The Mark II STC acquisition faced some similar issues to those faced by the Mark I STC acquisition but also some unique challenges. In order to develop a solution that mitigates or avoids these issues, the underlying causes must be addressed directly. An analysis of the Mark II STC acquisition indicates that a potential stakeholder management plan must:

- Clearly define the roles, responsibilities, and authorities of all stakeholders, both internal to the USNA and external or peer to the USNA.

- Clearly delineate the primary and alternate communications channels, as well as the responsible individuals or offices.

- To the extent practical, preserve institutional and organizational missions to maximize expertise and experience.

- Inventory and utilize both USNA formal and informal resources in support of the STC acquisition. Implicit in this is a unity of understanding and effort. Informal resources include social connections, previous positional or institutional experiences, etc.

- Properly sequence internal and external stakeholder engagement. The USNA will not be able to properly engage external parties (PEO Ships, potential designers, etc.) if proper internal stakeholder engagement is not conducted first.

4. Analysis: Project Sponsor

In detailing the genesis for the current research, the project sponsor (CDR Todd Greene, USN) outlined several concerns as they related to the Mark III STC acquisition. To an item, almost every concern was also articulated in the analysis of the Mark I STC and Mark II STC acquisitions. The primary issues discussed were overly detailed requirements that inhibits options in the requirements documentation. Another issue was the STC Mark II requirements documents often dictated the make and model of components, which removed any flexibility in the construction process. Additionally, there was budget and schedule issues of the Mark II STC. Specifically noted were the number of change orders (73) and the amount of assessed Delay and Disruption charges ($4.4 million). Finally, the clear lack of an identified plan for the internal processes of the USNA and Fales Committee, and by implication, a plan for the eventual transition to collectively working with external parties (Greene 2020).

The underlying causes for the drastic cost increases and schedule slippage of the Mark II STC were documented previously. Simply avoiding the decision to use ESE funding for the STC acquisition would likely ameliorate a majority of the budgetary and scheduling woes. However, such a decision was facilitated by a process that enabled stovepipe communication and did not encourage collective analysis or collaboration. Alternatively, processes that formally utilized open collaboration are better postured to avoid unintended consequences. As such, the degree of formal collaboration should be a deliberate factor in developing a process for STC development.

Both the historical record and the contemporary insights of the project sponsor identify the lack of a formal, structured internal acquisition plan as a key driver of acquisition issues. The lack of a structured and clear plan manifests its impact through poor communication, poor decision making, competing, or conflicting requirements, and general inefficiency. However, for a plan to be effective, it must be developed by the proper individuals and groups collaboratively and collectively. To do otherwise, is simply repeating the same mistakes via a different route as multiple key stakeholders will be excluded, roles will be unclear, and decision making will not be properly informed. From this perspective, in addition to the requirements described above, an effective potential solution to improve future STC acquisitions must:

- Identify and include all relevant internal USNA stakeholders for the development of an enduring STC acquisition process.
- Integrate and synchronize any developed internal STC acquisition processes or procedures with external acquisition processes.

5. Stakeholder Objectives

A consolidation of the requirements generated from an analysis of the Mark I and Mark II STC acquisitions, and those generated via the project sponsor generates the stakeholder objectives listed in Table 3. These objectives were prioritized based on potential impact and project sponsor preference.

Table 3. Stakeholder Objectives Hierarchy

PRIORITY	OBJECTIVE
1	Identify and include all relevant internal USNA stakeholders for the development of an enduring STC acquisitions process
2	Integrate and synchronize any developed internal STC acquisition processes or procedures with external acquisition processes
3	Clearly define the roles, responsibilities, and authorities of all stakeholders, both internal to the USNA and external or peer to the USNA
4	Inventory and utilize both USNA formal and informal resources in support of the STC acquisition. Implicit in this is a unity of understanding and effort. Informal resources include social connections, previous positional or institutional experiences, etc.
5	Clearly delineate the primary and alternate communications channels, as well as the responsible individuals or offices
6	To the extent practical, preserve institutional and organizational missions to maximize expertise and experience
7	Properly sequence internal and external stakeholder engagement. The USNA will not be able to properly engage external parties (PEO Ships, potential designers, etc.) if proper internal stakeholder engagement is not conducted first
8	Facilitate iterative, formal, and purpose driven engagements between all stakeholders that are clearly documented

B. SYSTEMS ANALYSIS AND CONTROL: REFERENCE STAKEHOLDER MANAGEMENT REVIEW

The Systems Analysis and Control phase is broken into subsections that identify essential elements problems in projects, essential elements of the possible solutions and the identification of performance measures. These three sections help identify the work that needs performed with the output of Measures of Performance (MOPs) for evaluating different elements and techniques of stakeholder management. These elements and MOPs were developed through a data collection and review of stakeholder management literature.

Articles about stakeholder management discussed stakeholder management problems and solutions for projects, techniques for dealing with stakeholders, how to identify who is most important, and how the stakeholders influence programs. The most referenced literature that discussed these topics was the Program Management Book of Knowledge (PMBOK), the Defense Acquisition Guide (DAG) and articles by the Program

Management Institute (PMI). Other books such as the *INCOSE Systems Engineering Handbook* and policies such as the Army Acquisition Policy AR 70-1, DoD Instruction 5000.02, and DoD Directive 5000.01, were also considered in this study. However, these documents were not used since they primarily discussed regulations and stakeholder requirements. Furthermore, the topics were too broad and did not discuss stakeholder management directly.

Among the major sources in this work, the PMI provided insight on why multiple stakeholders are a contributing factor to project failures. PMI conducted a series of surveys to collect information from project managers. These surveys would gather about the most defining characteristics of complex projects and the key to successful programs (Figure 5).

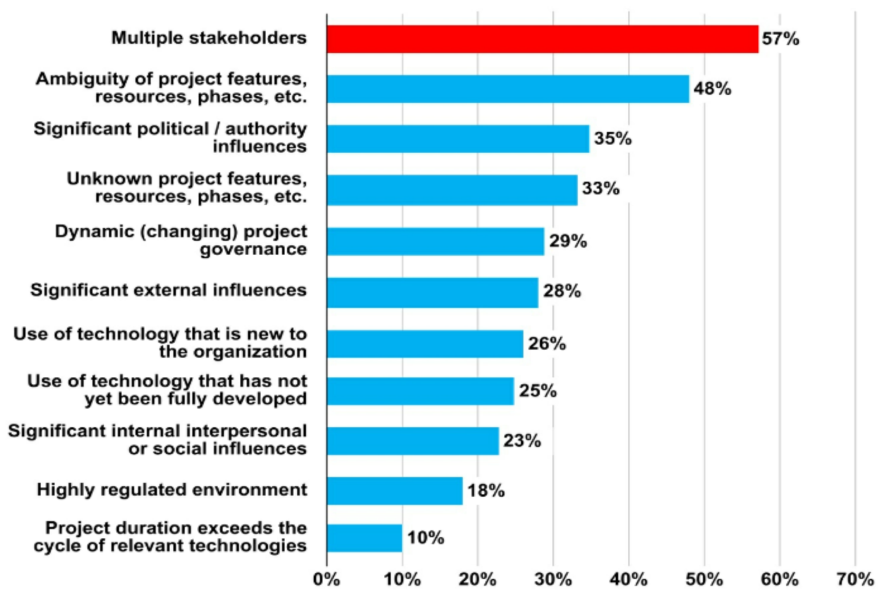

Figure 5. Defining Characteristics of Complex Projects.
Source: Barrow (2016).

According to another survey conducted by the PMI, project managers said effective communication to stakeholders is the most important to the program and a key trait of successful leaders (Barrow 2016, 205). This finding reveals that top leaders in acquisitions such as project managers believe that to be successful, one needs a good communication plan with stakeholders (Figure 6).

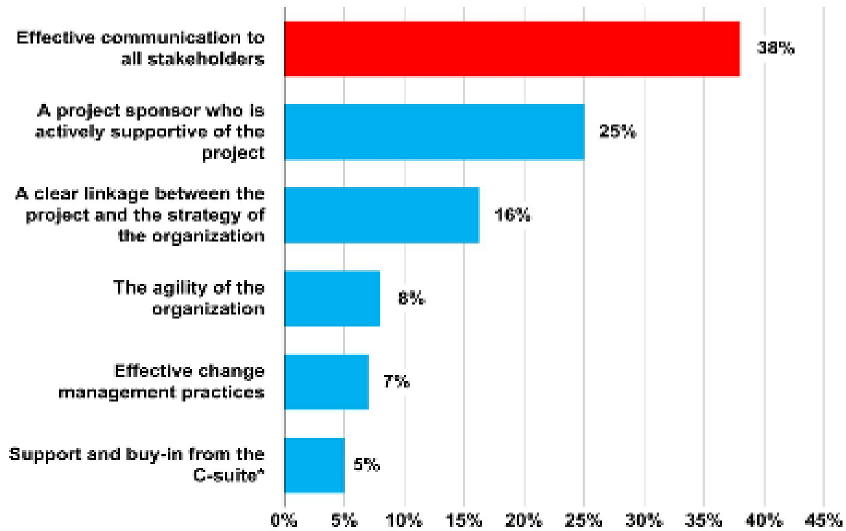

Figure 6. Keys to Successful Programs. Source: Barrow (2016).

Courtright and Smuddle's (2011) article a "Holistic approach to stakeholder management" discusses what stakeholders are and how describing them is helpful in building a stakeholder management plan. The authors say that classes of stakeholders are described as "having one, two, or all three of the following attributes: (1) the stakeholder's power to influence the firm, (2) the legitimacy of the stakeholder's relationships with the firm, and (3) the urgency of the stakeholder's claim on the firm" (Courtright and Smuddle 2011, 138). Categorizing stakeholders by attributes gives an understanding of how they have influence within the project.

