A Framework for Capturing the Hidden Stakeholder System

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Dedication

This dissertation is dedicated to my family, whose continuous strength and support carried me through both the high and low times encountered during this journey.

Acknowledgments

This effort was made possible by a wide range of people. First, I would like to thank my wife for supporting me and keeping our family and household running while much of my time spent outside my professional career was consumed by class-work and the efforts documented within this dissertation. I would also like to thank my former boss, whose artful ways of handling stakeholders served as the inspiration for these efforts. I would like to thank the faculty and staff of The George Washington University, especially my advisors, who taught me invaluable skills with regard to both Systems Engineering and academic research. I am also thankful for the support from "Team San Diego" and the rest of my PhD cohort. Finally, I would like to thank the SPAWAR team who helped execute the framework described in this dissertation.

Abstract

A Framework for Capturing the Hidden Stakeholder System

Managing stakeholder relations and interrelations is critical to program success, yet current architecture frameworks only capture the views of stakeholders not the relationships of stakeholders. By capturing all program stakeholders in a networked view, architecture frameworks would be able to more accurately portray a program's socio-technical system and aid systems engineers in better understanding how and why stakeholders influence their program. With this knowledge, it is anticipated that systems engineers would be able to achieve right-sized stakeholder involvement, promote effective use of resources, and increase the probability of overall program success with the assurance of lasting stakeholder commitment.

This dissertation describes the creation of a framework that systems engineers may employ to capture program stakeholders as a system composed of $n*(n-1)/2$ interfaces where n equals the number of stakeholders. The framework was developed based upon the state of the practice in the fields of Architecture Framework, Stakeholder Analysis, and Social Network Analysis. This new framework was tested by members of a U.S. Department of Defense (DoD) acquisition program via a pilot study and then updated based upon lessons learned. The architectural products produced via the refined framework (intended for use by both DoD and non-DoD programs) document the program's stakeholder concerns and illustrate how the stakeholders themselves interrelate over the system's life cycle. This unique insertion of stakeholder analysis and social network analysis techniques into an architecture framework helped fulfill an original intent in the field of Architecture Framework: capturing the entire socio-technical system.

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Glossary of Terms

Architecture – "The fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution" (ISO, 2007; IEEE, 2000)

Boundary Spanner – "A person who connects a department with other departments" (Anklam, 2005)

Broker – "Someone who communicates across subgroups" (Anklam, 2005)

Central Connector – "Someone who is highly connected to many others in the network, who may be either a key facilitator or a 'gatekeeper'" (Anklam, 2005)

Engineering and Manufacturing Development Phase – The phase dedicated to, "Develop a system or an increment of capability; complete full system integration…; develop an affordable and executable manufacturing process; ensure operational supportability with particular attention to minimizing the logistics footprint; implement human systems integration (HSI); design for producibility; ensure affordability; protect CPI by implementing appropriate techniques such as anti-tamper; and demonstrate system integration, interoperability, safety, and utility" (U.S. Department of Defense, 2008)

Legitimacy – "A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, definitions" (Mitchell, Agle, & Wood, 1997)

Materiel Solution Analysis Phase – The phase dedicated to, "Assess potential materiel solutions" (U.S. Department of Defense, 2008)

Operations and Support Phase – The phase dedicated to, “Execute a support program that meets materiel readiness and operational support performance requirements, and sustains the system in the most cost-effective manner over its total life cycle” (U.S. Department of Defense, 2008)

Peripheral Specialist – “Someone less connected or not connected at all” (Anklam, 2005)

Power – “A relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not have otherwise done” (Mitchell, Agle, & Wood, 1997)

Production and Deployment Phase – The phase dedicated to, “Achieve an operational capability that satisfies mission needs” (U.S. Department of Defense, 2008)

Pulsetaker – “Someone who uses his or her connections to monitor the health of an organization” (Anklam, 2005)

Stakeholder – “[A]ny group or individual who can affect or is affected by the achievement of the organization's objectives” (Freeman, 1984)

Stakeholder System – A system in which the stakeholders are the components and their interrelations form the $n*(n-1)/2$ interfaces where n equals the number of stakeholders

Technology Development Phase – “Reduce technology risk, determine and mature the appropriate set of technologies to be integrated into a full system, and to demonstrate CTEs [Critical Technology Elements] on prototypes” (U.S. Department of Defense, 2008)

Urgency – “The degree to which stakeholder claims call for immediate attention” (Mitchell, Agle, & Wood, 1997)

View - "[A] representation of a whole system from the perspective of a related set of concerns" (ISO, 2007; IEEE, 2000)

Viewpoint - "[A] specification of the conventions for constructing and using a view" (ISO, 2007; IEEE, 2000)

Chapter 1 — Introduction

As today's programs continue to rise in complexity and scope, the number of stakeholders involved in these programs also tends to increase. As the number of stakeholders increases, the number of relationships between the stakeholders increases exponentially. If these relationships are ignored or simply not understood, the program team may be entering an uncharted stakeholder minefield by failing to include the proper stakeholders, at the proper time, when making a critical program decision. This is because, when a person is making a decision for a program, that person must understand not only the first order impacts of that decision but also the second and third order impacts. What if the decision negatively affects the customer of the decision maker's customer? What if the decision requires a stakeholder to advocate for the decision maker, the same stakeholder that is upset because he or she has been excluded from previous decisions concerning the program? The primary intent of the pilot study documented in this dissertation was to demonstrate that stakeholder interrelations can be captured in an architectural view. An additional goal of this effort was to produce a framework for systems engineers that would guide them in capturing and characterizing their program's unique stakeholder system so that they would know to whom they must pay attention and at what times.

1.1 Problem Statement

Managing stakeholder relations and interrelations is critical to program success, yet current architecture frameworks only capture the views of stakeholders not the relationships of stakeholders. The following paragraphs explain the importance of understanding and managing stakeholder interrelations as well as the current use (and deficit) of architecture frameworks.

In developing his book, *Why Decisions Fail*, Paul Nutt studied more than 400 strategic decisions and concluded that more than half of these decisions failed (Nutt, 2002). Not only did Nutt's research reveal a high prevalence of strategic decision making failure as mentioned above, but Nutt's research further revealed that success or failure of a major initiative is more dependent upon the actions of a decision maker than the particulars of a situation faced by that decision maker. One of the failure traps that Nutt highlights in his book, *Why Decisions Fail,* is unmanaged political and social forces. Nutt states that, if stakeholder "interests can be uncovered and understood, the social and political forces that the interests stir up are usually manageable" (Nutt, 2002). In fact, previous research by Nutt shows that a thorough involvement of stakeholders in strategic decision making delivers a success rate of over 90 percent (Nutt, 1999).

In order to ensure stakeholder interests are incorporated into a program's design, many organizations employ formal architecture frameworks. Yet, even with these frameworks, most organizations still experience failures. The author of this dissertation posits that a current deficit of architecture frameworks is that they focus on stakeholders solely via isolated viewpoints, thereby failing to capture the stakeholders as a system. While stakeholders themselves are individuals, they do not think or act in a vacuum. Each individual stakeholder is a component in a larger stakeholder system. These stakeholders affect their stakeholder system and are also strengthened or constrained by the system.

When taking a systems approach with regard to stakeholders, the individual stakeholders as well as the relationships between the stakeholders are examined. Exemplifying the foregoing is a simple but poignant example described by Edward Cornish (2004): Imagine two people standing in front of you. There are several visible characteristics that can be observed (clothes, hairstyle, etc.); however, unseen is the relationship. What if they are a married couple? Bitter rivals? According to Cornish, "it is relationships among things, more than the things themselves, that shape events" (Cornish, 2004).

In addition to their own personal biases, program stakeholders are influenced by the many complex relationships of which they are a part. These relationships can be complicated by a myriad of factors such as interagency rivalries, intra-agency conflicts, lobbyist agendas, and even the media (Forman, 2002). Using the communications path formula from *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, there are in fact n*(n-1)/2 relationships where n is equal to the number of stakeholders (Project Management Institute, 2004). In systems terminology, the stakeholders are the components and their relationships are the interfaces. Defining both the components and the interfaces is required when defining the system.

1.2 Pilot Study Objectives

The pilot study described within this dissertation sought an affirmative answer to the following question: Can the stakeholder system be captured in an architectural view? While architecture frameworks capture the *views* of program stakeholders, architecture frameworks fall short of their intended purpose (i.e., capturing the *entire* socio-technical system) by failing to capture the *interrelations* of the stakeholders. In conjunction with the pilot study, a framework was developed to guide systems engineers in capturing and characterizing their program's unique stakeholder system. With the tools to capture and characterize both the components (i.e., stakeholders) and the interfaces (i.e., stakeholder relationships), systems engineers will have a much clearer understanding of their unique stakeholder system, a system that may aid and/or constrain any aspect of the program including technical design and implementation.

1.3 Intended Value

Introduction of a repeatable framework that produces architectural products to accurately characterize the stakeholder system has benefits to both systems engineering academia and practitioners of systems engineering, specifically those entrusted to build system architectures. From an academic standpoint, these efforts bridged the fields of Social Network Analysis and Architecture Framework and opened the door to future research efforts that can explore the effectiveness of new tools and the application of those tools in support of systems engineering and project management efforts. Additionally, linking these two fields fulfilled an original intent of Architecture Framework by capturing the *entire* socio-technical system. From a practitioner perspective, the framework allows seasoned systems engineers to use readily available tools to capture and document their stakeholder system. Although the framework was purposely designed to be applicable to any program, programs with stable environments and a high number of stakeholders (such as the Joint Service Department of Defense (DoD) program documented in this pilot study) are most likely to benefit.

Although evaluating the effectiveness of these tools is left to future research, it is expected that the resulting architectural products will provide several benefits. First, they will allow for right-sized stakeholder involvement by highlighting stakeholders with a vested concern that need to be involved in critical decision making such as engineering tradeoff decisions. Second, systems engineers can make more effective use of their resources by proactively involving stakeholders who are expected to have a future interest in the issue being resolved. Third, by obtaining commitment from stakeholders on key decisions, the probability of overall program success will be increased.

1.4 Dissertation Structure

This dissertation is divided into six chapters. This chapter, Chapter 1, is the topic introduction. Chapter 2 is a literature review that explores the fields of Architecture Framework, Stakeholder Analysis, and Social Network Analysis. It was found during this review that no formal architecture framework attempts to capture all stakeholders in a networked view; however, there were existing tools and techniques discovered that can be (and were) adopted for this purpose. Chapter 3 discusses the contributions to research this effort was expected to produce and includes an overview of the architectural products that were subsequently used to capture and characterize a program's stakeholder system. This is followed by Chapter 4 which describes the execution of the pilot study performed by members of a U.S. DoD acquisition program. This pilot effort affirmatively answered the question, "Can the stakeholder system be captured in an architectural view?" The pilot study also confirmed the usability of a new five-step framework developed by this author to guide systems engineers in capturing and characterizing their program's unique stakeholder system. Chapter 6 is dedicated to detailing the final framework which incorporates lessons learned from the pilot study. The final framework consists of the following five steps: Process Introduction & Stakeholder Identification, Stakeholder

Classification, Time-Phasing & Analysis, Stakeholder Network Map Creation, and Social Role Analysis. Finally, Chapter 7 provides the conclusions reached as a result of this process.

Chapter 2 — Literature Review

This study sought an affirmative answer to the following question: Can the stakeholder system (a system containing n*(n-1)/2 interfaces where n equals the number of stakeholders) be captured in an architectural view? A secondary goal for this study was to develop a framework for systems engineers that would guide them in capturing and characterizing their program's unique stakeholder system. In order to understand previous research performed in aspects related to this topic, the author examined the literature in three fields: Architecture Framework, Stakeholder Analysis, and Social Network Analysis.

This chapter starts by introducing a conceptual map of the literature review, showing the three fields studied and how they interrelate. The following sections contain brief synopses of key pieces of literature related to this pilot study. Next, the gaps and problem areas of the current state of research are identified, which leads to a discussion on the need for a new study.

2.1 Conceptual Map

Figure 2-1 below is the conceptual map for the literature review undertaken. The approach taken was to: 1) examine the three primary fields related to this pilot study (Architecture Framework, Stakeholder Analysis, and Social Network Analysis), 2) examine areas in current literature where these fields overlap, and 3) examine areas where a gap was identified in the literature. Figure 2-1 arranges the topics in a Venn diagram. The numbers in the diagram correspond to the subsections below which explore the topic or topics contained in that area of the diagram. For example, section 2.5 includes literature that relates to both Architecture Framework and Stakeholder Analysis.

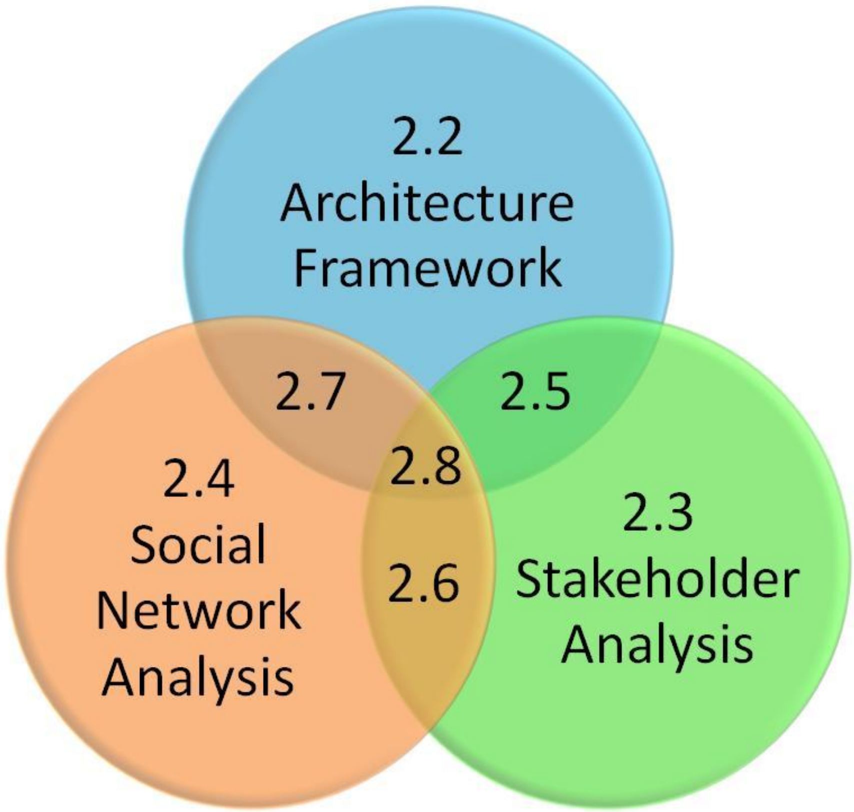


Figure 2-1: Conceptual map of literature review

2.2 Architecture Framework

Architecture framework is a methodology used to describe a system using differing views and viewpoints. In this context, a view is "a representation of a whole system from the perspective of a related set of concerns," and a viewpoint is "a specification of the conventions for constructing and using a view" (ISO, 2007; IEEE, 2000). The review of the literature below begins with Zachman's introduction of the architecture framework concept and continues with chronological reviews of the literature, including the state of the practice for architecture frameworks within the U.S. Department of Defense (DoD), the DoD Architecture Framework.

2.2.1 A Framework for Information Systems Architecture (Zachman, 1987)

The architecture framework concept is first documented by Zachman in 1987. In his paper titled, “A framework for information systems architecture,” he proposes leveraging the techniques from the field of Classical Architecture (i.e., the methodology used for creating physical buildings) to describe information system projects (Zachman, 1987). Classical Architecture leverages the use of different views of the same structure drawn with different target audiences in mind. The most common of these drawings are listed in the second column of Table 2-1 below. These are bubble charts (used to show the general size, shape, context, and purpose of the final building), architect’s drawings (vertical and horizontal representations of the building used to facilitate discussions between the owner and architect), architect’s plans (detailed depictions of unique aspects such as woodwork, masonry, and electrical systems used in negotiation with general contractors), contractor’s plans (a variation of the architect’s plan that accounts for constraints such as technological challenges, material costs, or time), and shop plans (a subcontractor design model of a specific piece of the final architecture), which all lead to the final creation of the intended product, the building. By using an analogous approach for building information systems, Zachman proposes this new (as of 1987) field will be able to leverage the “thousand or so years of experience that have been accumulated” in Classical Architecture. As such, Zachman’s framework describes the same system from many different angles (or views) with different collections dedicated to different stakeholders. Table 2-1 below also lists the information system artifacts. These are the scope/objectives (a listing of what the owner desires using nouns vice verbs), business model/descriptions (a listing of business rules that relate the entities of the business such as employees, products, and warehouses), information systems model/description (a portrayal of how information systems entities relate to each other), technology model/description (plans for the physical implementation of the information systems model), detailed description (specifications for a specific piece of the final architecture), and machine language description/object code (the programmer's code that enables the desired transactions).

Table 2-1: Comparison of Classical Architecture to Information Systems Architecture (adapted from Zachman, 1987)

Viewpoint	Classical Architecture Artifacts	Information Systems Architecture Artifacts
All Viewpoints	Bubble Charts	Scope/Objectives
Owner's Representation	Architect's Drawings	Business Model/Description
Designer's Representation	Architect's Plans	Information Systems Model/Description
Builder's Representation	Contractor's Plans	Technology Model/Description
Out-of-Context Representation	Shop Plans	Detailed Description
Machine Language Representation	N/A	Machine Language Description /Object Code
Product	Building	Information System

Zachman's work was critical to the efforts documented in this dissertation, because his work set the foundation for all subsequent architecture frameworks; however, while Zachman's approach captures stakeholder's views, and documents what is important for each stakeholder, his model does not explicitly portray the interrelations of those stakeholders.

2.2.2 Systems and Software Engineering – Recommended Practice for Architectural Description of Software-Intensive Systems (ISO, 2007; IEEE, 2000)

From a standards point of view, architecture frameworks are guided by the joint standard ISO 42010/IEEE 1471, "Systems and software engineering – Recommended practice for architectural description of software-intensive systems." This standard enacted by IEEE in 2000 and adopted by ISO in 2007, provides recommended guidance for use in developing and using architecture frameworks. The standard provides a conceptual framework that "establishes terms and concepts pertaining to the content and use of architectural descriptions." This is followed by a description of architectural practices to include example usage. The standard does not promote any single framework but rather describes the aspects of architectural frameworks that are generally considered to be best practices. The framework designed for the pilot study (which is described in detail later in the dissertation), applied these best practices, specifically the standard's recommendation of identifying stakeholders, their roles, and interests or concerns with regard to the system under development.

2.2.3 ANSI/IEEE 1471 and Systems Engineering (Maier, Emery, & Hilliard, 2004)

Maier, Emery, and Hilliard review the IEEE standard 1471 and demonstrate that while the standard is written for software intensive systems, the standard is equally applicable to systems engineering. In this article, the authors note that per the definition in 1471, "a system *always* has an architecture" (Maier, Emery, & Hilliard, 2004). The authors further highlight how systems engineering architectures are directly comparable to the software system architectures described in the standard. Finally, the authors explore actual architecture frameworks and show how these frameworks meet the needs of systems engineers as well as the intent of the IEEE standard. Maier, Emery, and Hilliard's work proved the applicability of IEEE's standard with regard to building the systems engineering architectural framework views that were created during the execution of the pilot study.

2.2.4 Supporting Strategic Enterprise Processes: An Analysis of Various Architecture Frameworks (Mykityshyn & Rouse, 2006)

In their article, Mykityshyn and Rouse propose the introduction of a strategic layer that describes processes that are distinct from the operational layer typically found in business architecture frameworks. These authors search through existing literature to determine whether an existing framework captures (or can capture) an enterprise's strategic processes. The authors specifically explore the application-class architecture frameworks, enterprise-class architecture frameworks, and human behavior and performance "architectures" (listed in Table 2-2 below). Mykityshyn and Rouse note that the quotation marks around the latter use of the term "architectures" are purposely included, since the human behavior and performance architectures are not architectures in the purest sense (i.e., they do not support the criteria listed in ISO 42010/IEEE 1471). The authors conclude that while none of the architecture frameworks reviewed adequately address the strategic processes described earlier in the article, there are pieces of several frameworks that may be adopted and incorporated into a new framework which addresses the strategic layer as well as the operational layer.

Table 2-2: Architecture frameworks reviewed in Mykityshyn & Rouse (2007)

Application-Class Architecture Frameworks	Enterprise-Class Architecture Frameworks	Human Behavior and Performance "Architectures"
DoD Architecture Framework	Open Systems Interconnection (OSI) Reference Model Framework	Skills, Rules, Knowledge (SRK) taxonomy
Federal Enterprise Architecture Framework	Zachman Framework	Optimal Control Model (OCM)
IBM's Service Oriented Architecture		
Typical Business Architecture Frameworks		

This article was of particular use for the efforts documented in this dissertation as it provided an overview of many architecture frameworks that could be considered as having the ability to capture stakeholder interrelations. Upon review, it appeared that one framework, the Optimal Control Model (OCM), may capture stakeholder interrelations. After careful review, however, the OCM was not chosen as a methodology for use within the framework developed for the pilot study. This is because the OCM only portrays human interrelations to the extent they support execution of the system's mission. That is, the OCM does not support detailing the relationships of external stakeholders that aid in the design, development, and/or future sustainment of the system.

2.2.5 DoD Architecture Framework (U.S. Department of Defense, 2009)

The state of the practice for architecture frameworks within the DoD is appropriately named the DoD Architecture Framework (DoDAF). DoDAF v2.0 takes it roots from the Command, Control, Communications, Computers, and Intelligence, Surveillance, and Reconnaissance (C4ISR) Architecture Framework originally released in 1996 in response to the Clinger-Cohen Act. In 2003, DoDAF v1.0 was released and the applicability was expanded to DoD capabilities beyond C4ISR. DoDAF v1.0 was followed by v1.5 in

2007 which was released mainly to address net-centric concepts with the architectural descriptions. Then, in 2009, DoDAF v2.0 was released.

The current version, v2.0, focuses on capturing program data without deference to any particular view; however, to facilitate discussion and evaluation, 50 pre-defined models are proposed. These models consist of varying views from the following viewpoints: All Viewpoint, Capability Viewpoint, Data and Information Viewpoint, Operational Viewpoint, Project Viewpoint, Services Viewpoint, Standards Viewpoint, and Systems Viewpoint (U.S. Department of Defense, 2009). Additionally, DoDAF 2.0 supports flexible "Fit-for-Purpose" views which are designed to describe an architecture in a manner that directly supports the decision making process while responding to internal and external stakeholder concerns.

While none of the pre-defined models depict stakeholder interrelations, the flexible nature of DoDAF 2.0 allows a program team to capture their stakeholder relationships within a custom Fit-for-Purpose view. This approach was leveraged during the execution of the pilot study documented in this dissertation. Specifically (as further explained in Chapter 4), a DoD acquisition program built new Fit-for-Purpose views using a framework developed by this author that was designed to capture stakeholders (individually) as well as their interrelations.

2.2.6 Model Based Systems Engineering with Department of Defense Architectural Framework (Piaszczyk, 2011)

Piaszczyk documents his use of models to execute the systems engineering process in, "Model based systems engineering with Department of Defense Architectural Framework." Specifically, he uses DoDAF v1.0 products to facilitate requirements derivation, system design, integration, verification, and validation activities. This approach provides many advantages. The models enable dialogue and full participation from the program stakeholders including customers, developers, and implementers. This approach also places attention on validation (i.e., answering the question, “are we building the right system?”) in earlier stages of the development cycle. Another advantage of model based systems engineering is that it allows the program team to quickly adjust to changes in requirements. These requirements often emerge as stakeholders learn more about the system (including the refinement of their own vision of the system). Also, over time, politics, budgets, and technologies will likely change in ways that affect the program stakeholders’ objectives, thereby driving more changes in the system requirements.

While the framework designed and documented within this dissertation could support traditional or model based systems engineering methods, much of Piaszczyk’s article is beyond the scope of this pilot study. Nevertheless, Piaszczyk’s highlighting of the fact that stakeholder attitudes may fluctuate over time due to the changing nature of politics, budgets, and technologies, identified a requirement that was included in the framework developed for the pilot study. As detailed in Chapter 3, this new framework was specifically designed to capture how the stakeholder landscape changes over time.

2.2.7 Architecture Framework Conclusions

While the Zachman Framework is still popular and in use, several other architecture framework varieties are also in use (Mikaelian, Nightingale, Rhodes, & Hastings, 2011). Some of the common varieties include: DoD Architecture Framework; Federal Enterprise Architecture Framework; Open Systems Interconnection (OSI) Reference Model

Framework; IBM's Service Oriented Architecture; Skills, Rules, Knowledge (SRK) taxonomy; and Optimal Control Model (OCM). Upon review, it was determined that none of these architecture frameworks attempt to capture all stakeholders in a networked view. Typically, stakeholders are solely captured via isolated viewpoints; however, some frameworks (such as OCM) do capture the human interactions that support system functions. Yet, these frameworks still fall short in capturing the interrelations of all stakeholders (Mikaelian, Nightingale, Rhodes, & Hastings, 2011; Mykityshyn & Rouse, 2006).

2.3 Stakeholder Analysis

Stakeholder Analysis studies the positive and negative effects of people who can influence, or are influenced by, a program. The field of Stakeholder Management traces back to *Strategic Management: A Stakeholder Approach* (Freeman, 1984). Although the field is rooted in management science, it has a wide and constantly growing range of applications. As our world becomes increasingly global and interconnected, the number and influence of stakeholders is increasing, thus creating an even stronger need for this field (Bryson, 2004). This literature review starts with Freeman's book. The review then continues with a chronological review of the literature, including *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* which provides the state of the practice from the perspective of the Project Management Institute.

