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Application of a Network Perspective to DoD Weapon System Acquisition: An Exploratory Study

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Application of a Network Perspective to DoD Weapon System Acquisition: An Exploratory Study

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Abstract

One of the foundations of military command and control is that authority must match responsibility. Yet in weapon system acquisition, a program manager is responsible to deliver capabilities to the warfighter without full control of the resources he needs to carry out this task. Successful program managers recognize their dependencies upon other actors and execute their programs using a network with a common goal of enhancing a specific warfighting capability. A hierarchical chain of command still exists, but the network enables the actors to carry out their objectives in an efficient and effective manner. This report describes how the acquisition process purportedly works in hierarchical terms. It also introduces a process model to describe the set of activities actually used and the actors who

are required to collaborate to deliver capabilities to the warfighter. The analysis of those activities between actors reveals that weapon system acquisition behaves like a network. Describing acquisition in network terms allows those involved in weapon system acquisition oversight, policy, and practice to have new insights and measurement tools to understand how to improve the weapon systems acquisition process.

Introduction

Prelude

Over one-hundred years ago, the Wright Brothers were the first to accomplish a manned, controlled, heavier-than-air-flight, making history at Kitty Hawk, North Carolina, on December 17, 1903. How did two bicycle mechanics from Dayton, Ohio, accomplish this feat against a host of inventors? And, why did the Wright's lose their advantage and not continue to make aviation history? The answer to both questions revolves around their networks. Early on, the Wright's were not only inventors, they were networked innovators. Shulman concluded that their early success was due to their correspondence and sharing of ideas with Samuel Langley and flight historian Octave Chanute, who had built an extensive network within the aviation community (2002). Following their successful flight, however, the Wright's network was limited through secrecy that was driven by a desire to patent the airplane and secure a monopoly, even Chanute's request for information about their maiden flights (Shulman, 2002). The Wrights cut themselves off from their network, preferring to secure the patents rather than build upon their technological feat. The loss of their network also led to stagnation in their innovation efforts. Glenn Curtiss, on the other hand, was anything but secretive. He and the Aerial Experiment Association built his June Bug aircraft and demonstrated flying to the public. Eventually, Curtiss' collaborative network yielded the invention of 500 aviation devices, many of which are still in use today. His factory invented and sold the flying boat to the Navy, along with 6,000 JN-1 Jenny's, making Curtiss Aircraft one of the largest aircraft companies in the world (Shulman, 2002). In essence, the duel between the Wrights and Curtiss proved that the success of complex projects is predicated upon the structure of the project's network of collaborators.

Would Curtiss recognize today's billion-dollar weapon system programs with their high-stakes decision-making process ensuring that entrepreneurs do not waste precious taxpayer resources? Or, has the world not changed that much… Do successful programs still collaborate and network to successfully deliver capabilities to warfighters?

Acquisition Process Problems

Department of Defense (DoD) weapon system acquisition programs are plagued with performance shortfalls, and even more notably, cost and schedule overruns. Addressing this problem has spawned numerous studies and reforms over many years. Most recently, the push to reinvent government in the 1990s resulted in a series of reforms that led acquisition toward a market-based model. Despite these efforts to improve efficiency, success has yet to be realized, with several recent studies noting increasing cost and schedule overruns. Civilian and military officials at the highest levels in the Pentagon have expressed frustration at the lack of balance among the competing interests of cost, schedule, and performance in weapon system acquisition programs. Given many stakeholders with multiple interests in the acquisition process and the inability of high-ranking officials to achieve a balance among competing interests, assigning a program manager responsibility for balancing cost, schedule, and performance appears to be a nearly impossible task.

In addition to problems managing costs, schedule, and performance, warfighters are asking even more from their weapon systems, requiring capabilities that are joint, interoperable, and able to seamlessly share information. Joint staffs are looking to gain an advantage on the battlefield based upon a revolution in military affairs driven by the explosion in information technology. A weapon system program manager must manage not only her own baseline but, in addition, rely on capabilities from other systems that are also in development.

Alternative Acquisition Organizations

Along with many initiatives to solve the fundamental acquisition problem, the strategic assumptions underlying acquisition reforms point to three alternative organizations: hierarchical control, market solutions, or network collaboration. Powell (1990) concluded that hierarchies, markets, and networks are the three basic forms of organization. Congressional and politically appointed civilian control of the weapon system acquisition process, along with the chain of command within the DoD, makes one think of acquisition in hierarchical terms. Alternatively, weapon system acquisition relies heavily on contractors who possess the know-how and resources to produce major weapon systems. A market-based solution to acquisition problems is also rational. Finally, acquisition programs create the need to cross organizational boundaries for decision-making—necessitating the need for a network form of governance.

The policy-makers and practitioners within the weapon system acquisition process do not typically think of the process in network terms. Yet, Powell (1990) concluded that networks are the predominant form of organization with a very few pure markets or hierarchies in existence. This project is devoted to describing the acquisition process in network terms. Therefore, the research question for this paper is: Does the DoD weapon system acquisition process behave as a network?

The focus of this project is to understand how weapon system acquisition programs accomplish their objectives, and whether those interactions fit within the description of a network. This analysis will offer a new perspective on the acquisition process.

Methodology

Chapter II describes the acquisition process and its interactions with both the warfighters who describe weapon system capability needs and the budget staff who balance alternative needs against fiscal constraints. A process model will be introduced to describe the full set of activities and interactions a program must go through from concept to delivery and operation.

With the activities of the acquisition process in mind, Chapter III highlights the characteristics of networks. A definition of networks is established, and aspects of networks are described from a review of literature. Several network analysis techniques are coupled with a description of operating within networks, allowing an analysis of the acquisition process in network terms in Chapter IV.

Finally, Chapter V offers conclusions to the basic research question of whether weapon system acquisition may be described in network terms. Further, several recommendations are offered to improve this analysis and further apply a network model to acquisition.

Weapon System Acquisition Process

The Department of Defense (DoD) weapon system acquisition process must be described before it can be characterized as a hierarchy, network, or market. This Chapter will describe the acquisition process and its interactions with other key processes. To analyze these interactions, a detailed process model will be introduced that describes the activities and actors involved in transforming inputs into outputs in the form of knowledge and, ultimately, weapon systems.

Background

The mission of defense acquisition is to deliver needed capabilities to warfighters. In the hands of warfighters, these capabilities are able to produce constructive effects on the battlefield. The defense acquisition system is, in essence, developing the set of equipment that will be used to fight the next war. The process of collaboration among competing agencies to make these decisions is a very complex task that combines optimization of doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) solutions within the Joint Capabilities and Integration Development System (JCIDS). Additionally, these decisions are dynamic, changing over time in response to environmental variables. This results in changing desires and continuing debate over what is the best solution.

Further, delivering materiel capability requires a complex set of actors, and even more stakeholders, who, from markedly different perspectives, seek to optimize the various processes of technology development, integration, test and evaluation, production, fielding, and sustainment of weapon systems. Nevertheless, the governing directive within the DoD, *Directive 5000.1*, gives the Program Manager the purported authority and the clear responsibility to deliver required capabilities to the warfighter (Department of Defense, 2003a). Therefore, the Program Manager must find ways to shape the capability needs from the JCIDS requirements generation system; choose a design architecture, mature technologies, and develop an acquisition strategy within the Defense Acquisition System; and seek resources from the Planning, Programming, Budgeting, and Execution (PPBE) System. Dynamic interaction among these systems is required to deliver a capability to the warfighter. Kadish, et al., described this interaction as the "Big A" acquisition process (2006). This paper will use this cross-cutting definition of the acquisition process.

This chapter will highlight the key processes and interactions required to deliver a capability. The JCIDS, Defense Acquisition System, and PPBE system will be briefly examined. A process model will be introduced to highlight the depth and complexity of the interactions the acquisition process must perform to deliver a capability.

Joint Capabilities Integration and Development System (JCIDS)

The Joint Capabilities Integration and Development System (JCIDS) was born out of the perception that each service parochially examined alternatives within its own core competencies, rather than from the perspective of a joint warfighting environment. *The Goldwater-Nichols Act* of 1986 created a framework where Combatant Commanders (COCOMs) are responsible for joint operations, and service secretaries and commanders are responsible to organize, train, and equip the military to conduct army, naval, and air operations in support of the combatant commanders (*Goldwater-Nichols Act, 1986*). *The Goldwater-Nichols Act* gave the COCOMs a significant voice in the funding process. JCIDS essentially took the next step and institutionalized a process in which requirements are jointly conceived, validated, and approved prior to each service implementing those needs.

The other effect of JCIDS is to define capabilities gaps rather than threat-driven needs. *The Chairman, Joint Chiefs of Staff Instruction* (*CJCSI*) *3170.01 E* defined capabilities as:

> The ability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. It is defined by an operational user and expressed in broad operational terms in the format of a joint or initial capabilities document or a joint doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) change recommendation (Chairman of the Joint Chiefs of Staff, 2005).

JCIDS Pattern of Relationships

The drivers of the JCIDS process are the representatives of the warfighting community. The Combatant Commands and Joint Staff run key portions of the process. The services' requirements communities become involved as they sponsor an approach that falls inside one of their warfighting core competencies. One difficulty in the JCIDS process is getting the services involved without corrupting the process by making it a forum for the each service to argue for its preferred approach. JCIDS is supposed to avoid this problem through Joint Staff analysis of capability gaps identified by the Combatant Commands.