Another article researched discussed ways to build and maintain relationships with key stakeholders. Courtright and Smuddle (2011) state that "communication is the key to maintaining relationships with stakeholders and, moreover, that communication must adhere to certain formal conventions which sufficiently and reasonably cover the drama of what is going on for an organization" (139). The PMBOK states that "the process of identifying and engaging stakeholders for the benefit of the project is iterative" (Project Management Institute 2018, 542). The PMBOK further details how although the processes appear to be a single occurrence, each process should be reviewed as the project moves to different phases; stakeholders change and evolve and major changes can occur in the organization or stakeholder community (Project Management Institute 2018).

As the literature that we have read has identified issues with stakeholder management, some provide evidence such as surveyed data. The next two sections of our literature analysis will further detail the essential problems of stakeholder management and examine solutions given from project management guidelines.

1. Essential Elements Stakeholder Management Problems in Projects

It is important to understand the problems that occur in current projects and stakeholders before searching for solutions. This section describes common elements that occur by conducting a literature review. Research into elements of stakeholder management problems revealed that problems occur due to complexity of programs and multiple stakeholders. Yeo (1995) argues that high complexity of projects brings about a major challenge due to the involvement of multiple stakeholders that leads to complex interrelationships and competing interest among the stakeholders (448).

Yang (2009) describes how using the wrong stakeholder management techniques contributes to problems in projects. The wrong techniques used in current stakeholder management methodology are problematic for a project like the STC due to its size and complexity. Aladpoosh, Sharoun, and Shaman (2012) argue that the few tools available are subjective and do not work because the current techniques are qualitative and lack quantitative analysis. Traditional stakeholder techniques categorize stakeholders and analyze their impacts based on individual attributes roles and attitudes, but these methods are constrained by incomplete stakeholder boundaries (Yang et al. 2009).

Authors such as Oppong, Chan, and Dansoh (2017) argue that "persistent stakeholder opposition contributes to delays and project failures" (1041). They argue that effective stakeholder management ensures transparency, openness and accountability of the process of decision making. Forsberg, Mooze, and Cotterman's (2005) *Visualizing*

Project Management also discusses stakeholder management and opposition and lack of teamwork contributes to failure. Different stakeholders pulling in different directions can create efficiency problems and put a strain on limited resources. The authors say that "most project teams, including stakeholders fail to adequately address teamwork factors" (Forsberg, Mooze, and Cotterman's 2005, 27).

Aladpoosh, Sharoun, and Saman (2012) addresses project failure due to weaknesses in stakeholder management (150). They argue that project management rarely uses a systematic stakeholder management approach that makes processes more formal and effective in achieving outcomes. They continue to describe that the reason stakeholder management plans are ineffective is that most projects do not focus on interactions among stakeholders but most of the effort is centralized on identifying stakeholders and analyzing the different relationship types (Aladpoosh, Sharoun, and Saman, 2012). In order to address areas where current stakeholder management techniques are lacking, the literature suggests that there needs to be a qualitative and quantitative approach. Research into what a good stakeholder management plan consists of needs to consider both approaches to address the shortcoming discussed.

2. Essential Elements of a Stakeholder Management Plan

The purpose of this section is to describe the consensus found during research of what the essential elements of a successful stakeholder management plan. Research literature about essential elements of a stakeholder management plan returned three major readings that discussed essential elements of a solution to stakeholder management issues. The most prevalent readings were the PMBOK, DAG and Program Management Institute. Though the PMBOK, DAG, and Program Management Institute all have different processes for the management of stakeholders, these three sources all have similar essential elements. The similarities between the PMBOK, DAG, and Program Management Institute show a consensus among essential elements of a stakeholder management plan.

Barrow's (2016) *Stakeholder Management: 50 Quick and Easy Ways to Become Brilliant at Stakeholder Management* argues that key skill areas identified in the PMBOK for stakeholder management are important, but there is so much more to a good stakeholder

Management plan. He goes on to say that elements of stakeholder management need to take the following actions:

- Engage stakeholders so that they are more likely to work with you, not against you, even if they do not agree with you.
- Communicate effectively with a diverse stakeholder community without it taking up all of your time.
- Manage difficult stakeholders and when to say no, even if you think your career may be on the line.
- How to get people to accept personal responsibility for delivery and how to hold them to account.
- How to motivate people and groups so that they act as a single, unified group in pursuit of a shared objective (Barrow 2017, 217).

The guidelines provided by Barrow represent a list of actions that need to be conducted to help manage stakeholders, though Barrow also acknowledges that this is not a complete list. This list of actions covers the communication and some management of stakeholders, which can solve the issue of management and communication. Although what these guidelines do not suggest is a way to manage or monitor stakeholders throughout an entire project.

According to the PMBOK, "The processes support the work of the project team to analyze stakeholder expectations, assess the degree to which they impact or are impacted by the project, and develop strategies to effectively engage stakeholders in support of project decisions and the planning and execution of the work of the project" (Project Management Institute 2018). In order to assess and analyze stakeholders and their impacts to a project, a project management process needs to be followed. The PMBOK describes the essential steps in the stakeholder management process:

- **Identify Stakeholders—**The process of identifying project stakeholders regularly and analyzing and documenting relevant information regarding their interests, involvement, interdependencies, influence, and potential impact on project success.

- **Plan Stakeholder Engagement—**The process of developing approaches to involve project stakeholders based on their needs, expectation, interests, and potential impact on the project.

- **Manage Stakeholder Engagement—**The process of communicating and working with stakeholders to meet their needs and expectations, address issues, and foster appropriate stakeholder engagement involvement.

- **Monitor Stakeholder Engagement—**The process of monitoring project stakeholder relationships and tailoring strategies for engaging stakeholders through the modification of engagement strategies and plans. (Project Management Institute 2018, 540).

The processes provided by the PMBOK represent a list of essential steps that need to be conducted to ensure a successful project. This list of actions covers the entirety of what a good stakeholder management plan should contain. The monitor step differentiates this process from the process Barrow discussed. This step is vital to allow stakeholder relationships to be maintained throughout the project.

A stakeholder management plan is typically built not just for initial project start, but for the entirety of the project. The engagement and monitor steps allow the process to flow through the life cycle of the project. The PMBOK (Project Management Institute 2018) further details the key inputs, tools and techniques, and outputs of each step (Figure 7).

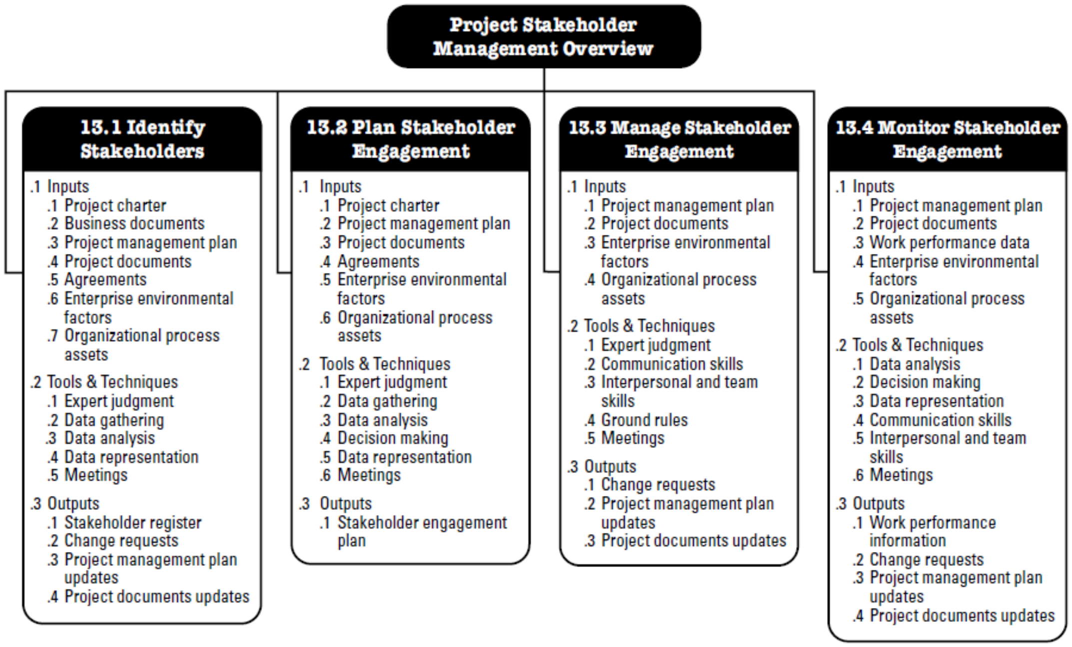

Figure 7. PMBOK Stakeholder Management Overview.
Source: Project Management Institute (2018).

According to Barrow (2016, 29) “the process of stakeholder management starts almost as soon as you have a potential project on your hands.” The stakeholder management Process is an iterative process that has distinct steps that can be revised and updated at any time. Barrow (2016) describes a ten-step process to executing the stakeholder management process:

1. Begin by reviewing your projects vision and see how it links to the business strategy or benefits.

2. Create a list of your project’s potential stakeholders, rank them in importance.

3. Connect with your key stakeholders, introduce yourself to them and explain your remit and what you aim to accomplish. Ask them about their take on the project, their expectations, concerns and needs. Confirm how often they want to be updated, what they want to be updated on and how they want to be kept informed.

4. Carry out a stakeholder analysis to clarify where your stakeholders stand, based on your conversations with them.
5. Identify key stakeholder relationships to understand potential stakeholder alliances and who may influence them.
6. Develop your Stakeholder Management Strategy so that you know how you plan to engage with your stakeholders.
7. Produce your Stakeholder Communications Plan and review it with your stakeholders so that they can see that you've taken their views and concerns into account. At the same time, produce your Stakeholder Engagement Plan that tells the story of your project and that of its stakeholders. This focuses on the feelings and emotions of your stakeholders.
8. Add your communications and engagement activities into your project plan so that you make time for your Stakeholder Management activities.
9. Put your Stakeholder Communications Plan into action. Aim to strengthen and deepen relationships with stakeholders and manage conflict between them.
10. Monitor your plans and adjust over time, but don't give up (Barrow 2016 29).

The ten-step process that Barrow presents shows a detailed process from identification to the monitoring of stakeholders. This process is very detailed and explains every step and since stakeholder management can be a difficult task to complete, a complete list of steps is necessary for success.