2.3.1 Strategic Management: A Stakeholder Approach (Freeman, 1984)

Within *Strategic Management: A Stakeholder Approach*, Freeman defines a stakeholder as "any group or individual who can affect or is affected by the achievement of the organization's objectives." This would include, for example, both the end user (someone who will be affected) and a regulatory agency (who can affect (i.e., delay) fielding of the product). In the first section of his book, Freeman describes the needed transition from a managerial view of an organization such as a firm or company to a stakeholder view of that same organization. In the managerial view, the corporation and its managers interact with four entities: owners, suppliers, customers, and employees. In the stakeholder view, the corporation interacts with owners, suppliers, customers, and employees (as before), but it also interacts with governments, local community organizations, consumer advocates, competitors, media, special interest groups, and environmentalists. Freeman's approach to considering a wide range of entities as stakeholders was the approach adopted in the framework developed by this author to support the pilot study documented in this dissertation.

Freeman's approach to defining and characterizing stakeholders was also of particular use to this author for the pilot study documented in this dissertation. First, Freeman explores and documents the observed behavior of stakeholders. Next, he develops theories on why stakeholders behaved in the manner observed. He then looks at the potential the stakeholders have to form coalitions with other stakeholders involved in the program. The framework developed by this author to support the pilot study documented in this dissertation followed Freeman's approach by using the observed behavior of stakeholders to classify them in a manner presented by Mitchell, Agle, and Wood (see the following subsection). The stakeholders were then portrayed graphically in a networked view which allowed systems engineers to develop strong theories on why stakeholders behaved in the manner observed as well as recognize potential (and active) coalitions.

2.3.2 Toward A Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts (Mitchell, Agle, & Wood, 1997)

Mitchell, Agle, and Wood work to define the characteristics of stakeholders in "Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts." In this article, the authors discuss an in depth literature review of stakeholder theory, looking for answers to the question, "Who is a stakeholder, and what is a stake?" Their literature review uncovers differences in stakeholder definitions which can be placed into two main categories. First, there are those who take a narrow view of stakeholders, which limits the list of stakeholders to only those with "legitimate" stakes (i.e., entities to whom the organization is either contractually or morally bound). This approach is favored by those seeking practicality and a manageable number of stakeholders. The second category consists of those who take a broad view of stakeholders. This more encompassing approach includes any stakeholder who has the power to influence, regardless of whether or not there is a contractual or moral obligation to that stakeholder.

In addition to legitimacy and power, Mitchell, Agle, and Wood introduce a third characteristic: urgency. The authors acknowledge that the characteristic of urgency is not a primary attribute in any organizational theory; however, they do believe it to be implicit in each theory. The authors believe this third characteristic is required as, "Urgency…adds a catalytic component to a theory of stakeholder identification, for urgency demands attention." Table 2-3 below provides working definitions for the three characteristics of stakeholders as provided by Mitchell, Agle, and Wood.

Table 2-3: Stakeholder characteristics (Mitchell, Agle, and Wood, 1997)

Characteristic	Definition
Power	*A relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not have otherwise done*
Legitimacy	*A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, definitions*
Urgency	*The degree to which stakeholder claims call for immediate attention*

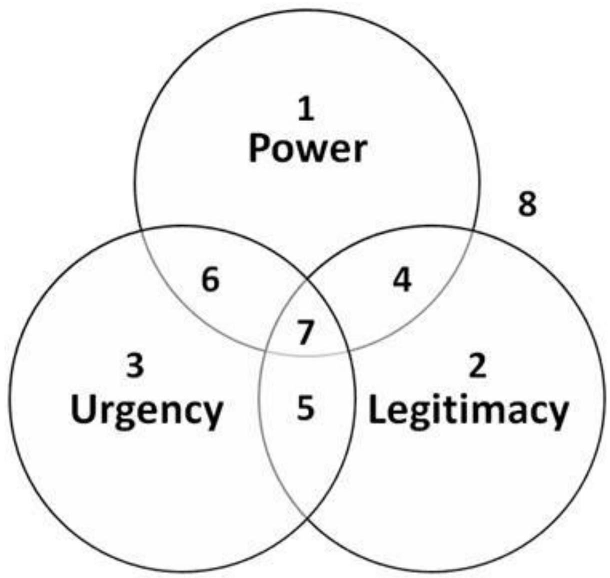


Figure 2-2: Characteristics and classes of stakeholders (Mitchell, Agle, & Wood, 1997)

As shown in Figure 2-2 above, stakeholders may possess one or more of the three characteristics (power, legitimacy, and urgency). This possession of one or more characteristics gives rise to eight classes of stakeholders: Dormant, Discretionary, Demanding, Dominant, Dangerous, Dependent, Definitive, and Nonstakeholder. Table 2-4 shows the correlation of these classes to the stakeholder characteristics illustrated in Figure 2-2. Mitchell, Agle, and Wood elaborate that each of these classes has different expectations and requires different management approaches. The authors further note that stakeholder characteristics (and, hence, stakeholder classes) are dynamic in that they change over time. This is most clearly and often seen with regard to the characteristic of urgency but can also occur with regard to changes in power and/or legitimacy.

Table 2-4: Classes of stakeholders (Mitchell, Agle, & Wood, 1997)

Number	Class of Stakeholder
1	Dormant
2	Discretionary
3	Demanding
4	Dominant
5	Dangerous
6	Dependent
7	Definitive
8	Nonstakeholder

Mitchell, Agle, and Wood's approach to defining and characterizing stakeholders is also widely used by organizations performing stakeholder analysis (Smudde & Courtright, 2011). This approach was also wholly adopted for the framework employed during the pilot study. Then, as addressed in Chapter 5, the Mitchell, et al. approach was slightly modified for the final framework. Instead of using the numbers shown in Figure 2-2 and Table 2-4 to label stakeholders, the final framework used combinations of the letters P, L, and U to denote whether or not the stakeholder posses power, legitimacy, and/or urgency.

2.3.3 Surprising but True: Half of the Decisions in Organizations Fail (Nutt, 1999)

The article's title, "Surprising but true: Half of the decisions in organizations fail" sets the stage for Nutt's discussion on decision making. The claim in the title is based on 356 decisions made by medium to large organizations in both the U.S. and Canada. Although failed decisions are often blamed on external circumstances (e.g., poor economy or unforeseen political pressure), Nutt's research shows that most failed decisions are the result of poor decision making tactics. Nutt discusses well known but rarely used tactics that often lead to success (such as performing a thorough analysis of all potential solutions) as well as commonly used tactics that often lead to failure (such as choosing a solution for the sole reason that it was used by an analogous organization).

Nutt describes decision making as a three-stage process. The first stage is establishing direction. The second stage is identifying options. The third stage is implementing decisions. Nutt provides common processes and tactics associated with each phase and shows the percent of the cases studied that applied each tactic.

One key lesson Nutt promotes is: "Involve people affected by a decision." Actively involving as many stakeholders as feasible is shown to be the most successful approach to implementing strategic decisions. In fact, the foregoing approach has a success rate "well above 90 percent." It is from this lesson that the concept for the pilot study described in this dissertation emerged. If program teams were provided tools to help them understand which stakeholders to involve in key decision making, then programs would have a much greater probability of success. When a systems approach is taken, understanding stakeholders requires an understanding of both the stakeholders (i.e., the system components) and their relationships (i.e., the system interfaces).

2.3.4 Why Decisions Fail (Nutt, 2002)

In 2002, Nutt released his book, *Why Decisions Fail*. This book expands upon Nutt's previous research and includes 400 decisions studied over 20 years. Still, Nutt's research shows that "decisions fail *half* of the time." Nutt's book provides more structured guidelines than his previous article reviewed above. Specifically, Nutt describes three common blunders (failure-prone decision-making practices, premature commitments, and time and money spent on the wrong things) which drive decision makers into the following seven traps:

- Failing to take charge by reconciling claims
- Ignoring barriers to action
- Providing ambiguous direction
- Limiting search
- Misusing evaluation
- Overlooking ethical questions
- Failing to learn

The majority of Nutt's book is dedicated to describing these traps, the blunders that precede them, real life examples, and techniques to avoid the traps. Of particular note for this literature review, Nutt dedicates a full chapter to the traps arising from unmanaged social and political forces. Nutt states that, if stakeholder "interests can be uncovered and understood, the social and political forces that the interests stir up are usually manageable." In the failed cases that Nutt highlights in that chapter, social and political forces were ignored and "left to fester" (Nutt, 2002). This lesson led the author of this dissertation to the conclusion that decision makers (and the systems engineers that support them) need a methodology of determining who to involve while making key decisions. Without understanding which stakeholders impact (or will be impacted by) a particular decision, program teams may involve too many stakeholders, a solution that is cumbersome at best. In contrast, program teams may involve too few stakeholders, an approach that has been shown (by Nutt) to be disastrous.

2.3.5 What to Do When Stakeholders Matter: A Guide to Stakeholder Identification and Analysis Techniques (Bryson, 2003)

In 2003, Bryson presented a paper to the London School of Economics and Political Science titled, “What to do when stakeholders matter: A guide to stakeholder identification and analysis techniques.” Bryson asserts that “Stakeholder analyses are arguably more important than ever because of the increasingly interconnected nature of the world,” and that “[f]ailure to attend to the information and concerns of stakeholders clearly is a kind of flaw in thinking or action that too often and too predictably leads to poor performance, outright failure, or even disaster” (Bryson, 2003).

According to Bryson, stakeholder analysis is so lacking in the public sector that he proposes this deficiency be studied as “an important research issue in its own right.” Bryson observes that among the reasons for avoiding stakeholder analysis is the shortage of how-to guides, an assumption that the efforts will require significant resources, and/or a fear that the results will upset others, including the stakeholders being examined.

Bryson goes on to discuss who should be involved in stakeholder analysis and provides an array of stakeholder analysis techniques. These techniques include:

- Power Versus Interest Grids
- Stakeholder Influence Diagrams
- Finding the Common Good
- Tapping the Individual Stakeholder Interests
- Problem-Frame Stakeholder Mapping
- Ethical Analysis Grids
- Support Versus Opposition Grids

By applying one or more of these techniques, Bryson asserts that both public and nonprofit organizations will discover good ideas and be able to assess them with regard to their feasibility of being implemented.

Several aspects of Bryson's work were incorporated into the author's framework further described in Chapters 3 and 4. For example, Bryson's theories on why stakeholder analysis is often avoided (shortage of how-to guides, an assumption that the efforts will require significant resources, and/or a fear that the results will upset others, including the stakeholders being examined) served as the basis for several requirements of the new framework. Additionally, Bryson's methods of brainstorming potential stakeholders, documenting stakeholders' primary concerns regarding the system under development, and creating stakeholder influence diagrams were incorporated into the new framework.

2.3.6 A Guide to the Project Management Body of Knowledge (PMBOK Guide) (Project Management Institute, 2004)

Project Management Institute's *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* contains standard terminology, processes, and knowledge areas for project managers. This book places a strong emphasis on communications management, specifically identifying stakeholders, planning communications with those stakeholders, and managing stakeholder expectations. This guidebook reinforced the need for and significance of the pilot study and framework documented in this dissertation as the resulting architectural products will be able to assist project managers and systems engineers in better supporting communications management activities (which Nutt previously proved to be a critical factor in program success). Additionally, this book provided the formula for calculating the number of interfaces a stakeholder system contains: n*(n-1)/2 where n equals the number of stakeholders (Project Management Institute, 2004).

2.3.7 A Holistic Approach to Stakeholder Management: A Rhetorical Foundation (Smudde & Courtright, 2011)

Public relations practitioners are particularly mindful of the attitudes of external stakeholders. In their article titled, "A holistic approach to stakeholder management: A rhetorical foundation," Smudde and Courtright discuss how to create new stakeholders (particularly new customers), how to maintain relationships with stakeholders, and how to improve relationships with stakeholders. According to the authors, stakeholders are not merely identified through research; they are created. Creating stakeholders begins with communication. Communication from both inside and outside the organization reveals what the organization can provide to their potential stakeholders. Once this is understood, stakeholders will "decide to buy into it [the organization], literally and/or metaphorically." The authors note the work of Mitchell, Agle, and Wood and highlight their successful approach in showing who is a stakeholder and what is a stake (see section 2.3.2). The authors also introduce the need for a stakeholder map "so that management knows precisely to whom it must pay attention, on what matters, and in what ways" (Smudde & Courtright, 2011).

Just as communication was the key to creating stakeholders, communication is also the key to maintaining relationships with stakeholders. The authors posit that stakeholders inherently share common interests. When conflict is identified amongst stakeholders, officials must rethink problems and express them in ways that support value creation for all parties. The authors note that communications can also be initiated from the stakeholders and directed at the company. Regardless of the origin, companies must take stakeholder communications seriously and present coherent and consistent themes.

Stakeholder relationships can be improved, and a key way to improve relationships is through communication. According to the authors, humans seek order. When internal or external actions disrupt the order of things for an organization, that organization must inform their stakeholders of the new order of their environment. Whether the news is positive or negative, creating a clearer understanding will improve stakeholder relations.

The authors recommend that organizations take a proactive role in stakeholder management. The organizations must make conscious efforts to seek out new stakeholders, maintain stakeholder relations, and improve stakeholder relations. From the perspective of a single stakeholder these actions occur sequentially; however, from the organization's perspective these must occur concurrently in order to continually manage all stakeholders. For this reason, the authors assert a holistic approach must be taken that encompasses all three aspects of stakeholder management simultaneously.

This work further reinforces previous findings from Nutt and the Project Management Institute regarding the critical importance of maintaining stakeholder relationships. As with the communications management aspects provided by the Project Management Institute, the architectural products developed through the use of the framework documented in this dissertation will aid project managers and systems engineers in identifying new stakeholders, maintaining stakeholder relations, and improving stakeholder relations, because the framework (which is further detailed in the subsequent chapters of this dissertation), provides a means to identify which stakeholders to involve in support of specific decisions or objectives.

2.3.8 Stakeholder Analysis Conclusions

The literature reviewed identified that stakeholder analysis is critical to program success (Nutt, 2002; Project Management Institute, 2004; Smudde & Courtright, 2011). At the same time, the literature revealed that stakeholder analysis is often avoided (Nutt, 2002; Bryson, 2003). Bryson observes that among the reasons for avoiding stakeholder analysis is the shortage of how-to guides, an assumption that the efforts will require significant resources, and/or a fear that the results will upset others, including the stakeholders being examined (Bryson, 2003). The literature also provided relevant tools which were incorporated into the framework developed by the author and documented in this dissertation. These include Mitchell, et al.'s approach to characterizing stakeholders as well as Bryson's approach to both identifying potential stakeholders and creating stakeholder influence diagrams.

2.4 Social Network Analysis

Social Network Analysis examines the networks that intertwine individuals, groups, and organizations (Liebowitz, 2005). These networks can be derived from any sources such as family ties, friendships, and political associations. As discussed in the literature reviewed below, humans receive strength from their networks, but they are also constrained by their networks.

Like Stakeholder Analysis, Social Network Analysis can be and is applied within a variety of disciplines including anthropology, psychology, and management (Liebowitz, 2005). Although the roots of this discipline lay in Sociology, which was commenced by

Georg Simmel in 1908 when he wrote about the emergent behavior of a collection of humans, the fruit of this discipline can be traced to Social Capital, the field that examines the collective knowledge of human groups (Scott & Carrington, 2011).

In order to obtain an overview of the broad and historically rich discipline of Social Capital, a secondary source (a literature review performed by Alejandro Portes, Professor of Sociology at Princeton University) was reviewed and is described below. This is followed by a chronological review of the expanding (and improving) literature that explores a wide range of subtopics such as social networks' effect on an organization's productivity and the evaluation of product development systems through the use of social network analysis tools.

2.4.1 Social Capital: Its Origins and Applications in Modern Society (Portes, 1998)

Portes traces the origins of Social Capital in his article titled, "Social Capital: Its origins and applications in modern society." This article is focused on the sociological perspective of Social Capital. Portes successfully argues that while the term "social capital" is in vogue, its concept is rooted in classical times. According to Portes, it is well known throughout the sociological field that there are positive consequences associated with social interactions and these non-monetary consequences (i.e., capital) are a source of power and influence. The recent (as of 1998) revival of Social Capital started in France during the 1980s through the works of Pierre Bourdieu. Bourdieu's focus is on the gains received by an individual through participation in social groups and how an individual structures his groups to fit his personal needs. In the late-1980s and early-1990s, James Coleman explored social capital in terms of its functions based on the sources and effects of social interactions. Critical to this discussion, according to Coleman, are the motivations of the recipients and the more complex motivations of the donors.

Portes discusses the effects of social capital which fall into three main groups: a source of control, a source of support, and a source of benefits through linkages with other networks. Portes references several authors such as Zhou, Bankston, and Hagan, who have researched how an individual's behavior is controlled by social networks, specifically the control shown in cultural groups. Portes also explores the rich writings on extra-network interactions including the works of Anheier, Granovetter, Burt, Lin, Ensel, and Vaughn. These authors explore both the strong (direct) and weak (indirect) ties between sub-networks and how they can be used to benefit individuals.

For the efforts documented in this dissertation, Portes' literature review helped clarify why social networks (including stakeholder networks) are important. Members obtain social capital through leveraging those in their network. These members' behavior is also controlled by their network. Additionally, these members retain strong ties (which are frequently used for interrelations) and weak ties (which are existing but not often leveraged). All of the foregoing aspects of social networks reinforce the fact that to truly understand any stakeholder's impact on a program, one must also understand that stakeholder's participation in the stakeholder system.

2.4.2 Social Networks and the Performance of Individuals and Groups (Sparrowe, Liden, Wayne, & Kraimer, 2001)

Sparrowe, Liden, Wayne, and Kraimer also built upon Granovetter's work on strong and weak ties (as discussed by Portes) in their article titled, "Social networks and the performance of individuals and groups." Their study looked at 38 work groups that encompassed a total of 190 employees from five organizations. As introduced by Coleman, donors have complex motivations (Portes, 1998). Sometimes these motivations create a desire to withhold or otherwise inhibit information transfer. To discuss these negative relationships, the authors introduce the term "hindrance network." This is contrary to the "advice network" which aids the flow of information. As predicted, the results of the survey showed that individuals with high centrality within the advice network exhibited high performance while individuals with high centrality within the hindrance network exhibited low performance. Although this study was inconclusive with regard to the relationship between advice network density and group performance, it was able to prove a relationship between hindrance network density and poor group performance.

Sparrow, et al.'s article identified a new network characteristic that systems engineers must be cognizant of when working with their stakeholder system. While the majority of stakeholders are seeking program success, some may in fact be working to inhibit that success via their hindrance network. One example of a potential member of a hindrance network is a person who supports a legacy system intended to be replaced by a new program.

2.4.3 The People Who Make Organizations Go-Or Stop (Cross & Prusak, 2002)

In their article titled, "The people who make organizations go-or stop," Cross and Prusak posit that "information is found and work gets done" via informal networks vice traditional hierarchies. In order to manage these invisible networks, leadership must focus on key role-players. To promote this new type of management, the authors introduce and describe four roles as follows: Central connectors are identified as the go-to people within a network and appear as a hub on network maps. Boundary spanners link multiple central connectors and serve as liaisons between domains. Information brokers link key members or groups within a network and can often limit (intentionally or unintentionally) information flow. Peripheral specialists appear as outsiders to a main grouping. The authors note that the appearance of a peripheral specialist may be caused by geographic separation or necessitated by the sensitivity of the work performed by the person in question.

Cross and Prusak's work highlights the need to understand and manage the informal networks such as the stakeholder network that inspired the efforts documented in this dissertation. Cross and Prusak also provide important definitions that help define roles that stakeholders perform. These definitions are further expanded by Anklam (as discussed below) and used in the architectural products produced by the framework described in this dissertation.

2.4.4 Social Network Analysis in the KM Toolkit (Anklam, 2005)

Anklam is a contributor in *Knowledge Management Tools and Techniques* (Rao, 2005). In her chapter titled, "Social network analysis in the KM toolkit," Anklam posits that social network analysis can focus improvement efforts. By understanding how knowledge flows across organizations, leaders can address responsiveness, innovation, reuse, knowledge awareness, and knowledge transfer. Anklam introduces social network analysis and ties it to social capital, which she defines as "the sum of relationships, norms, values, and trust in the organization." In order to tap into this capital, Anklam states that basic social network analysis skills must be developed. A critical part of those skills is understanding the roles people play in the network. Anklam then describes central connectors, brokers, boundary spanners, and peripheral specialists in nearly the same manner as Cross and Prusak, but then also introduces the term pulsetaker (Cross & Prusak, 2002). This term refers to someone who, through their social connections, monitors the health of an organization.

The social network roles and definitions provided by Anklam are summarized in Table 2-5 below. These roles were incorporated into the framework described within this dissertation and were used to label key roles stakeholders perform within the stakeholder system.

Table 2-5: Social network roles and definitions (Anklam, 2005)

Role	**Definition**
Central Connector	*Someone who is highly connected to many others in the network, who may be either a key facilitator or a "gatekeeper"*
Broker	*Someone who communicates across subgroups*
Boundary Spanner	*A person who connects a department with other departments*
Peripheral Specialist	*Someone less connected or not connected at all*
Pulsetaker	*Someone who uses his or her connections to monitor the health of an organization*

2.4.5 Evaluating Product Development Systems Using Network Analysis (Collins, Yassine, & Borgatti, 2009)

In this article, Collins, Yassine, and Borgatti explore the use of social network analysis to evaluate product development systems. As described by these authors, standard systems engineering tools provide only a partial view of the development process whereas network analysis tools reveal the emergent properties, because network analysis focuses on the relations and patterns of relations. As further described by

Collins, et al., these techniques "provide insight into how individual elements affect institutions they are part of, and how institutions constrain their individual elements."

Although Collins, Yassine, and Borgatti's work is not directly applicable to the pilot study described in this dissertation, their insight lends credence to the approach of augmenting standard systems engineering tools (e.g., architecture frameworks) with network analysis tools that focus on the relations and patterns of relations. The framework described within this dissertation will aid systems engineers in capturing their stakeholder system in a networked view. It is expected (but left for future research efforts) that systems engineers will then be able to apply social network analysis metrics such as in-degree centrality, out-degree centrality, clustering, density, betweenness centrality, centrality, and brokerage to further define both the stakeholder system and individual relations.

2.4.6 Social Network Analysis Conclusions

The literature reviewed above provided additional justification for the pilot study, framework, and resulting architectural products described within this dissertation. It confirmed that humans (such as the stakeholders these efforts are focused upon) are both strengthened and constrained by the networks of which they are members (Portes, 1998; Sparrowe, Liden, Wayne, & Kraimer, 2001; Cross & Prusak, 2002). These networks are created by both strong (highly active) ties and weak (existing but rarely used) ties (Portes, 1998; Sparrowe, Liden, Wayne, & Kraimer, 2001). Traditional systems engineering tools (such as architecture frameworks) need to be augmented with social network analysis tools in order for systems engineers to better understand the relations and patterns of relations that affect their program (Collins, Yassine, & Borgatti, 2009). This literature also provided key terms that were used in the framework developed by the author of this dissertation, specifically the terms defined by Anklam (see Table 2-5).

2.5 Architecture Framework and Stakeholder Analysis

This section looks at a subset of the literature that combines concepts from the field of Architecture Framework as well as Stakeholder Analysis. This rich area of literature is explored chronologically starting with a discussion on combining politics with a system's architecture and ending with a series of case studies that examine how architecture tools can support communications with stakeholders.

2.5.1 The Political Process and Systems Architecting (Forman, 2002)

"If the politics don't fly, the system never will." This quote is the essence of Forman's chapter, "The political process and systems architecting" found in *The Art of Systems Architecting* (Maier & Rechtin, 2002). Although the quote and the chapter are geared towards publically supported programs, Forman notes that even private companies creating products for the private sector are not immune to politics, be it from government regulation or matters internal to the company itself. Program stakeholders are naturally involved in relationships complicated by factors such as interagency rivalries, intra-agency conflicts, lobbyist agendas, and even the media. Although frustrating to engineers and architects, the hard truth (according to Forman) is that without continued support from a wide variety of stakeholders, programs will be stalled or cancelled. In order to help engineers and architects understand and maneuver in the political world, Forman offers five rules:

- *Politics, not technology, sets the limits of what technology is allowed to achieve.*
- *Cost rules.*

- *A strong, coherent constituency is essential.*
- *Technical problems become political problems.*
- *The best engineering solutions are not necessarily the best political solutions.*

Forman explains that politics cannot be avoided, but they can be understood. Then, once they are understood, politics become yet another tool that can be leveraged to ensure program success.

Forman's sentiment mirrors that of Nutt. Both authors identify the necessity of understanding and managing the social and political forces that are active in any program. Forman, however, goes further in explaining how architects play a critical role in this effort. As system architects create the various views for their project (such as those used by Zachman), they must understand the constraints put upon the system. While sometimes these constraints are due to technology limitations, they are often due to political or social implications. Unfortunately, as discussed in section 2.2 above, current architecture frameworks fail to capture the interrelations of stakeholders which form the basis of political and social networks; hence, the need for the pilot study and framework described within this dissertation.

2.5.2 CAFCR: A Multi-View Method for Embedded Systems Architecting; Balancing Genericity and Specificity (Muller, 2004)

In his dissertation titled, "CAFCR: A multi-view method for embedded systems architecting; balancing genericity and specificity," Muller attempts to bridge the gap between the industrial world's pragmatic application of systems architecting and the academic world's scientific approach to systems architecting. Muller's approach to systems architecting flows through the following sequence tied to the acronym CAFCR:

- Customer objectives: defining the customer what

- Application: defining the customer how
- Functional: defining the product what
- Conceptual: defining the product how
- Realization: defining the product how

Of particular importance to this literature review is Muller's approach to understanding his customer's objectives. First, Muller elicits the customer's key drivers or objectives that provide direction for the requirements gathering and focus for the system development. All future architectural products are linked back to the key drivers, including forthcoming design choices. Muller argues that a short list of key drivers provides a clearer understanding of the customer and his or her desires than a long list of requirements. This approach is consistent with ISO 42010/IEEE 1471 and has been shown to be successful in several new development programs (Bonnema, Borches, Kauw-A-Tjoe, & van Houten, 2010; Bonnema, 2011). This approach was also adopted for use in the author's framework described within this disseration.