Several presentations at the PEO/SYSCOM Conference in December 2003 outlined what are essentially opposing views on the service's role during a panel on aligning JCIDS and the Defense Acquisition System. Dr Glenn Lamartin, OSD(AT&L) Director of Defense Systems noted throughout his briefing that the new JCIDS and Acquisition policies had to be followed with collaborative relationships between the OSD, the Functional Capabilities Boards, and the Services to support decision-making (2003). Dr. Nancy Spruill, OSD(AT&L) Director of Acquisition Resources and Analysis, supported a view that the OSD ought to be the decision-maker in the process, holding cross-cutting Defense Acquisition Boards and either cutting or accelerating service programs to meet joint needs (2003). Essentially, Dr Spruill viewed the services as materiel providers who would react to OSD-defined solutions, whereas Dr Lamartin valued the services' inputs to the joint architectures and decisions as a critical interdependency. The right viewpoint is the one that recognizes how information is distributed. If information that is needed for decision-making is distributed within the services and the combatant commands, the services ought to be involved. If the Combatant Commands and Joint Staff have the information they need to derive alternatives that integrate with current warfighting systems and doctrine, then the services might be viewed as implementers of systems.

JCIDS Realities

As structured as the JCIDS process appears, the reality is that requirements change over time. As technological possibilities and threat conditions change, so do needs of the warfighter. Within the acquisition system, "requirements creep" may show up late in the process in the form of expectations or actual changes to written requirements. JCIDS institutionalized this concept with the Capabilities Production Document, offering the opportunity for requirements changes before entering low-rate initial production (Matthews, 2004). Further, the expectations of the warfighter are often not met in a timely manner because expectations evolve over time. Without changing written requirements, the operational community may interpret what was previously stated in a requirements document differently. Therefore, both the perception and the reality is that the desired outputs of the acquisition system are dynamic.

Planning, Programming, Budgeting, and Execution System

The funding for the program comes through the PPBE process. Every other year, the OSD issues budget guidance, and the services begin a biannual cycle of preparing program objective memorandums (POM) to advocate their program's needs among other service priorities. Eventually, the OSD comptroller and the Office of Management and Budget (OMB) prepare the defense portion of the President's Budget. Even though Congress normally appropriates money for only each fiscal year, the POM for a program portrays the budget reflected in the Future Year Defense Program. This, in essence, gives the budget community a forecast of what the budget will look like to satisfy spending priorities for the next several fiscal years.

The Planning, Programming, Budgeting, and Execution system is a centralized, structured way of allocating resources to support the National Security Strategy. McCaffrey and Jones described the goal of PPBE as balancing forces, equipment, and support given resource constraints (2004). Given the competitive nature of the services, this process allows the Secretary of Defense to balance competing objectives and select the most beneficial use of resources.

The overlap of the planning, programming, budgeting, and execution phases, along with the multitude of disparate stakeholders, makes the system very complex. Nonetheless, there is structure from the strategies of the planning phase, to the alternatives of the programming phase, the constraining of the budgeting phase, and finally, the execution phase where funds are appropriated, allocated, re-allocated, and expended. Lewis, Brown, and Roll contend that the Air Force budget process includes centralized planning and decentralized execution with the Major Commands (MAJCOMs) playing a key role as the interface with the COCOMs. The JCIDS process generates capability needs that flow through Air Staff to OSD to become part of the budget. Budget and manpower flow through Air Staff to the program office for execution (2002).

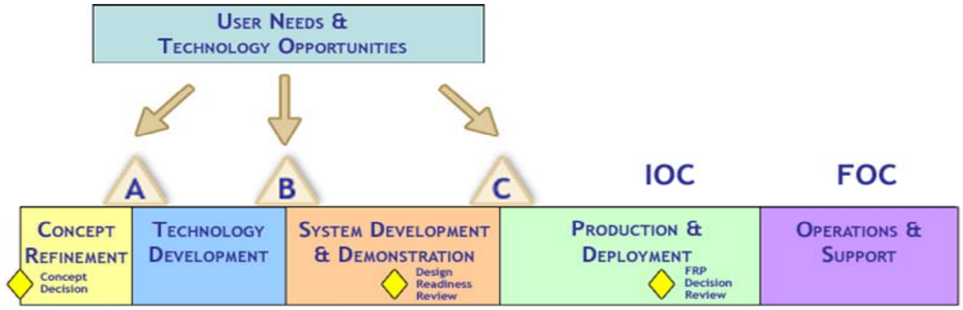
Defense Acquisition System

The Defense Acquisition System refines concepts; matures technologies; develops and integrates system designs; and tests, produces, sustains, and disposes of weapon systems in response to warfighter needs. The Department of Defense Directive (*DODD 5000.1*) (Department of Defense, 2003a, sec. 3.2) governing weapon system acquisition defines an acquisition program as: "a directed, funded effort that provides a new, improved, or continuing materiel, weapon or information system or service capability in response to an approved need."

The sponsor (i.e., a Major Command in the Air Force) uses the JCIDS process as outlined above to define the need. The interface with the acquisition community is through the Initial Capabilities Document. This input is refined in the concept-refinement phase through the Analysis of Alternatives process to select a materiel alternative that is operationally and cost-effective. The sponsor is responsible for the analysis of alternatives using a collaborative process with the acquirer, developer, tester, and other enabling communities to refine the "art of the possible" (Air Force, 2005, p. 9).

The acquisition process uses a high-level framework as shown in Figure 1 that serves as a common reference and set of expectations for all programs. The reality is that every program is unique. An infamous retort within the acquisition community when asked a general question about acquisition programs is, "It depends." The expectations for each program are established through the milestone decision authority at a milestone decision.

Figure 1. Acquisition Phases and Milestones
(Department of Defense, 2003b)



Despite many interdependencies across the acquisition stakeholder community, *DoD Directive 5000.1* names the milestone decision authority and program manager as key participants. The milestone decision authority is given overall responsibility for the program, while the program manager is, "the designated individual with the responsibility for and authority to meet program objectives" (2003a). The reality, however, is that the program manager must collaborate among many interests to accomplish program objectives. Collaboration using integrated product teams (IPT) is the tool designated to resolve competing interests. The collaborative process is not specified in detail, although *DoD Directive 5000.1* (2003a) lists the communities that ought to participate in collaborative decision-making and identifies the IPT as the entry point for organizations that want to collaborate. The program manager and milestone decision authority use the IPTs' advice to make better decisions (Department of Defense, 2003a).

Weapon system acquisition process model

Purpose

Given a plethora of the stakeholders and a complex product-development process, the set of interactions required to manage a program need to be well understood. Describing the process to manage an acquisition program helps assess who interacts and how they interact to accomplish a program. The Assistant Secretary of the Air Force (Acquisition Integration), SAF/AQX, formed the Acquisition Process Action Team (APAT) in Spring 2005 to describe the set of processes Air Force weapon systems were using to accomplish their missions. The goals were to baseline the acquisition processes and form a common language and basis of measurement across the stakeholders in the acquisition process. The group focused mainly on the defense acquisition system itself and its interactions with JCIDS and PPBE.

Lt. Col. Michael Paul and Major Ryan Mantz, SAF/AQXA, led the APAT effort. A group of consultants from the Center for Reengineering and Enabling Technologies (CRET) provided the methodology and manpower to support the data-gathering effort. Mr. Mike Wilhelm, CRET, was instrumental in managing the effort.

In order to assess the interactions within weapon system acquisition, the APAT used an enterprise process-model approach. A process model offers a look across the many disciplines within weapon system acquisition to understand what behaviors the team is using to solve the problem. The model is put into process terms, where each step is defined as a verb-subject relationship. Instead of describing a contracting/source selection process, the step is simply "Select Source." This allows the team to focus on the stakeholders' inputs to the process instead of driving the description solely in contracting terms.

Another important aspect of a process model is to describe the relationship between the steps and other actors. In essence, the process model is a look at the interdependencies within the acquisition system. Each step in the process is described in terms of inputs, outputs, triggers, and mechanisms. A source of those characteristics is also described. This allows the model to describe interaction with other steps in the process.

Data Gathering

The APAT team used the *DOD 5000* series regulations as a jumping-off point. The major steps in the process were chosen as the high-level steps in the process. This allowed the model to refer back to a reference to which acquisition, logistics, finance, contracting, test, and requirements personnel could relate. Beginning with the high-level process, the APAT team held several workshops with a core group to decompose the high-level process into a series of lower-level process steps. To ensure that the process model reflected the interactions across the Air Force acquisition process, the team established a series of workshops with acquisition personnel to refine the second-level of the model and develop the third and lower-levels of the model. Each workshop lasted approximately two days and was focused on a particular phase of the acquisition process. Participants from all bases were invited, but the main, working-level participants were from the host base. A series of workshops were held at the Pentagon, Eglin AFB, Warner-Robins AFB, and Wright-Patterson AFB, which gathered 120 collective participants from across acquisition functions of requirements, engineering, test, program management, finance, sustainment, maintenance, and disposal. Further, telephone conferences were held to refine the results.

Results

The team used the following definitions as part of the process-decomposition effort:

Process	Logical set of steps transforming an input into an output
Inputs	Information or resource consumed in the activity to create the output
Outputs	Information produced by an activity
Suppliers	Those who provide the input to the process
Customers	Those who receive the output of the process
Key Players	Those ultimately responsible for the process being accomplished
Controls	Business rules that govern the performance of an activity
Mechanisms	Resource that performs or supports an activity, but is not consumed by the activity

Processes were decomposed into roughly five to seven sub-processes that were the key components of the higher-level process. The workshop participants were instructed to keep decomposing processes until they were defined at an "actionable level." In reality, the processes were decomposed until workshop participants could not agree on sub-processes that generally fit most programs.