According to the DAG, a stakeholder management strategy should be developed to be program-specific by the Program Manager. The proven Stakeholder Engagement Process includes analysis, planning, and execution. The probability of success is greatly increased with the outcome of the Stakeholder Engagement Process. The DAG details the Stakeholder Engagement Process in Figure 8.

Figure 8. Stakeholder Engagement Process. Source: DAU (2020).

The DAG introduces this six-step process to stakeholder engagement that is comparable to what the PMBOK and Barrow say is a management plan. This technique is useful to this project because it identifies the same process steps that would be useful in a stakeholder management plan.

Barrow, the PMBOK, and the DAG describe four similar Stakeholder Management/Engagement Processes that can be used to increase the chances of a successful project. Three of the four processes contain identification, analyze, communication and monitor/evaluate. With the known issues of previous STC acquisitions and stakeholder management, these processes found can be expanded upon or tailored to meet the needs of the USNA. Therefore, the functional needs of the USNA STC stakeholders need to be identified to ensure those needs are properly nested with the overall solution for stakeholder management. The Venn diagram below shows the relationships between the essential elements described by the PMBOK, the DAG, and Barrow. By showing the relationships of all three methods, we are able to identify the elements that are most common to the three processes analyzed. The essential elements identified were Identify, Analysis, Engage, Monitor.

The identify essential element refers to determining stakeholder’s vs non-stakeholders, internal or external to the organization. Additionally, prioritizing the stakeholders by power, urgency and proximity and consider the operating environment with consideration to stakeholders. The analysis essential element simply assesses the influence, interest, power and analyzes social connections and networks to account for interactions between stakeholders. The engagement essential element is a plan to engage stakeholders with consideration to their equity, uniqueness and modify the plan based off the different stakeholders. The essential element of monitor is a plan to conduct assessments, monitor satisfaction and be transparent with the stakeholders.

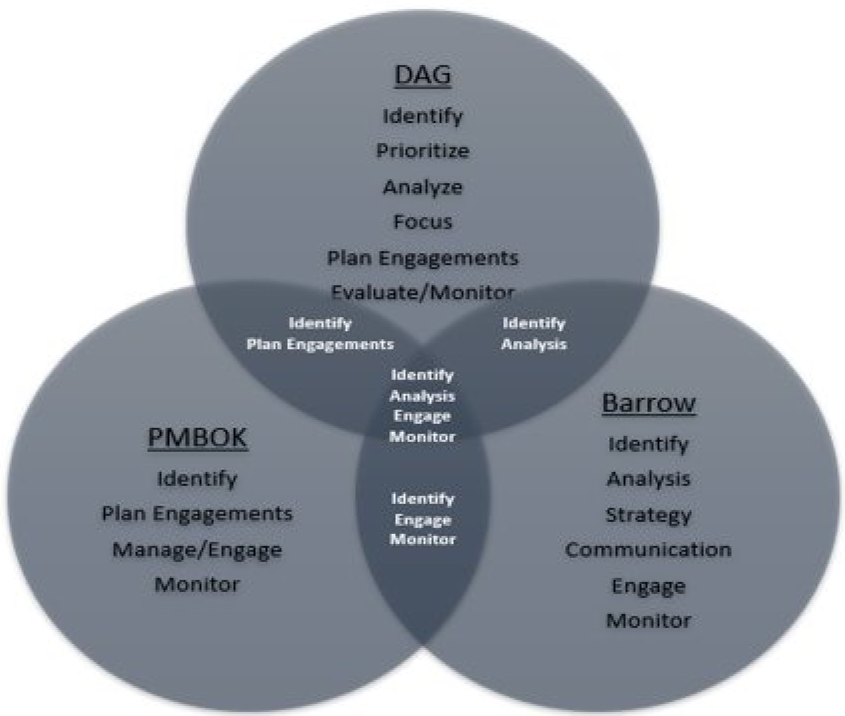

Figure 9. Essential Elements

3. Measures of Performance

The purpose of this section is to identify MOPs that evaluate possible solutions used to develop an effective stakeholder management plan. The MOPs developed were established by connecting what the essential elements of a stakeholder management plan can do, common measures used in stakeholder management techniques found during research and assigning the MOPs to one of the essential elements discussed in the essential element section of this chapter (identify, analysis, engage, and monitor).

Each metric provides a measure of performance for any plan developed to address the STC acquisition. Metrics will be assessed binarily as it eliminates subjectivity in the evaluation of the generated plans. The following MOPs are the result of this analysis.

a. Essential Element: Identification

Measure of Performance:

- Operating Environment—The plan or technique must identify and describe the operating environment of the program or organization and consider the dynamic of the stakeholders.

- Stakeholder vs Non-Stakeholder—The plan or technique must identify those that are stakeholders and separate them from those that are non-stakeholders.

- Internal and External—The plan or technique must identify stakeholders that are internally affiliated with the program and have official standing with the program. External stakeholders, such as contractors and subcontractors, have a stake in the program but can influence the internal stakeholders through interpersonal connections or rapport.

- Prioritizes Stakeholders—Must prioritize stakeholders by considering their power, urgency and proximity to the STC program.

b. Essential Element: Analyze

Measure of Performance:

- Assess Influence—Must analyze stakeholders or organizations direct and indirect ability to effectively influence, cause changes or outcomes.

- Assess Interest—Must analyze stakeholder interest and correlates directly with the level of concern in the program’s outcomes and costs.

- Assess Power—Stakeholder power is assessed according to their direct authority within the program. The identified power is analyzed for their ability to terminate or use their influence for change.

- Analyzes Social Connection and Social Networks—Must analyze the stakeholder's network to account for the interactions and interdependence among and between stakeholders.

- Assesses Engagement—Must assess engagement approaches to communicate with stakeholders and engagement strategies for all stakeholders.

c. Essential Element: Engagement

Measure of Performance:

- Considers Equity-The engagement plan must consider equity of the stakeholders.

- Disaggregates Stakeholders- Must separate stakeholder's uniqueness and characteristics.

- Tailored Engagement-Must have the ability to modify engagement plans for each stakeholder and organization.

d. Essential Element: Monitor

Measure of Performance:

- Follow-up Assessments- Technique or plan must allow for after engagements with stakeholders for successful implementation of identified corrections and updated communications.

- Monitors Satisfaction- Surveys, questionnaires or interviews to monitor stakeholders and their level of satisfaction. This measure helps ensure success in the program by attempting to keep stakeholders happy.

- Transparency—Must have the information easy to access and ensure there is open communication between the program and stakeholders. The meetings need to be available to the necessary stakeholders.

- Flexibility/Adaptability—The plan or technique must be modifiable when conditions change.

C. FUNCTIONAL ANALYSIS: STAKEHOLDER TECHNIQUE LITERATURE REVIEW AND TECHNIQUE

An inventory of techniques that our team have derived from the literature review are discussed and inventoried. Our team identified Measures of Performance (MOP), listed the technique attributes, and developed a hierarchy for application. The functional analysis leads to the design synthesis of the stakeholder management plan.

1. Inventory of Stakeholder Management Techniques

Research into stakeholder management theory revealed multiple methods utilized in the civilian sector and some that support the DoD perspective as outlined in the Defense Acquisitions Guidebook (DAG). The literature review process guided the research to present 11 different stakeholder management techniques that offer a variety of functionality to the STC problem. The 11 stakeholder management techniques are assessed by the essential elements of a stakeholder management plan (stakeholder identification, stakeholder analysis, and stakeholder engagement) and the corresponding measures of performance in the design analysis section.

Technique 1: Stakeholder Circle: Familiarity with stakeholders and their potential impacts is required and according to Bourne and Shelley (2008) should be carefully considered. The "success of an organization's activities to achieve its business strategies and objectives (often projects) depend on the engagement and involvement of the stakeholder community" (Bourne 2010, 5). Another important concept that was discovered during research is that stakeholder relationship management is complex and there is no formula to use to because each person is unique and the relationships is also complex (Bourne 2010). According to Walker, Bourne, and Shelley (2008) "A Stakeholder

Circle is a method that consists of five parts: step 1—identify; step 2—prioritize; step 3—visualize; step 4—engage; step 5—monitor" (9). Description of actions for these steps are found in Table 4.

Table 4. Stakeholder Circle Steps.
Adapted from Walker, Bourne, and Shelley (2008).

Step	Description
Step 1-Identify Stakeholders	Project stakeholders are identified and then categorized into groups indicating how they may influence the outcomes of the project: upwards for senior managers; downwards for members of the project team: sidewards for peers of the project manager and outwards for other stakeholder outside the project
Step 2- Prioritize Stakeholders	Prioritize stakeholders and assess their importance by power (power to influence or limit and proximity) and urgency (what is their stake and what lengths are the stakeholders willing to go to achieve their outcomes?
Step 3-Visualize Stakeholders	Transform the data from the previous steps into a Stakeholder Circle
Step 4-Engage Stakeholders	Identify engagement approaches to communicate with stakeholders and give special attention to the top stakeholders but develop engagement strategies for all stakeholders
Step 5-Monitor Effectiveness of Communication	Include the stakeholder communication and management plan in the schedule and regularly review stakeholder meetings results

When Stakeholder Circle steps are complete the finished product looks like Figure 10. Down the right side in the color key there is a list of stakeholders identified by different colors. Looking at the stakeholder circle each color correlates to a stakeholder to identify their importance and who how they are involved in the program.