2.5.3 NATO Architecture Framework (NATO Consultation, Command and Control Board, 2007)

Similar to DoDAF (see section 0), NATO maintains its own architecture framework. The NATO Architecture Framework (NAF) incorporates views and experiences from the U.S. DoDAF, the U.K. Minister of Defense Architecture Framework, as well as from other nations, industry, and academia. The entire second chapter of the NAF is focused on architecture stakeholders.

In the second chapter's introduction, the authors explain how the number of NATO stakeholders involved in new system development is large and diverse. Further, each stakeholder may have multiple and diverse views of his or her own. "In other words, the field of stakeholders in the capability development process of new interoperable systems is large, spans across all levels of NATO, and represents a great variety of interests in that process" (NATO Consultation, Command and Control Board, 2007). According to the NAF, the first step in architecting is taking an inventory of the main stakeholders and their concerns. In doing so, the architect must first identify and describe the stakeholders in terms of their architecture-related interests. Next, the architect must examine the Communities of Interest (COIs) in which the stakeholders collaborate. Once the COIs are determined, the interests of those COIs must be identified. Finally, using the interests identified as a basis, the architect must determine which architecture views will be developed to deliver appropriate information to the COIs.

The NAF contributed to the efforts documented within this dissertation by further confirming the presence of a multitude of stakeholders. The NAF's authors also acknowledged stakeholders' participation in communities, which highlights the importance of understanding how stakeholders interrelate within and between these communities. Additionally, the NAF approach to identifying stakeholders and grouping them by COI was directly integrated into the framework developed by the author and documented within this dissertation.

2.5.4 Requirements Engineering: Fundamentals, Principles, and Techniques (Pohl, 2010)

Pohl's goal was to create a comprehensive textbook on requirements engineering that could be used by professionals, students, and lecturers. While Pohl admits there are many good books on requirements engineering, he could not find a single, comprehensive text. Similar to that of Muller, Pohl's method as described in *Requirements Engineering:*

Fundamentals, Principles, and Techniques requires understanding the system's context (Muller, 2004). Pohl also derives requirements in a similar manner as Muller by first seeking out customer goals, then scenarios, and, finally, solution-oriented requirements.

After eliciting and documenting requirements, Pohl's method accounts for a negotiation phase. Pohl provides established techniques for negotiation including identifying conflicts, analyzing conflicts, resolving conflicts, and documenting conflict resolutions. It is expected (although left for future research efforts) that systems engineers will be able to use the architectural products that resulted from executing the author's framework documented in this dissertation to support Pohl's negotiation techniques.

2.5.5 Architecture Framework and Stakeholder Analysis Conclusions

As seen in this section of the literature, architects must understand and account for the stakeholders' political and social motives (Forman, 2002). This literature also provides useful tools for identifying stakeholders and grouping them by COI (NATO Consultation, Command and Control Board, 2007). Further, it was shown that identifying key concerns or key drivers for each stakeholder is useful in both developing and understanding a system architecture (Muller, 2004; Pohl, 2010).

2.6 Stakeholder Analysis and Social Network Analysis

Despite the popularity of both stakeholder analysis and social network analysis, the literature review performed by the author found that very few practitioners combine the tools of the two fields, although two relevant examples were identified. Prell, Hubacek, and Reed use social network analysis to identify key stakeholders to involve when addressing critical issues concerning a national park in the United Kingdom. Soh, Chua, and Singh use social network analysis to monitor how stakeholders interrelate during the implementation of an enterprise information system.

2.6.1 Stakeholder Analysis and Social Network Analysis in Natural Resource Management (Prell, Hubacek, & Reed, 2009)

"Stakeholder analysis and social network analysis in natural resource management," is written around a case study performed in the Peak District National Park of the United Kingdom. The Peak District faces social, economic, political, and environmental pressures. Specifically, in this case, scientific areas are being affected by overgrazing and rotation burning by the area's inhabitants. Through focus groups and interviews, the authors identify eight categories and 22 initial stakeholders. These 22 stakeholders are interviewed and asked questions concerning: issues related to the eight categories, people they knew in each category, and how often they communicate with that person. This leads to the identification of 147 networked stakeholders linked via differing strengths of ties.

Through this case study, Prell, Hubacek, and Reed show how social network analysis can feed and inform stakeholder analysis. Specifically, in this case study, social network analysis is performed to identify key stakeholders to include in focus group discussions. The authors discover that performing social network analysis leads to the identification of well connected and well respected members of the stakeholder categories. They also discover, however, that the cost of this approach is higher than their former, ad hoc approach to focus groups. Nevertheless, Prell, et al. anticipates more thorough information sharing will result based upon the new set of representatives.

The work of Prell, et al. shows another potential use for the architectural products that result from executing the author's framework documented in this dissertation. It is expected (but left for future research efforts) that these products can be used to identify key stakeholders to include when making critical program decisions. Prell, et al.'s documented use of UCINET social network analysis software also led the author of this dissertation to explore and use the UCINET's NetDraw component in support of the refined framework described in Chapter 5.

2.6.2 Managing Diverse Stakeholders in Enterprise Systems Projects: A Control Portfolio Approach (Soh, Chua, & Singh, 2011)

Soh, Chua, and Singh examine the multiple stakeholder environments of enterprise information system projects in "Managing diverse stakeholders in enterprise systems projects: A control portfolio approach." The purpose of their research is to confirm whether or not enterprise information systems that span multiple stakeholder groups have different management techniques than a typical information system. Through examining a single case over 14 months, the authors discover that the added stakeholder groups create complexity among both vertical and horizontal relationships. The research finds, as expected, that both formal and informal controls were used.

Another unique finding is that, in this particular case study, more than one controller group is in play. In fact, the study identifies that the principal controller's support was often initiated by other controllers. The authors recommend that anyone managing complex, multi-stakeholder projects must "identify the key stakeholder groups, consider whether there are important differences in the tasks, knowledge and skills, expectation, and organizational cultures, and how these are likely to impact project success." Then, managers must create separate controls to address the concerns of each group.

Just as Sparrowe, Linden, Wayne, and Kraimer's work identified a new social network (the hindrance network) of which systems engineers employing the framework developed and documented in this dissertation must be cognizant, Soh, et al.'s work identifies the distinct possibility that multiple sub-networks may be in play within the stakeholder network. Recognizing this possibility assisted the systems engineers who participated in the pilot study (documented in Chapter 4) in understanding the results of their efforts and in quickly determining that their unique stakeholder system entailed three sub-networks.

2.6.3 Stakeholder Analysis and Social Network Analysis Conclusions

The articles reviewed above that bridged both Stakeholder Analysis and Social Network Analysis provided two important insights to this author's efforts. First, the literature highlighted another potential use for the new framework's resulting architectural products: determining which stakeholders to include for key decision making. Second, the literature provided the knowledge that systems engineers employing the author's framework should not be surprised to find multiple sub-networks active within their stakeholder system.

2.7 Social Network Analysis and Architecture Framework

One article emerged that (although not explicitly) incorporates social network analysis with an architecture framework. This incorporation is proposed as an addition to the NATO architecture framework (see Section 2.5.3). Although other architecture frameworks (including DoDAF) do not exclude the use of social network analysis tools, these tools appear particularly appropriate in performing the NATO approach to capturing the human view.

In “Architecture Framework Human View: The NATO approach,” Handley and Smillie discuss the approach used to identify architectural views that focus on humans as part of a system for a proposed addition to the NATO Architecture Framework (Handley & Smillie, 2008). Knowing that architects in several countries were developing or had developed human view products, the team evaluates products from the United Kingdom, Canada, the United States, and the Netherlands. Finally, a consensus is achieved on the specific products that are to be proposed. The proposed products are:

- HV-A Concept
- HV-B Constraints
- HV-C Functions
- HV-D Roles
- HV-E Human Network
- HV-F Training
- HV-G Metrics
- HV-H Human Dynamics

Of particular note for this literature review is the HV-E Human Network product. This product is intended to capture the interaction of humans that support the system’s mission or function. More specifically, the HV-E is expected to capture “human-to-human communication patterns that occur as a result of ad hoc or deliberate team formation, especially teams distributed across space and time” (Handley & Smillie, 2008). Some elements that may be included in HV-E are role groupings, cohesiveness indicators, performance impacts, and dependencies. While the proposed views are purposely written without regard to specific tools, one could apply social network analysis tools to achieve the goals of HV-E. As shown in Chapter 3, the HV-E is similar to the framework developed for the pilot study, but the HV-E is unable to support all of the desired requirements. Most notably, the HV-E is intended to capture only the stakeholder active in supporting mission objectives and does not capture external stakeholders.

2.8 Architecture Framework, Stakeholder Analysis, and Social Network Analysis

The literature review performed by the author also uncovered one very recent (Spring 2012) article that calls for incorporating aspects from the fields of Architecture Framework, Stakeholder Analysis, and Social Network Analysis. This is part of a study performed by Bartolomei, Hastings, de Neufville, and Rhodes of the Massachusetts Institute of Technology.

In "Engineering Systems Multiple-Domain Matrix: An organizing framework for modeling large-scale complex systems," Bartolomei, Hastings, de Neufville, and Rhodes present a new modeling framework built to support the expansive scope and complexity of present day systems (Bartolomei, Hastings, de Neufville, & Rhodes, 2012). The Engineering Systems Multiple-Domain Matrix (ESM-DM) applies a six by six matrix with both the rows and columns consisting of the six node classes the authors identify. These node classes are: System Drivers, Stakeholders, Obejectives, Functions, Objects, and Activities (Bartolomei, Hastings, de Neufville, & Rhodes, 2012).

In the ESM-DM, stakeholders are evaluated against themselves (showing stakeholder to stakeholder relationships) as well as against the other node classes (such as stakeholders to system drivers). For the stakeholder-to-stakeholder view, the authors recommend using social network analysis to help understand interactions and "improve organizational design, information flow, and process efficiency" (Bartolomei, Hastings, de Neufville, & Rhodes, 2012).

For applying the ESM-DM, the authors state that spreadsheet software (such as Microsoft Excel) can be used to create simple versions; however, to realize the full potential of the ESM-DM, more sophisticated tools are required. For the case study documented within this article, a team of researchers from MIT developed specific software they called the System Modeling and Representation Tool (SMaRT). Over a two-year period, Bartolomei observes a U.S. Air Force unmanned air vehicle project and creates an ESM-DM using SMaRT. He uses a time-sequenced ESM-DM to analyze the dynamic complexity of the system development process. From the case study, the authors determine that the ES-MDM "holds promise as a tool to gather, organize, and analyze information to better understand the structure and behavior of an engineering system."

Bartolomei, et al.'s work is analgous to that documented within this disseration, especially with regard to their stakeholder-to-stakeholder view; however, as highlighted by Muller, there needs to be a balance between the industrial world's pragmatic application of systems architecting and the academic world's scientific approach to systems architecting (Muller, 2004). While the ESM-DM appears to be a thorough tool, based upon their two-year case study using custom developed software, it does not appear to be simple enough for a wide range of systems engineers to apply.

2.9 Gaps and Problems Areas

Despite scouring current literature, no formal architecture framework was discovered that attempts to capture all stakeholders in a networked view. In general, stakeholders are captured via isolated viewpoints. Additionally, some frameworks capture the human interactions that support system functions yet they still fall short in capturing the interrelations of all stakeholders (Mikaelian, Nightingale, Rhodes, & Hastings, 2011).

Based upon the literature review performed by the author, there appears to be very limited work bridging the fields of Stakeholder Analysis and Social Network Analysis. Use of social network analysis tools and techniques are generally focused and applied inward. That is, companies or organizations use these tools and techniques to evaluate what is directly within their control. Social network analysis appears to be rarely applied to evaluate external stakeholders.

In a similar vein, the proposed NATO Human View is also inwardly focused. The architectural product HV-E is intended to capture the human-to-human network that supports execution of the system objectives (Handley & Smillie, 2008). It is not intended to capture the network of all stakeholders related to the system.

A single article was uncovered that calls for incorporating aspects from all three fields reviewed: Architecture Framework, Stakeholder Analysis, and Social Network Analysis. Unfortunately, the article by Bartolomei, Hastings, de Neufville, and Rhodes does not provide any recommendations on how to perform either stakeholder analysis or social network analysis (Bartolomei, Hastings, de Neufville, & Rhodes, 2012). Instead, it only mentions the fact that a team of researchers from MIT created new software to support evaluation of their Engineering Systems Multiple-Domain Matrix and that the observation and documentation period that supported their case study spanned two years. This article appears to support two of Bryson's observations: stakeholder analysis is often not performed due to a shortage of how-to guides and an assumption that the efforts will require significant resources (Bryson, 2003).

2.10 Need for a New Study

The review of the literature revealed to the author that although stakeholder analysis is critical to program success, stakeholder analysis is often avoided (Nutt, 2002; Project Management Institute, 2004; Smudde & Courtright, 2011Bryson, 2003). Bryson observes that among the reasons for avoiding stakeholder analysis is the shortage of how-to guides, an assumption that the efforts will require significant resources, and/or a fear that the results will upset others, including the stakeholders being examined (Bryson, 2003). The review also uncovered literature that confirms humans (such as the stakeholders these efforts are focused upon) are both strengthened and constrained by the networks of which they are members (Portes, 1998; Sparrowe, Liden, Wayne, & Kraimer, 2001; Cross & Prusak, 2002). Further, the literature noted that traditional systems engineering tools (such as architecture frameworks) need to be augmented with social network analysis tools in order for systems engineers to better understand the relations and patterns of relations that affect their program (Collins, Yassine, & Borgatti, 2009). It was also shown that architects, who must understand and account for system constraints, must consider the constraints brought upon the program from the social and political ties of the program's stakeholders (Forman, 2002).

The pilot study described within this dissertation sought an answer to the following question: Can the stakeholder system be captured in an architectural view? Based upon the literature alone, the answer is yes. This is shown by the work of Bartolomei, Hastings, de Neufville, & Rhodes. The second goal of these efforts was to identify a framework that guides systems engineers in capturing and characterizing their program's unique stakeholder system. The literature review failed to identify such a framework, although it did uncover several tools that were used to create the author's framework described in the following chapters. The literature review also revealed potential uses for the architectural products created via this author's framework such as identifying key stakeholders to include when making critical program decisions and leveraging the products in support of requirements negotiations.

2.11 Chapter Summary

Through this literature review, an affirmative answer was found for the question: Can the stakeholder system be captured in an architectural view? Additionally, several tools and techniques were discovered that were subsequently incorporated into a new framework intended to guide systems engineers in capturing and characterizing their program's unique stakeholder system. This new framework is introduced in Chapter 3, further developed in Chapter 4, and refined in Chapter 5.

Chapter 3 — Contribution to Research

In Chapter 2, several tools and techniques were discovered that can aid systems engineers in capturing and characterizing their unique stakeholder system. This chapter documents the maturation of the framework used to capture the stakeholder system as well as the architectural products expected to be produced by the framework. This chapter also documents the requirements that evolved from the literature review and the pilot study objectives. These requirements were then transformed into hypotheses and sub-hypotheses.

3.1 Purpose of Pilot Study

The primary purpose of the pilot study was to affirmatively answer the question: Can the stakeholder system be captured in an architectural view? More specifically, the efforts investigated the possibility of capturing the stakeholder system (a system containing n*(n-1)/2 interfaces where n equals the number of stakeholders) in a networked view. Additionally, the pilot study tested the feasibility of a repeatable framework that can be used to produce architectural views that capture and characterize stakeholders and the stakeholder system as it evolves through the program's life cycle.

3.2 Framework Requirements

The knowledge gained from studying relevant literature (see Chapter 2) was used to derive a set of six requirements for the proposed framework. The first two requirements derived were related to the intended end product, the architectural views. First, based upon the work of Smudde and Courtright, all stakeholders must be graphically portrayed in a networked view (Smudde & Courtright, 2011). Second, there must be a way to capture changes in the stakeholder network over time since, as Piaszczyk noted, stakeholder attitudes may change over time due to changing politics, budgets, and technologies (Piaszczyk, 2011).

The next four requirements derived were related to how the architectural views are created. All of these requirements were derived from Bryson's discussion on why stakeholder analysis is not performed (Bryson, 2003). It is anticipated (but left to further research to explore) that by eliminating these barriers, more program teams will actively perform stakeholder management activities. The first of these requirements was that systems engineers must be provided with a guide (i.e., the framework developed for the pilot study) to help them identify and characterize stakeholders. The second of these requirements was that the execution of the framework could not be overly time consuming and force the program into a state of "analysis paralysis." The third of these requirements was that the framework could be executed with readily available tools (as opposed to custom software such as that used by (Bartolomei, Hastings, de Neufville, & Rhodes, 2012)). The fourth and final of these requirements was that the framework would be executed in a manner that did not alert program stakeholders that the analysis was being performed, allowing the program team to keep the results of the analysis private, "since they may be embarrassing or otherwise upsetting for different stakeholders, including the analyzers" (Bryson, 2003). Table 3-1 below summarizes the framework requirements as well as the literature source that provided the primary inspiration for each requirement.

Table 3-1: Framework requirements and inspiration

ID	Requirement	Primary Inspiration
R1	Capture all stakeholders in a networked view	Smudde & Courtright, 2011
R2	Capture changes in the stakeholder network over time	Piaszczyk, 2011
R3	Provide a How-To Guide	Bryson, 2003
R4	Require only a small time investment	Bryson, 2003
R5	Use commonly available tools	Bryson, 2003
R6	Conduct the analysis in a manner that the results may be kept private	Bryson, 2003

3.3 Architectural Products

Two architectural products were created to capture and characterize the stakeholder system: the Stakeholder Crosswalk and the Stakeholder Network Map. The Stakeholder Crosswalk was designed to show which stakeholders were relevant for a particular decision and at what stage(s) in the program said stakeholders were relevant for that decision. The Stakeholder Network Map was based on the influence diagram described by Bryson which connects stakeholders with directional arrows in order to depict which stakeholders influenced (or were influenced by) other stakeholders (Bryson, 2003).

Figure 3-1 is a graphical representation of the Stakeholder Crosswalk. In this diagram, stakeholders are categorized in terms of power, legitimacy, and urgency in the manner recommended by Mitchell, et al. (Mitchell, Agle, & Wood, 1997). These characteristic categorizations are then combined with existing architectural models. The combining then results in the Stakeholder Crosswalk, a matrix that lists the stakeholders across the top (generically A, B, and C in this figure) and the architectural models down the left side (DoDAF views such as the OV-4 and SV-6 were listed as representative examples in this figure). The Stakeholder Crosswalk is further defined in Section 3.3.1 below.

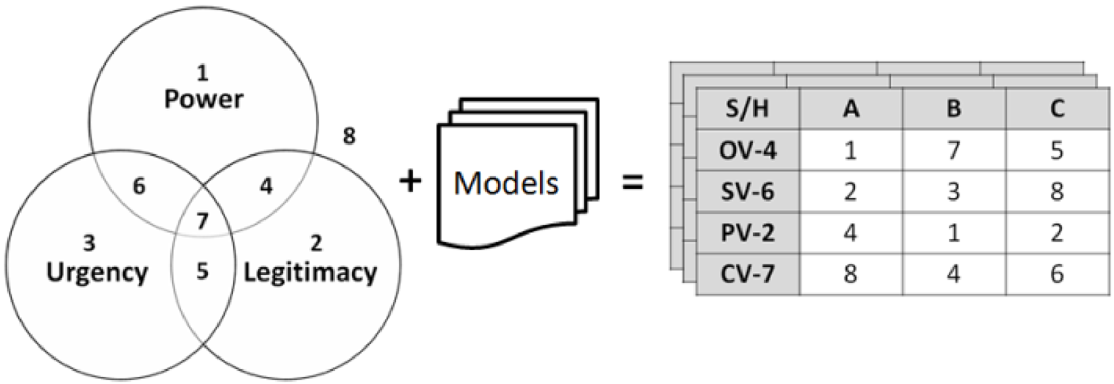


Figure 3-1: Graphical concept of the Stakeholder Crosswalk

Figure 3-2 is a simplified graphical representation of the Stakeholder Network Map. The group of individuals on the left represent the program stakeholders. These are combined with the social network roles (with representative graphics shown to the right of the plus sign). The result of combining the stakeholders with social network roles is the simplified representation of the Stakeholder Network Map which graphically portrays how stakeholders interrelate. The Stakeholder Network Map is further defined in Section 3.3.2 below.

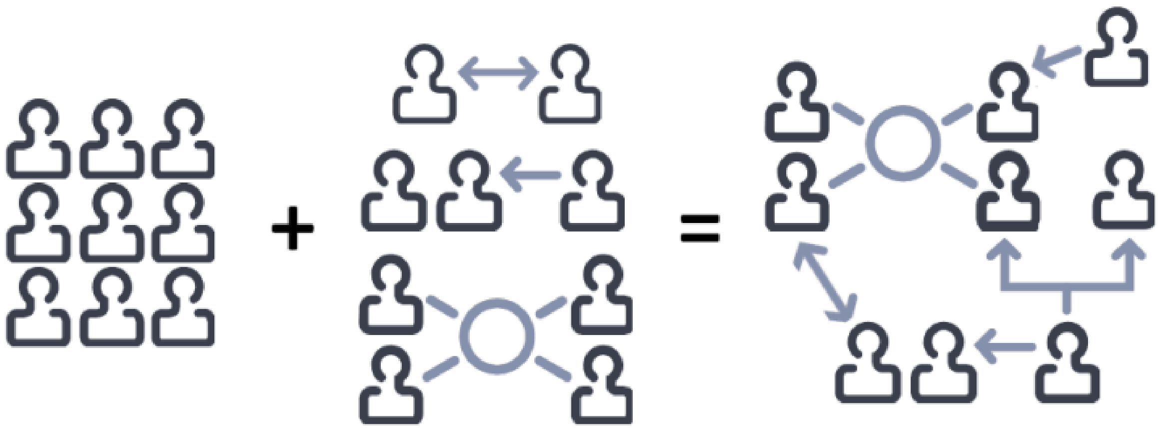


Figure 3-2: Graphical concept of the Stakeholder Network Map

3.3.1 Stakeholder Crosswalk

The Stakeholder Crosswalk described below was tailored for application within the DoD, since that was the target of this pilot study (as discussed in Chapter 4). It is important to note, however, that the underlying concept of the Stakeholder Crosswalk was purposely designed (although left to future research to confirm) to be applicable to programs outside of the DoD so long as the target program employs an architecture framework.

The Stakeholder Crosswalk created was essentially a series of matrices. A separate matrix was dedicated to each program phase as defined in DoDI 5000.02 and summarized in Table 3-2 (U.S. Department of Defense, 2008). Across the top of these matrices was a listing of all identified program stakeholders, each with its own corresponding column. The rows of each matrix were dedicated to the pre-defined DoDAF models such as the SV-1 (which depicts system nodes, systems resident at the nodes, and interfaces between systems and nodes) and the OV-5 (which depicts inputs, outputs, and relationships of performing activities or organizations). The cells in the matrices contained information that categorized each stakeholder's interest in the items captured by the DoDAF model. This categorization was based upon the work of Mitchell, Agle, and Wood and described stakeholders through their possession of one or more of the following traits: power, legitimacy, and urgency (Mitchell, Agle, & Wood, 1997; see Table 2-3). The last matrix created is a roll-up matrix. This matrix continued to have columns for the stakeholders and rows for the DoDAF models but each DoDAF model was now given several rows, one for each phase of the program. This roll-up view was built to help decision makers quickly grasp not only which stakeholders were active in the current phase of the program, but also how each stakeholder's influence would rise or fall as the program progressed. Chapter 4 details the step-by-step creation of the Stakeholder Crosswalks by a U.S. DoD program. Full results are also provided in Appendix A.

Table 3-2: Program phases (U.S. Department of Defense, 2008)

Phase	Purpose
Materiel Solution Analysis Phase	*Assess potential materiel solutions*
Technology Development Phase	*Reduce technology risk, determine and mature the appropriate set of technologies to be integrated into a full system, and to demonstrate CTEs [Critical Technology Elements] on prototypes*
Engineering and Manufacturing Development Phase	*Develop a system or an increment of capability; complete full system integration…; develop an affordable and executable manufacturing process; ensure operational supportability with particular attention to minimizing the logistics footprint; implement human systems integration (HSI); design for producibility; ensure affordability; protect CPI by implementing appropriate techniques such as anti-tamper; and demonstrate system integration, interoperability, safety, and utility*
Production and Deployment Phase	*Achieve an operational capability that satisfies mission needs*
Operations and Support Phase	*Execute a support program that meets materiel readiness and operational support performance requirements, and sustains the system in the most cost-effective manner over its total life cycle*

3.3.2 Stakeholder Network Map

The Stakeholder Network Map was built to provide a visual diagram of stakeholder interrelations. Maps of this type are often generated via specialized software. Software that relies on email usage to automatically derive relationships and draw the corresponding network map works well in an organization that utilizes a single email system; however, this software would not be as effective when multiple email networks are in play. For example, network mapping software would be unable to traverse the multiple email networks commonly in use within the DoD environment where separate military service email networks as well as multiple defense contractor email networks may all be used in support of one program. Interviewing stakeholders may work for some fields, but interviewing stakeholders often presents two major problems. First, program managers are typically unwilling to offer access to stakeholders for a "science project." Second, even if this hurdle was overcome, stakeholders who participated would be eager to see the results. This could potentially put the program manager in the uncomfortable position of explaining to a senior company official, for example, why he or she was not found to be a legitimate and/or powerful stakeholder.

For the reasons stated above, the framework developed (see Chapter 4 for the initial five-step framework and Chapter 5 for the refined five-step framework) provided a means to build the network in-house by program personnel familiar with the roles, responsibilities, concerns, and personality of each stakeholder. This team created the network map by plotting stakeholders connected by directional arrows that indicated lines of influence. This team was also guided by the five social network roles defined by Anklam (Anklam, 2005; see Table 2-5). By understanding a stakeholder's role, the team could anticipate either a small or large number of influence lines stemming from a particular stakeholder to other stakeholders associated with the program. For example, a peripheral specialist would likely influence a small number of other stakeholders while a central connector would likely influence a large number. The social network roles provided by Anklam are summarized in Table 2-5 and demonstrative examples are provided in Table 3-3 below. Chapter 4 details the step-by-step creation of the

Stakeholder Network Map by a U.S. DoD program. Full results are also provided in Appendix A.