Appendix A depicts the output from the APAT effort. The APAT effort identified 27 process steps supporting the five major *DoD 5000* acquisition phases. Beneath the major processes are 107 sub-processes with 172 supporting activities. The workshop participants were more comfortable with the latter three phases of the acquisition process than the first two. Concept Refinement and Technology Development had fewer sub-process and supporting activity steps upon which participants were able to agree.

Even more important than the numbers of steps are the key players, suppliers, and customers of each process step. To make the data more manageable for this paper, key sub- processes and supporting activities were chosen in the Concept-refinement, Technology-development, and System-design and Development phases of the acquisition process. These phases shape the program and lock-in the design characteristics that affect cost schedule and performance during the latter phases. Therefore, this paper focuses on these early phases of acquisition.

What is a Network?

Introduction

Chapter II defines both how weapon system acquisition purportedly and actually behaves. There is a defined, hierarchical chain of command with a milestone decision authority and a program manager who is responsible for delivering a weapon system capability. The APAT process study also revealed that the inputs required to deliver this capability require a set of stakeholder interactions that go outside the boundaries of the traditional chain of command. Further, the stakeholders involved have differing and dynamic objectives causing both real and perceived instability within the acquisition process. First, however, to address the question of whether the defense acquisition system can be characterized as a network, one must first define networks and understand their basic properties.

Markets, Hierarchies, and Networks

The specialized support required for a project often conjures up images of hierarchical organizations that integrate these specialties together for a common purpose. Alternatively, a project might be accomplished through the marketplace where products and services are efficiently offered to those who have the highest willingness to pay. Ronald Coase's early work on transaction costs compared firms and markets as alternatives to one another. According to Coase, firms resorted to hierarchy when it was less costly compared establishing and monitoring individual contracts in a market. The growth of the firm was balanced with the increasing expenses to organize a larger labor force due to diminishing marginal returns. Eventually, the cost of an additional transaction within the firm was equal to the cost of contracting in the marketplace for the same goods or services (Coase, 1937).

Powell introduced the concept that a network existed between a self-forming marketplace and a hierarchical organization. He rejected the view that networks are neither part of a market-to-hierarchy continuum, nor do they represent a hybrid form of hierarchy. As evidence, Powell offered two examples that pointed to the existence of networks. He noted the blurring of the boundaries between markets and inter-organizational collaborations, such as cooperative joint ventures. His second example was the creation of enduring relationships between hierarchies and their consulting, law, and banking firms—indicating that a network form of governance existed between these organizations (1990).

Defining Networks

Why Network?

Before delving into the definitions of a network, it is worth noting the inherent strengths and weaknesses of each form of organization. Markets are ideal for simple transactions in which inputs and outputs are measurable and are not based on a number of contingencies. Coase (1937, p. 287) described the marketplace as: "under no central control […] supply is adjusted to demand, and production to consumption."

Hierarchies evolved to control the specialized inputs needed to produce complex products or services for which the inputs may not be available in the commercial marketplace. Coase (1937) used the classic example of specialized labor where a firm chose to employ an individual with specific skills, thereby internalizing the uncertainties associated with inputs. Additionally, the firm would also observe that person's work on the job and make adjustments (Williamson, 1973). Therefore, hierarchies excel when inputs have uncertainty, since they allow internal observation and adjustment during the course of business.

Networks are adept at handling uncertainty associated with both inputs and outputs. O'Toole (1997) described uncertainty as leading to wicked problems that cannot be divided into tasks that are isolated from each other. Powell agreed that networks form as organizations choose to pool resources to manage uncertainties, thereby creating interdependencies from which a firm cannot easily walk away. He elaborated that networks are particularly adept at exchanging resources that are difficult to measure, such as "know-how, technological capability, a particular approach or style of production" (1990, p. 304).

Network Definition

While a network is fairly well understood in today's society, such familiarity with networks may lead to a variety of definitions. The most straight forward definition of a network comes from sociology. Borgatti and Foster (2003, p. 992) described this type of governance this way: "A network is a set of actors connected by a set of ties." Marsden and Lin (1982) and Knoke and Kuklinski (1991) emphasized persistent relationships among actors, focusing on their relationships rather than the actors themselves or the groups to which they belong. Whereas an actor continues to exist apart from the network, a network does not exist without the relationship between the actors.

Another example of networks comes from the field of public administration where networks are used among government, non-government, and private agencies. Kickert, Klijn, and Koppenjan (1997, p. 6) described networks as "stable patterns of social relations between interdependent actors, which take shape around policy problems and/or policy programmes." This definition is broad, spanning coalitions of intergovernmental and non-governmental actors organized around both issues and delivery of public goods and services.

This report will utilize the Kickert, et al. (1997) definition of networks in which actors are dependent upon one another; there are lasting, stable relationships; and the network is formed around a policy or project. In comparing this definition with others, Klijn (1997) identified three characteristics of networks:

- Networks form due to interdependencies between actors.
- Networks consist of multiple actors who have their own objectives.

- Networks consist of the lasting relationships between the various actors.

The first condition for a network is interdependencies. Klijn (1997) suggested resource dependency is a key driver of lasting relationships since organizations require exchange of capital, personnel, and knowledge with other organizations. Powell (1990) and Jones, Hesterly, and Borgatti (1997) similarly emphasized actors within networks performing complex exchanges and transactions using trust and norms rather than market-driven, legally enforceable contracts.

Again, the condition for more than one actor comes into the definition with the added criteria that each has his/her own objectives. Scharpf (1978) concluded that within government, there is no single actor and no unifying goal. Instead, policy was a result of interactions among multiple actors in which coordination is achieved through exchanges of material, information, and legitimacy.

The final characteristic of networks is that they are composed of lasting relationships among the actors. Klijn (1997) and Jones, Hesterly and Borgatti (1997) concluded that relationship patterns in a network are defined according to their frequency over time. Repeated interactions strengthen the relationship. As a pattern of behavior develops during on-going interactions, actors will begin to understand who they can trust and who they cannot trust. Therefore, the basis for the network is the willingness to establish interdependency based on that frequent, lasting relationship.

Network Analysis

Network Structure

In analyzing a network, the individuals within the network are not as important as the relationships between them. Since networks imply interactions in which no one individual has all the resources to solve a problem, the dyadic relationship is the basic unit of structure. At the next higher level of analysis, the network as a whole will determine the success of outcomes. How the dyadic relationships are arranged to form a network count in achieving a result. Therefore, structure determines how the group as a whole will perform.

Figure 2. Asymmetric Informational Network
(Knoke, 1990, p. 237)

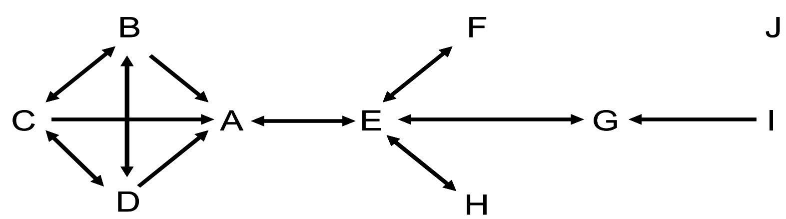


Table 1. Matrix Representation of an Asymmetric Network
(Knoke, 1990, p. 237)

	A	B	C	D	E	F	G	H	I	J	Total
A		0	0	0	1	0	0	0	0	0	1
B	1		1	1	0	0	0	0	0	0	3
C	1	1		1	0	0	0	0	0	0	3
D	1	1	1		0	0	0	0	0	0	3
E	1	0	0	0		1	1	1	0	0	4
F	0	0	0	0	1		0	0	0	0	1
G	0	0	0	0	1	0		0	0	0	1
H	0	0	0	0	1	0	0		0	0	1
I	0	0	0	0	0	0	1	0		0	1
J	0	0	0	0	0	0	0	0	0		0
Total	4	2	2	2	4	1	2	1	0	0	18

To illustrate the concepts of measuring information flow in a network, a hypothetical example of a network in which actors exchange information asymmetrically is shown in Figure 2. The arrows depict the flow of information. An adjacency matrix is used to represent this information flow from actors to one another. The number one in a row represents transmitting information from the actor in the row to the actor in the column, whereas a zero indicates that no information is transmitted. The number one in a column represents receipt of information, and a zero represents no information receipt. Knoke (1990) developed the above matrix in Table 1, concluding from the totals for the columns and rows that A receives the information from more sources, and E transmits information to the most actors.

Actors' Positions within the Network

Switching from the network back to the individual actor as a unit of analysis, the above tools also allow an assessment of how the actor fits into the structure of the network. Freeman (1977) introduced measures of a node's centrality based on his definition of position centrality: "the degree they stand between others, and can therefore facilitate, impede or bias the transmission of messages." These nodes control the information flow in the network more than others.

Centrality appears to be directly correlated with the efficiency of the network and the power of the individual who is more central. Freeman (1977) applied centrality measures to other studies of communication in small group settings, and concluded that centrality was related to solving problems with speed, efficiency and personal satisfaction. Likewise, Krackhardt's (1990) work correlated Freeman's measures of centrality to perceived power in a small, entrepreneurial organization.