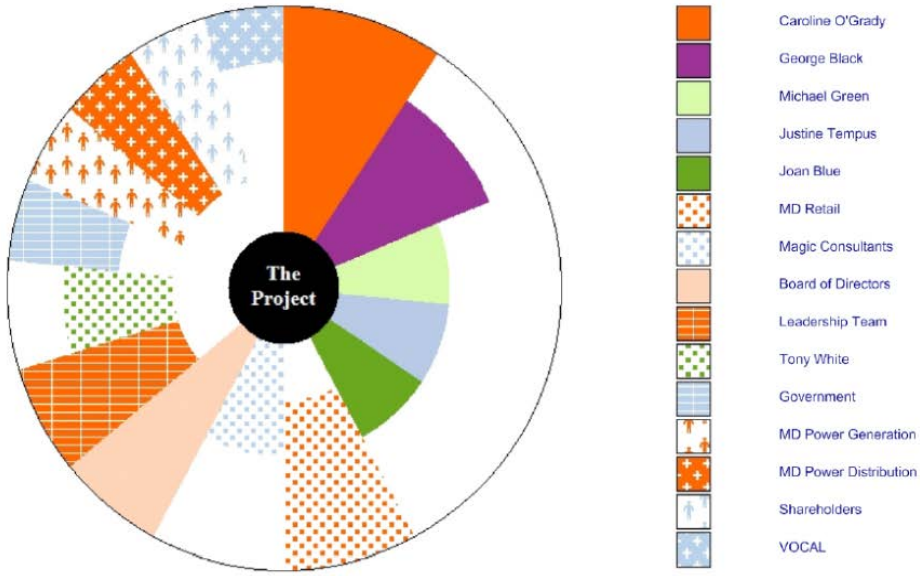

Figure 10. Stakeholder Circle. Source: Walker, Bourne, and Shelley (2008).

Technique 2: Performance Measures of Stakeholders: Oppong, Chan, and Dansoh (2017) argue that "persistent stakeholder opposition contributes to delays and project failures" (1041). They say that effective stakeholder management ensures transparency, openness and accountability of the process of decision making. They go on to point out that the purpose of an effective stakeholder management plan is to curtail any events that adversely affect the project. The authors further argue that performance indicators should be used in measuring stakeholder management. According to Oppong, Chan, and Dansoh (2017) "measures of stakeholder management could be rated on a scale such as 1044): 1=very dissatisfied 2=dissatisfied 3=slightly dissatisfied 4=neither dissatisfied nor satisfied 5=slightly satisfied 6=satisfied 7=very satisfied" (1044). This method needs input from stakeholders and honest feedback. In order to receive feedback. A limitation to this technique is that the project office must have correctly identified stakeholders.

Technique 3: Managing-for-Stakeholders: According to Harrison, Bosse, and Phillips (2012), this management technique requires a firm to have minimum requirements for their stakeholders. This method allows a firm to acquire nuanced information regarding the stakeholder's utility functions. (Harrison, Bosse, and Phillips 2012) Collecting information on stakeholder's utility function can lead the firm to having a competitive edge over competitors. The nuanced knowledge gained in the managing for stakeholders' technique will also lead to value creation for a firm. Though the utility functions of stakeholders can change due to innovations, firms entering and existing an industry, due to other influences or trends. (Harrison, Bosse, and Phillips 2012) Figure 11 below shows how a firm's management of stakeholders with utility functions can lead to value creation for a firm.

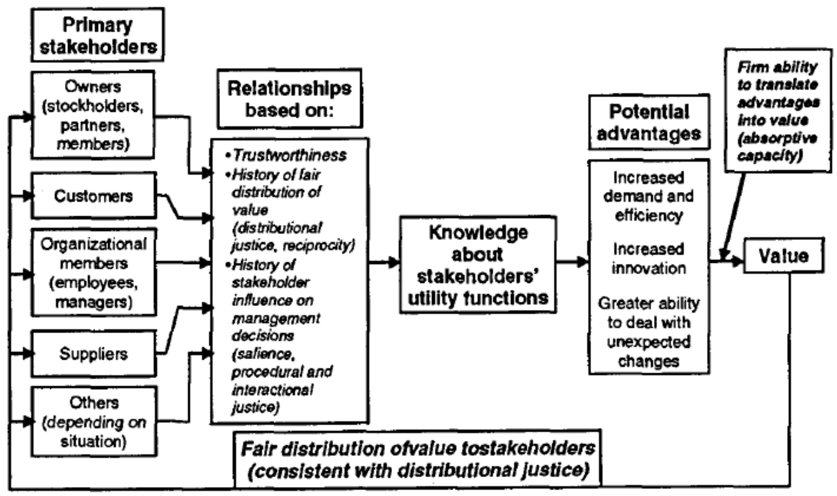

Figure 11. Managing for Stakeholders and Value Creation.
Source: Harrison, Bosse, and Phillips (2012).

Technique 4: Fairness Approach: Bridoux and Stoelhorst (2014) offer this technique as "more effective in attracting, retaining, and motivating reciprocal stakeholders to create value" (108) based on fairness considerations:

- Fairness is the driver for the creation of value from the stakeholders, the outcome of fairness is the interpersonal treatment the stakeholders receive.
- The formal process of linking stakeholders to the firm is not as strong due to the lack of detail, both parties rely on trust between parties. The informal structure is heavily relied on rather than legal enforcement.

- The relationships between stakeholders tend to be longer with a more informal process.

This technique promotes open and honest exchange of information from the stakeholders to the project leader as well as between stakeholders. Even though communication between stakeholders is open and honest, standard and requirements tend to be poorly defined and confusion can occur (Bridoux and Stoelhorst 2014).

Technique 5: Arm's-Length-Approach: According to Bridoux and Stoelhorst (2014), the Arm's-Length- Approach is a contrast approach to the Fairness Approach. This technique "is more effective in motivating self-regarding stakeholders with high bargaining power" (108). In this approach, value created is divided up between stakeholders, using the stakeholders bargaining power to drive the process. The outcome of this process is determined on the stakeholder's contribution to the project and the interpersonal treatment of the stakeholders depends on how the stakeholder performs. The Arms-Length-Approach relies heavily on the economic and legal sanctions; these sanctions ensure that agreed upon obligations are enforced. These obligations are typically in a formal contract with detailed performance standards and requirements (Bridoux and Stoelhorst 2014). This technique is rather counter-productive in the sense it is meant to try to create value through forcing stakeholders to work against one another. An arms-length approach can be seen in firm policies that are based on incomplete or asymmetrical information to resolve problems through conflict or confrontation. This approach also requires relationships with stakeholders being short (Bridoux and Stoelhorst 2014).

Technique 6: Mega Construction Projects: In examining mega-construction projections, Mok, Shen, and Yank (2014) identified those stakeholder models and techniques that are best suited to address those elements unique to projects of the scale, scope, and impact of mega-construction. As such, the authors recommend a stakeholder salience model combined with a vested interest-impact index. Additionally, they recommend utilizing social network analysis to account for the interactions and interdependence among and between stakeholders. While these in-depth and more formal techniques aid in managing a large, diverse, and dynamic stakeholders associated with mega-construction projects, they are more resource demanding and may not be appropriate for smaller, less diverse, or less dynamic stakeholders. A key premise of Mok, Shen, and Yang (2014) is that very large projects have unique attributes that cannot be managed by informal processes. Specifically, due their size and complexity, mega-construction projects have three challenges:

- The involvement of numerous stakeholders leading to complex stakeholder interrelationships and conflicting interests.
- The dynamics and growing capacity leading to high project uncertainty.
- Their governance by a stringent multi-role administrative structure leading to high public attention and controversies. (Mok, Shen, and Yank 2014)

Projects with these attributes require a formal, systematic approach. As such, the authors recommend that a layered, compound approach be formally utilized. Specifically, a chosen methodology should address the entire project life cycle, be formally integrated into the project, and include both traditional stakeholder analysis as well as social network analysis. Due to the nature of their approach, the authors address multiple stakeholder techniques and methods for stakeholder identification, assessment, and management. While the suggested methods are catered towards mega-construction projects, other projects that face similar challenges as discussed above may benefit from the approaches or techniques discussed.

Technique 7: Power Interest Grid: Ackerman and Eden (2011) discuss the utilization of the Power Interest Grid as a stakeholder identification technique. In its most basic form, project manager places potential stakeholders on a quad chart with axis for power and interest. The authors note that the precise locations of stakeholders are relatively determined once all potential stakeholders are added to the chart (Figure 12). They also note that the concept of "power" is left undefined since it may take many forms. This technique may be relatively time intensive as iterations capture additional stakeholders and is geared towards management "teams" to perform collectively (Ackerman and Eden 2011).

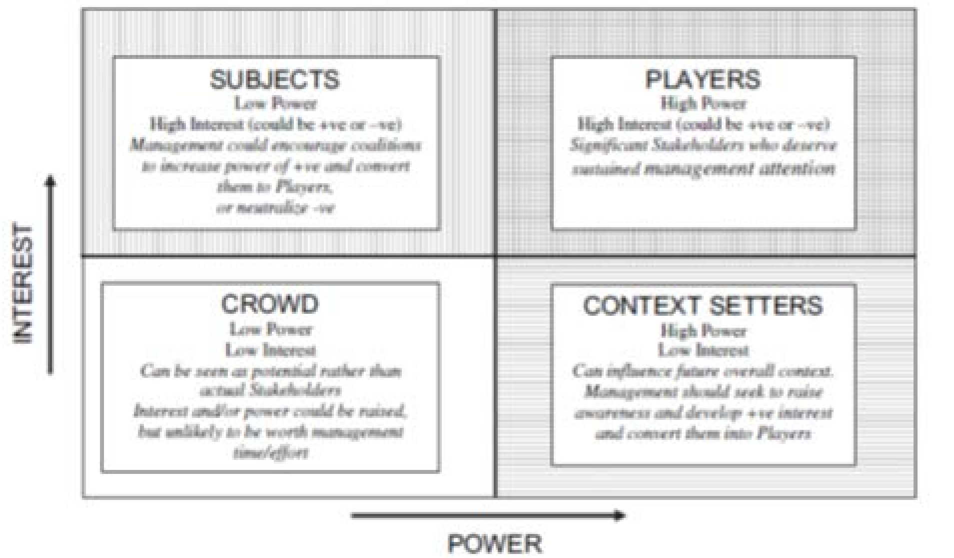

Figure 12. Power-Interest Grid. Source: Ackerman and Eden (2011).