Table 3-3: Fictitious examples of stakeholders that personify the roles identified by Anklam (2005)

Role	Fictitious Example
Central Connector	Personable and well-liked "gray beard" with many years of experience in the industry and extensive relationships with people at all levels throughout the community
Broker	Someone who recently transferred jobs and has personal connections to others within both his/her former subgroup and new subgroup
Boundary Spanner	Upper-level manager who is responsible for two or more departments
Peripheral Specialist	Designer of a high-tech component whose current interest is in further scientific research vice application of previously discovered technology
Pulsetaker	Certifying official for an industry responsible for assigning grades relating to performance in accordance with published standards

3.4 Framework Overview

The framework developed for and tested via this pilot study consisted of five steps:

- Stakeholder Identification
- Stakeholder Classification
- Time-Phasing and Analysis
- Stakeholder Network Sketch
- Social Role Analysis

The stakeholder identification step was built to follow the methods provided by Bryson on brainstorming stakeholders and their key concerns (Bryson, 2003). This method was also consistent with several other documented approaches (IEEE, 2000; Muller, 2004; ISO, 2007; NATO Consultation, Command and Control Board, 2007). The stakeholder classification step was created to identify the characteristics of stakeholders using the terms provided by Mitchell, Agle, and Wood; however, it assigned these characteristics not for the program as a whole but with regard to each individual aspect of the program (Mitchell, Agle, & Wood, 1997). The time-phasing and analysis step was used to predict the changes over time in stakeholder characteristics as suggested by Piaszczyk (2011). The stakeholder network sketch step captured the stakeholder map identified as necessary by Smudde and Coutright by using a modified version of the influence diagram techniques provided by Bryson (Smudde & Courtright, 2011; Bryson, 2003). The social role analysis step was used to identify stakeholders who played key roles in the stakeholder network. These roles were identified by the characteristics provided by Anklam (2005). All of these steps are explained in further detail in Chapter 4. Chapter 4 also disucsses the specific results of each step.

3.5 Comparable Frameworks

The framework proposed in this dissertation was created to satisfy the requirements and produce the architectural products detailed above. While this was a unique framework, two other frameworks were documented in the literature that met some of the requirements identified above. The first model is the Human View proposed for use in the NATO Architecture Framework (NAF) (Handley & Smillie, 2008). The second model is the Engineering Systems Multiple-Domain Matrix (ESM-DM) (Bartolomei, Hastings, de Neufville, & Rhodes, 2012). The intent of the following subsections is to show how the framework used in this dissertation was unique and show the areas in which this framework differs from the two comparable frameworks identified above.

3.5.1 Identified Weaknesses of Comparable Frameworks

While the NAF's proposed Human Network View (HV-E) will help systems engineers understand how stakeholders interrelate, it is limited to the stakeholders who support execution of the system objectives (Handley & Smillie, 2008). Based on the literature review performed (see Chapter 2), this weakness is not unique to NATO's Human View. Based upon the literature review performed, it was found that researchers who combine techniques from the fields of Stakeholder Analysis and Social Network Analysis typically evaluate only the internal stakeholders (vice both internal and external stakeholders).

Although similar in intent, the ESM-DM fails to meet three of the requirements identified above. First, the authors (Bartolomei, Hastings, de Neufville, and Rhodes) do not provide any recommendations on how to perform either stakeholder analysis or social network analysis and, therefore lack a how-to guide. Second, sophisticated tools (such as the MIT-developed SMaRT) are required to realize the full potential of the ESM-DM. Third, applying the ESM-DM appears to require a significant investment in time, as evidenced by the fact that, in the case-study provided, the observation and documentation period spanned two years (Bartolomei, Hastings, de Neufville, & Rhodes, 2012).

3.5.2 Comparison of Frameworks

Based upon the findings described above, Table 3-4 was created to show how the two related frameworks compare to the framework created by the author and documented in this dissertation. This table identifies the extent to which each framework is able to achieve the requirements identified in Table 3-1 above. Green indicates the requirement can be fully achieved. Yellow indicates the requirement can be partially achieved. Red indicates the requirement cannot be achieved. White indicates that it is not currently known whether or not the requirement can be achieved (either fully or partially).

Table 3-4: Comparison of related frameworks

ID	Requirement	NAF Human View	ESM-DM	Proposed Framework
R1	Capture all stakeholders in a networked view	Partial (Internal Stakeholders Only)	Yes	Yes
R2	Capture changes in the stakeholder network over time	Partial (HV-H Captures State Transitions)	Yes	Yes
R3	Provide a How-To Guide	No	No	Yes
R4	Require only a small time investment	Unknown	No	Yes
R5	Use commonly available tools	Unknown	Partial (Will Not Achieve Full Potential of Model)	Yes
R6	Conduct the analysis in a manner so that results may be kept private	Yes	Yes	Yes

3.6 Selection of Hypotheses and Sub-Hypotheses

The two hypotheses tested in the pilot study detailed in Chapter 4 were derived from requirements R1 and R2 introduced in Section 3.2 above. These requirements were related to the intended end product, the architectural views, created to affirmatively answer the question: Can the stakeholder system be captured in an architectural view? These two hypotheses were:

- H1: Stakeholders and their interrelations can be captured in a network view.
- H2: Changes over time in stakeholder characteristics and interrelations can be captured.

These hypotheses were further divided into sub-hypotheses that were derived from requirements R3 through R6 introduced in Section 3.2 above. These requirements were related to how the architectural views were created and support the second goal of these efforts, developing a framework to guide systems engineers in capturing and characterizing their program's unique stakeholder system. These sub-hypotheses are identified in the subsections below.

3.6.1 Hypothesis 1 and Sub-Hypotheses

The first hypothesis (H1) was that stakeholders and their interrelations can be captured in a network view. The following sub-hypotheses relate to the manner in which stakeholders and their interrelations were captured:

- H1a: Stakeholders and their interrelations can be captured through the use of a how-to guide (i.e., the framework described above).
- H1b: Stakeholders and their interrelations can be captured with a small time investment.
- H1c: Stakeholders and their interrelations can be captured with commonly available tools.
- H1d: Stakeholders and their interrelations can be captured while keeping the results private.

3.6.2 Hypothesis 2 and Sub-Hypotheses

The second hypothesis (H2) was that changes over time in stakeholder characteristics and interrelations can be captured. The following sub-hypotheses relate to the manner in which changes over time in stakeholder characteristics and interrelations were captured:

- H2a: Changes over time in stakeholder characteristics and interrelations can be captured through the use of a how-to guide (i.e., the framework described above).

- H2b: Changes over time in stakeholder characteristics and interrelations can be captured with a small time investment.
- H2c: Changes over time in stakeholder characteristics and interrelations can be captured with commonly available tools.
- H2d: Changes over time in stakeholder characteristics and interrelations can be captured while keeping the results private.

3.7 Reliability and Validity Considerations

Unfortunately, there were reliability and validity concerns associated with the hypotheses and sub-hypotheses. While it was easy to determine whether or not stakeholders and their interrelations were captured in a network view, it was not readily apparent to someone external to the program whether or not the networked view was an accurate portrayal. For this reason, this study relied on the judgment of program personnel.

Greater concerns existed with regard to capturing changes over time in stakeholder characteristics and interrelations. Not only would validation require intimate knowledge of the program, it would also require significant amounts of time (more than was available for this pilot study) to see if the predicted characteristics and interrelations proved to be true at that stage in the program. Again, this study relied upon the judgment of program personnel and their assessment of the validity of the results; however, follow-up studies could be performed at program milestones that would validate or invalidate initial predictions relating to stakeholder characteristics and interrelations.

Additional reliability concerns related to the characterization of resources: small time investment and commonly available tools. Programs range widely in terms of size and scope. Large programs typically have more resources at their disposal; therefore, what a large program may consider a small amount of time or a commonly available tool may be unattainable for a much smaller program. For these reasons, this study initially considered activities that do not disrupt the flow of the program to be small amounts of time. For this specific pilot study, this "small amount of time" was further defined by the author and members of the participating program team to be less than 10 hours. This study also initially considered tools to be "commonly available" if the program team could attain access to those tools within one week of identifying the need. Again, after discussions with the program team, the term "commonly available tools" was further refined to mean Microsoft Office products.

3.8 Chapter Summary

This chapter defined both the framework and the architectural products the new framework was built to create. This chapter also connected the original pilot study objectives to framework requirements and, ultimately, hypotheses and sub-hypotheses. These hypotheses and sub-hypotheses were tested via the pilot study described in the following chapter.

Chapter 4 — Pilot Study and Results

This chapter details the execution of the pilot study performed to answer the question: Can the stakeholder system (a system containing n*(n-1)/2 interfaces where n equals the number of stakeholders) be captured in an architectural view? This study also tested the usability of a framework developed to guide systems engineers in capturing and characterizing their program's unique stakeholder system. The chapter then concludes with a summary of lessons learned via this pilot study.

4.1 Measurement Instrument

The production of architectural products was used as the measurement instrument that confirmed the hypotheses and sub-hypotheses being tested. Table 4-1 below lists these anticipated (and later successfully produced) artifacts.

Table 4-1: Artifacts anticipated to support the hypotheses and sub-hypotheses

ID	Hypothesis or Sub-Hypothesis	Artifact to support the Hypotheses or Sub-Hypotheses
H1	Stakeholders and their interrelations can be captured in a network view	Visual graph of stakeholder network
H1a	Stakeholders and their interrelations can be captured through the use of a how-to guide	Visual graph of stakeholder network produced via five-step process
H1b	Stakeholders and their interrelations can be captured with a small time investment	Visual graph of stakeholder network produced in less than 10 hours
H1c	Stakeholders and their interrelations can be captured with commonly available tools	Visual graph of stakeholder network produced via Microsoft Office products
H1d	Stakeholders and their interrelations can be captured while keeping the results private	Visual graph of stakeholder network produced without stakeholder involvement
H2	Changes over time in stakeholder characteristics and interrelations can be captured	Time-series views of the stakeholder network and stakeholder crosswalk
H2a	Changes over time in stakeholder characteristics and interrelations can be captured through the use of a how-to guide	Time-series views of the stakeholder network and stakeholder crosswalk produced via five-step process
H2b	Changes over time in stakeholder characteristics and interrelations can be captured with a small time investment	Time-series views of the stakeholder network and stakeholder crosswalk produced in less than 10 hours
H2c	Changes over time in stakeholder characteristics and interrelations can be captured with commonly available tools	Time-series views of the stakeholder network and stakeholder crosswalk produced via Microsoft Office products
H2d	Changes over time in stakeholder characteristics and interrelations can be captured while keeping the results private	Time-series views of the stakeholder network and stakeholder crosswalk produced without stakeholder involvement

4.2 Privacy Considerations

Privacy is a concern for most case studies, including this one. For the documentation of this pilot study, the program was described but not named. The participants' levels of experience were provided, but the participants themselves were not named. Additionally, published results used generic labels instead of stakeholder names or organizations. The author introduced these privacy measures to the study team and offered to include further measures to increase privacy; however, no further measures were requested by the participants.

4.3 Participating Program and Personnel

Due to this author's familiarity with U.S. Department of Defense (DoD) programs, personnel, and the DoD Architecture Framework (DoDAF), a DoD program was a natural target. A Joint DoD program supporting two or more of the U.S. Armed Services provided additional stakeholders and exponentially more stakeholder relations. Further, a program executed out of southern California (where the author lived and worked) simplified logistics. For these reasons, a Joint DoD program team operating out of the Navy's Space and Naval Warfare (SPAWAR) Systems Center in San Diego, California was requested to participate in the pilot study.

After a briefing describing the impact of stakeholders, a discussion of the literature review undertaken, and an introduction to the proposed framework; a Joint DoD program from SPAWAR Systems Center volunteered three members to participate in the pilot study. The participating personnel all served in systems engineering roles and had between two and four years of experience with this particular program. These participants were directly involved in the system architecture and conceptual design efforts supporting the government sponsor (vice the development contractor). Their efforts were analogous to domain B3 of the Friedman and Sage case study framework (Friedman & Sage, 2004).

The program personnel that participated in the pilot study were involved in a DoD acquisition effort that anticipated spending more than $140 million (in U.S. Fiscal Year 2000 constant dollars) in research, development, test, and evaluation. In DoD terms, this program was classified as Acquisition Category II (U.S. Department of Defense, 2008). The goal of the program was to field information technology equipment that would support multiple branches of the armed services, incorporate stringent security policies, and operate at extremely high levels of availability; however, current program schedules depicted seven more years of development and testing prior to the initial fielding of operational equipment.

As mentioned in Chapter 3, reliability concerns relate to characterization of resources, namely small time investment and commonly available tools. For this pilot study, it was jointly determined between the author and the participating program personnel that a small time investment would be considered less than 10 hours (two hours per day across a five-day workweek). It was also jointly determined that the "commonly available tools" would be limited to Microsoft Office products.

The proposed effort consisted of executing the five-step framework over five days, with one step performed each day. This effort was anticipated to take a total of five hours spread over the five days. The five steps and initial time estimates were:

- Stakeholder Identification: 45 minutes
- Stakeholder Classification: 1.5 hours
- Time-Phasing and Analysis: 30 minutes

- Stakeholder Network Sketch: 1.5 hours
- Social Role Analysis: 45 minutes

The following sections detail the framework steps taken and the results experienced when performed by this DoD team. The artifacts produced as a result of the performance of each of these steps are contained in Appendix A. Additionally, the Microsoft PowerPoint slides used to support this effort are supplied in Appendix B.

4.4 Step 1: Stakeholder Identification

The goal of Step 1 was to create a list of potential stakeholders. Since this was the first step in the process, approximately 10 minutes was dedicated to introducing the background, motivation, and theory behind the framework as well as describing the framework itself. Next, the landmark definition of a stakeholder ("any group or individual who can affect or is affected by the achievement of the organization's objectives") as well as general stakeholder communities of interest (e.g., acquirers, sponsors, evaluators, etc.) were provided by the author to the participants (Freeman, 1984). At this point, team members took approximately five minutes to individually brainstorm. Back in a group setting, stakeholder organizations were listed across a row in an Excel spreadsheet. The organizations were then grouped by community of interest and each stakeholder's top one or two concerns were captured. In all, 31 stakeholders were identified and captured in Excel. Including time spent on the introductory material, the first session lasted approximately one hour. A sample extract of the resulting spreadsheet is provided in Figure 4-1 and a full copy is provided in Appendix A. The first row identified the grouping (i.e., community of interest). The second row listed DoD organizations; however, due to privacy concerns these organizational names were replaced with generic headings (such as "Eval G" in the figure below). The third row listed the major concern or key driver the stakeholder had with regard to the program in general. As shown in the extract below, concerns included compliance with published standards, ability to execute the military mission, and technological feasibility of the design.

Grouping	Evaluators					
Organization	**Eval G**	**Eval H**	**Eval I**	**Eval J**	**Eval K**	**Eval L**
Concern	compliance	mission	compliance	feasibility	feasibility	compliance, mission

Figure 4-1: Sample extract of Step 1

4.5 Step 2: Stakeholder Classification

At the beginning of the second session, a brief recap of the previous session was presented. At this time, one team member introduced an additional stakeholder that was added to the spreadsheet. Next, a common approach to stakeholder classification was introduced (Prell, Hubacek, & Reed, 2009). This approach, captured by Mitchell, et al., describes a stakeholder by his/her possession of power, legitimacy, and/or urgency (Mitchell, Agle, & Wood, 1997; see Table 2-3). The Mitchell, et al. definitions of those terms were also provided to help guide discussions. The spreadsheet from the previous session was augmented with a listing of existing DoDAF products. Three rows were dedicated to each of the 15 models previously created by this program for inclusion in their Information Support Plan. These rows represented power, legitimacy, and urgency. The team focused on the current phase of the program and answered "yes" or "no" to the three categories for each stakeholder. Their answer was dependent upon how the team perceived that particular stakeholder would exhibit power, legitimacy and/or urgency in response to changes to the program as captured in that particular DoDAF model. The listing of primary concerns was often referenced when determining which categories were in play for a particular stakeholder. The grouping of stakeholders (by type) and

DoDAF models (by viewpoint) made the effort very efficient. In fact, it took less than one hour to complete 480 cells (15 models x 32 stakeholders). A sample extract of this spreadsheet is provided in Figure 4-2 below. Note: The designations in the first column (AV-1 and AV-2) are shorthand descriptions for the DoDAF models evaluated.

	Grouping	Acquirers			
	Organization	**Acq A**	**Acq B**	**Acq C**	**Acq D**
	Concern	cost, sched	acq risk	acq risk	reputation, profit
AV-1	Power	Y	N	Y	N
	Legitimacy	Y	Y	N	N
	Urgency	Y	N	N	N
AV-2	Power	Y	N	Y	N
	Legitimacy	Y	Y	N	N
	Urgency	Y	N	N	N

Figure 4-2: Sample extract of Step 2 (figure 1 of 2)

The pilot study team saw merit in focusing on the category questions vice using the numbers proposed by Mitchell, Agle, and Wood (see Figure 2-2 and Table 2-4). Doing so appeared to keep the results from influencing decisions as some participants recognized they were being persuaded more by the value of the number than the characteristic(s) the number was intended to represent. The translation from the yes/no answers to the numerical categorizations proposed by Mitchell, et al. was accomplished after the fact in a separate spreadsheet utilizing formulas in Excel. Figure 5-2 provides a sample extract of this step's results displaying a Mitchell, et al. number for each stakeholder (e.g., "Acq A") for each DoDAF model (e.g., AV-1). Full results are provided in Appendix A.

Grouping	Acquirers			
Organization	**Acq A**	**Acq B**	**Acq C**	**Acq D**
Concern	cost, sched	acq risk	acq risk	reputation, profit
AV-1	7	2	1	8
AV-2	7	2	1	8
OV-1	5	8	1	8
OV-2	5	8	1	8
OV-3	5	8	1	8
OV-4	5	8	1	8
OV-5	5	8	1	8
OV-6c	5	8	1	8

Figure 4-3: Sample extract of Step 2 (figure 2 of 2)

4.6 Step 3: Time-Phasing and Analysis

As before, this session began with a recap of the previous session. Next, a brief discussion was provided on the program phases as defined in DoDI 5000.02. Those phases are: Materiel Solution Analysis, Technology Development, Engineering and Manufacturing Development, Production and Deployment, and Operations and Support (U.S. Department of Defense, 2008; see Table 3-2). The spreadsheet built during the prior session was replicated three more times in order to provide a basis for evaluating future phases (Note: only a total of four phases were captured, since the program was already in the Technology Development Phase). Finally, an additional tab was created that automatically populated the stakeholder classification for each phase for each stakeholder for each DoDAF model. This allowed for viewing how each stakeholder's classification changed as the program progressed. A sample extract of the results of step 3 is provided in Figure 4-4 below and a full version is provided in Appendix A. In the figure below, TD, EMD, P&D, and O&S were used as short hand for the DoD program phases. Additionally, cells were color coded to reflect a stakeholder's possession of

Mitchell, et al. qualities. Gray indicated the stakeholder possessed none of the qualities. Yellow indicated the stakeholder possessed one of the qualities. Orange indicated the stakeholder possessed two of the qualities. Red indicated the stakeholder possessed all three qualities.

	Grouping	Operators					
	Organization	**Op A**	**Op B**	**Op C**	**Op D**	**Op E**	**Op F**
	Concern	mission, promotion	profit, reputation	mission	mission	mission	mission
SV-4a	TD	8	8	8	8	8	1
	EMD	8	8	8	8	8	1
	P&D	2	2	2	2	2	4
	O&S	2	2	2	2	2	4

Figure 4-4: Sample extract of Step 3

While the team's focus was narrowed to just the differences per phase (vice recreating the entire spreadsheet for each phase), the effort took approximately 1.25 hours. Although time intensive to create, the team found merit in evaluating the time-phased roll-up summary. As observed in the previous session, stakeholder groups tended to have very similar scores for each DoDAF viewpoint. It was also noted that there was at least one stakeholder category change through the phases for every model except for the OV-1 (High Level Operational Concept Graphic) and OV-4 (Organizational Relationships Chart). The Production and Deployment Phase and the Operation and Sustainment Phase were tied with the highest number of active stakeholders (28 for each). The DoDAF model with the highest number of active stakeholders for each phase was the SV-5a (Operational Activity to Systems Function). The quantity of stakeholders categorized as legitimate for each model was usually between 1/2 and 2/3 of the active stakeholders. It was also noted that the category of urgency was decidedly missing from most stakeholder classifications.

4.7 Step 4: Stakeholder Network Sketch

After discussing the previous session's efforts, the team was introduced to typical social network analysis approaches and the deficiencies of those approaches for this effort. Software that relies on email usage works great in a corporation but is unable to traverse the multiple DoD and contractor networks that are actively used in this program. Interviewing stakeholders may work for some fields, but this presents two major problems in the DoD. First, program managers are typically unwilling to offer access to stakeholders for a "science project." Second, even if this hurdle were overcome, stakeholders who participated would be eager to see the results. This could potentially put the program manager in the uncomfortable position of explaining to a senior officer, for example, why that officer is in fact not a legitimate and/or powerful stakeholder.

The team was then introduced to the following social network roles: Central Connector, Broker, Boundary Spanner, Peripheral Specialist, and Pulsetaker. These terms were defined using the verbiage provided by Anklam and augmented with pictures provided by Cross, et. al. (Anklam, 2005; Cross & Prusak, 2002; see Table 2-5). Using a blank tab in Excel, the team created a Stakeholder Network Map similar to that described by Bryson where stakeholders are interconnected with directional arrows to depict which stakeholders influence (or are influenced by) other stakeholders (Bryson, 2003). In this case, the team dedicated a cell for each stakeholder and interconnected the cells using arrows from the "Shapes" drop-down menu. As before, the effort started with the current phase of the program since that is the phase with which the team was most familiar. It was then determined that separate network diagrams should be drawn for the subsequent phases, as the lines of influence were expected to change.

In all, this effort took approximately 1.5 hours. The large workspace in Excel proved very useful; however, different software could have created more visually pleasing displays. Two things became apparent to the team as they viewed the diagrams. First, for each phase, more than one network was in play. This was identified by the natural clustering of arrows around central stakeholders and was expected due to the author previously informing the participants of this possibility based upon knowledge of occurrences in stakeholder analysis research (Soh, Chua, & Singh, 2011). Second, it became clear that certain stakeholders were directly influenced by a plethora of other stakeholders. The team recognized the stakeholder management nightmare this posed (due to the need to communicate directly with a large number of stakeholders who likely had differing opinions about any given topic) and brainstormed ways to lessen this burden (such as having designated representatives for subsets of these stakeholders). A sample extract from step 4 is provided in Figure 4-5 below and the full figure is provided in Appendix A. As with the Stakeholder Crosswalks, the actual DoD organizational names were replaced with generic labels such as “Op A” to represent a member of the operational community of interest and “Eval K” to represent a member of the evaluation community of interest.

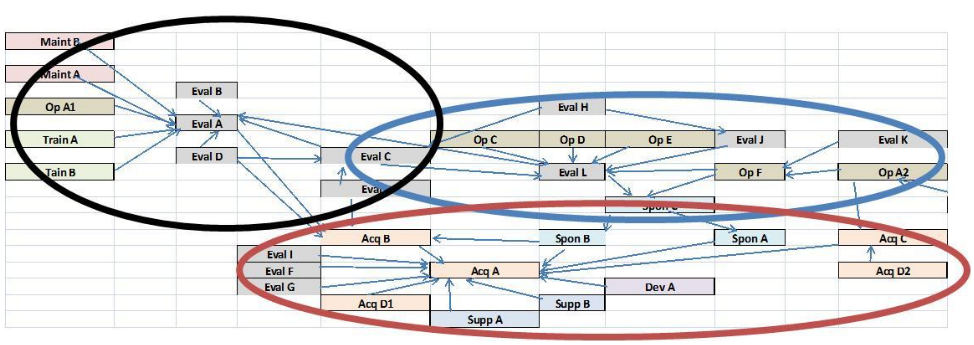


Figure 4-5: Sample extract of Step 4

4.8 Step 5: Social Role Analysis

After recapping the events of the previous session and viewing the network maps, the team returned to the definitions provided by Anklam (Anklam, 2005; see Table 2-5). Then, the team dissected the network map for the current phase of the program. First, the networks in play were identified on the map by their groupings around central connectors. These networks were then named for ease of future reference. For example, stakeholder "Acq A" is the central connector in the Acquisition network (as shown within the red oval in Figure 4-5). Taking one network at a time, the team identified other social network roles that various stakeholders performed. Finally, the description of each stakeholder was augmented with their network (or subgroup, as the study team preferred to call them) memberships along with any roles they fulfilled. Figure 4-6 provides a sample extract of the augmented descriptions for members of the evaluation community of interest. Full results can be found in Appendix A.

Grouping	Evaluators				
Organization	**Eval A**	**Eval B**	**Eval C**	**Eval D**	**Eval E**
Concern	compliance	compliance	compliance	compliance	compliance
Major Role	Central Connector	Peripheral Specialist	Boundary Spanner	Peripheral Specialist	N/A
Sub Group	Evaluation	Evaluation	Evaluation/COCOM	Evaluation	Evaluation

Figure 4-6: Sample extract of Step 5

The pilot study team found that central connectors and boundary spanners were the easiest social network roles to identify. It was also noted that all social network roles identified by Anklam were present in the program. The team was also able to identify paths of stakeholder influence via their newly created Stakeholder Network Map. For example, stakeholder "Eval L" was influenced by "Eval J" who, in turn, was influenced by "Eval H." An additional and important item arose: One central connector identified via the Stakeholder Network Map was not previously identified by the team as a major stakeholder (possessing two or more of the Mitchell, et al. categories), thus exemplifying and clarifying the difference between perception and facts.

4.9 Findings

The following subsections detail the pilot study findings with regard to the hypotheses and sub-hypotheses. As explained below, all hypotheses and sub-hypotheses were confirmed during the execution of this pilot study.