Relating Network Structure to Network Effectiveness

From the perspective of the network as a whole, a definition of network effectiveness must be defined on multiple levels across multiple agencies. Provan and Milward (2001) offer the community, or area the network serves, the network itself, and the organization and participants as the levels among which a network should be evaluated to satisfy multiple stakeholder perspectives. Their empirical study developed the following conclusions:

- Networks are more effective when they are integrated through centralization, although networks that are integrated through a core agency and integrated through dense links among members will be less effective than those are integrated through a core agency alone.
- Networks are most effective when external controls are directly applied, rather than applied through an agency.
- Networks are most effective when a degree of stability is achieved, especially when the stability and uncertainty impacts clients.
- When the above conditions are optimal, resource scarcity will limit the effectiveness of the network. Conversely, resource abundance allows the network to range from low to high effectiveness, depending on the conditions above.

Analysis

Application of the network Perspective to weapon system acquisition

Chapter II described the acquisition system and its formal hierarchical operating structure. Chapter III introduced the network perspective and its basic assumptions and methodology. This chapter draws on the data from the APAT process model and concludes that the acquisition system has network-like properties. The implications of the acquisition system's network characteristics are explored in terms of acquisition governance.

Interdependencies between Actors

One of the key characteristics of a network is the relationships between the actors. Interdependencies between actors are the basis for the formation of networks (Klijn, 1997; Powell, 1990; Jones, Hesterly & Borgatti, 1997). The interdependencies are based on the exchange of resources, and develop in situations in which the actors need capital, personnel, and knowledge to accomplish their objectives (Klijn, 1997).

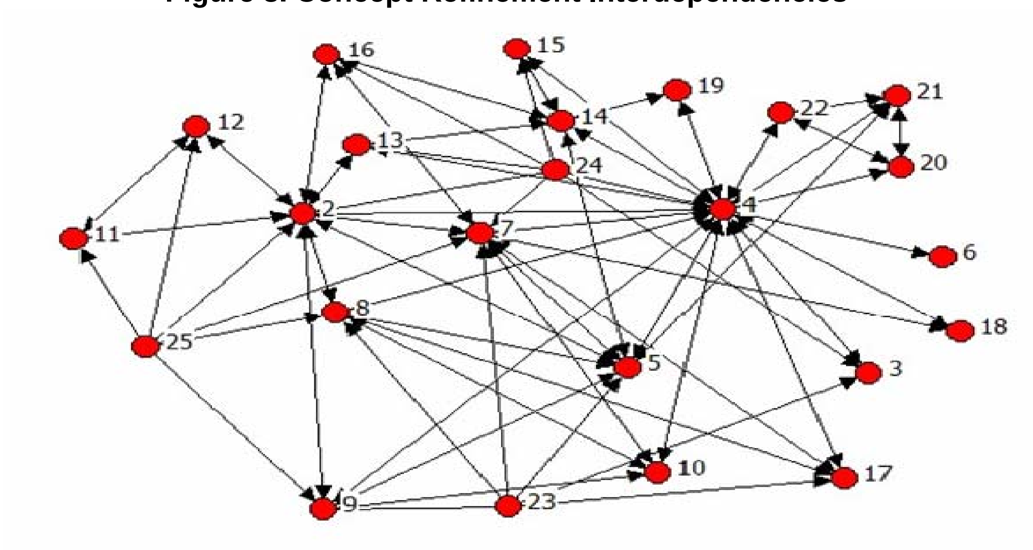
To deliver a weapon system, numerous actors are involved, as shown in the relationship matrices in Appendix B. One of the key interdependencies during the acquisition process is the exchange of knowledge between actors. During the first three phases of the acquisition process, knowledge about what you need to buy and how the system should be designed to meet that need is the focus of the activities. As shown in Appendix A, Process 1.0, the outputs of the Concept Refinement phase include an approved Course of Action, identification of resources needed for the next phase, approved milestone decision documents, a signed acquisition-decision memorandum, and a technology-development strategy. All of this knowledge is based on the collaborations among the stakeholders during each activity.

The interdependencies between actors for Concept Refinement are modeled in Figure 3. For modeling purposes, the interactions are assumed to be two-way, directed collaborations. The relationships are those that are specified in the Concept Refinement processes or may be inferred from the type of documents that are approved during that phase. For example, approval of a Test Evaluation Master Plan for a large program requires an OSD (DOT&E) signature. Of course, these are not the only relationships that a program might need to carry out the objectives of this phase of the acquisition cycle. This is a minimum set that one would expect to see for any major acquisition program.

The diagram shown in Figure 3 illustrates the interdependencies required to define the weapon system concept, select the course of action, and prepare for the Technology Development phase. As one could guess based on the description of responsibilities in JCIDS and the *DoD 5000* series regulations, the lead acquisition organization program manager (node 4), the MAJCOM requirements organization (node 2), and the milestone decision authority (node 5) have critical roles during this phase. Freeman's measure of degree centrality (1977) for those nodes is relatively higher indicating the probability that they will control resources in the network.

Graphically, Figure 3 portrays the collaboration required with the other 22 actors to accomplish the outputs of this acquisition phase. Individually, the lead acquisition organization, the MAJCOM requirements organization, and the milestone decision authority do not interface with all of the other actors. The spreadsheet in Appendix B for the Concept Refinement interactions denotes the lead acquisition organization collaborating with 18 other actors. Of the seven actors with which the lead acquisition organization does not interface, the program manager must rely on other organizations to gather information from those parts of the network.

Figure 3. Concept Refinement Interdependencies

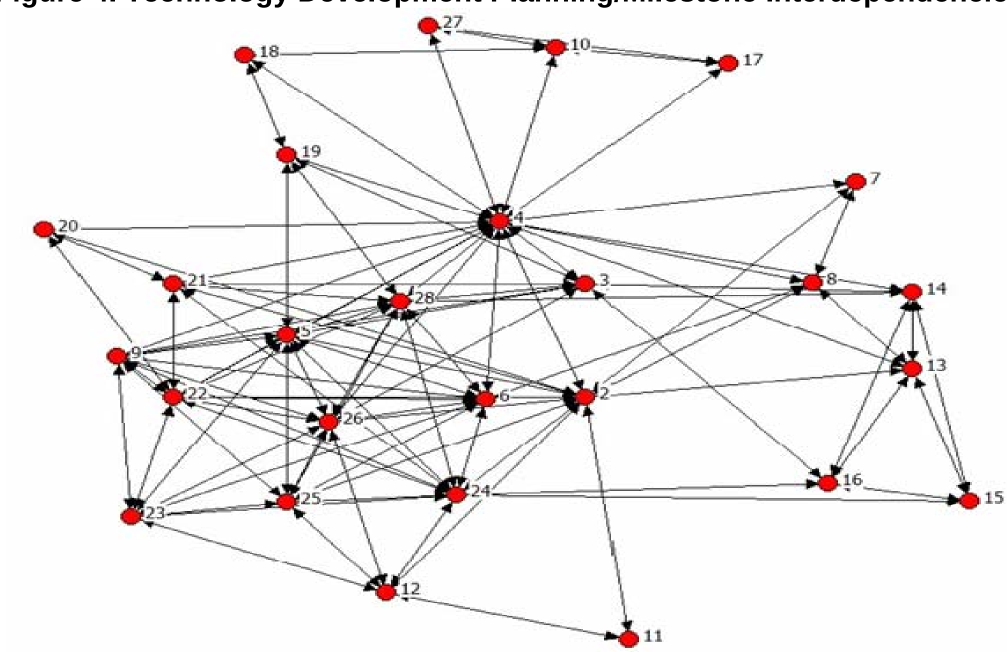


Given a weapon system concept, the purpose of the Technology Development phase of the acquisition process is to mature key technologies and to plan for weapon system development. These two activities require a diverse set of interdependencies. Maturing technology requires an in-depth understanding of the concept and system architecture as well as a diverse network of technology providers. Furthermore, the program must define the capability needs in the Capabilities Development Document (CDD). Along with the capability needs, operational, support, maintenance, and interoperability concepts must be refined so the weapon system may be designed with these plans in mind. The acquisition systems engineering, test, logistics, contracting, and financial-management communities collaborate with the warfighters to translate concepts into an executable acquisition program.

To understand these interactions, this analysis focuses on process 2.1.2, *Identify Technologies for Maturation*, process 2.1.3, *Define Technology Maturation Plan*, and process 2.5, *Develop and Prepare Documents for Milestone B*, which the APAT model decomposed as noted in Appendix A. The diagram of the interdependencies for this phase is illustrated in Figure 4, while the matrix-view is in Appendix B.