Technique 8: Disaggregation and Uniqueness: Ackerman and Eden (2011) discuss the value of disaggregating identified stakeholders from the general to specific. The intent behind this process is to get to a level of specificity that is manageable and lends itself to the development of unique strategies versus generically identified stakeholders creating generic strategies. The authors noted that project managers often find this useful because it shifts focus to individuals, who are actionable, versus organizations. Further, the disaggregation begins to suggest tailored courses of action for managing the identified stakeholders (Ackerman and Eden 2011). Related to stakeholder disaggregation, the authors discuss stakeholder disposition, or the stakeholder's level of project support. This is similar to other stakeholder identification methods that suggest addressing the stakeholder's vested interest in a project or their potential impact on the project. Like the Power-Interest Grid discussed above, the authors note that disaggregation and uniqueness can be time intensive and are geared towards management teams (Ackerman and Eden 2011).

Technique 9: Stakeholder-Influence Network: Ackerman and Eden (2011) identify that the interconnection and interdependence of stakeholders cannot be neglected as the actions of one affect others, especially if informal or formal coalitions exist. They discuss the use of the stakeholder-influence network diagram to graphically depict these relationships to better guide emergent management techniques (Ackerman and Eden 2011). The authors note that to be effective, the stakeholder-influence network diagrams should capture both formal and informal power (Ackerman and Eden 2011). It should be noted that unlike previous techniques, the social-influence network diagram is not centered on power and interest, but instead seeks to identify those stakeholders who are well connected and could have significant impacts on a project if they choose or are motivated to do so (Ackerman and Eden 2011).

Technique 10: Stakeholder Management Web: Ackerman and Eden (2011) discuss the stakeholder management web (SMW) as a technique that goes beyond stakeholder identification and assessment, and utilizes the power-interest grid and the stakeholder-influence network to develop management strategies for individual stakeholders. The focal stakeholder is mapped to those he/she may affect (power) and those that may affect him/her (interest). This visually demonstrates relationships and by identifying how the parties utilize their influence, and in turn fosters specific management strategies for the stakeholder (Ackerman and Eden 2011).

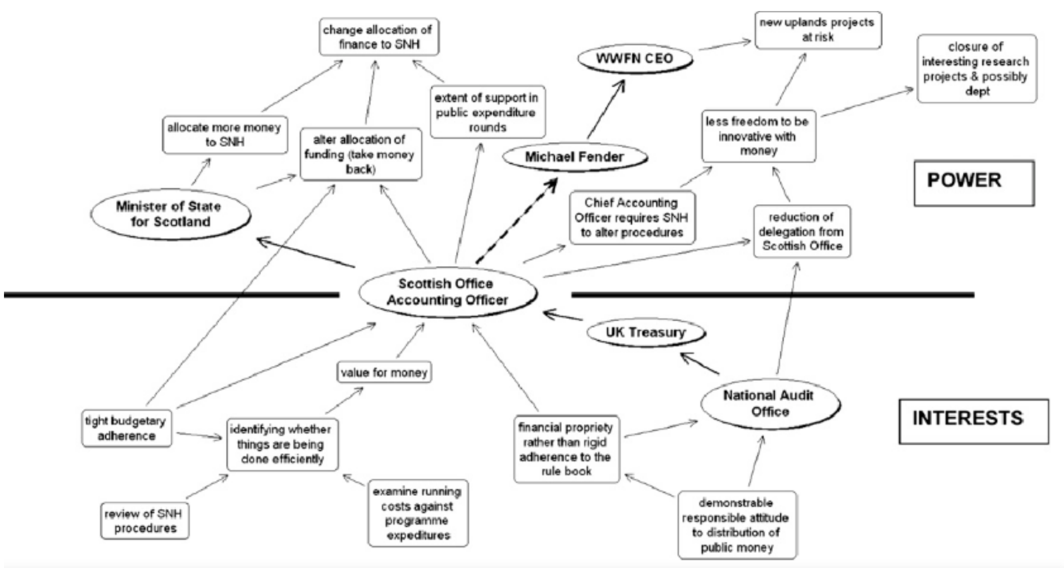

Figure 13. Example of Stakeholder Management Web.
Source: Ackerman and Eden (2011).

Technique 11: Stakeholder Landscaping: Aaltonen and Kujala (2015) state that the majority of stakeholder management efforts and research focus on the institutions and individuals, and neglects to analyze the landscape of their operations. Aaltonen and Kujalo Project identify four key attributes for the analysis and classification of operational landscapes: complexity, uncertainty, dynamism, and institutional context (Aaltonen and Kujala 2015). According to the authors, the use of these attributes to analyze and classify project landscapes may aid in proactively identifying the type of challenges a project may face, and guide resource allocation (Aaltonen and Kajala 2015). As the value of this technique lies in its ability to anticipate potential problems and issues, it may prove of limited value if not conducted early in a project timeline.

Complexity	Uncertainty	Dynamism	Institutional Context
• Stakeholder element complexity • Number of project stakeholder • Variety of project stakeholders and their goals • Stakeholders' internal complexity • **Stakeholder relationship complexity** • Number of relationships among stakeholders • Variety of relationships • Patterns of relationships • Relationships' internal complexity • External stakeholder relationships	• Lack of information related to stakeholders and their relationships • Project management's experience with respect to stakeholders and stakeholder analysis • Analyzability of the stakeholder environment • Ambiguous information concerning stakeholders	• Changes in stakeholders' attributes • Changes in stakeholders' position • Changes in relationships among stakeholders • Emergent stakeholders and relationships • Changes in appropriate ways of engaging stakeholders • Changes in stakeholders' influence strategies	• Stakeholders' local embeddedness • Legitimized structures and processes for stakeholder engagement • The nature of stakeholders' legitimized influence strategies • Multiplicity of institutional environments • Complexity of the stakeholders' interpretation process

Figure 14. Four Stakeholder Landscapes. Source: Aaltonen and Kajalo (2015).

2. Functional Hierarchy or Tree

The next step of our analysis is to decompose a stakeholder management plan into its subcomponents down the most fundamental components. This is method of decomposition will enable the team to accurately develop a management plan that can group the attributes of the stakeholder with respect to the project team (Project

Management Institute 2018, 312) This purpose of this analysis is to understand the relationships between the subcomponents identified during the projects system analysis. Applying systems these engineering methods will develop the functional components with the stakeholder management analysis to produce the stakeholder management plan.

Decomposition of the Stakeholder Management Project was completed by developing the previous stakeholder management plan literature and then breaking down the functional components. The first level of break down, the core functions that our plan need to be able to do, were 1) Identify Stakeholders, 2) Conduct Stakeholder Analysis, 3) Plan Engagement of Stakeholders, and 4) Manage Stakeholders. The process further breaks down the four functions into their subfunctions resulting in realistic outputs that will result in actionable outcome the team can leverage into a thoughtful and complete Stakeholder Management Plan (Figure 15).

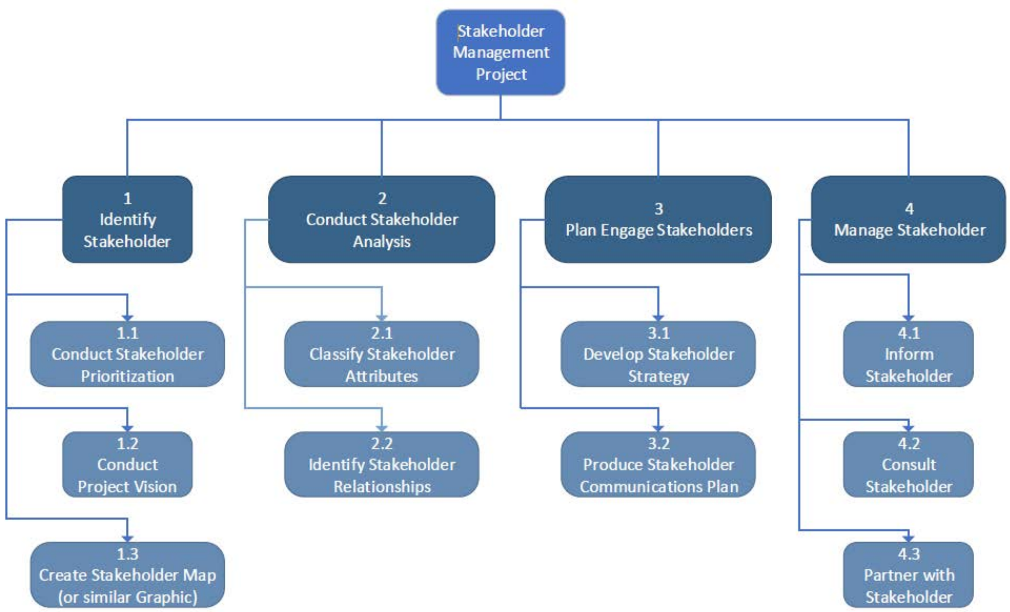

Figure 15. Functional Hierarchy

D. DESIGN SYNTHESIS: STAKEHOLDER TECHNIQUE ANALYSIS

Design Synthesis follows Functional Analysis, and developments a physical architecture or several physical architectures that satisfy the requirements derived from the functional decomposition (DAU 2001). At the conclusion of the Functional Analysis of a Stakeholder Management Plan, a Morphological Box was established consisting of the essential functional elements of a Stakeholder Management Plan (Identify, Analyze, Engage, and Monitor) as well as developed measures for assessing the degree a given stakeholder management technique addressed an element (Table 5).

Table 5. Morphological Box

Inventoried Stakeholder Management Techniques

Elements of Stakeholder Management Plan

Measures for Each Essential Element

Essential Elements of a Stakeholder Management Plan

Element	Measure	Stakeholder Circle/ Organizational Zoo	Performance Measures of Stakeholders	Managing for Stakeholders	Fairness Approach	Arms Length Approach	Mega Construction Projects	Power Interest Grid	Disaggregation & Uniqueness	Stakeholder Influence Network	Stakeholder Management Web	Stakeholder Landscaping
	Formal Processes											
Identify	Operating Environment											
	Stakeholder vs. Non-Stakeholders											
	Internal vs. External											
	Prioritizes Stakeholders											
Analyze	Assesses Ability to Influence											
	Assesses Interest											
	Assesses Informal Power											
	Analyzes Social Connection & Networks											
	Assesses Engagement											
Engage	Considers Equity											
	Disaggregates Stakeholders											
	Tailored Engagement											
Monitor	Follow-Up Assessments											
	Monitors Satisfaction											
	Transparency											
	Flexibility/Adaptability											

Potential architectures, or management techniques, that could form the foundation of a comprehensive Stakeholder Management Plan were developed by identifying those techniques that addressed each of the four essential functional elements of Identify, Analyze, Engage, and Monitor. Differentiation among techniques that met this requirement was assessed by identifying the various capabilities present within a technique that addressed an essential element in multiple ways. For example, the essential element of Identify can be addressed by discriminating among stakeholders and non-stakeholders, internal and external stakeholders, and by prioritizing among identified stakeholders. All inventoried techniques were scored binarily, they either addressed the described capability or they did not. Assessments were made based on a plain reading of the supporting article for the technique, with minimal inferences to limit potential subjectivity (Table 6).