4.9.1 Hypothesis 1 and Sub-Hypotheses

The first hypothesis (H1) was that stakeholders and their interrelations can be captured in a network view. H1 was confirmed due to the program team's ability to produce the Stakeholder Network Maps. Since the results of the pilot study were able to confirm this hypothesis, the sub-hypotheses to H1 were also evaluated.

Sub-hypothesis H1a was that stakeholders and their interrelations can be captured through the use of a how-to guide. H1a was confirmed, since the program team was able to produce the Stakeholder Network Maps using the five-step method provided. Sub-hypothesis H1b was that stakeholders and their interrelations can be captured with a small time investment. H1b was confirmed, since the program team executed the five-step process in less than six hours. Sub-hypothesis H1c was that stakeholders and their interrelations can be captured with commonly available tools. H1c was confirmed, since the program team produced the Stakeholder Network Map using Microsoft Excel. Sub-hypothesis H1d was that stakeholders and their interrelations can be captured while keeping the results private. H1d was confirmed, since the program team produced the Stakeholder Network Map without involving additional stakeholders.

4.9.2 Hypothesis 2 and Sub-Hypotheses

The second hypothesis (H2) was that changes over time in stakeholder characteristics and interrelations can be captured. H2 was confirmed due to the program team's ability to produce the roll-up view of the Stakeholder Crosswalk and Stakeholder Network Maps for future program phases. Since the results of the pilot study were able to confirm this hypothesis, the sub-hypotheses to H2 were evaluated.

Sub-hypothesis H2a was that changes over time in stakeholder characteristics and interrelations can be captured through the use of a how-to guide. H2a was confirmed, since the program team was able to produce the roll-up view of the Stakeholder Crosswalk and Stakeholder Network Maps for future program phases using the five-step method provided. Sub-hypothesis H2b was that changes over time in stakeholder characteristics and interrelations can be captured with a small time investment. H2b was confirmed, since the program team was able to produce the roll-up view of the Stakeholder Crosswalk and Stakeholder Network Maps for future program phases in less than six hours. Sub-hypothesis H2c was that changes over time in stakeholder characteristics and interrelations can be captured with commonly available tools. H2c was confirmed, since the program team was able to produce the roll-up view of the Stakeholder Crosswalk and Stakeholder Network Maps for future program phases using Microsoft Excel. Sub-hypothesis H2d was that changes over time in stakeholder characteristics and interrelations can be captured while keeping the results private. H2d was confirmed, since the program team was able to produce the roll-up view of the Stakeholder Crosswalk and Stakeholder Network Maps for future program phases without involving additional stakeholders.

4.9.3 Summary of Findings

Based upon the artifacts created, all hypotheses and sub-hypotheses were confirmed. Table 4-2 lists the hypotheses and sub-hypotheses and the artifacts identified in previously in this chapter that were used to confirm the hypotheses and sub-hypotheses.

Table 4-2: Evaluation of hypotheses and sub-hypotheses

ID	Hypothesis or Sub-Hypothesis	Artifact to support the Hypotheses or Sub-Hypotheses	Confirmed?
H1	Stakeholders and their interrelations can be captured in a network view	Visual graph of stakeholder network	Yes
H1a	Stakeholders and their interrelations can be captured through use of a how-to guide	Visual graph of stakeholder network produced via 5-step process	Yes
H1b	Stakeholders and their interrelations can be captured with a small time investment	Visual graph of stakeholder network produced in less than 10 hours	Yes
H1c	Stakeholders and their interrelations can be captured with commonly available tools	Visual graph of stakeholder network produced via Microsoft Office products	Yes
H1d	Stakeholders and their interrelations can be captured while keeping the results private	Visual graph of stakeholder network produced without stakeholder involvement	Yes
H2	Changes over time in stakeholder characteristics and interrelations can be captured	Time-series views of the stakeholder network and stakeholder crosswalk	Yes
H2a	Changes over time in stakeholder characteristics and interrelations can be captured through use of a how-to guide	Time-series views of the stakeholder network and stakeholder crosswalk produced via 5-step process	Yes
H2b	Changes over time in stakeholder characteristics and interrelations can be captured with a small time	Time-series views of the stakeholder network and stakeholder crosswalk produced	Yes

	investment	in less than 10 hours	
H2c	Changes over time in stakeholder characteristics and interrelations can be captured with commonly available tools	Time-series views of the stakeholder network and stakeholder crosswalk produced via Microsoft Office products	Yes
H2d	Changes over time in stakeholder characteristics and interrelations can be captured while keeping the results private	Time-series views of the stakeholder network and stakeholder crosswalk produced without stakeholder involvement	Yes

4.10 Lessons Learned

The most important lesson learned was that a stakeholder system can be captured and characterized. When applied and facilitated by a seasoned systems engineer, the proposed framework produced architectural products that provided an insight into the stakeholder system that previously had not been readily perceived. This pilot study also provided insight into areas of the initial five-step framework that could be improved.

One aspect of the Mitchell, et al. classification that proved confusing for several members of the program team was that the value of the number associated with a stakeholder did not directly equate to the relative strength or importance of the stakeholder. Rather, these numbers were simply a convenient way to identify which characteristics a particular stakeholder possessed (Mitchell, Agle, & Wood, 1997). An alternate, and perhaps clearer, method to accomplish the same task is to use letters that correspond to each of the three categories. In other words, use P for power, L for legitimacy, and U for urgency (as defined in Mitchell, et al., see Table 2-3), and combine them when multiple categories apply to a particular stakeholder. This new categorization identifies the stakeholder characteristics outright and eliminates the need for a legend to decode the categories. A mapping of original Mitchell, et al. numbers to new acronyms is provided in Table 4-3 below.

Table 4-3: Correlation of Mitchell, et al. numbers to descriptive acronyms

Characteristic(s)	Original Number	New Acronym
Power	1	P
Legitimacy	2	L
Urgency	3	U
Power, Legitimacy	4	PL
Power, Urgency	5	PU
Legitimacy, Urgency	6	LU
Power, Legitimacy, Urgency	7	PLU
None	8	N/A

The pilot study team also found an effective way to speed up the stakeholder classification by grouping the architecture framework artifacts (in this case, the DoDAF models) and grouping the stakeholders on the matrices. Architecture framework artifacts were grouped by viewpoints (e.g., all Operational Views were listed followed by all System Views). Stakeholders were grouped by their community of interest (e.g., all acquisition stakeholders were listed followed by all evaluation stakeholders). The grouping made the analysis effort very efficient and allowed liberal use of "copy and paste," since members of any particular community of interest generally had the same characteristics relative to a particular viewpoint. In fact, it took less than one hour to complete 480 cells (15 architecture framework artifacts x 32 individual stakeholders).

Identifying a key concern (such as compliance with published standards or technical feasibility) for each stakeholder also proved helpful. At times, the pilot study team would stall or hesitate when classifying a particular stakeholder. This was often overcome by focusing on the key concern for that stakeholder. This focus helped the study team to dismiss the less important traits or concerns of that particular stakeholder.

The final lesson learned was that manually drawing out the stakeholder network within Excel was unexpectedly time consuming and tedious. Following the pilot study, the author experimented with NetDraw social network analysis software. The use of NetDraw allowed for quicker organization and creation of the network map, allowed for easier visualization (see Figure 4-7), and also allowed for more comprehensive analysis. In fact, NetDraw identified an additional network the pilot study team had not discovered while working with the Excel map. Software of this type does not require the email mining or surveys discussed above. It simply allows a team to input their knowledge of stakeholder relationships and use the software to transform that knowledge into a Stakeholder Network Map. This software is free for use; however, depending on local rules and regulations, it may not be an option for some program offices to install this software on their computers. For example, utilizing NetDraw on a strictly controlled Navy-Marine Corps Intranet (NMCI) workstation is not immediately permissible. In situations where social network analysis software is not permitted, the Stakeholder Network Maps can still be hand-built within Microsoft Excel (as demonstrated during the pilot study).

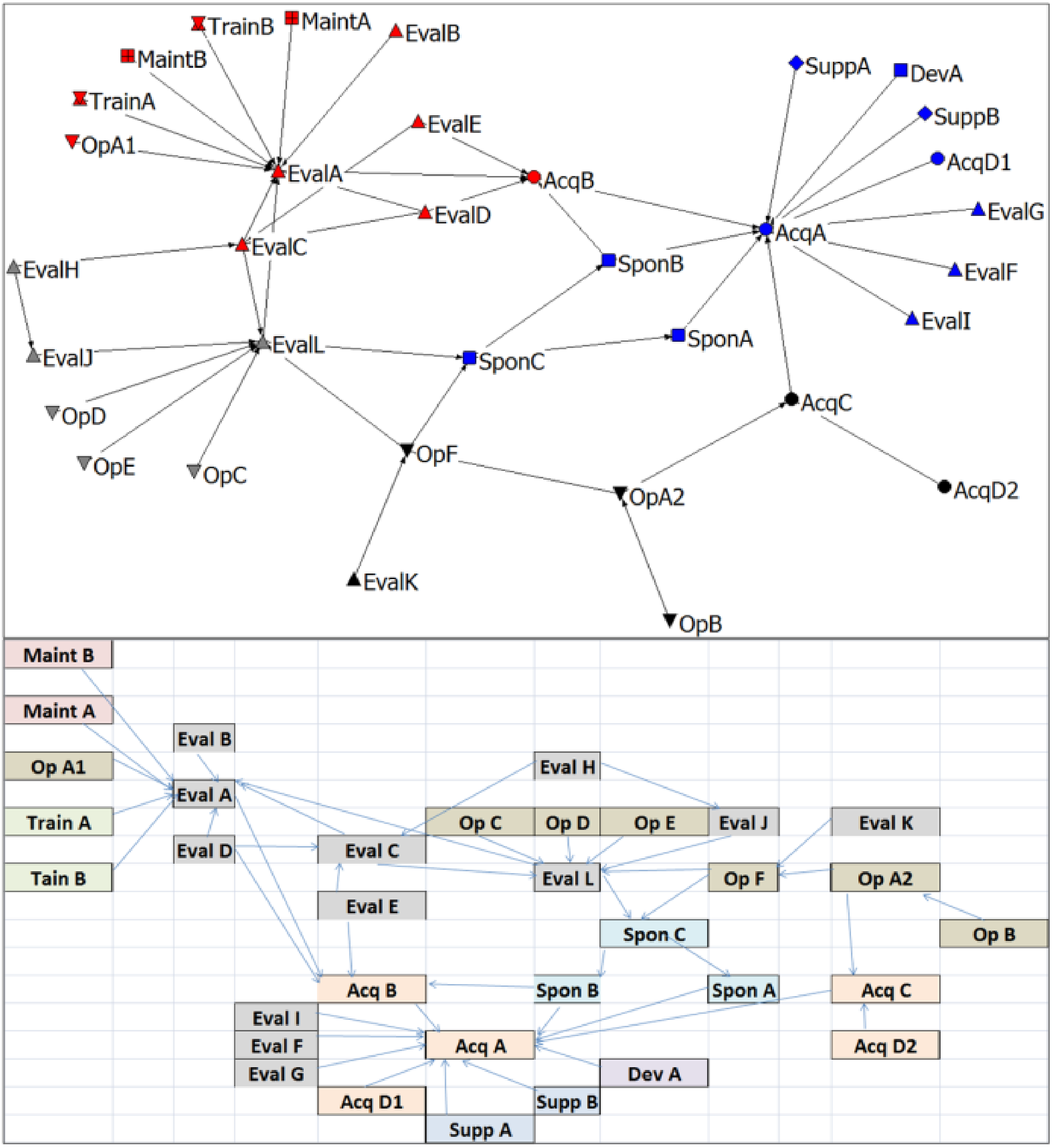


Figure 4-7: Comparison of study results in NetDraw (top) and Excel (bottom)

4.11 Chapter Summary

The pilot study described in this chapter successfully confirmed all hypotheses and sub-hypotheses. Despite these successes, the pilot study also uncovered areas of the initial framework that could be improved. Since the creation of a framework to guide systems engineers in capturing and characterizing their program's unique stakeholder system was a major driver for these efforts, the author has created an updated and refined framework that incorporated the lessons learned via this pilot study. This final framework is provided in the following chapter.

Chapter 5 — Detailed Framework for Capturing the Stakeholder System

The framework presented in this chapter represents the fruit of the efforts described in this dissertation. This framework was developed to guide seasoned systems engineers in capturing and characterizing their program's unique stakeholder system. Although the framework was purposely designed to be applicable to any program, programs with stable environments and a high number of stakeholders (such as the Joint Service Department of Defense (DoD) program documented in the pilot study) are most likely to benefit from the architectural products produced.

5.1 Step 1: Process Introduction & Stakeholder Identification

First, the program must identify a willing team of personnel familiar with the roles, responsibilities, concerns, and personality of each stakeholder. This team should include both systems engineers and program management staff, since stakeholder management requires knowledge of both the program domain and the product domain (Sharon, de Weck, & Dori, 2011). Next, the facilitator should briefly describe the goals of this effort and the process being undertaken to accomplish these goals. The objectives of this effort are to identify the primary areas of interest for each stakeholder and illustrate how each stakeholder interrelates with other program stakeholders over the program's life cycle. This will be realized by building Stakeholder Crosswalks and Stakeholder Network Maps via the five-step method.

Next, the landmark definition of a stakeholder ("any group or individual who can affect or is affected by the achievement of the organization's objectives") should be provided (Freeman, 1984). The team members should then take a few moments to individually brainstorm potential stakeholders. Back in a group setting, the identified stakeholders should be listed across the first row in an Excel spreadsheet.

The stakeholders should then be grouped within communities of interest such as those identified in the NATO Architecture Framework (NATO Consultation, Command and Control Board, 2007). The team should confirm that, at a minimum, they have captured the users of the system, acquirers of the system, developers of the system, and maintainers of the system as recommended by ISO 42010/IEEE 1471 (ISO, 2007; IEEE, 2000).

Next, each stakeholder's top one or two concerns should be captured. These concerns form an abstracted view that highlights the top goals each stakeholder hopes to achieve (Pohl, 2010). This approach is consistent with ISO 42010/IEEE 1471 as identified by Maier, Emery, and Hillard (2004). These concerns may be in the form of key drivers as defined by Muller and employed in FunKey architecting ((Muller, 2004; Bonnema, 2011; Bonnema, Borches, Kauw-A-Tjoe, & van Houten, 2010). At a minimum, however, the concerns identified should include: the mission of the system, the appropriateness of the system, the feasibility of constructing the systems, risks in development and operation, maintainability of the system, deployability of the system, and the evolvability of the system (ISO, 2007; IEEE, 2000).

The desired outcome of Step 1 is a list of potential stakeholders with the stakeholders grouped by community of interest. Also, documented with each stakeholder will be that stakeholder's key driver(s). If the time and situation allow, the team should work with program stakeholders to validate the team's understanding of each stakeholder's role and concern(s). An example extract of the resulting spreadsheet is provided in Figure 5-1.

Additionally, Appendix A may be referenced to find a similar spreadsheet developed by the pilot study team as describe in Chapter 4.

COI	Evaluation		
Stakeholder	**Eval A**	**Eval B**	**Eval C**
Key Driver(s)	*Mission*	*Feasibility*	*Compliance, Mission*

Figure 5-1: Sample outcome for Step 1

5.2 Step 2: Stakeholder Classification

The second session should open with a brief recap of the efforts performed during the previous session. Next, the approach to stakeholder classification should be introduced. This approach, proposed by Mitchell, et al., describes a stakeholder by his or her possession of power, legitimacy, and/or urgency (Mitchell, Agle, & Wood, 1997). The definitions of those terms (as summarized in Table 2-3) should be provided to help guide discussions. The spreadsheet from the previous session should be populated with a listing of existing architecture framework artifacts. For example, if it is a U.S. DoD program, the team could populate one row for each of the DoD Architecture Framework (DoDAF) models contained in that program's Information Support Plan. If architectural products do not yet exist for the program, the performing team can use descriptions of products from their preferred architecture framework as a starting point. Focusing on one architecture framework artifact at time, the team should add a P, U, and/or L (representing power, urgency, legitimacy) for each stakeholder depending on how the team perceives that stakeholder would exhibit each characteristic in response to changes to the program as captured in that particular architecture framework artifact. During this stage of the effort, only the current program phase (such as those defined by DoDI 5000.02 and summarized in Table 3-2) should be considered.

The desired outcome for Step 2 is the first Stakeholder Crosswalk. This is a matrix that correlates each stakeholder's characteristic(s) of interest with the information captured in each architecture framework artifact as anticipated in the current program phase. Grouping stakeholders by type and architecture framework artifact by viewpoint can make the effort very efficient. Figure 5-2 provides a truncated example outcome for a program employing DoDAF. Additionally, Appendix A may be referenced to view a full spreadsheet produced during the execution of the pilot study described in Chapter 4; however, it should be noted that the study team used a numerical classification structure vice the P/L/U structure recommended in this chapter.

COI	**Acquisition Management**		
Stakeholder	**Acq A**	**Acq B**	**Acq C**
Key Driver(s)	*Cost, Schedule*	*Compliance with Standard Process*	*Application of Documented Best Practices*
AV-1	PLU	L	P
AV-2	PLU	L	P
OV-1	PU	N/A	P
OV-2	PU	N/A	P
OV-3	PU	N/A	P

Figure 5-2: Sample outcome for Step 2

5.3 Step 3: Time-Phasing & Analysis

As before, this session should start out with a recap of the previous session. Next, a brief explanation of the program phases (such as those defined by DoDI 5000.02 and summarized in Table 3-2) should be provided. The spreadsheet built during the prior session should be replicated several more times in order to provide a basis for evaluating future phases of the program (Note: this number will vary depending on the phase in which the program currently resides and the number of phases that remain). Finally, an additional worksheet should be created to automatically populate the stakeholder classification for each phase for each stakeholder for each architecture framework artifact. This will provide a means for viewing how each stakeholder's classification changes as the program progresses. Next, the team should consider how the program will evolve with each phase, and what areas will be more or less important to particular stakeholders. The team should document these changes in stakeholder classifications for each model in each phase.

The desired outcomes of Step 3 are Stakeholder Crosswalks for upcoming phases of the program and a time-phased rolled-up summary crosswalk that illustrates how each stakeholder's concerns (per the Mitchell, et al. definition, see Table 2-3) change over time (see Figure 5-3 for an example using DoDAF and the program phases defined in DoDI 5000.02). Additionally, Appendix A can be reference to see the roll-up summary crosswalk produced by the pilot study team as described in Chapter 4.

COI	**Operations**		
Stakeholder	**Op A**	**Op B**	**Op C**
Key Driver(s)	*Mission, Promotion*	*Profit, Reputation*	*Mission*
SV-4a			
TD Phase	N/A	N/A	P
EMD Phase	N/A	N/A	P
P&D Phase	L	L	PL
O&S Phase	L	L	PL

Figure 5-3: Sample outcome for Step 3

5.4 Step 4: Stakeholder Network Map Creation

After discussing the efforts from the previous session, the team should be introduced to basic social network analysis techniques. A good reference is the article titled "The

People Who Make Organizations Go-Or Stop" which contains social network role definitions accompanied with example graphics (Cross & Prusak, 2002). Next, the team should embark on building a Stakeholder Network Map for each phase of the program starting with the current phase. Two approaches for building the map are provided below.

If the program team is unable to easily install new software on their computer workstations, the team should build the network map using spreadsheet software such as Microsoft Excel. Using a cell for each stakeholder, the team can populate a blank spreadsheet. Starting with themselves and working out, the team can add arrows that indicate primary lines of influence. In other words, starting with "Stakeholder A," the team should identify whom that stakeholder listens to or is strongly influenced by (for example, Stakeholders B and C). Then lines should be drawn to reflect those influences. Next, the team should move to Stakeholder B and repeat the process. The team should continue these iterations until the primary influencers of each stakeholder have been identified and mapped. Since the lines of influence may change as the program progresses, separate network diagrams should be drawn for the subsequent program phases.

If the team is able to easily install new software on their computer workstations, social network analysis software such as the free version of NetDraw should be utilized to automatically create the Stakeholder Network Maps. If NetDraw is chosen, the team should input their stakeholder data via the Nodelist DL format. To accomplish this, the team should first work their way through the list of stakeholders one at a time. For each stakeholder, the team identifies the primary influencer(s) and documents them in a text file as described in “A Brief Guide to Using NetDraw” (Borgatti, 2002). Once complete, this text file should be imported into the software and the network map will be automatically created. The desired outcome of Step 4 is a set of Stakeholder Network Maps (one for each phase of the program). Figure 5-4 provides an example outcome produced with NetDraw.

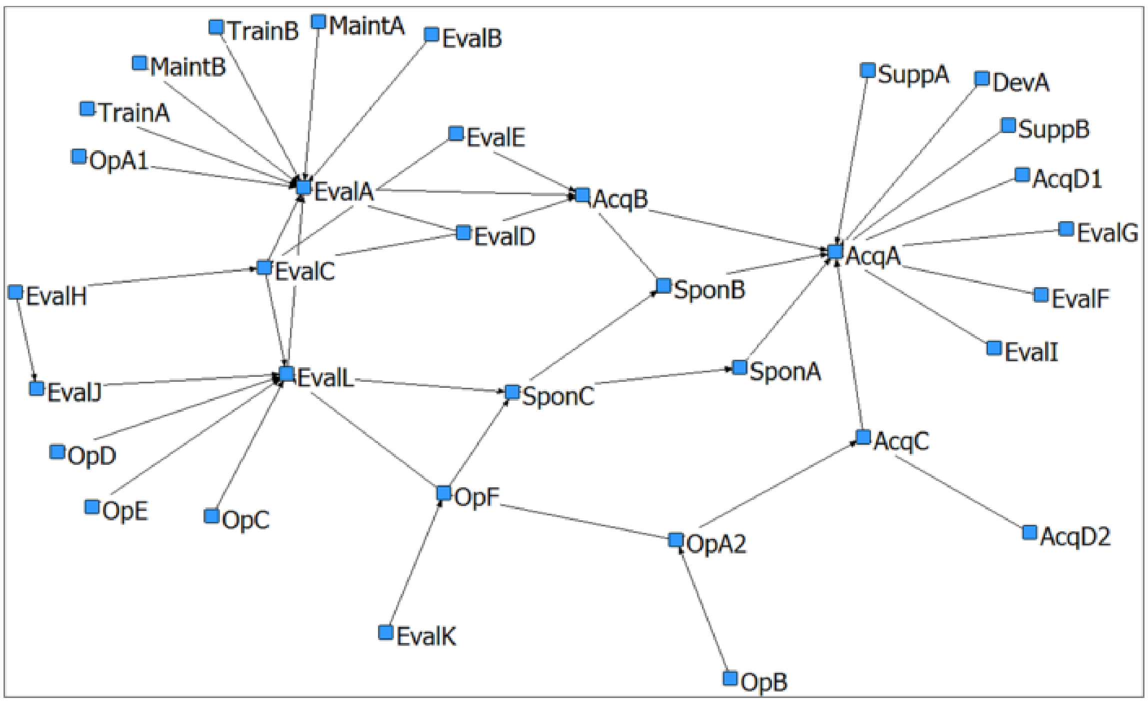


Figure 5-4: Sample outcome for Step 4

5.5 Step 5: Social Role Analysis

After recapping the events of the previous session and viewing the network maps, the team should work on identifying any subgroups within each network map. If spreadsheet software was utilized in Step 4, then the team should work to manually identify subgroups (characterized by clusters). If social network analysis software was utilized, the software’s inherent analysis capabilities should be leveraged to identify subgroups (see Figure 5-5). These subgroups should then be named by the team to facilitate future references.

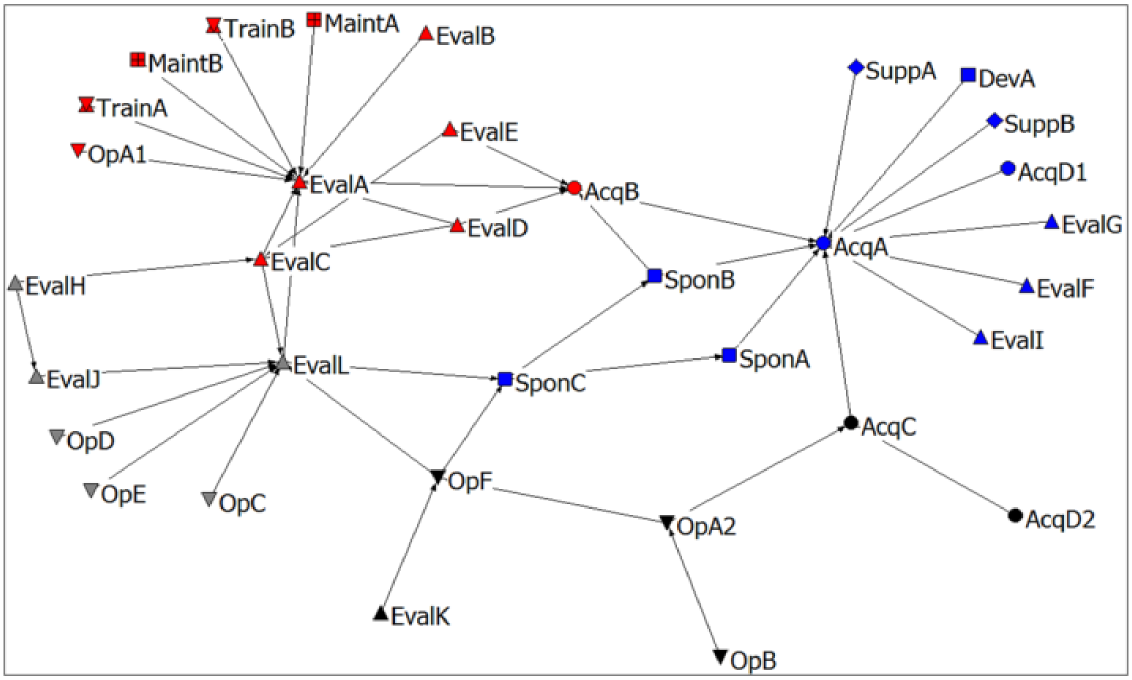


Figure 5-5: Sample outcome for Step 5 using NetDraw (different colors denote different subgroups)

Next, the team should examine social network roles. Taking one network map at a time, the team should identify key social network roles that various stakeholders perform. Table 2-5 and Table 3-3 provide Anklam's social network role definitions and fictitious examples for each role (Anklam, 2005). Finally, the description of each stakeholder should be augmented with his or her subgroup memberships (by program phase) along with any social network role(s) the stakeholder fulfills. Appendix A (which contains artifacts from the pilot study described in Chapter 4) may be referenced for an example listing of stakeholder roles and subgroup membership.