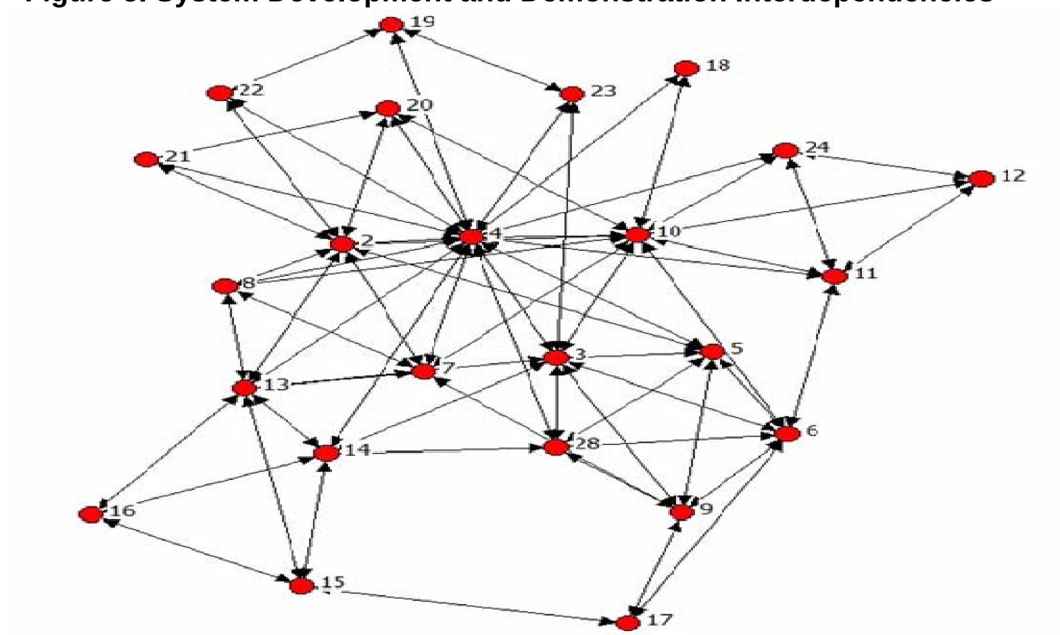
The diagram in Figure 4 reveals that there are 28 actors involved in the acquisition program, an increase from the Concept-refinement phase. Based on degree centrality, the lead acquisition organization/program manager (node 4) remains the most central actor, maintaining many of the relationships from the previous phase. Likewise, the MAJCOM requirements organization (node 2) and the milestone decision authority (node 5) also maintain their central role. A number of other actors at the OSD and service-level become more prominent, as demonstrated by their degree centrality. The network relies on relationships with these actors to provide guidance and priorities that shape the program from an operational, acquisition strategy, and budget perspective. Therefore, the influence of the key actors is still great, but there are many relationships developing during this phase that are beyond the control of the key actors.

Figure 4. Technology Development Planning/Milestone Interdependencies



During System Development and Demonstration, the critical activities include allocating requirements and developing a design, testing the design, and preparing for production and fielding of the system. This analysis focuses on process 3.1, *Manage the Program* and process 3.2.3, *Develop Detailed Design* from the APAT effort in Appendix A.

Figure 5. System Development and Demonstration Interdependencies



The diagram in Figure 5 depicts a less dense, decentralized network. In terms of degree centrality, the program manager (node 4) is still the most central actor, although the MAJCOM requirements organization (node 2) is now less central than the contractor (node 10) in influencing the network. The rise of the contractor's centrality indicates the importance of the contractor's information to the network in a monopolistic environment. This measure of centrality for the sole non-governmental actor is of interest to those who want to influence the outcome of the network at the community, network, and organizational levels of analysis.

Multiple, Independent Actors Formed around a Project

Another characteristic of a network is that there is more than one actor who shares some common attribute that forms the context of their relationship. Using the types of network relationships from Knoke and Kuklinski (1991), the actors involved in concept refinement would share several types of relationships. Since information is a key resource, many relationships are communication relations. Relationships with industry might be described in transactional terms, where dollars are expended so resources can be utilized to help gather information on different acquisition concepts. Finally, authority/power relations exist among the relationships. Process 1.1 in Appendix A describes the controls on the process from the Congressional, OSD, and service level. These controls may be targeted specifically at a program, such as when Congress earmarks an appropriation for a specific program.

One of the key questions is whether the actors remain independent to pursue their own objectives for the project. As noted above, there are authority/power relations exerted on the program. In fact, the lead acquisition organization program manager works for the service acquisition executive, typically through the PEO as an intermediate supervisor. Many of the actors, however, do not work for one another. Congress clearly does not work for the program manager, and the converse is also true. In addition, key collaborators such as the MAJCOM and the lead acquisition organization do not work for one another even though they are in the same service. If the lead acquisition organization and the MAJCOM requirements organization had a dispute, they would have to resolve it at the Chief of Staff of the Air Force/Secretary of the Air Force level. Issues are not resolved typically at that level. Instead, the actors utilize their relationship with one another to collaborate and work through issues.

Lasting, Stable Relationships between Actors

The final characteristic to be analyzed is the pattern of relationships between actors over time. Again, the literature stresses the importance of this characteristic based on the need to strengthen relationships (Klijn, 1997). In long-term acquisition programs with both complexity and uncertainty, this characteristic is important to allow actors to establish trust with one another. This trust enables actors to make transaction-specific investments that will further the objectives of both the actors and the network.

To examine this variable, the set of actors in the first three acquisition phases were analyzed to determine if the relationship spanned multiple acquisition phases—which could last from a couple of years to over a decade. The analysis is inexact since only select processes from the Technology Development phase and System Development and Demonstration phase were analyzed. Nonetheless, a group of 10 actors form 13 enduring relationships that span the formation and development of an acquisition program. This group of key players and their relationships are displayed in Appendix B.

High-degree centrality among this core group denotes the actors who continually control resources over time. Not surprisingly, the program office has the highest degree centrality within this persistent group of core actors. Interestingly, the MAJCOM budget organization and modernization budget integrator on Air Staff, SAF/AQX, also have high-degree centrality—stemming from their control over the fiscal resources needed to execute the acquisition program.

Network Governance

A network view of acquisition allows an analyst to examine outcomes and management strategies in a new way. Rather than focusing on accountability, the focus shifts to understanding how to enable the network as a whole to create greater value. As Provan and Milward (2001) suggested, the effectiveness of the network ought to be analyzed at the community, network, and participant level. Understanding the outcomes desired from acquisition programs across the Congressional and warfighting community, the acquisition community, and the individual organizations within the network allows a holistic analysis of how the network ought to be structured to accomplish these desires.

A review of the data in Appendix B supports the conclusion that the Lead Acquisition Organization/Program Manager is the most central actor within the acquisition process in terms of degree centrality. Furthermore, this actor has the greatest range of relationships, brokering information from the warfighter, budget community, technology community, and contractor. This places the Program Manager in a very important position in the network.

Not all program managers perform equally. Some may be unable to stabilize their inherently unstable networks. Other managers may have perfectly adequate networks, but the manager is unable to understand how to manage in a network. Whatever the case, understanding the structure of the network should enable program managers to understand the environment within which successful programs are executed.

Further, an understanding of the network allows an analysis of second-order effects due to changes in the network. Provan and Milward (1995) concluded that resource scarcity would limit the effectiveness of any network. When resources are adequate, however, factors such as centralization, direct external controls, and stability may also affect the outcomes of networks. An understanding of the structure of the acquisition program network would allow an analysis of the effects of changes using modeling. The resultant outcomes could be analyzed at the participant, network, and community level. In other words, a network view of acquisition would allow individual participants to understand how their outcomes and the network's outcomes would be affected by the continuing change in policy, resources, and players in the acquisition system.

Conclusions and Recommendations

Conclusions

Research Question

The focus of this paper was to answer the following research question: does the DoD weapon system acquisition process behave as a network?

The characterization of the "Big A" acquisition system as a complex interaction of the JCIDS subsystem, the PPBE subsystem, and the defense acquisition subsystem identified multiple stakeholders who value different outcomes. Each of these players attempts to utilize some form of hierarchy to break down tasks and assign responsibility to ensure task accomplishment.

However, the APAT process model revealed a more complex, interactive process among the JCIDS, PPBE, and the acquisition subsystems. Appendix B portrays the key players in the first three phases of the acquisition cycle. An analysis of these players reveals that many do not work for one another and may have differing objectives. Furthermore, examination of the key activities within the Concept Refinement, Technology Development, and System Development and Demonstration phases, and the interactions of the key players who were involved in the controls, inputs, activities, and outputs of each subsystem, revealed key interdependencies and long, stable relationships among independent actors. This analysis led to the conclusion that weapon system acquisition can be conceptualized as a network.

Further Refinements

Analysis of the APAT process model data also led to an understanding that centrality is not equally distributed within the network. The lead acquisition organizations/program manager is a central figure who has the greatest number of relationships and is most central to the network measured in terms of degree of centrality. Despite the program manager's lack of a high position within a hierarchical model, network analysis reveals that the program manager has the greatest number of contacts and interactions within the network.

Additionally, there is a core group of actors who have a persistent set of relationships during the early, critical stages of the acquisition process. While the program manager is well-placed within this core group, there are other important actors who deal with budgets and have sustained relationships over time. Understanding the structure of this group and their relationships with the rest of the network will be important in helping the acquisition community develop strategies to govern the network and influence changes for improved network performance and outcomes.

Recommendations

Validate the Model

First, the data gathered in the APAT model were intended to serve as a framework to understand the current acquisition process as it applies to a majority of programs. The scope of the data-gathering process limited the ability to focus on all interactions. Therefore, activities such as milestone decisions were described as an exercise in document writing. Those involved in the APAT effort recognized that the documents generated for a milestone decision were actually the culmination of a set of interactions to gather data and develop a strategy for a particular portion of the acquisition program. For this effort, the official who approved the document and the program office WIPT were assumed to be the only participants. This is, in fact, probably not true. Participants might include other organizations, depending on the subject matter of the program and local procedures.

Therefore, the model serves as a good first step to begin to explore certain interactions within the acquisition system. If a certain set of interactions or a set of actors are of interest, gathering more detailed data would be valuable to further the understanding of the network and to validate the model.

Network Framework to Study Improved Outcomes

The data-gathering effort for the APAT model was not prescriptive. While the sponsors of the effort were interested in recognizing areas for improvement, the model was meant to describe the current process. There are reasons for the patterns of relationships established in the model, but there also may be improved ways of interacting.

Indeed, the network model, once validated, could be utilized as a framework to assess program success. Those who control acquisition policy or who participate in acquisition programs likely would be interested in studying how the networks of these programs of interest differ from the norm. *DoD Directive 5000.1* gives the program manager and milestone decision authority flexibility to decide what the correct set of activities and relationships should be for a particular acquisition program. Studying network models of similar programs might enable decision-makers to tailor their efforts and focus resources on valuable relationships. Alternatively, acquisition strategies could be modeled to discover if information flows efficiently and effectively given several scenarios for organizing a program.