Table 6. Technique Assessments

			Stakeholder Circle/ Organizational Zoo	*Performance Measures of Stakeholders*	*Managing for Stakeholders*	*Fairness Approach*	*Arms Length Approach*	*Mega Construction Projects*	*Power Interest Grid*	*Disaggregation & Uniqueness*	*Stakeholder Influence Network*	*Stakeholder Management Web*	*Stakeholder Landscaping*
Essential Elements of a Stakeholder Management Plan		Formal Processes	X		X	X	X	X	X	X	X	X	
	Identify	Operating Environment											X
	Identify	Stakeholder vs. Non-Stakeholders	X		X	X		X	X				
	Identify	Internal vs. External	X		X	X	X	X	X				
	Identify	Prioritizes Stakeholders	X		X		X	X	X				
	Analyze	Assesses Ability to Influence	X		X		X	X	X		X	X	
	Analyze	Assesses Interest	X		X	X		X	X	X	X	X	
	Analyze	Assesses Informal Power	X				X	X	X	X	X	X	
	Analyze	Analyzes Social Connection & Networks	X		X	X		X			X	X	
	Analyze	Assesses Engagement	X		X			X	X		X	X	
	Engage	Considers Equity			X	X	X						
	Engage	Disaggregates Stakeholders					X			X		X	
	Engage	Tailored Engagement	X		X	X				X		X	
	Monitor	Follow-Up Assessments	X	X	X								
	Monitor	Monitors Satisfaction	X	X			X						
	Monitor	Transparency		X	X	X							
		Flexibility/Adaptability	X	X		X							

Initial analysis revealed that four inventoried techniques addressed all the essential elements of a stakeholder management plan (Table 7):

- Stakeholder Circle/Organizational Zoo.
- Managing for Stakeholders.
- Fairness Approach.
- Arm’s Length Approach.

Table 7. Technique Assessment Finalist.

Essential Elements of a Stakeholder Management Plan			Stakeholder Circle/ Organizational Zoo	Performance Measures of Stakeholders	Managing for Stakeholders	Fairness Approach	Arms Length Approach	Mega Construction Projects	Power Interest Grid	Disaggregation & Uniqueness	Stakeholder Influence Network	Stakeholder Management Web	Stakeholder Landscaping
		Formal Processes	X		X	X	X	X	X	X	X	X	
	Identify	Operating Environment											X
		Stakeholder vs. Non-Stakeholders	X		X	X		X	X				
		Internal vs. External	X		X	X	X	X	X				
		Prioritizes Stakeholders	X		X		X	X	X				
	Analyze	Assesses Ability to Influence	X		X		X	X	X		X	X	
		Assesses Interest	X		X	X		X	X	X	X	X	
		Assesses Informal Power	X				X	X	X	X	X	X	
		Analyzes Social Connection & Networks	X		X	X		X			X	X	
		Assesses Engagement	X		X			X	X		X	X	
	Engage	Considers Equity			X	X	X						
		Disaggregates Stakeholders					X			X		X	
		Tailored Engagement	X		X	X				X		X	
	Monitor	Follow-Up Assessments	X	X	X								
		Monitors Satisfaction	X	X			X						
		Transparency		X	X	X							
		Flexibility/Adaptability	X	X		X							

Since these techniques all nominally address the required essential elements of a stakeholder management plan, they could each potentially form the basis of a comprehensive stakeholder management plan. Before evaluating each of the four techniques in greater depth, a general evaluative framework was established. First, a stakeholder management plan centered around one of the identified techniques was preferable to a plan created piecemeal from several techniques. This was based on the belief that there would be some degree of value in a maintaining a consistent internal logic for the plan versus multiple conceptual frameworks. Secondly, due the absence of clearly identified and articulated specific capabilities for the stakeholder management plan, greater capabilities are preferable to fewer capabilities. Third, due to the relative costs and benefits of using formal and informal stakeholder management techniques, techniques that could be utilized in both settings were preferred to those techniques that were limited to one or the other, formal or informal. Finally, in situations where multiple plans may have the same number of capabilities, but of differing composition, this would be considered "trade space" and decided based on which capabilities were best aligned with the known elements of the STC stakeholder problem set. With this framework established, each technique was individually assessed by quantifying the capabilities present (Table 8). This quantitative approach revealed a clear demarcation. The Stakeholder Circle technique (13) and the Managing for Stakeholders technique (12) represented significantly more capabilities than either the Fairness Approach technique (9) or the Arm's Length Approach technique (8). However, the quantified evaluation does not indicate a clear choice between the Stakeholder Circle technique and the Managing for Stakeholders technique. A more detailed comparison between the two techniques revealed the specific differences underlying their respective scores.

Table 8. Quantifiable Assessment

			Stakeholder Circle/ Organizational Zoo	*Managing for Stakeholders*	*Fairness Approach*	*Arms Length Approach*
Essential Elements of a Stakeholder Management Plan		Formal Processes	X	X	X	X
	Identify	Operating Environment				
		Stakeholder vs. Non-Stakeholders	X	X	X	
		Internal vs. External	X	X	X	X
		Prioritizes Stakeholders	X	X		X
	Analyze	Assesses Ability to Influence	X	X		X
		Assesses Interest	X	X	X	
		Assesses Informal Power	X			X
		Analyzes Social Connection & Networks	X	X	X	
		Assesses Engagement	X	X		
	Engage	Considers Equity		X	X	X
		Disaggregates Stakeholders				X
		Tailored Engagement	X	X	X	
	Monitor	Follow-Up Assessments	X	X		
		Monitors Satisfaction	X			X
		Transparency		X	X	
		Flexibility/Adaptability	X		X	
		Capabilities	13	12	9	8

Both techniques scored the same with regard to the Identify element. For the Analyze element, Stakeholder Circle presented one additional capability as it also assessed informal power. For the Engage element, Managing for Stakeholders holds an advantage as it considers equity in the engagement process where the Stakeholder Circle does not. Supporting the Monitor element, the Stakeholder Circle monitors satisfaction and is adaptable where Managing for Stakeholders is not, but it is transparent. Evaluating these differences add some additional preference to the Stakeholder Circle technique. The capabilities of equity is likely of limited use in the STC acquisition context as all potential stakeholders are internal to a single organization, and a significant number of them would fall under a military hierarchy that makes major equity concerns secondary. Additionally, the capability to assess informal power would be preferred to assist in managing non-military stakeholders within a military context. In total all of these factors indicate an advantage to the Stakeholder Circle technique, that while not large, is still significant. It should be noted that there are several other factors outside these evaluative criteria that make the Stakeholder Circle technique a preferred choice. Since it is a commercially marketed stakeholder management approach, there are readily available tools to assist in the implementation of the technique. This may prove especially useful in an environment where explicit stakeholder management has not been previously implemented, and those undertaking the management do not have a stakeholder management background. No such supporting materials were found for other techniques inventoried. Secondly, the Stakeholder Circle is field agnostic whereas Managing for Stakeholders is designed primarily for a business context, due to its utilization economic based modeling (Harrison, Bosse, and Phillips 2012). This is not to say that the Managing for Stakeholders methodology could not be effective, but simply to point out that the implementation may be more challenging for those unfamiliar with stakeholder management principles relative the Stakeholder Circle method.

The identification of a preferred technique is but a single aspect of the development of a comprehensive stakeholder management plan. The selected technique must be integrated into both the suite of stakeholder management activities as well as the overall project management activities. In the case of STC requirements generation, this is relatively straightforward and simple task. The functional aspects of stakeholder management (identify, analyze, engage, and monitor) are technique independent that would be performed regardless of the selected methodology. There could be differentiation at the margins, but generally the functional elements of a comprehensive stakeholder management plan are technique independent. Similar to the functional elements of the stakeholder management activities, the required project activities are likewise technique independent. As the primary task to the USNA in support of the STC acquisition is to provide actionable requirements to the design activity, the primary project tasks are requirements elicitation and requirements specification. These functional tasks are independent of the stakeholder management technique utilized. This allows for seamless integration of the stakeholder management activities into the overall requirements generation activities. Additionally, by utilizing iterative requirements generations activities, the value of stakeholder management activities can be further leveraged through regular updates to stakeholder assessments and engagement approaches.

There likely exist stakeholder management plans or stakeholder management paradigms that merge stakeholder management activities and project management activities more comprehensively. While there could be potential value in such an approach, maintaining functional independence is preferred in the current case. This allows modification to any single element without significant modification to other elements, it allows easier implementation for those without stakeholder management expertise, and keeps functional activities detached from any required documentation formats.

By utilizing the essential elements of a stakeholder management plan previously developed in conjunction with inventoried stakeholder management capabilities, the collected stakeholder management techniques were quantitatively assessed. This assessment revealed that only four techniques addressed all of the essential elements required of an effective stakeholder management plan. Further evaluation showed that two techniques, the Stakeholder Circle and Managing for Stakeholders, provided significantly greater capabilities than other alternatives. Finally, a side by side comparison of these two techniques indicated that the Stakeholder Circle technique was preferred as the foundational technique for the development of a comprehensive stakeholder management plan.