5.6 Completed Framework

At the end of Step 5, the team should now have a completed set of Stakeholder Crosswalks and Stakeholder Network Maps that capture the "socio" side of the enterprise's complex socio-technical system. These products should detail stakeholder interrelations throughout the system life cycle and can be used for future trade off decisions (by examining the row that corresponds to the particular architecture framework artifact that best describes the item being evaluated and determining which stakeholders are most affected). The products can also be used to build winning coalitions for volatile topics (by identifying the key stakeholder opposing the idea, viewing his or her location on the Stakeholder Network Map, and strategizing a plan to systematically address other stakeholders that influence the target stakeholder). Additionally, with the possession of a Stakeholder Network Map, the program team can now apply a variety of Social Network Analysis tools and techniques documented in the rich literature of Social Network Analysis.

As the program progresses, the stakeholder landscape is expected to change. New stakeholders may emerge, while others may disappear. New personalities may exhibit more or less power and urgency than their predecessors. Even if the people remain the same, politics, budgets, and technologies will likely change in ways that affect the program's stakeholders and create new key drivers (Piaszczyk, 2011). For these reasons, the Stakeholder Crosswalks and Stakeholder Network Maps developed through the use of this framework should be re-evaluated and updated on a recurring basis. This re-evaluation can be annually or, at a minimum, in conjunction with each major program milestone (such as those defined within DoDI 5000.02 (U.S. Department of Defense, 2008)).

5.7 Framework Weakness

During the execution of the pilot study (see Chapter 4), only one weakness was identified that could not be addressed by modifying the framework itself. This weakness is that the framework assumes the program team possesses an initial understanding of the stakeholder roles and personalities associated with their program. Unfortunately, this may not be the case if this is a brand new program or if the engineer is new to the program.

While this weakness cannot be mitigated by modifying the framework itself, there are alternatives means to mitigate the weakness. For example, if the framework is being applied to a brand new program, engineers from similar programs can be queried for their knowledge of potential stakeholder roles and personalities. If this framework is being executed by an engineer new to the program, he or she can seek assistance from more experienced members of the program team who have personally witnessed stakeholders in action. Furthermore, if this framework is adopted by an organization, the results of each instance can be added to a repository. This ever growing and refining repository of stakeholder traits can be used as a starting point for new programs desiring to employ this framework.

In addition to the steps above, a collection of heuristics could prove to be an important mitigation tool. Heuristics can be collected that focus on identifying stakeholders, determining a stakeholder's key driver(s), correlating stakeholders to specific social network roles, and identifying patterns of influence. These heuristics can build upon those provided by ISO/IEEE, Keeney, Rechtin, and Maier and should apply the heuristics guidelines set forth in Chapter 2 of *The Art of Systems Architecting* (ISO, 2007; IEEE, 2000; Keeney, 1992; Rechtin, 1991; Maier & Rechtin, 2002).

5.8 Fictitious Application

The following fictitious scenario is intended to provide an example usage of the architectural products created via the application of the five-step framework documented in this chapter. Inspired by the use case provided by Hari, Kasser, and Weiss, the product being designed in the simplistic example below is a new flashlight intended for security guards (Hari, Kasser, & Weiss, 2007).

5.8.1 Problem Identification

During requirements analysis, a program team identifies a set of conflicting requirements. Specifically, the team determines that providing a means to momentarily illuminate the bulb in the new flashlight impairs the design team's ability to reduce the new flashlight's weight and their ability to reduce the effort required to engage the constant illumination switch. The team also realizes that the requirement in question is of lower priority than the two requirements with which it conflicts. The requirement for the momentary illumination feature was levied by the Operations community of interest and is best depicted in the program's DoDAF SV-5 diagrams that depict the relationship between operational activities and the system functions required to support desired features.

5.8.2 Using the Stakeholder Crosswalk

The team references their Stakeholder Crosswalk and observes that there are two legitimate stakeholders (per the Mitchell, et al. definition, see Table 2-3) with interest in this item. These two stakeholders oversee the operational community. During this example, these stakeholders will be referred to as L1 and L2. The team also recognizes there is an additional stakeholder (a former operator, now engineer) who wields power among other stakeholders with regard to operational issues. This stakeholder will be referred to as P1. Then, the team looks at their time-phased roll-up summary Stakeholder Crosswalk and identifies a stakeholder that is expected to emerge in a future phase of the program. This stakeholder is a member of the testing community, who is rated as both powerful and legitimate in the Production and Deployment Phase. This stakeholder will be referred to as PL1.

Informal phone calls are made to L1, L2, and P1 to describe the situation and proposed solution. L1 and P1 understand the need to achieve the higher priority requirements and express hesitant support for eliminating the momentarily illumination requirement. L2, however, does not support this recommendation.

5.8.3 Using the Stakeholder Network Map

Using the Stakeholder Network Map, the team sees that L2 is heavily influenced by the senior user of the legacy flashlight due to be replaced by the new design. Viewed individually, this senior user does not possess power, legitimacy, or urgency (per the Mitchell, et al. definition); however, the program team sees that this stakeholder's relationship with L2 makes him powerful in this scenario. During this example, the new stakeholder will be referred to NA1.

The team makes a call to NA1 to explain the situation and proposed elimination of the momentarily illumination requirement. NA1 agrees with the proposed approach, noting that the current crew of security guards does not use the momentary illumination button found on the legacy flashlight. The senior guard explains that the requirement is a holdover from a time when the security guards used flashing light signals to communicate at night. Now, the security guards utilize two-way radios that were fielded after the original flashlights were put into service.

Relatively confident they can now gather full support for eliminating the momentarily illumination requirement, the program team hosts a formal requirements review with L1, L2, P1, PL1, and NA1. The team presents their case on how the momentary illumination feature would hamper the design team's ability to reduce the new flashlight's weight and their ability to reduce the effort required to engage the constant illumination switch. Next, the team asks NA1 how often the momentary illumination feature is used during typical operations. NA1 provides the meeting attendees with the same answer that was previously provided to the program team (i.e., it is no longer used to communicate now that radios have been provided).

The program team initiates a poll, and requests each member provide either concurrence with eliminating the momentary illumination requirement or non-concurrence. The team first asks NA1 who promptly concurs with eliminating the requirement. Next, they ask P1 who also concurs. Now, the team asks L1 to concur or non-concur. L1 concurs. After a deep breath, the program team requests L2 provide concurrence or non-concurrence. L2 also concurs. Finally, the team asks PL1 for concurrence or non-concurrence. PL1, who now sees there is no operational need for this requirement, concurs. Following the meeting, the program team records the results of the meeting and updates the requirements documentation to reflect the agreed upon changes.

5.8.4 Example Benefits to the Program

During the fictitious example provided above, the program team realized a number of benefits attributable to their use of Stakeholder Crosswalks and Stakeholder Network Map. These benefits are summarized in Table 5-1 below.

Table 5-1: Example benefits from using the Stakeholder Crosswalks and Stakeholder Network Map

Benefit	Discussion
Right-Sized Stakeholder Involvement	Only five out of 15 program stakeholders were involved in the decision making process.
Effective Use of Resources	The team was able to quickly identify a path to convince an opposing stakeholder of the proposed approach's design benefits. The team was able to identify the benefit of involving a system tester at the requirements meeting and potentially eliminated contention during future test events.
Stakeholder Commitment	All stakeholders that would be affected or who could affect the product with regard to the requirement in question jointly decided upon the change in requirements early in the design phase.

5.9 Chapter Summary

This chapter documented a five-step framework that systems engineers can use to produce Stakeholder Crosswalks and Stakeholder Network Maps that characterize program stakeholders and their interrelations. This framework represents the fruit of the efforts described in this dissertation. Additionally, areas of potential use were explored via a fictitious scenario. Measuring the actual effectiveness of these new architectural products (vice using fictitious scenarios) is included in the recommendations for future research provided in the next chapter.

Chapter 6 — Conclusions and Future Work

This chapter provides the final conclusions related to the efforts documented within this dissertation. It also provides suggestions for areas of future research that will further expand the knowledgebase of both the stakeholder system and the framework introduced to capture that system.

6.1 Conclusions

Managing stakeholder relations and interrelations is critical to program success. If these efforts are ignored, program sponsors will needlessly waste funds on ineffective solutions and rework—a path that is unacceptable, especially in fiscally constrained environments such as those currently faced by many organizations. This dissertation explored how popular architecture frameworks successfully capture the *views* of program stakeholders but fail to capture the *interrelations* of these stakeholders. These interrelations serve as the $n*(n-1)/2$ interfaces (where n equals the number of stakeholders) that connect individual stakeholders within a stakeholder system. By understanding both the components (stakeholders) and interfaces (stakeholder interrelations), it is anticipated that systems engineers will be better prepared to work with their unique stakeholder system and achieve the ultimate goal of their program: fielding and sustaining a successful product.

Two new architectural products (Stakeholder Crosswalks and Stakeholder Network Maps) were introduced as a means to accurately capture and characterize a program's stakeholder system. A pilot study was conducted to test the feasibility of these architectural products and ultimately answer the question: Can the stakeholder system be captured in an architectural view? The pilot study confirmed that this stakeholder system can be captured. Simultaneously, the pilot study tested the usability of a framework developed to guide systems engineers in capturing and characterizing their program's unique stakeholder system. The pilot study also confirmed the usability of the framework when facilitated by a seasoned engineer.

Based upon the lessons learned through the execution of the pilot study, the framework used to produce the architectural views was refined and is now available to assist practicing systems engineers build their own Stakeholder Crosswalks and Stakeholder Network Maps. Although the framework was purposely designed to be applicable to any program, programs with stable environments and a high number of stakeholders (such as the Joint Service Department of Defense (DoD) program documented in this pilot study) are most likely to benefit. This framework and resulting architectural products provide a unique insertion of Social Network Analysis into Architecture Framework and fulfill an original intent of Architecture Framework by capturing the *entire* socio-technical system. Through the application of these architectural products, the author anticipates systems engineers will be able to field systems more efficiently and field them with the assurance of lasting stakeholder commitment.

6.2 Future Work

During the efforts documented within this dissertation, three main areas of future work were identified. The first area was evaluating the effectiveness of the architectural products. The second area was validating the architectural products. The third area was further validating and improving the framework.

6.2.1 Evaluating the Effectiveness of the Architectural Products

While the pilot study successfully showed that stakeholder interrelations can be captured with commonly available tools and with relatively little time investment, future work should explore the employment of the Stakeholder Crosswalk and Stakeholder Network Map. These research efforts could examine the effectiveness of the tools during the execution of trade-off decisions and/or their effectiveness in support of coalition building. Research could also be performed to examine the effectiveness of the tools in support of the requirements negotiation techniques provided by Pohl (2010). The results of research efforts of this type could be leveraged to support a cost-benefit analysis and identify programs that are mostly likely to benefit from use of the architectural products.

6.2.2 Validating the Architectural Products

While the pilot study confirmed that the architectural products could be created, the validation of the accuracy of these products was left to the participating program personnel. Future research could be in the manner of follow-up studies performed at program milestones that would validate or invalidate initial findings relating to stakeholder characteristics and interrelations. After several programs were examined, further research could create a means to grade the architectural products in terms of their accuracy. This research could then lead to identifying errors in the products prior to their usage.

6.2.3 Validating and Improving the Framework

Although the framework was successfully executed by one U.S. DoD program, the framework should be validated with a larger set of programs both inside and outside of the DoD. Other research efforts could explore variations of the Stakeholder Crosswalk and Stakeholder Network Map such as applying different stakeholder and/or social network approaches. This could include using different stakeholder characteristics like those introduced by Highsmith that classify stakeholder by their ability to veto or delay a program (Highsmith, 2010). This could also include using social network analysis software other than NetDraw such as the examples provide by Anklam (2005). In addition to possibly creating more accurate architectural products, variations of the framework could be tested for ease of use. Ideally, a revised framework would emerge that would require minimal systems engineering experience to execute.

Future research could also seek to determine an optimum number of participants to use when executing the framework. The research could additionally explore the optimum skill set (e.g., number of years on the program, systems engineering experience, and/or project management experience) for participants executing the framework. Further research could be performed to determine if this framework should be merged with other development approaches such as the Incremental Commitment Model which holds stakeholder satisficing as a key principle for program success (Boehm & Lane, 2008).

References

Anklam, P. (2005). Social network analysis in the KM toolkit. In M. Rao, *Knowledge management tools and techniques* (pp. 329-346). Burlington, MA: ELSEVIER.

Bartolomei, J. E., Hastings, D. E., de Neufville, R., & Rhodes, D. H. (2012). Engineering Systems Multiple-Domain Matrix: An organizing framework for modeling large-scale complex systems. *Systems Engineering*, *15*(1), 41-61.

Boehm, B., & Lane, J. (2008). *Guide for Using the Incremental Commitment Model (ICM) for Systems Engineering of DoD Projects.* Center for Systems and Software Engineering. Los Angeles, CA: University of Southern California.

Bonnema, G. M. (2011). Insight, innovation, and the big picture in system design. *Systems Engineering*, *14*(3), 223-238.

Bonnema, G. M., Borches, D. P., Kauw-A-Tjoe, R. G., & van Houten, F. J. (2010). Communication: Key Factor in Multidisciplinary System Design. *8th Conference on Systems Engineering Research.* Hoboken, NJ: CSER.

Borgatti, S. (2002). A Brief Guide to Using NetDraw. Cambridge, MA: Harvard: Analytic Technologies.

Bryson, J. M. (2003). *What to do when stakeholders matter: A guide to stakeholder identification and analysis techniques.* A paper presented at London School of Economics and Political Science.

Bryson, J. M. (2004). What to do when stakeholders matter. *Public Management Review*, *6*(1), 21-53.

Collins, S. T., Yassine, A. A., & Borgatti, S. P. (2009). Evaluating Product Development Systems Using Network Analysis. *Systems Engineering*, *12*(1), 55-68.

Cornish, E. (2004). *Futuring: The Exploration of the Future* . Bethesda, MD: World Future Society.

Cross, R., & Prusak, L. (2002, June). The people who make organizations go-or stop. *Harvard Business Review*, 5-12.

Forman, B. (2002). The political process and systems architecting. In M. Maier, & E. Rechtin, *The Art of Systems Architecting* (pp. 237-248). Boca Raton, FL: CRC Press LLC.

Freeman, E. (1984). *Strategic management: A stakeholder approach.* Boston, MA: Pitman.

Friedman, G., & Sage, A. (2004). Case studies of systems engineering and management in systems acquisition. *Systems Engineering, 7*(1), 84-97.

Handley, H. A., & Smillie, R. J. (2008). Architecture Framework Human View: The NATO Approach. *Systems Engineering, 11*(2), 156-164.

Hari, A., Kasser, J. E., & Weiss, M. P. (2007). How lessons learned from using QFD led to the evolution of a process for creating quality requirements for complex systems. *Systems Engineering, 10*(1), 45-63.

Highsmith, J. (2010). *Agile Project Management.* Boston, MA: Pearson Education, Inc.

IEEE. (2000, October). ANSI/IEEE Std 1471–2000 Recommended Practice for Architectural Description of Software-Intensive Systems.

ISO. (2007, July). ISO/IEC 42010 Recommended Practice for Architectural Description of Software-Intensive Systems.

Keeney, R. L. (1992). *Value Focused Thinking: A Path to Creative Decisionmaking.* Cambridge, MA: Harvard University Press.

Liebowitz, J. (2005). Linking social network analysis with the analytic hierarchy process for knowledge mapping in organizations. *Journal of Knowledge Management*, *9*(1), 76-86.

Maier, M., & Rechtin, E. (2002). *The Art of Systems Architecting.* Boca Raton, FL: CRC Press LLC.

Maier, M., Emery, D., & Hilliard, R. (2004). ANSI/IEEE 1471 and systems engineering. *Systems Engineering*, *7*(3), 257-270.

Mikaelian, T., Nightingale, D., Rhodes, D., & Hastings, D. (2011, August). Real options in enterprise architecture: A holistic mapping of mechanisms and types for uncertainty management. *IEEE Transactions on Engineering Management*, *58*(3), 457-470.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997, October). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *The Academy of Management Review*, *22*(4), 853-886.

Muller, G. (2004). *CAFCR: A Multi-view Method for Embedded Systems Architecting.* Delft, Netherlands: Technical University Delft.

Mykityshyn, M. G., & Rouse, W. B. (2006). Supporting strategic enterprise processes: An analysis of various architecture frameworks. *Information Knowledge Systems Management*(6), 145-175.

NATO Consultation, Command and Control Board. (2007). *NATO Architecture Framework Version 3.* Brussels, Belgium: North Atlantic Treaty Organization.

Nutt, P. C. (1999). Surprising but true: Half the decisions in organizations fail. *The Academy of Management Executive*, *13*(4), 75-90.

Nutt, P. C. (2002). *Why decisions fail: Avoiding blunders and traps that lead to debacles.* San Francisco, CA: Berrett-Koehler Publishers.

Piaszczyk, C. (2011). Model based systems engineering with Department of Defense Architectural Framework. *Systems Engineering, 14*(3), 305-326.

Pohl, K. (2010). *Requirements Engineering.* Berlin, Germany: Springer-Verlag.

Portes, A. (1998). Social capital: Its origins and applications in modern sociology. *Annual Review of Sociology, 24*, 1-24.

Prell, C., Hubacek, K., & Reed, M. (2009). Stakeholder analysis and social network analysis in natural resource management. *Society and Natural Resources, 22*, 501-518.

Project Management Institute. (2004). *A Guide to the Project Management Body of Knowledge.* Newtown Square, PA: Project Management Institute.

Rao, M. (2005). Overview: The social life of KM tools. In M. Rao, *Knowledge management tools and techniques* (pp. 1-73). Burlington, MA: ELSEVIER.

Rechtin, E. (1991). *Systems Architecting: Creating and Building Complex Systems.* Englewood Cliffs, NJ: Prentice Hall P T R.

Scott, J., & Carrington, P. (2011). *The SAGE Handbook of Social of Social Network Analysis.* Thousand Oaks, CA: SAGE.

Sharon, A., de Weck, O. L., & Dori, D. (2011). Project management vs. systems engineering management: A practitioners' view on integrating the project and product domains. *Systems Engineering, 14*(1), 427-440.

Smudde, P. M., & Courtright, J. L. (2011). A holistic approach to stakeholder management: A rhetorical foundation. *Public Relations Review, 37*(2), 137-144.

Soh, C., Chua, C., & Singh, H. (2011, March). Managing diverse stakeholders in enterprise systems projects: A control portfolio approach. *Journal of Information Technology*, *26*(1), 16-31.

Sparrowe, R. T., Liden, R. C., Wayne, S. J., & Kraimer, M. L. (2001 йил April). Social networks and the performance of individuals and groups. *The Academy of Management Journal*, *44*(2), 316-325.

U.S. Department of Defense. (2008). *DoDI 5000.02: Operation of the Defense Acquisition System.* Washington, DC: Department of Defense.

U.S. Department of Defense. (2009). *DoD Architecture Framework Version 2.0: Volume 1*. Washington, DC: Department of Defense.

U.S. Department of Defense. (2009). *DoD Architecture Framework Version 2.0: Volume 2.* Washington, DC: Department of Defense.

U.S. Department of Defense. (2009). *DoD Architecture Framework Version 2.0: Volume 3.* Washington, DC: Department of Defense.

Zachman, J. A. (1987). A framework for information systems architecture. *IBM Systems Journal*, *26*(3), 276-292.

Appendix A — Pilot Study Artifacts

This appendix contains artifacts from the pilot study (see Chapter 4) with a subsection dedicated to the results of each of the five steps executed. Due to their size, the Excel charts were broken into multiple pieces in order to be legible in this format.

Step 1: Stakeholder Identification

Grouping	Acquirers					
Organization	**Acq A**	**Acq B**	**Acq C**	**Acq D**		
Concern	cost, sched	acq risk	acq risk	reputation, profit		
Grouping	Sponsors					
Organization	**Spon A**	**Spon B**	**Spon C**			
Concern	cost	cost	mission			
Grouping	Evaluators					
Organization	**Eval A**	**Eval B**	**Eval C**	**Eval D**	**Eval E**	**Eval F**
Concern	compliance	compliance	compliance	compliance	compliance	compliance
Grouping	Evaluators (cont)					
Organization	**Eval G**	**Eval H**	**Eval I**	**Eval J**	**Eval K**	**Eval L**
Concern	compliance	mission	compliance	feasibility	feasibility	compliance, mission
Grouping	Developers					
Organization	**Dev A**					
Concern	profit, reputaiton					
Grouping	Trainers					
Organization	**Train A**	**Train B**				
Concern	profit, reputaiton	mission, promotion				
Grouping	Maintainers					
Organization	**Maint A**	**Maint B**				
Concern	profit, reputation	mission, promotion				
Grouping	Suppliers					
Organization	**Supp A**	**Supp B**				
Concern	profit, reputation	profit, reputation				
Grouping	Operators					
Organization	**Op A**	**Op B**	**Op C**	**Op D**	**Op E**	**Op F**
Concern	mission, promotion	profit, reputation	mission	mission	mission	mission

Step 2: Stakeholder Classification

Grouping	Acquirers			
Organization	**Acq A**	**Acq B**	**Acq C**	**Acq D**
Concern	cost, sched	acq risk	acq risk	reputation, profit
AV-1	7	2	1	8
AV-2	7	2	1	8
OV-1	5	8	1	8
OV-2	5	8	1	8
OV-3	5	8	1	8
OV-4	5	8	1	8
OV-5	5	8	1	8
OV-6c	5	8	1	8
SV-1	7	2	4	1
SV-2	7	2	4	1
SV-4a	7	2	4	1
SV-5a	7	2	4	1
SV-6	7	2	4	1
TV-1	7	4	1	1
TV-2	7	4	1	1

Grouping	Sponsors		
Organization	**Spon A**	**Spon B**	**Spon C**
Concern	Cost	Cost	mission
AV-1	8	1	8
AV-2	8	1	8
OV-1	1	1	1
OV-2	1	1	1
OV-3	1	1	1
OV-4	1	1	1
OV-5	1	1	1
OV-6c	1	1	1
SV-1	1	1	1
SV-2	1	1	1
SV-4a	1	1	1
SV-5a	1	1	1
SV-6	1	1	1
TV-1	1	1	1
TV-2	1	1	1

Grouping	Evaluators					
Organization	**Eval A**	**Eval B**	**Eval C**	**Eval D**	**Eval E**	**Eval F**
Concern	compliance	compliance	compliance	compliance	compliance	compliance
AV-1	8	8	8	8	8	8
AV-2	8	8	8	8	8	8
OV-1	8	8	8	8	8	8
OV-2	8	8	8	8	8	8
OV-3	8	8	8	8	8	8
OV-4	8	8	8	8	8	8
OV-5	8	8	8	8	8	8
OV-6c	8	8	8	8	8	8
SV-1	2	2	2	2	2	2
SV-2	2	2	2	2	2	2
SV-4a	2	2	2	2	2	2
SV-5a	2	2	2	2	2	2
SV-6	2	2	2	2	2	2
TV-1	2	2	4	2	2	2
TV-2	2	2	4	2	2	2

Grouping						
Organization	**Eval G**	**Eval H**	**Eval I**	**Eval J**	**Eval K**	**Eval L**
Concern	compliance	mission	compliance	feasibility	feasibility	compliance, mission
AV-1	8	8	8	8	8	8
AV-2	8	8	8	8	8	8
OV-1	8	8	8	8	8	2
OV-2	8	8	8	8	8	2
OV-3	8	8	8	8	8	2
OV-4	8	8	8	8	8	2
OV-5	8	8	8	8	8	2
OV-6c	8	8	8	8	8	2
SV-1	2	1	2	1	1	4
SV-2	2	1	2	1	1	4
SV-4a	2	1	2	1	1	4
SV-5a	2	1	2	1	1	4
SV-6	2	1	2	1	1	4
TV-1	2	1	2	1	8	4
TV-2	2	1	2	1	8	4

Grouping	Developers
Organization	**Dev A**
Concern	profit, reputaiton
AV-1	8
AV-2	8
OV-1	8
OV-2	8
OV-3	8
OV-4	8
OV-5	8
OV-6c	8
SV-1	8
SV-2	8
SV-4a	8
SV-5a	8
SV-6	8
TV-1	8
TV-2	8

Grouping	Trainers	
Organization	**Train A**	**Train B**
Concern	profit, reputaiton	mission, promotion
AV-1	8	8
AV-2	8	8
OV-1	8	8
OV-2	8	8
OV-3	8	8
OV-4	8	8
OV-5	8	8
OV-6c	8	8
SV-1	8	8
SV-2	8	8
SV-4a	8	8
SV-5a	8	8
SV-6	8	8
TV-1	8	8
TV-2	8	8

Grouping	Maintainers	
Organization	**Maint A**	**Maint B**
Concern	profit, reputation	mission, promotion
AV-1	8	8
AV-2	8	8
OV-1	8	8
OV-2	8	8
OV-3	8	8
OV-4	8	8
OV-5	8	8
OV-6c	8	8
SV-1	8	8
SV-2	8	8
SV-4a	8	8
SV-5a	8	8
SV-6	8	8
TV-1	8	8
TV-2	8	8