Simulate Changes to the Acquisition System

Of course, there are number of challenges within the acquisition process. Consistently delivering cost, schedule, and performance is rare as Augustine and Fabini (1983), Jones (1996), and McNutt (1998) agreed. Improving consistency of the system has spawned a number of changes—some of which are initially declared successful, only to be later discredited for their "unintended consequences." An example is the initiative to give the contractor Total System Performance Responsibility. This initiative gave the contractor more flexibility and responsibility for the performance of the acquisition program. Unfortunately, the effects of this change were probably not studied using a network analysis. The decision-makers acted upon the ideology that the marketplace solved all their problems.

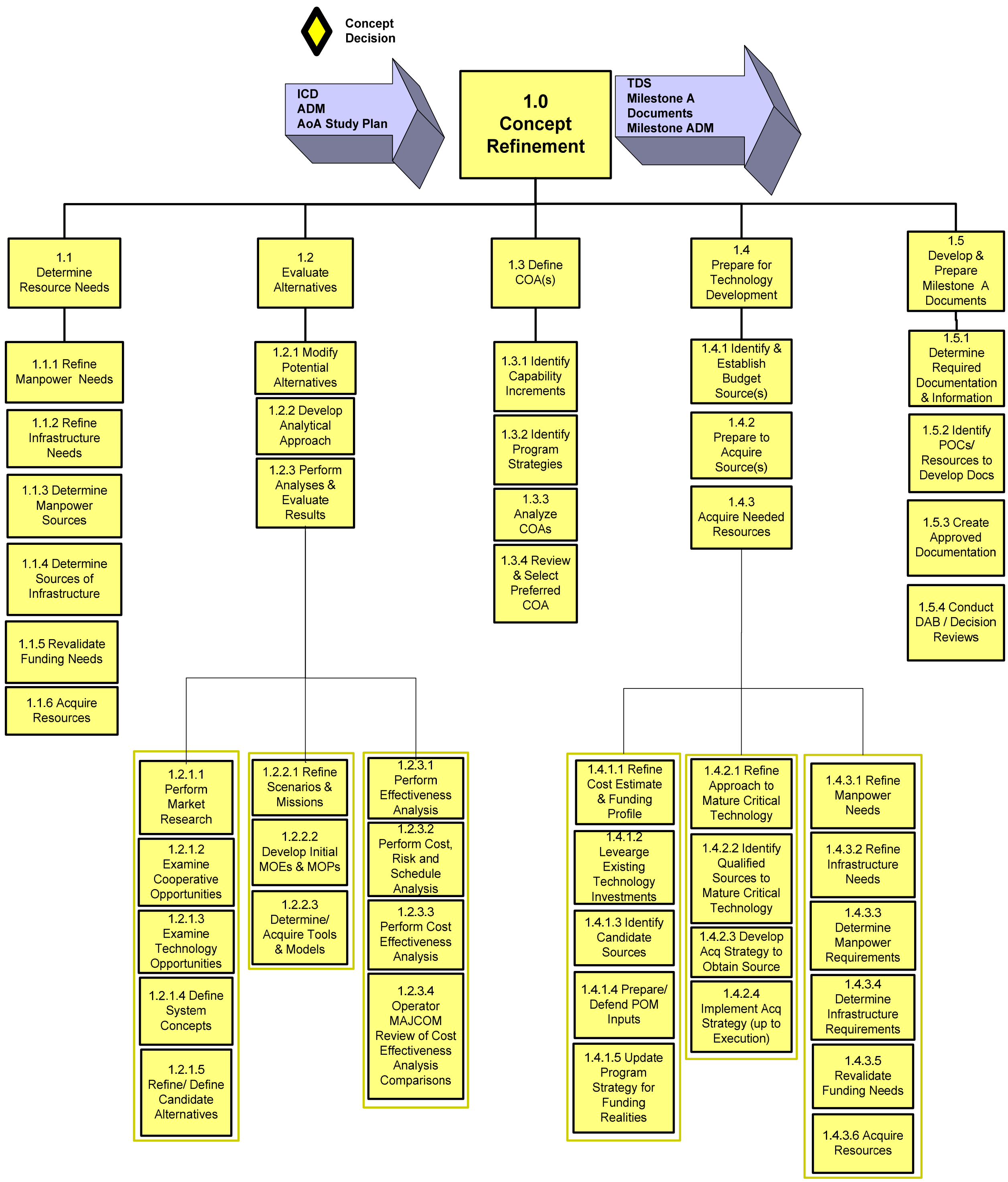
A number of changes to the acquisition system are being considered today. JCIDS mandates that programs have been have a Net-ready Key Performance Parameter (Chairman of the Joint Chiefs of Staff, 2005). This attempt to build a communication system by mandating interoperability from those who will utilize the system is much like the chicken and the egg conundrum. First, the architecture of the network must have some definition. Those who are developing a network and the users of the network must collaborate to solve this problem. Clearly, a network analysis to identify who is involved and how they are collaborating would be more beneficial than mandating a change and hoping that those actors in the network would comply.

Summary

Networks describe both formal and informal ways of getting things done in the acquisition system. The marketplace rarely delivers what the DoD needs at the quantity that it is needed. Some commodities may be purchased in the marketplace, but the uncertainties associated with DoD needs do not allow firms to match their supply to demand. Also, many of the DoD's needs are based on interoperability between programs that must be defined before the market can react to this need. The largest transactions, which involve the lion's share of the modernization budget, rely on the interactions between JCIDS, PPBE, and the acquisition system. A hierarchy exists to account for the resources input into the process. However, the complexities and dynamic nature of the process can best be described as a network of actors who use their relationships to affect outcomes.

Would Glenn Curtiss recognize this network that delivers today's innovative stealth aircraft, advanced combat systems, and ships? He probably would. If you brought Mr. Curtiss into a meeting with a program manager, MAJCOM requirements officer, and a contractor, he would feel right at home. Mr. Curtiss was no stranger to hierarchies given the size of the Curtiss Aircraft Company. Nonetheless, he knew that innovation occurs when a network of collaborators shares ideas to solve their common problems.