E. VERIFICATION AND VALIDATION

The system engineers must translate the stakeholder need into technical requirements to guide the design team (do verification to check if the technical requirement expresses the operational need). These efforts will be evaluating any test data and analytical findings against the stakeholder needs. The processes will be conducted using systems engineering verification and validation methods to ensure the Stakeholder Plan correctly performs all intended activity as well as performs the functions and has the features the stakeholders' value. The value of these processes will reduce overall program risk as well as provide feedback on the stakeholder management performance. It is imperative that the verification and validation effort continues beyond this research as well as continue throughout the program's activities.

1. Methods

Inspections will examine the output of the Stakeholder activity though requirement analysis and the comparison of the proposed solution. (excluding modeling, prototypes, and system analysis). This analysis will determine, using binary criteria (pass or fail, includes or does not include) if the stakeholder requirements are met. Demonstration will be unable to demonstrate the Stakeholder plan due to the scope of the research. Analysis will rely heavily on analysis by using analytical models to verify engineering activity outputs and will be demonstrated in a traceability matrix. Our team did not conduct any test and evaluation during this process.

Of note, the Stakeholder Management plan does not meet the requirements for "-ility" testing. The applications of functional analysis that is common among systems engineering such as Reliability analysis, Maintainability analysis, Human Factors analysis, Maintenance and logistical support, Producibility and Sustainability, and Affordability. It should be factored that these areas of analysis have not been overlooked, however, omitted due to the lack of applicability.

2. Verification

The Verification process determines whether the program correctly conducts each system engineering requirement outlined in such that the outputs match stakeholder expectations. This analysis is based off the literature review findings and assessments, as well as the following analysis. Verification analysis will answer if the requirements engineering activity correctly transforms the stakeholder needs into a set of system requirements, did the design activity generate specifications addressing those system requirements, did the research team build the system in compliance with the design specifications. We will also ensure that the verification activity checks the output of each activity to ensure no errors were introduced during the activity.

The findings of the literature review included the acquisition history of the Mark I and Mark II STC as well as other articles that described attributes that aided other stakeholder efforts. Comparing these methods lead to the generation of the methodology that would develop outputs of an effective stakeholder management plan. These efforts are outlined in the Methodology of this project. In consideration of the methodology are elements of the Stakeholder Management Plan, Measures for Each Essential Element, and an Inventory of Stakeholder Management Techniques. Analysis of these factors lead the team to develop a functional diagram to identify the four top level functions; Identification, Analyze, Engagement, and Monitor. This allowed the team to trace the finding from the literature review to a morphological box that could measure the effectiveness of various stakeholder management plans.

As seen in Figure 16 the Stakeholder management plan will incorporate all the elements traced from the literature review, analysis, and functional breakdown conducted as part of this project. After careful inspection and analysis based off of this model, we can see that the findings are well justified and supported.

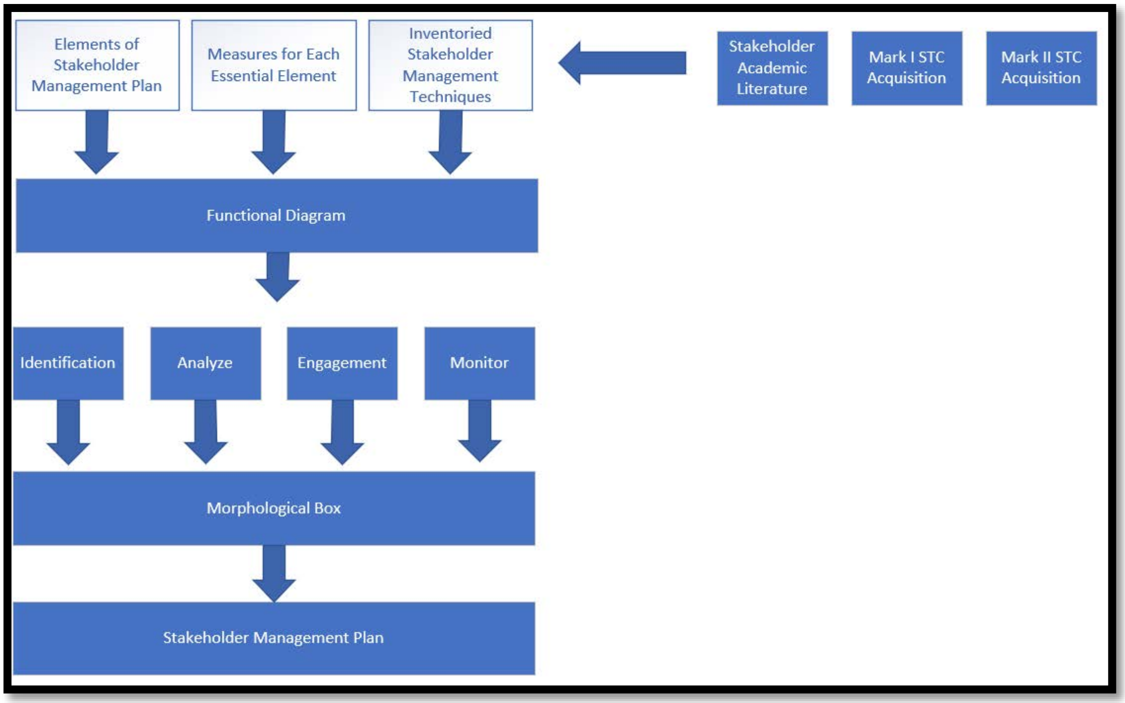

Figure 16. Traceability of Essential Elements

3. Validation

Validation determines whether the system meets the stakeholder's needs and its design purpose in its operational environment. While the validation activities generate data, the evaluation of the data and whether it meets stakeholder needs can be subjective. Validation is conducted with the customer, in this case the project sponsor, and involves user acceptance as the result. This will be utilized in conjunction with our Morphological Box to break down identified requirements and how they translate to the proposed solution. Stakeholder objectives were previously documented in Table 3 (see page 31). These stakeholder objectives will be the reference requirements for the stakeholder management plan. The objectives hierarchy are requirements and are the basis for the validation of the stakeholder management plan. These sponsor objectives are then cross-referenced with the measures of performance to identify the validation with the required requirements. Table 10 shows that crosswalk to satisfy validation requirements.

Table 9. Validation Crosswalk

Objective Number	Stakeholder Objective Requirements	1. Identify Stakeholder	2. Conduct Stakeholder Analysis	3. Plan Engage Stakeholderse	4. Manage Stakeholder
		Stakeholder Circle Requirement Matrix			
1	Identify and include all relevant internal USNA stakeholders for the development of an enduring STC acquisitions process	A.1. The plan or technique must identify and describe the operating environment of the program or organization and consider the dynamic of the stakeholders.		C.1. The engagement plan must consider equity of the stakeholders	
2	Integrate and synchronize any developed internal STC acquisition processes or procedures with external acquisition processes	A.2.The plan or technique must identify those that are stakeholders and separate them from those that are non-stakeholders.			
3	Clearly define the roles, responsibilities, and authorities of all stakeholders, both internal to the USNA and external or peer to the USNA	A.3. identify stakeholders that are internally affiliated with the program and have official standing with the program. External stakeholders, such as contractors and subcontractors, have a stake in the program but can influence the internal stakeholders through interpersonal connections or rapport.	B.1.Must analyze stakeholders or organizations direct and indirect ability to effectively influence, cause changes or outcomes		
4	Inventory and utilize both USNA formal and informal resources in support of the STC acquisition. Implicit in this is a unity of understanding and effort. Informal resources include social connections, previous positional or institutional experiences, etc.		B.3. Stakeholder power is assessed according to their direct authority within the program. The identified power is analyzed for their ability to terminate or use their influence for change.		
5	Clearly delineate the primary and alternate communications channels, as well as the responsible individuals or offices	A.4. Must prioritize stakeholders by considering their power, urgency and proximity to the STC program.	B.5. Must assess engagement approaches to communicate with stakeholders and engagement strategies for all stakeholders.	C.2. Must separate stakeholder's uniqueness and characteristics.	D.3. Must have the information easy to access and ensure there is open communication between the program and stakeholders. The meetings need to be available to the necessary stakeholders.
6	To the extent practical, preserve institutional and organizational missions to maximize expertise and experience		B.4. Must analyze the stakeholder's network to account for the interactions and interdependence among and between stakeholders.	C.3. Must have the ability to modify engagement plans for each stakeholder and organization.	
7	Properly sequence internal and external stakeholder engagement. The USNA will not be able to properly engage external parties (PEO Ships, potential designers, etc.) if proper internal stakeholder engagement is not conducted first				D.4. Must have the information easy to access and ensure there is open communication between the program and stakeholders. The meetings need to be available to the necessary stakeholders.
8	Facilitate iterative, formal, and purpose driven engagements between all stakeholders that are clearly documented				D.1. Technique or plan must allow for after engagements with stakeholders for successful implementation of identified corrections and updated communications

The use of measures of performance is applied as it relates to both the sponsor's objectives as well as the functional attributes of the stakeholder management plan. After the MOPs were validated, the stakeholder Objectives were then tied to the functional components of the stakeholder management plan. The use of measures of performance clearly shows that all sponsor objectives were met and will meet all stated needs.

V. CONCLUSIONS AND RECOMMENDATIONS

At the onset of the preceding research, several objectives were articulated that would frame the purpose and scope of the overall research effort. These objectives identified the primary lines of efforts that would guide the research. Specifically, the objectives were:

- Explore the applicability of the systems engineering process to stakeholder management.
- Identify methods to assess stakeholder's level of responsibility and impact in the acquisition of the STC.
- Investigate how the application of the systems engineering process can streamline the internal processes of USNA's procurement of the STC.
- Deliver a stakeholder management plan to the project sponsor.

At their core, these objectives were a collective effort to explore and understand the applicability of the systems engineering process to non-quantitative domains, and how the process could lead to more effective processes with better outcomes.

Objective: Explore the applicability of the systems engineering process to stakeholder management.