Grouping	Suppliers	
Organization	**Supp A**	**Supp B**
Concern	profit, reputation	profit, reputation
AV-1	8	8
AV-2	8	8
OV-1	8	8
OV-2	8	8
OV-3	8	8
OV-4	8	8
OV-5	8	8
OV-6c	8	8
SV-1	8	8
SV-2	8	8
SV-4a	8	8
SV-5a	8	8
SV-6	8	8
TV-1	8	8
TV-2	8	8

Grouping	Operators					
Organization	**Op A**	**Op B**	**Op C**	**Op D**	**Op E**	**Op F**
Concern	mission, promotion	profit, reputation	mission	mission	mission	mission
AV-1	8	8	8	8	8	8
AV-2	8	8	8	8	8	8
OV-1	8	8	2	2	2	4
OV-2	8	8	2	2	2	4
OV-3	8	8	2	2	2	4
OV-4	8	8	2	2	2	4
OV-5	8	8	2	2	2	4
OV-6c	8	8	2	2	2	4
SV-1	8	8	8	8	8	1
SV-2	8	8	8	8	8	1
SV-4a	8	8	8	8	8	1
SV-5a	8	8	2	2	2	4
SV-6	8	8	8	8	8	1
TV-1	8	8	8	8	8	8
TV-2	8	8	8	8	8	8

Step 3: Time-Phasing and Analysis

	Grouping	Acquirers			
	Organization	**Acq A**	**Acq B**	**Acq C**	**Acq D**
	Concern	cost, sched	acq risk	acq risk	reputation, profit
AV-1	TD	7	2	1	8
	EMD	7	2	1	8
	P&D	7	2	1	8
	O&S	7	2	1	8
AV-2	TD	7	2	1	8
	EMD	7	2	1	2
	P&D	7	2	1	2
	O&S	7	2	1	8
OV-1	TD	5	8	1	8
	EMD	5	8	1	8
	P&D	5	8	1	8
	O&S	5	8	1	8
OV-2	TD	5	8	1	8
	EMD	5	8	1	2
	P&D	5	8	1	8
	O&S	5	8	1	8
OV-3	TD	5	8	1	8
	EMD	5	8	1	2
	P&D	5	8	1	8
	O&S	5	8	1	8
OV-4	TD	5	8	1	8
	EMD	5	8	1	8
	P&D	5	8	1	8
	O&S	5	8	1	8
OV-5	TD	5	8	1	8
	EMD	5	8	1	2
	P&D	5	8	1	8
	O&S	5	8	1	8
OV-6c	TD	5	8	1	8
	EMD	5	8	1	2
	P&D	5	8	1	8
	O&S	5	8	1	8

	Grouping	Acquirers			
	Organization	**Acq A**	**Acq B**	**Acq C**	**Acq D**
	Concern	cost, sched	acq risk	acq risk	reputation, profit
SV-1	TD	7	2	4	1
	EMD	7	2	4	4
	P&D	7	2	4	4
	O&S	7	2	4	2
SV-2	TD	7	2	4	1
	EMD	7	2	4	4
	P&D	7	2	4	4
	O&S	7	2	4	2
SV-4a	TD	7	2	4	1
	EMD	7	2	4	4
	P&D	7	2	4	4
	O&S	7	2	4	2
SV-5a	TD	7	2	4	1
	EMD	7	2	4	4
	P&D	7	2	4	4
	O&S	7	2	4	2
SV-6	TD	7	2	4	1
	EMD	7	2	4	4
	P&D	7	2	4	4
	O&S	7	2	4	2
TV-1	TD	7	4	1	1
	EMD	7	4	1	4
	P&D	7	4	1	1
	O&S	7	4	1	2
TV-2	TD	7	4	1	1
	EMD	7	4	1	4
	P&D	7	4	1	1
	O&S	7	4	1	2

	Grouping	Sponsors		
	Organization	**Spon A**	**Spon B**	**Spon C**
	Concern	cost	cost	mission
AV-1	TD	8	1	8
	EMD	1	1	8
	P&D	1	1	8
	O&S	8	1	8
AV-2	TD	8	1	8
	EMD	1	1	8
	P&D	1	1	8
	O&S	8	1	8
OV-1	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
OV-2	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
OV-3	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
OV-4	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
OV-5	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
OV-6c	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1

	Grouping	Sponsors		
	Organization	**Spon A**	**Spon B**	**Spon C**
	Concern	cost	cost	mission
SV-1	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
SV-2	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
SV-4a	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
SV-5a	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
SV-6	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
TV-1	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1
TV-2	TD	1	1	1
	EMD	1	1	1
	P&D	1	1	1
	O&S	1	1	1

	Grouping	Evaluators					
	Organization	**Eval A**	**Eval B**	**Eval C**	**Eval D**	**Eval E**	**Eval F**
	Concern	compliance	compliance	compliance	compliance	compliance	compliance
AV-1	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
AV-2	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-1	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-2	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-3	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-4	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-5	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-6c	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8

	Grouping	Evaluators					
	Organization	**Eval A**	**Eval B**	**Eval C**	**Eval D**	**Eval E**	**Eval F**
	Concern	compliance	compliance	compliance	compliance	compliance	compliance
SV-1	TD	2	2	2	2	2	2
	EMD	2	2	2	2	2	2
	P&D	2	2	2	2	2	2
	O&S	2	2	2	2	2	2
SV-2	TD	2	2	2	2	2	2
	EMD	2	2	2	2	2	2
	P&D	2	2	2	2	2	2
	O&S	2	2	2	2	2	2
SV-4a	TD	2	2	2	2	2	2
	EMD	2	2	2	2	2	2
	P&D	2	2	2	2	2	2
	O&S	2	2	2	2	2	2
SV-5a	TD	2	2	2	2	2	2
	EMD	2	2	2	2	2	2
	P&D	2	2	2	2	2	2
	O&S	2	2	2	2	2	2
SV-6	TD	2	2	2	2	2	2
	EMD	2	2	2	2	2	2
	P&D	2	2	2	2	2	2
	O&S	2	2	2	2	2	2
TV-1	TD	2	2	4	2	2	2
	EMD	2	2	4	2	2	2
	P&D	2	2	4	2	2	2
	O&S	2	2	4	2	2	2
TV-2	TD	2	2	4	2	2	2
	EMD	2	2	4	2	2	2
	P&D	2	2	4	2	2	2
	O&S	2	2	4	2	2	2

	Grouping						
	Organization	**Eval G**	**Eval H**	**Eval I**	**Eval J**	**Eval K**	**Eval L**
	Concern	compliance	mission	compliance	feasibility	feasibility	compliance, mission
AV-1	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
AV-2	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-1	TD	8	8	8	8	8	2
	EMD	8	8	8	8	8	2
	P&D	8	8	8	8	8	2
	O&S	8	8	8	8	8	2
OV-2	TD	8	8	8	8	8	2
	EMD	8	8	8	8	8	2
	P&D	8	8	8	8	8	2
	O&S	8	8	8	8	8	2
OV-3	TD	8	8	8	8	8	2
	EMD	8	8	8	8	8	2
	P&D	8	8	8	8	8	2
	O&S	8	8	8	8	8	2
OV-4	TD	8	8	8	8	8	2
	EMD	8	8	8	8	8	2
	P&D	8	8	8	8	8	2
	O&S	8	8	8	8	8	2
OV-5	TD	8	8	8	8	8	2
	EMD	8	8	8	8	8	2
	P&D	8	8	8	8	8	2
	O&S	8	8	8	8	8	2
OV-6c	TD	8	8	8	8	8	2
	EMD	8	8	8	8	8	2
	P&D	8	8	8	8	8	2
	O&S	8	8	8	8	8	2

	Grouping						
	Organization	**Eval G**	**Eval H**	**Eval I**	**Eval J**	**Eval K**	**Eval L**
	Concern	compliance	mission	compliance	feasibility	feasibility	compliance, mission
SV-1	TD	2	1	2	1	1	4
	EMD	2	1	2	1	1	4
	P&D	2	1	2	1	1	4
	O&S	2	1	2	1	1	4
SV-2	TD	2	1	2	1	1	4
	EMD	2	1	2	1	1	4
	P&D	2	1	2	1	1	4
	O&S	2	1	2	1	1	4
SV-4a	TD	2	1	2	1	1	4
	EMD	2	1	2	1	1	4
	P&D	2	1	2	1	1	4
	O&S	2	1	2	1	1	4
SV-5a	TD	2	1	2	1	1	4
	EMD	2	1	2	1	1	4
	P&D	2	1	2	1	1	4
	O&S	2	1	2	1	1	4
SV-6	TD	2	1	2	1	1	4
	EMD	2	1	2	1	1	4
	P&D	2	1	2	1	1	4
	O&S	2	1	2	1	1	4
TV-1	TD	2	1	2	1	8	4
	EMD	2	1	2	1	8	4
	P&D	2	1	2	1	8	4
	O&S	2	1	2	1	8	4
TV-2	TD	2	1	2	1	8	4
	EMD	2	1	2	1	8	4
	P&D	2	1	2	1	8	4
	O&S	2	1	2	1	8	4

	Grouping	Developers
	Organization	**Dev A**
	Concern	profit, reputaiton
AV-1	TD	8
	EMD	8
	P&D	8
	O&S	8
AV-2	TD	8
	EMD	2
	P&D	8
	O&S	8
OV-1	TD	8
	EMD	8
	P&D	8
	O&S	8
OV-2	TD	8
	EMD	8
	P&D	8
	O&S	8
OV-3	TD	8
	EMD	8
	P&D	8
	O&S	8
OV-4	TD	8
	EMD	8
	P&D	8
	O&S	8
OV-5	TD	8
	EMD	8
	P&D	8
	O&S	8
OV-6c	TD	8
	EMD	8
	P&D	8
	O&S	8

	Grouping	Developers
	Organization	**Dev A**
	Concern	profit, reputaiton
SV-1	TD	8
	EMD	4
	P&D	2
	O&S	8
SV-2	TD	8
	EMD	4
	P&D	2
	O&S	8
SV-4a	TD	8
	EMD	4
	P&D	2
	O&S	2
SV-5a	TD	8
	EMD	4
	P&D	2
	O&S	2
SV-6	TD	8
	EMD	4
	P&D	2
	O&S	2
TV-1	TD	8
	EMD	2
	P&D	2
	O&S	2
TV-2	TD	8
	EMD	2
	P&D	2
	O&S	2

	Grouping	Trainers	
	Organization	**Train A**	**Train B**
	Concern	profit, reputaiton	mission, promotion
AV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
AV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-3	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-4	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-5	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-6c	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8

	Grouping	Trainers	
	Organization	**Train A**	**Train B**
	Concern	profit, reputaiton	mission, promotion
SV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
SV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
SV-4a	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
SV-5a	TD	8	8
	EMD	8	8
	P&D	2	2
	O&S	2	2
SV-6	TD	8	8
	EMD	8	8
	P&D	2	2
	O&S	2	2
TV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
TV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8

	Grouping	Maintainers	
	Organization	**Maint A**	**Maint B**
	Concern	profit, reputation	mission, promotion
AV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
AV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-3	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-4	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-5	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-6c	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8

	Grouping	Maintainers	
	Organization	**Maint A**	**Maint B**
	Concern	profit, reputation	mission, promotion
SV-1	TD	8	8
	EMD	8	8
	P&D	2	2
	O&S	2	2
SV-2	TD	8	8
	EMD	8	8
	P&D	2	2
	O&S	2	2
SV-4a	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
SV-5a	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
SV-6	TD	8	8
	EMD	8	8
	P&D	2	2
	O&S	2	2
TV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
TV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8

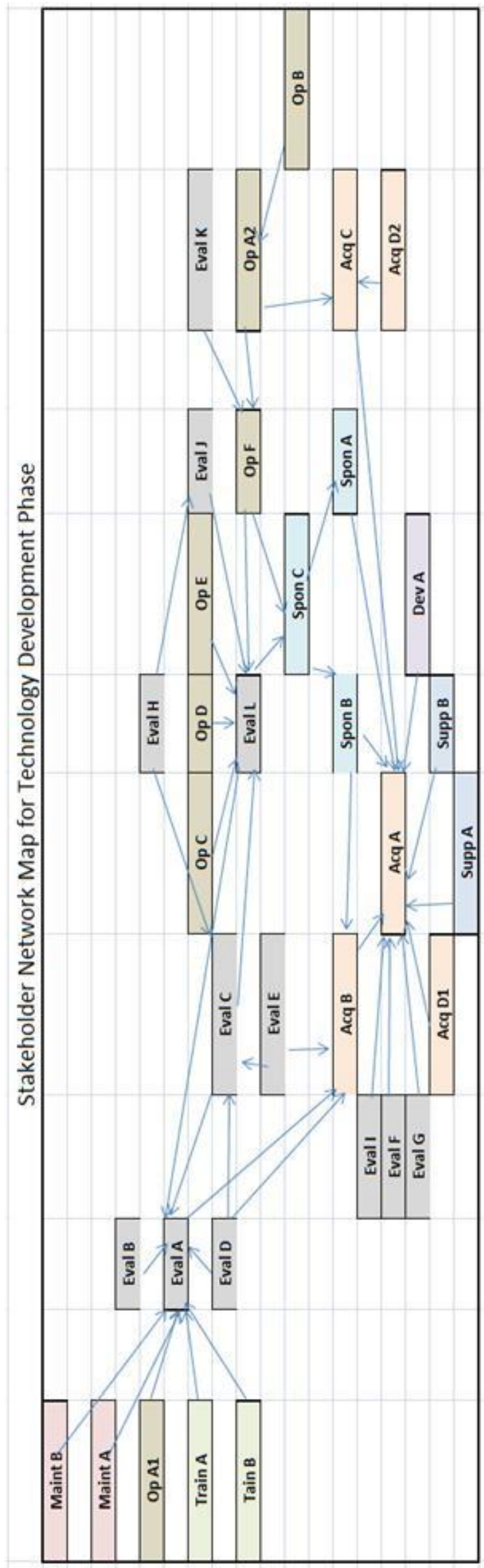
	Grouping	Suppliers	
	Organization	**Supp A**	**Supp B**
	Concern	profit, reputation	profit, reputation
AV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
AV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-3	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-4	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-5	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
OV-6c	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8

	Grouping	Suppliers	
	Organization	**Supp A**	**Supp B**
	Concern	profit, reputation	profit, reputation
SV-1	TD	8	8
	EMD	2	2
	P&D	2	2
	O&S	2	2
SV-2	TD	8	8
	EMD	8	8
	P&D	2	2
	O&S	2	2
SV-4a	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
SV-5a	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
SV-6	TD	8	8
	EMD	8	8
	P&D	2	2
	O&S	2	2
TV-1	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8
TV-2	TD	8	8
	EMD	8	8
	P&D	8	8
	O&S	8	8

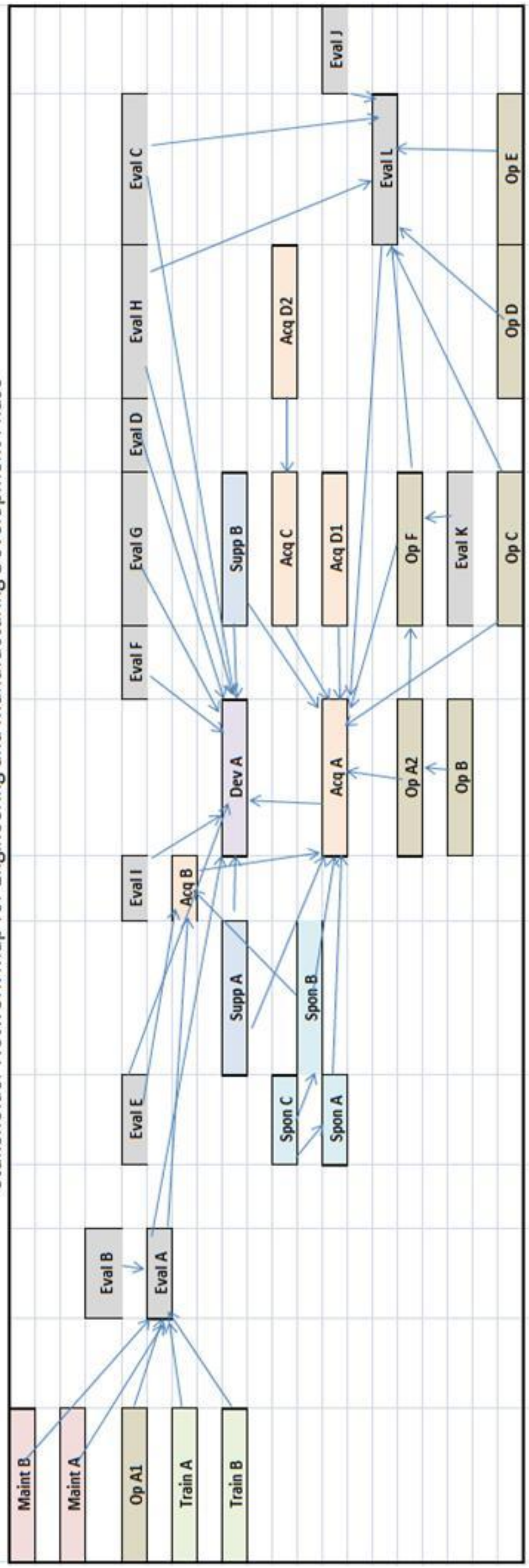
	Grouping	Operators					
	Organization	**Op A**	**Op B**	**Op C**	**Op D**	**Op E**	**Op F**
	Concern	mission, promotion	profit, reputation	mission	mission	mission	mission
AV-1	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
AV-2	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
OV-1	TD	8	8	2	2	2	4
	EMD	8	8	2	2	2	4
	P&D	8	8	2	2	2	4
	O&S	8	8	2	2	2	4
OV-2	TD	8	8	2	2	2	4
	EMD	8	8	2	2	2	4
	P&D	8	8	2	2	2	4
	O&S	8	8	2	2	2	4
OV-3	TD	8	8	2	2	2	4
	EMD	8	8	2	2	2	4
	P&D	8	8	2	2	2	4
	O&S	8	8	2	2	2	4
OV-4	TD	8	8	2	2	2	4
	EMD	8	8	2	2	2	4
	P&D	8	8	2	2	2	4
	O&S	8	8	2	2	2	4
OV-5	TD	8	8	2	2	2	4
	EMD	8	8	2	2	2	4
	P&D	8	8	2	2	2	4
	O&S	8	8	2	2	2	4
OV-6c	TD	8	8	2	2	2	4
	EMD	8	8	2	2	2	4
	P&D	8	8	2	2	2	4
	O&S	8	8	2	2	2	4

	Grouping	Operators					
	Organization	**Op A**	**Op B**	**Op C**	**Op D**	**Op e**	**Op F**
	Concern	mission, promotion	profit, reputation	mission	mission	mission	mission
SV-1	TD	8	8	8	8	8	1
	EMD	8	8	8	8	8	1
	P&D	8	8	8	8	8	1
	O&S	8	8	8	8	8	1
SV-2	TD	8	8	8	8	8	1
	EMD	8	8	8	8	8	1
	P&D	8	8	8	8	8	1
	O&S	8	8	8	8	8	1
SV-4a	TD	8	8	8	8	8	1
	EMD	8	8	8	8	8	1
	P&D	2	2	2	2	2	4
	O&S	2	2	2	2	2	4
SV-5a	TD	8	8	2	2	2	4
	EMD	8	8	2	2	2	4
	P&D	2	2	2	2	2	4
	O&S	2	2	2	2	2	4
SV-6	TD	8	8	8	8	8	1
	EMD	8	8	8	8	8	1
	P&D	8	8	8	8	8	1
	O&S	8	8	8	8	8	1
TV-1	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8
TV-2	TD	8	8	8	8	8	8
	EMD	8	8	8	8	8	8
	P&D	8	8	8	8	8	8
	O&S	8	8	8	8	8	8

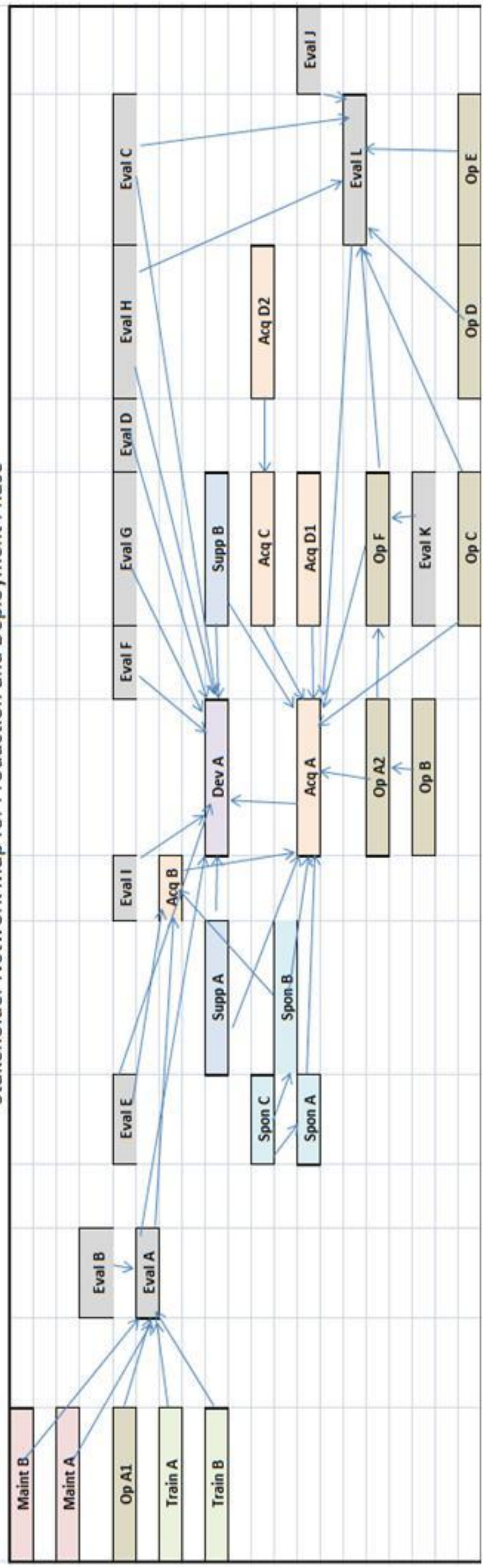
Step 4: Stakeholder Network Sketch



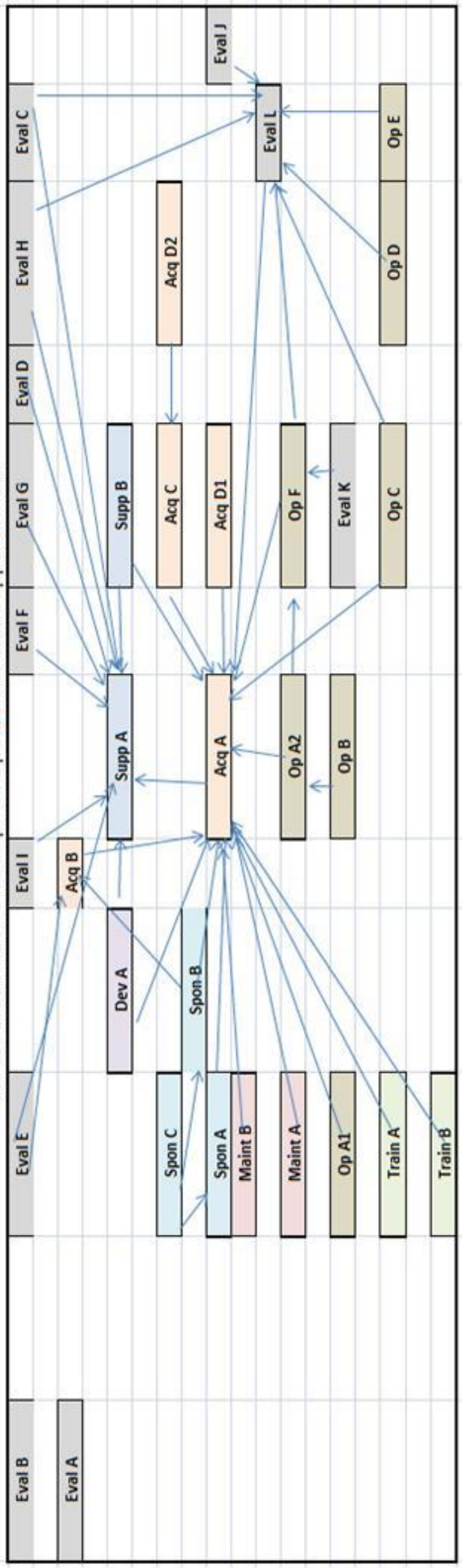
Stakeholder Network Map for Engineering and Manufacturing Development Phase



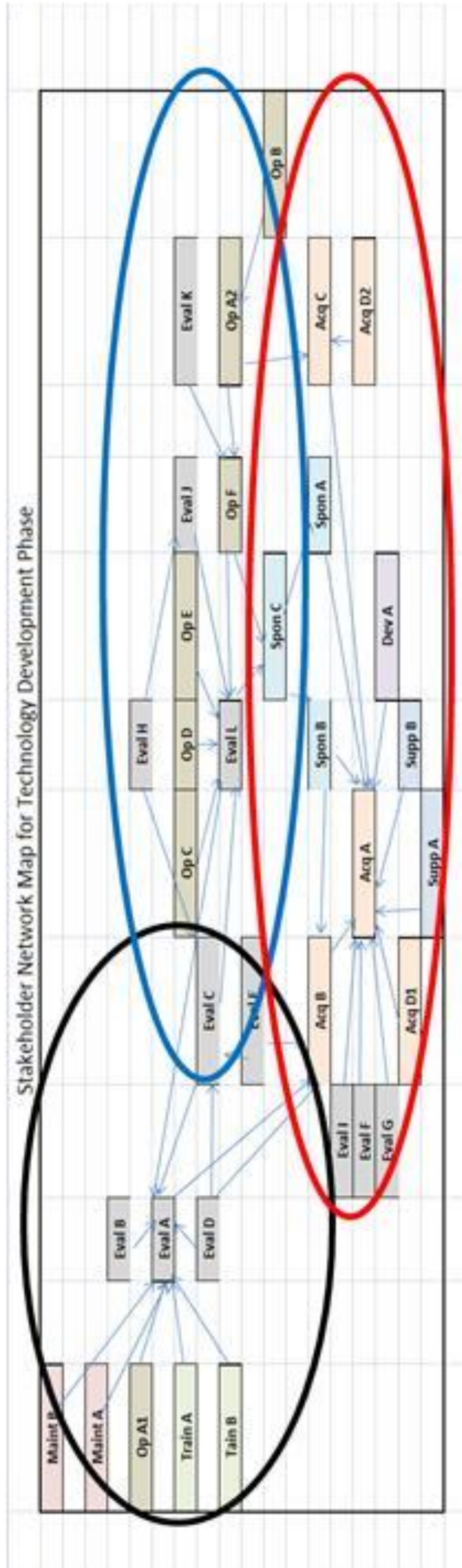
Stakeholder Network Map for Production and Deployment Phase