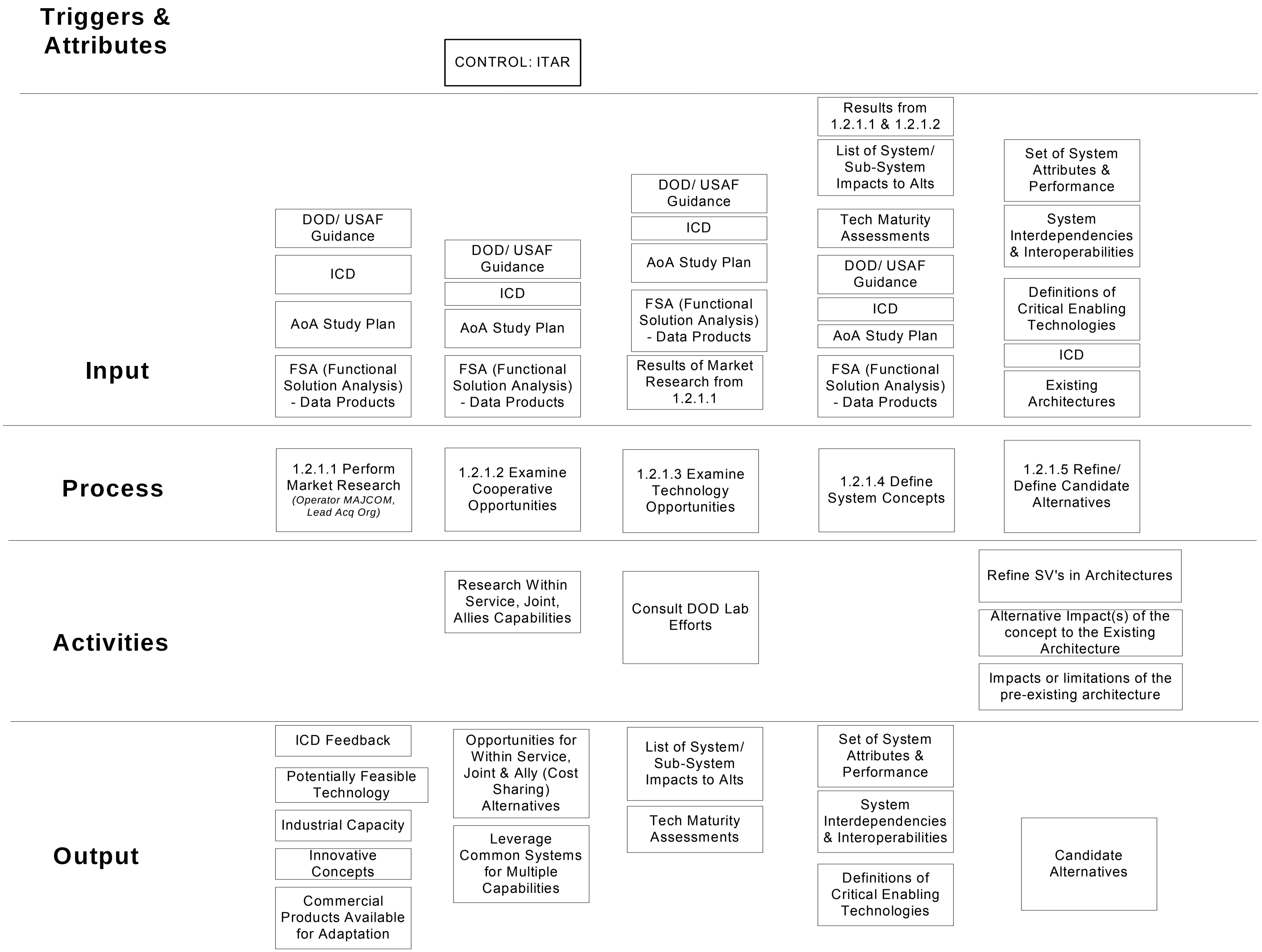
Appendix A. DOD 5000 process Model



1.1 Determine Resource Needs for Concept Refinement

	1.1.1	1.1.2	1.1.3	1.1.4	1.1.5	1.1.6
Controls	Manpower Models, Laws	Funding & Time Constraints, Leadership Directives	Organizational UMD, STE Caps, OSD Mandates, Statutory Mandates	USAF & Org Priorities,	PPBE Process, Appropriation Laws, New Start Authority,	PPBE Process, Appropriation Laws, New Start Authority, Existing Contracts
Trigger	Trigger: Concept Decision ADM Signed					
Input	ICD *(Operator MAJCOM)* ADM *(MDA)* AoA Study Plan *(Operator MAJCOM)* Lead Acq Organization Identified *(AFMC)*	ICD *(Operator MAJCOM)* ADM *(MDA)* AoA Study Plan *(Operator MAJCOM)* Lead Acq Organization Identified *(AFMC)*	ICD *(Operator MAJCOM)* ADM *(MDA)* AoA Study Plan *(Operator MAJCOM)* Lead Acq Organization Identified *(AFMC)* Identified Manpower Skills & Numbers *(Operator MAJCOM, Lead Acq Org,)*	ICD *(Operator MAJCOM)* ADM *(MDA)* AoA Study Plan *(Operator MAJCOM)* Lead Acq Organization Identified *(AFMC)* Identified Infrastructure Needs *(Operator MAJCOMs, Lead Acq Orgs)*	ICD *(Operator MAJCOM)* ADM *(MDA)* AoA Study Plan *(Operator MAJCOM)* Lead Acq organization Identified *(AFMC)* Specific Manpower identified Specific Infrastructure identified	Funding Requirement *(Operator MAJCOM, Lead Acq Org)* Specific Manpower identified Specific Infrastructure identified
Process	1.1.1 Refine Manpower Needs *(Operator MAJCOM, Lead Acq Org,)*	1.1.2 Refine Infrastructure Needs *(Operator MAJCOM, Lead Acq Org,)*	1.1.3 Determine Manpower Sources *(Operator MAJCOM, Lead Acq Org,)*	1.1.4 Determine Sources of Infrastructure *(Operator MAJCOM, Lead Acq Org,)*	1.1.5 Revalidate Funding Needs *(Operator MAJCOMs, Lead Acq Orgs)*	1.1.6 Acquire Resources *(Operator MAJCOM, Lead Acq Org,)*
Activities	Analyze Management & Subject Matter Expertise Requirements		Make Organic/ Non-Organic Decision	Make Organic/ Non-Organic Decision		May or may not require contract action
Output	Identified Manpower Skills & Numbers *(Operator MAJCOM, Lead Acq Org,)*	Identified Infrastructure Needs *(Operator MAJCOMs, Lead Acq Orgs)*	Specific Manpower identified (both organic or non) *(Operator MAJCOMs, Lead Acq Org)*	Specific Infrastructure identified (both organic or non) *(Operator MAJCOM, Lead Acq Org,)*	Funding Requirement *(Operator MAJCOM, Lead Acq Org)*	Funding Acquired *(Operator MAJCOM, Lead Acq Org)* Specific Manpower Acquired Specific Infrastructure Acquired
Metrics	Not at this point in time	Not at this point in time	Authorized vs. Assigned Manpower	IRR (Infrastructure Readiness Review- CE)	Unfunded Requirement	Authorized vs. Assigned Manpower
Mechanisms	Manpower Models, SM Expertise, Certification Requirements	AFMC - IPT (REUs), SM Expertise	Functional Leads, Prior Experience	Base (CE) Facilities Plan, Facilities Modernization Plan	Cost Models, SME's	Other Available Resources, FFRDC's, Reprogramming Authority

1.2.1 Modify Potential Alternatives



1.2.2 Develop Analytical Approach

Trigger	Trigger: AoA Assigned		
Input	System Threat Assessment AoA Study Plan ICD SPG Scenarios & Other Capability Studies Candidate Alternatives (input from 1.2.1)	Approved Scenarios & Details for Modeling System Threat Assessment AoA Study Plan ICD SPG Scenarios & Other Capability Studies Candidate Alternatives (input from 1.2.1)	MOEs & MOPs System Threat Assessment AoA Study Plan ICD SPG Scenarios & Other Capability Studies Candidate Alternatives (input from 1.2.1) Scenarios & Details for Modeling
Process	1.2.2.1 Refine Scenarios & Missions	1.2.2.2 Develop Initial MOEs & MOPs	1.2.2.3 Determine/ Acquire Tools & Models
Activities	Develop Data Sets Review w/ Intel Community	Coordinate/ Collaborate Reviews of MOEs & MOPs	Identify Needed Engineering, Costs, & Operational Models Determine Availability of existing Models Modify/ Refine Models
Output	Approved Scenarios & Details for Modeling	Initial MOEs & MOPs (Threshold & Objective Levels)	Conceptual Engineering, Costs, & Operational Models

1.2.3 Perform Analyses & Evaluate Results

Input	Candidate Alternatives (input from 1.2.1) AoA Study Plan ICD Approved Scenarios & Details for Modeling Initial MOEs & MOPs (Threshold & Objective Levels) Conceptual Engineering, Costs, & Operational Models	Performance Assessment against MOEs & MOPs AoA Study Plan ICD Candidate Alternatives (input from 1.2.1) Approved Scenarios & Details for Modeling Initial MOEs & MOPs (Threshold & Objective Levels) Conceptual Engineering, Costs, & Operational Models	Risk Assessment Cost and Schedule Assessment Performance Assessment against MOEs & MOPs Performance & Capability Drivers(Sensitivities)	ICD Relative Comparison of Alternatives
Process	1.2.3.1 Perform Effectiveness Analysis	1.2.3.2 Perform Cost, Risk and Schedule Analysis	1.2.3.3 Perform Cost Effectiveness Analysis	1.2.3.4 Operator MAJCOM Review of Cost Effectiveness Analysis Comparisons
Activities	Assess Technical Performance / Capability Identify Sensitivities	Perform Risk Analysis Perform Cost & Schedule Analysis	Analyze Results of Cost Effectiveness Analysis	
Output	Performance Assessment against MOEs & MOPs Performance & Capability Drivers(Sensitivities)	Risk Assessment Cost and Schedule Assessment	Relative Comparison of Alternatives	Preferred Alternative