While the systems engineering process may not be perfectly suited for stakeholder management or stakeholder management planning, it is definitively value added. However, the benefits of applying the systems engineering process, as well as the limitations, are direct results of the nature of stakeholder management being both substantive and procedural. The systems engineering process's foundation in requirements analysis forces a deliberate connection between the issue to be addressed and the product ultimately created. Further, the allocation of functional elements aids in tailoring and scoping potential solutions. Together, these steps in the systems engineering process act as key transformative levers in the translation of problems into capacities. In this regard, applying the systems engineering process to address the substantive aspects of stakeholder management proved both intuitive and effective. Analysis of historical STC acquisitions revealed actionable, albeit general, requirements that could be translated to a substantive capability of a stakeholder management plan. It must be noted that since the requirements were general, this made tailoring particular stakeholder management techniques more challenging. This ultimately resulted in a decision to provide as many capabilities within the plan as possible since this does not increase costs or in other ways impact the overall plan. Further research is necessary to determine if this was a product of the specific characteristics of this problem set or if it is endemic to the application of the systems engineering process to stakeholder management. The limitations of applying the systems engineering process were particularly apparent in areas beyond simply identifying and selecting the substantive capabilities of a given stakeholder management methodology. Stakeholder management is the confluence of substantive analytical techniques and iterative processes occurring in support of specific project goals. As such, much of stakeholder management occurs organically, in real-time. This makes quantification and measurement extremely challenging beyond a most rudimentary level. Overall, the application of the systems engineering process to stakeholder management, and other non-quantitative fields, merits further research. The process creates firm links between problem and system requirements, and at worst established a functional floor that ensures that a product addresses the problem.

Avenues for future research could include an examination of using proxy metrics to identify specific procedural elements of a stakeholder management plan that should be included in a tailored plan and on identifying correlations between identified problem elements and specific analytical elements best suited to address them. Some research exists on correlating management techniques based on the project type at the macro-level (Mok, Shen, and Yank 2014), but additional research could examine the possibilities on aligning specific requirements with specific analytical capabilities. The potential impacts of this work would be significant as it could develop a framework for stakeholder management plan requirements elicitation that results in more refined and more effective stakeholder management plans.

Objective: Identify methods to assess stakeholder's level of responsibility and impact in the acquisition of the STC

The lens of the systems engineering process revealed stakeholder management in significant depth and detail. The creation of an inventory of modern stakeholder management techniques and methods allowed the detailed identification of a multitude of ways to assess the impact potential stakeholders may have on a project. However, all of these techniques suffer from the same limitation. They are all subjective assessments of potential stakeholders conducted by those attempting to manage them. There were no objective measures found for quantifying human behavior. A significant portion of stakeholder management literature is devoted to measuring the degree of impact potential stakeholders may have on a given project. This is unsurprising, given the identification of those whom a project owner must effectively manage is a critical step in stakeholder management. However, power alone quickly becomes insufficient as a metric when project complexity increases. If there are multiple stakeholders that can determine the fate of a project, an additional attribute must be used to differentiate among this group. It is this capability that many stakeholder management methodologies differentiated themselves. More robust theories looked beyond simply the concept of power, but also of interest, proximity, and social connectedness. This layered analysis serves two purposes. First, it facilitates more refined and nuanced assessment of stakeholders. This in turn allows a more accurate determination of who the most important stakeholders are, and the creation of more tailored engagement strategies. Secondly, by assessing multiple aspects of a stakeholder, there is more margin for error. While power is clearly important, it is also extremely difficult to define, however, easy its effects can be seen. By assessing multiple characteristics that relate to the significance of any single stakeholder, it is less critical that any single assessment be without error.

As noted above, many stakeholder analytics are either stand-ins or modifiers for the concept of power. This concept is critical in stakeholder management, and future research should focus on determining if a quantifiable distinction exists between different analytics in accurately assessing stakeholder priority or is there greater value or accuracy in composite assessments. Longer-term research could examine the use of a weighted allocation for different analytical measures of stakeholder power. This would facilitate the efficient allocation of management resources and more effective engagement.

Objective: Investigate how the application of the systems engineering process can streamline the internal processes of USNA's procurement of the STC.

The overall improvement of future acquisitions of the STC at the USNA was a key goal for the project sponsor, and it was in this particular area where utilizing the systems engineering process proved most valuable. In order to develop the system requirements needed as part of the systems engineering process, an in-depth and critical examination of past acquisitions was conducted. This examination highlighted multiple similarities and differences between the two-modern era STC acquisitions and revealed seemingly mundane and well-intentioned decisions directly led many of the observed issues that plagued these previous acquisitions. It is in this regard that the systems engineering process is so valuable. It absolutely requires and insists on a thorough understanding of the problem space in detail. This is equally applicable to non-quantitative areas as well as the quantitative. If the systems engineering process does nothing more than this, then it has already improved the STC acquisitions process. This foundational, critical examination establishes a necessary baseline, required to assess future acquisitions and make informed acquisitions related decisions. It was the application of the systems engineering process that examined more than dollars over budget or years behind schedule. The systems engineering process required critical analysis beyond this to ensure that underlying structural causes were addressed. The generation of decision information is one of the multiple goals of the systems engineering process. By identifying causal relationships and their impacts, the process facilitates informed, deliberate decision making.

Future USNA Sail Training Craft research should focus on assessing the effectiveness of the stakeholder management plan developed and evaluating how well the management plan addressed the activities of requirements elicitation and requirements specification. Opportunities to utilize an iterative development process for stakeholder management plans are seldom available, and the research possibilities offered by these opportunities are valuable. As the STC is a periodic acquisition, there is opportunity to assess the effectiveness of the developed management plan, the degree of utilization of the management plan, and the areas for improvement within the management plan.

Objective: Deliver a stakeholder management plan to the project sponsor.

Similar to the applicability of the systems engineering process to stakeholder management in general, the utilization of the systems engineering process to deliver a stakeholder management plan for the project sponsor was mixed. The use of the systems engineering process was effective in identifying the possible capabilities differing management techniques provided, and in making rudimentary selections among those techniques. However, it was not effective in developing a plan. This is mostly attributable to the amorphous structural definition of what a stakeholder management plan is. As the research indicated, stakeholder management plans are functionally defined, and contain very general elements that are decomposed into many sub-tasks. On its face, this would seem perfectly aligned with the functional focus of the systems engineering process. However, there is a key differentiation that frustrates the development of a stakeholder management plan. A specific stakeholder management plan is designed for a specific project and a specific set of stakeholders, it is unique. Therefore, there is no way to test a set of capabilities arrayed in a set structure for effectiveness. Granted, case studies and lessons learned can be utilized for some benefit, but the core conflict remains. The construction of a detailed stakeholder management plan for a third-party is analogous to attempting to build a custom race car for an unknown course, an unknown driver, and unknown operating conditions. It is known that it will require breaks, but what type and on how many wheels is indeterminable. The systems engineering process simply is not designed to accommodate these undefined requirements. As discussed previously, this often leads to a more is better approach when it comes to capabilities but is more challenging when addressing the structure of a stakeholder management plan. Regarding the STC, the nature and scope of the problems requiring a solution provided some relief. As the problem requiring a solution is limited to the requirements generation process internal to the USNA, it was possible to draft a relatively simple requirements elicitation and specification timeline that is integrated with primary stakeholder management activities. Further, the process preserved iterative elements to allow real-time modification and updating of all stakeholder management activities. While this is not ideal, it addresses the limitations of the systems engineering process to the problem set, while still providing a comprehensive solution to the sponsor. The development of a more effective and specialized stakeholder management plan would require an expansion of the time horizon and viewing each acquisition as an opportunity to validate a given stakeholder management technique and activity sequence.

The application of the systems engineering process to the development of a stakeholder management plan for the acquisition of the STC demonstrated both the capabilities and limits of the systems engineering process. Requirements analysis necessitates a full and complete understanding of the problem and in doing so sets conditions for a properly scaled and scoped solution. However, the process is obviously less well suited for dealing with the undefined requirements that are simply a part of stakeholder management. The critical analysis that undergirds the systems engineering process is highly valuable in any context and a tailored and deliberate deployment that acknowledges the limitations of the process in certain situations can prove highly effective. Future research regarding the application of the systems engineering process to the development of stakeholder management plans should focus on addressing the procedural nature of stakeholder management, more acutely aligning stakeholder analytics with specific stakeholder problems, eliciting specific stakeholder management requirements, and evaluating the effectiveness of stakeholder management plans developed using the systems engineering process.

APPENDIX. MEASURES OF PERFORMANCE DEFINITIONS

Measure of Performance	**Definition**
Operating Environment	Identify and describe the operating environment of the program or organization and consider the dynamic of the stakeholders
Stakeholder vs Non-Stakeholder	Identify those that are stakeholders and separate them from those that are non-stakeholders
Internal and External	Identify stakeholders that are internally affiliated with the program and have official standing with the program. External stakeholders, such as contractors and subcontractors, have a stake in the program but can influence the internal stakeholders through interpersonal connections or rapport
Prioritizes Stakeholders	Prioritize stakeholders by considering their power, urgency and proximity to the STC program
Assess ability to Influence	Analyze stakeholders or organizations direct and indirect ability to effectively influence, cause changes or outcomes
Assess Interest	Analyze stakeholder interest and correlates directly with the level of concern in the program's outcomes and costs
Assess Informal Power	Stakeholder power is assessed according to their direct authority within the program. The identified power is analyzed for their ability to terminate or use their influence for change
Analyzes Social Connection & Networks	Analyze the stakeholder's network to account for the interactions and interdependence among and between stakeholders
Assesses Engagement	Assess engagement approaches to communicate with stakeholders and engagement strategies for all stakeholders
Considers Equity	Consider equity of the stakeholders
Disaggregates Stakeholders	Separate stakeholder's uniqueness and characteristics
Tailored Engagement	Ability to modify engagement plans for each stakeholder and organization

Measure of Performance	**Definition**
Follow-up Assessments	Technique or plan must allow for after engagements with stakeholders for successful implementation of identified corrections and updated communications
Monitors Satisfaction	Surveys, questionnaires or interviews to monitor stakeholders and their level of satisfaction. This measure helps ensure success in the program by attempting to keep stakeholders happy
Transparency	Information easy to access and ensure there is open communication between the program and stakeholders. The meetings need to be available to the necessary stakeholders
Flexibility/Adaptability	Modifiable when conditions change

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