Stakeholder Network Map for Operations and Support Phase



Step 5: Social Role Analysis



Grouping	Acquirers					
Organization	**Acq A**	**Acq B**	**Acq C**	**Acq D**		
Concern	cost, sched	acq risk	acq risk	reputation, profit		
Major Role	Central Connector	Boundary Spanner	N/A	N/A		
Sub Group	Acquistion	Acquistion/Evaluation	Acquistion	Acquistion		

Grouping	Sponsors					
Organization	**Spon A**	**Spon B**	**Spon C**			
Concern	cost	cost	mission			
Major Role	N/A	N/A	Boundary Spanner			
Sub Group	Acquistion	Acquistion	Acquisition/COCOM			

Grouping	Evaluators					
Organization	**Eval A**	**Eval B**	**Eval C**	**Eval D**	**Eval E**	**Eval F**
Concern	compliance	compliance	compliance	compliance	compliance	compliance
Major Role	Central Connector	Peripheral Specialist	Boundary Spanner	Peripheral Specialist	N/A	Boundary Spanner
Sub Group	Evaluation	Evaluation	Evaluation/COCOM	Evaluation	Evaluation	Acquisition/Evaluation

Grouping	Evaluators (cont)					
Organization	**Eval G**	**Eval H**	**Eval I**	**Eval J**	**Eval K**	**Eval L**
Concern	compliance	mission	compliance	feasibility	feasibility	compliance, mission
Major Role	N/A	Peripheral Specialist	N/A	Pulsetaker	N/A	Central Connector
Sub Group	Acquistion	COCOM	Acquistion	COCOM	COCOM	COCOM

Grouping	Developers
Organization	**Dev A**
Concern	profit, reputaiton
Major Role	N/A
Sub Group	Acquisition

Grouping	Trainers	
Organization	**Train A**	**Train B**
Concern	profit, reputaiton	mission, promotion
Major Role	N/A	N/A
Sub Group	Evaluation	Evaluation

Grouping	Maintainers	
Organization	**Maint A**	**Maint B**
Concern	profit, reputation	mission, promotion
Major Role	N/A	N/A
Sub Group	Evaluation	Evaluation

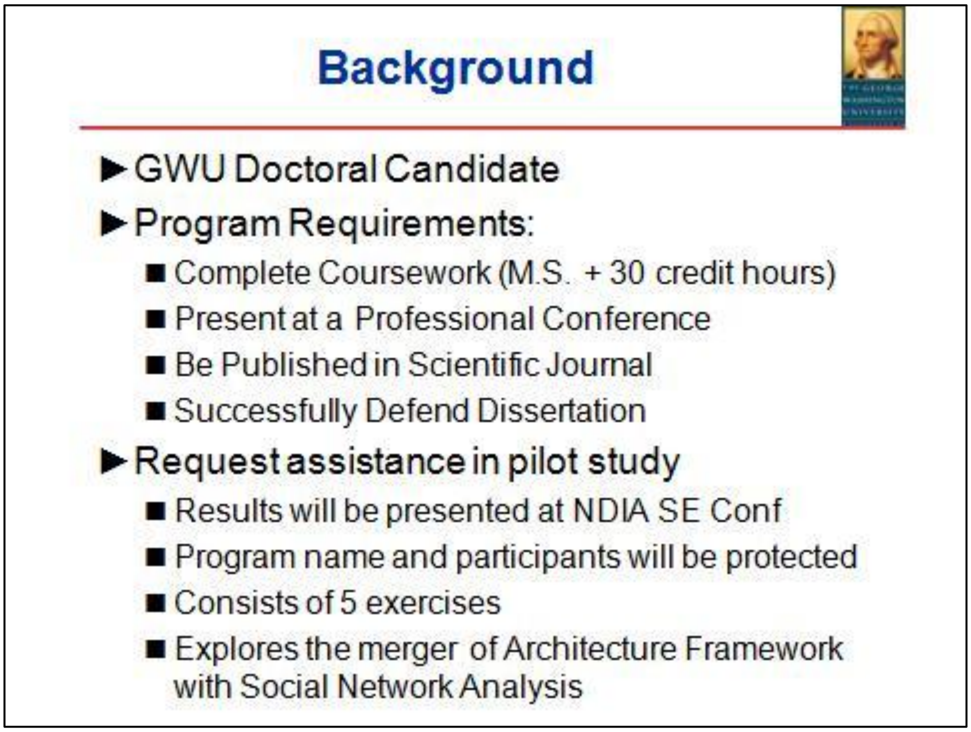
Grouping	Suppliers	
Organization	**Supp A**	**Supp B**
Concern	profit, reputation	profit, reputation
Major Role	N/A	N/A
Sub Group	Acquisition	Acquisition

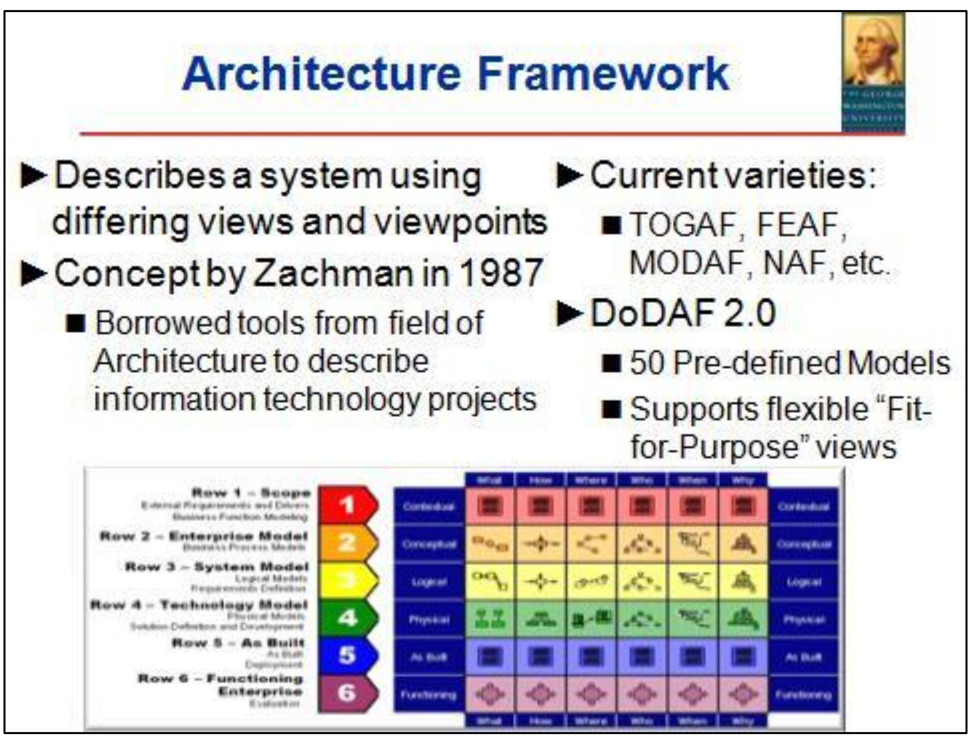
Grouping	Operators					
Organization	**Op A**	**Op B**	**Op C**	**Op D**	**Op E**	**Op F**
Concern	mission, promotion	profit, reputation	mission	mission	mission	mission
Major Role	N/A	N/A	N/A	N/A	N/A	Broker
Sub Group	COCOM	COCOM	COCOM	COCOM	COCOM	COCOM

Appendix B – Supporting Slides

The following slides were used to support the execution of the pilot study.

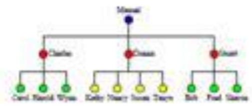
Concept Introduction



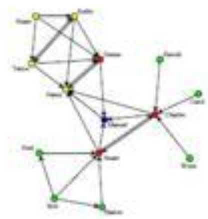


Social Network Analysis

- Rooted in Sociology
  - Simmel in 1908 discussed emergent behavior of a collection of humans



- Applied in a variety of disciplines
- Explores informal (vice formal) organizational structure
  - 6 degrees of Kevin Bacon
  - Water cooler network
  - Who you know, not what you know



SOURCE: Brandes, Raab and Wagner (2001)

Research Topic

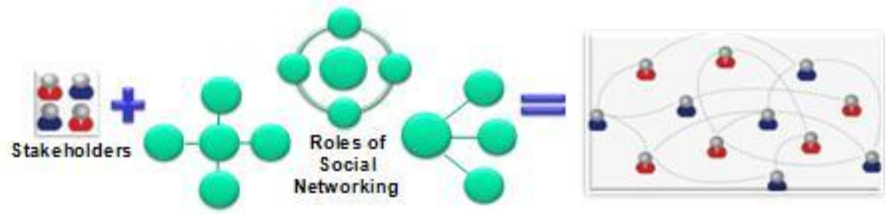
Effects of a Fit-for-Purpose DoDAF view detailing stakeholder interrelations on system development within the DoD

- DoDAF captures the views of program stakeholders but fails to capture the interrelations of those stakeholders (a system with n*(n-1)/2 interfaces)
- A "Fit-for-Purpose" DoDAF view is proposed to characterize this stakeholder system
  - Provides unique insertion of Social Network Analysis into Architecture Framework
  - Fulfills original intent of Architecture Framework by capturing the *entire* socio-technical system
- Application of systems thinking enables systems engineers to field systems more efficiently and provides assurance of lasting stakeholder support

Pilot Study Goal: Build Fit for Purpose DoDAF View

Stakeholder Crosswalk Defines the Who

Stakeholder Network Defines the How



5 Exercises

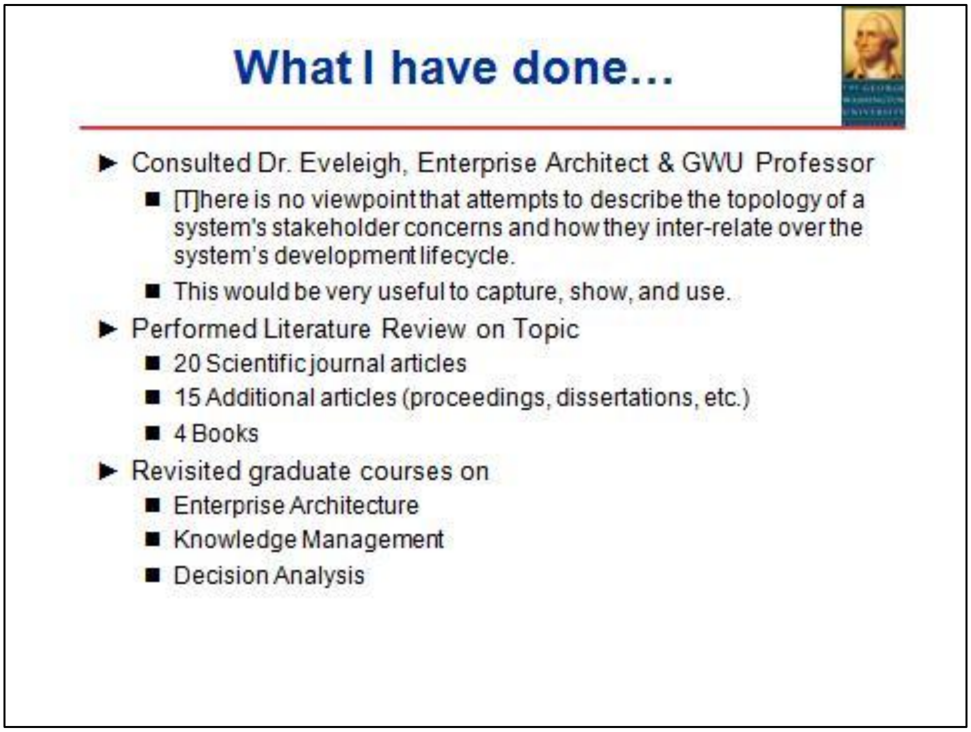
1. Stakeholder Identification
   - Time estimate: 45 minutes
2. Stakeholder Classification
   - Time estimate: 1.5 hours
3. Time-Phasing and Analysis
   - Time estimate: 30 minutes
4. Draw the Stakeholder Network
   - Time estimate: 1.5 hours
5. Identify Stakeholder Network Roles
   - Time estimate: 45 minutes

Inspiration

- Half of strategic decisions fail
  - Failure has 3 forms
- In general, public sector avoids stakeholder analysis
- DoD does, however, consider stakeholders using JCIDS, DAS, and DoDAF

Is there a problem? YES!

- DoD program performance is dismal, and the nation is in the midst of a financial crisis.
- Simple (and optimistic) math shows stakeholder impact
  - ~70 JCIDS and Acquisition Documents
  - 1 week per document to collect input (70 weeks)
  - ½ of those require 2nd pass, additional week (35 weeks)
  - 1/8 of those require face to face meeting, additional 4 weeks for planning and conducting (17 weeks)
  - 122 weeks equates to almost 2 years and 4 months!
- Confirmed with cost and schedule data from 12 Air Force programs
  - Included both Joint and Single Service programs
  - T-test statistically confirmed larger average schedule delays for Joint programs versus single service
  - Underestimation of complexity in satisfying joint stakeholders



Step 1: Stakeholder Identification

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Stakeholders

- Landmark definition by Freeman in 1984
  - "any group or individual who can affect or is affected by the achievement of the organization's objectives"
- Includes:
  - Acquirers
  - Sponsors
  - Evaluators
  - Developers
  - Trainers
  - Maintainers
  - Suppliers
  - Operators

(Woods & Rozanski, 2005; Emery 2003)

Exercise 1: Brainstorm Stakeholders

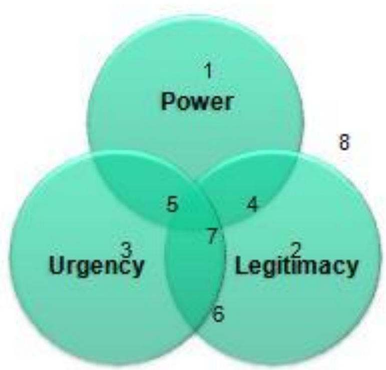
- Each participant take 10 minutes to list proposed stakeholders
  - Include primary interest/concern for each stakeholder
- Create master spreadsheet with each identified organization across the top row and the specific stakeholder's name and primary interest/concern below
- Record observations in Word or PowerPoint

Step 2: Stakeholder Classification

EXERCISE 2: STAKEHOLDER CLASSIFICATION

Stakeholder Classification

- Stakeholders are defined by their possession of:
  - Power
  - Legitimacy
  - Urgency



(Mitchell, Agle, and Wood, 1997)

Power

"A relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not have otherwise done"

- "Like Pfeffer and Weber, we concur that "power may be tricky to define, but it is not that difficult to recognize: '[it is] the ability of those who possess power to bring about the outcomes they desire' " (Salancik & Pfeffer, 1974: 3)."

(Mitchell, Agle, and Wood, 1997)

Legitimacy

"A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, definitions"

- "Many scholars…make an implicit assumption that legitimate stakeholders are necessarily powerful…and that powerful stakeholders are necessarily legitimate…"

(Mitchell, Agle, and Wood, 1997)

Urgency

"The degree to which stakeholder claims call for immediate attention."

- "[U]rgency is based on the following two attributes: (1) time sensitivity-the degree to which managerial delay in attending to the claim or relationship is unacceptable to the stakeholder, and (2) criticality-the importance of the claim or the relationship to the stakeholder."

(Mitchell, Agle, and Wood, 1997)

Exercise 2: Build Crosswalks

- Modification of Calabrese Model
- In a spreadsheet, list stakeholders across the top and primary DoDAF models down the first column
- Start with the current phase of the program and identify the stakeholder classification for each stakeholder and each product
- Spreadsheet logic may be helpful to automatically calculate classification number
- Repeat for subsequent phases
- Record observations in Word or PowerPoint

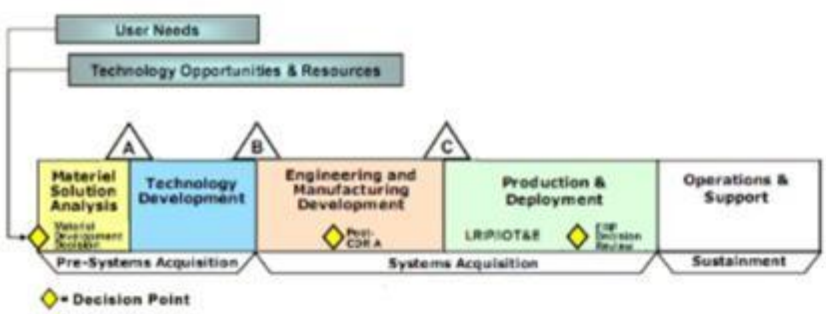
S/H	A	B	C	D
OV-4	1	7	5	3
SV-6	2	3	8	7
PV-2	4	1	2	1
CV-7	8	4	6	5

(Bailey, Murray, and Wood, 2011)

Step 3: Time-Phasing and Analysis

EXERCISE 3: CROSSWALK TIME-PHASING AND ANALYSIS

System Lifecycle



(www.dau.mil)

Exercise 3: Crosswalk Time-Phasing and Analysis

- Identify any trends in stakeholder classification as the program progresses
  - Spreadsheet logic could build this automatically
- Identify any stakeholder or stakeholder group that is consistently important (#4,5,6, or 7)
- Record observations in Word or PowerPoint

Step 4: Stakeholder Network Sketch

EXERCISE 4: STAKEHOLDER NETWORK

Social Network

- Informal vice formal interactions
  - "Lance Corporal Network"
- Can be captured by:
  - Email data mining (IBM Atlas)
  - Stakeholder interviews (UCINET)
- Bryson (2003) notes the political sensitivity of stakeholder analysis
- Reverse engineering the network is less intrusive and results can be kept private

Roles People Play in Networks

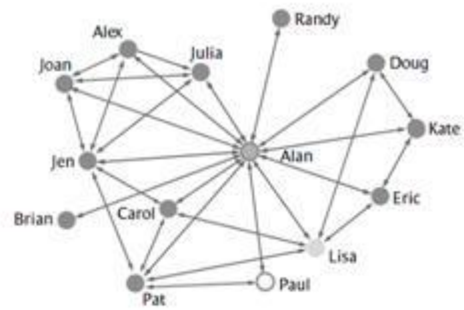
- Central connector – Someone who is highly connected to many others in the network, who may be either a key facilitator or a "gatekeeper"
- Broker – Someone who communicates across subgroups
- Boundary spanner – A person who connects a department with other departments
- Peripheral specialist – Someone less connected or not connected at all
- Pulsetaker – Someone who uses his or her connections to monitor the health of an organization

(Anklam, 2005)

Central Connectors and Peripheral Specialists

Finding Central Connectors and Peripheral Specialists

Even though Lisa is the head of the department, Alan is considered the go-to person for information within this informal network. He plays the role of central connector. Meanwhile, Paul operates on the perimeter of the network, offering expertise to members of the group as it's needed, but not necessarily connecting with many other colleagues frequently. Paul plays the role of peripheral specialist.

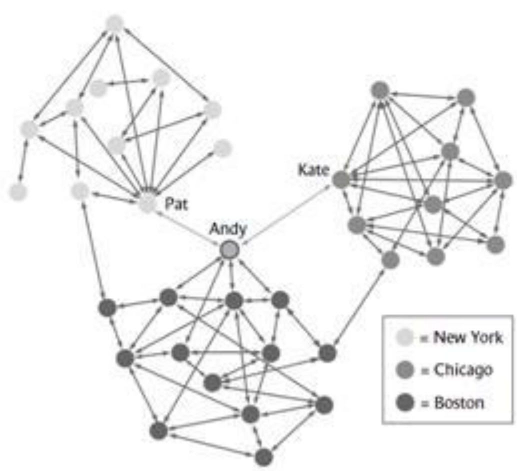


(Cross & Prusak, 2002)

Boundary Spanners

Spotting Boundary Spanners

Because of his links to the central connectors in two other informal networks, Andy serves as the main conduit of information between the Boston network and groups in Chicago and New York. He plays the role of boundary spanner.



(Cross & Prusak, 2002)

Information Brokers

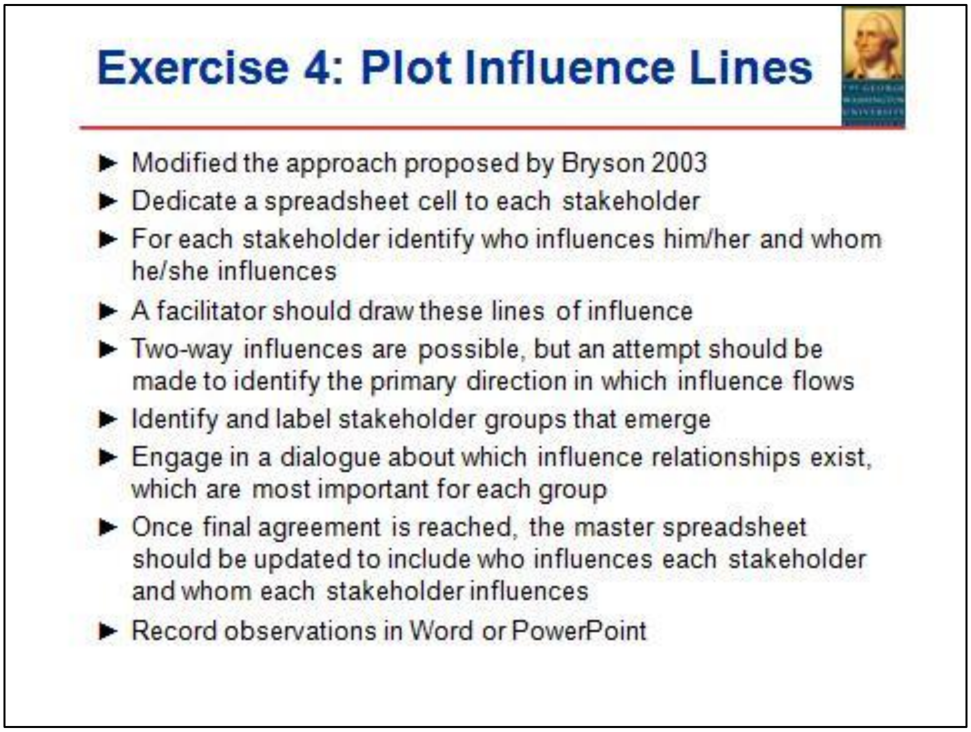
Identifying Information Brokers

Joe holds the various parts of this large informal network together. He may not have as many direct connections with colleagues as the central connectors in the network do, but he has a wealth of indirect associations. If Joe were removed, this large informal network would splinter into three smaller, disjointed subnetworks. Joe is the information broker.

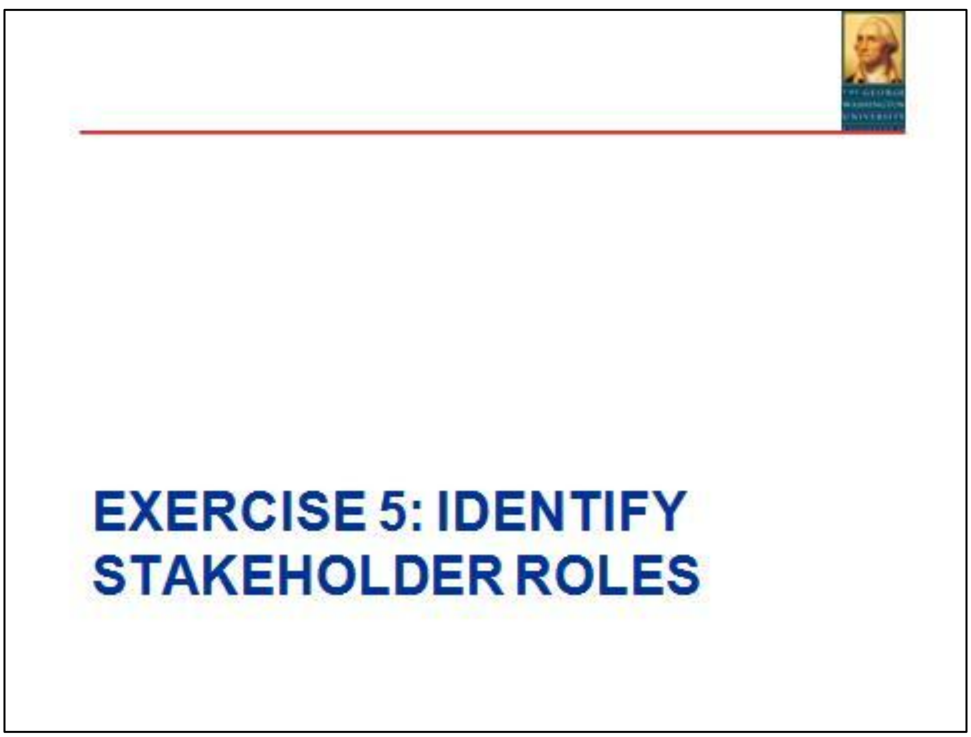
(Cross & Prusak, 2002)

Pulsetakers

- Could not find graphical representation or further definition
- Any thoughts?



Step 5: Social Role Analysis



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(Anklam, 2005)

Exercise 5: Identify Stakeholder Network Roles

- Analyze the stakeholder network built in Exercise 4
- Identify which of the 5 roles (Anklam, 2005) each stakeholder performs
- For each stakeholder, identify stakeholder group(s) and corresponding role(s)
- Record observations in Word or PowerPoint