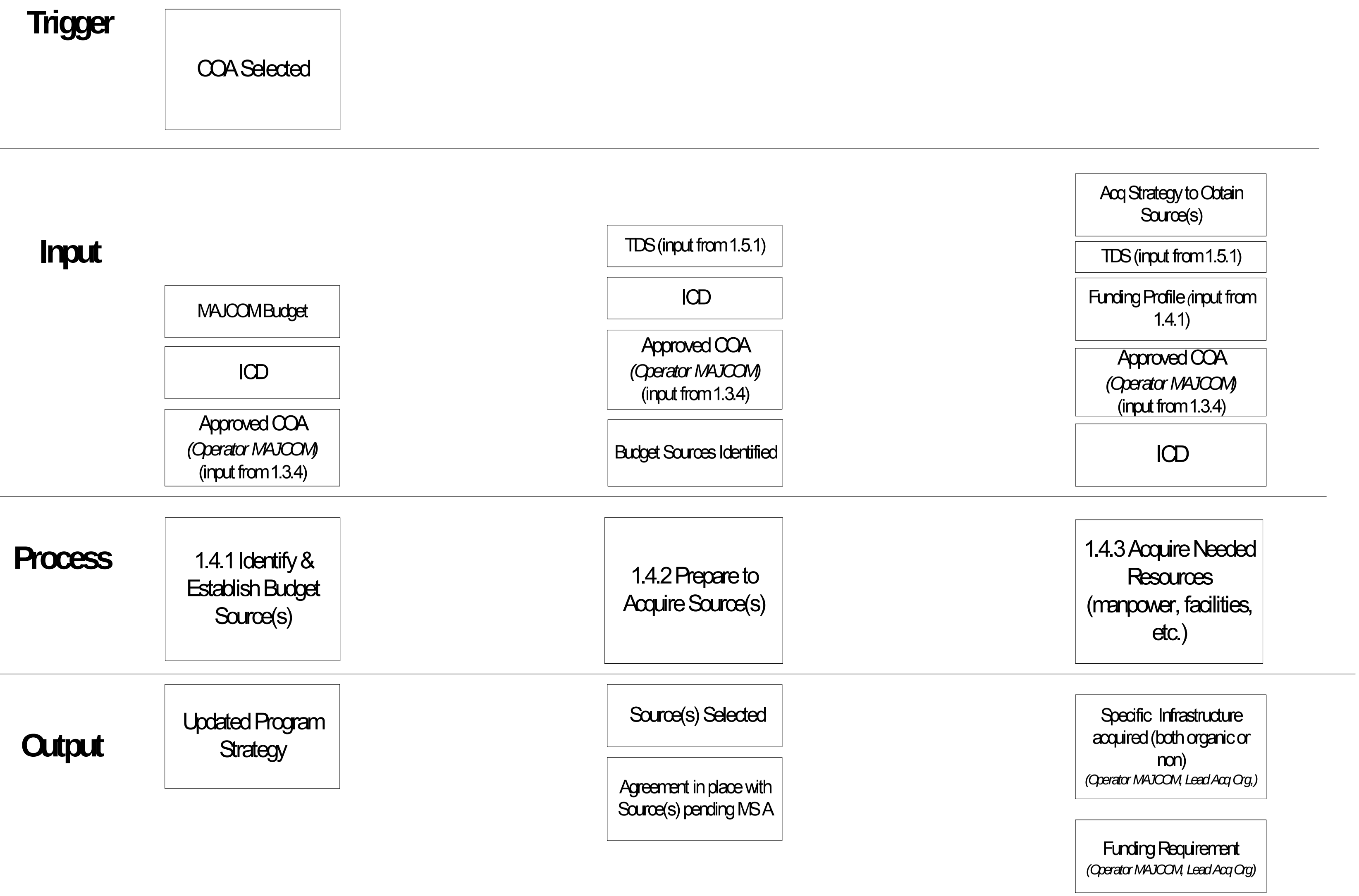
Notes

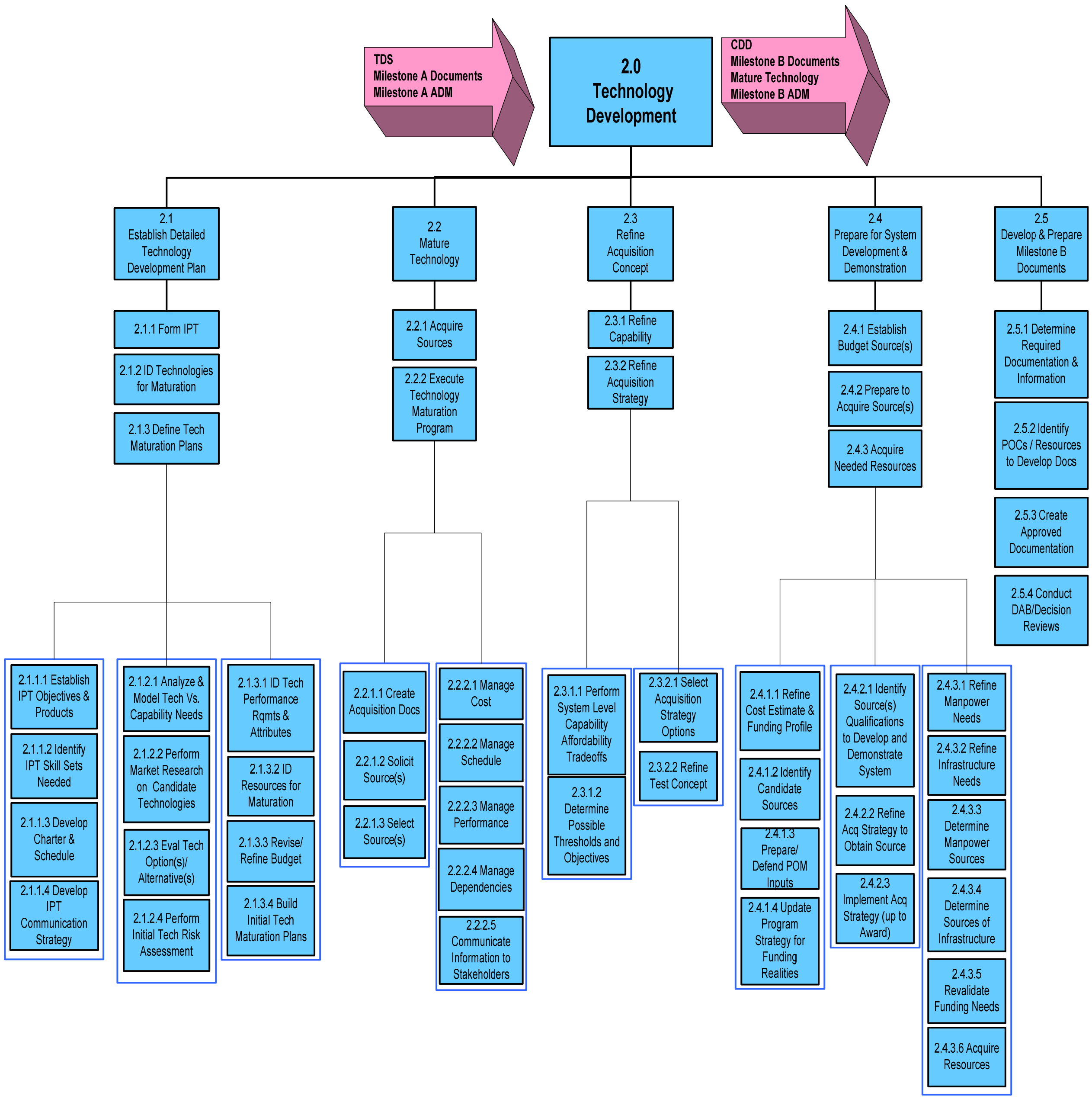
1. Assess Technology Sub System is a part of the Risk Analysis in 1.2.3.2

1.3 Define Alternative Courses of Action COA(s)

Input	ICD Feedback on AoA Out brief Preferred Alternative (input from 1.2.3.4)	ICD Feedback on AoA Out brief Preferred Alternative (input from 1.2.3.4) Potential Capability Increments	ICD Feedback on AoA Out brief Preferred Alternative (input from 1.2.3.4) Potential Program Strategies for COAs	Preferred Alternative (input from 1.2.3.4) ICD Relative Comparison of COAs
Process	1.3.1 Identify Capability Increments	1.3.2 Identify Program Strategies	1.3.3 Analyze COAs	1.3.4 Review & Select Preferred COA
Activity	Brainstorm Potential Incremental Approaches Conduct User Interaction Consider Operator MAJCOM Budget & TOA	Evaluate Historical COA Conduct Systems Engineering Analysis Develop Cost, Schedule, Risk and Effectiveness Estimates Conduct Operator MAJCOM Interaction - review Consider Operator MAJCOM Budget & TOA	Conduct Operator MAJCOM Interaction - Review Consider Operator MAJCOM Budget & TOA	Conduct Lead Acq Review MDA Approves COA Operator MAJCOM Reviews & Approves COA
Output	Potential Capability Increments	Potential Program Strategies for COAs	Relative Comparison of COAs	Approved COA Indication of Next Phase(s)

1.4 Prepare for Technology Development




TDS
Milestone A Documents
Milestone A ADM
2.0 Technology Development
CDD
Milestone B Documents
Mature Technology
Milestone B ADM
2.1 Establish Detailed Technology Development Plan
2.1.1 Form IPT
2.1.2 ID Technologies for Maturation
2.1.3 Define Tech Maturation Plans
2.1.1.1 Establish IPT Objectives & Products
2.1.1.2 Identify IPT Skill Sets Needed
2.1.1.3 Develop Charter & Schedule
2.1.1.4 Develop IPT Communication Strategy
2.1.2.1 Analyze & Model Tech Vs. Capability Needs
2.1.2.2 Perform Market Research on Candidate Technologies
2.1.2.3 Eval Tech Option(s)/ Alternative(s)
2.1.2.4 Perform Initial Tech Risk Assessment
2.1.3.1 ID Tech Performance Rqmts & Attributes
2.1.3.2 ID Resources for Maturation
2.1.3.3 Revise/ Refine Budget
2.1.3.4 Build Initial Tech Maturation Plans
2.2 Mature Technology
2.2.1 Acquire Sources
2.2.2 Execute Technology Maturation Program
2.2.1.1 Create Acquisition Docs
2.2.1.2 Solicit Source(s)
2.2.1.3 Select Source(s)
2.2.2.1 Manage Cost
2.2.2.2 Manage Schedule
2.2.2.3 Manage Performance
2.2.2.4 Manage Dependencies
2.2.2.5 Communicate Information to Stakeholders
2.3 Refine Acquisition Concept
2.3.1 Refine Capability
2.3.2 Refine Acquisition Strategy
2.3.1.1 Perform System Level Capability Affordability Tradeoffs
2.3.1.2 Determine Possible Thresholds and Objectives
2.3.2.1 Select Acquisition Strategy Options
2.3.2.2 Refine Test Concept
2.4 Prepare for System Development & Demonstration
2.4.1 Establish Budget Source(s)
2.4.2 Prepare to Acquire Source(s)
2.4.3 Acquire Needed Resources
2.4.1.1 Refine Cost Estimate & Funding Profile
2.4.1.2 Identify Candidate Sources
2.4.1.3 Prepare/ Defend POM Inputs
2.4.1.4 Update Program Strategy for Funding Realities
2.4.2.1 Identify Source(s) Qualifications to Develop and Demonstrate System
2.4.2.2 Refine Acq Strategy to Obtain Source
2.4.2.3 Implement Acq Strategy (up to Award)
2.4.3.1 Refine Manpower Needs
2.4.3.2 Refine Infrastructure Needs
2.4.3.3 Determine Manpower Sources
2.4.3.4 Determine Sources of Infrastructure
2.4.3.5 Revalidate Funding Needs
2.4.3.6 Acquire Resources
2.5 Develop & Prepare Milestone B Documents
2.5.1 Determine Required Documentation & Information
2.5.2 Identify POCs / Resources to Develop Docs
2.5.3 Create Approved Documentation
2.5.4 Conduct DAB/Decision Reviews

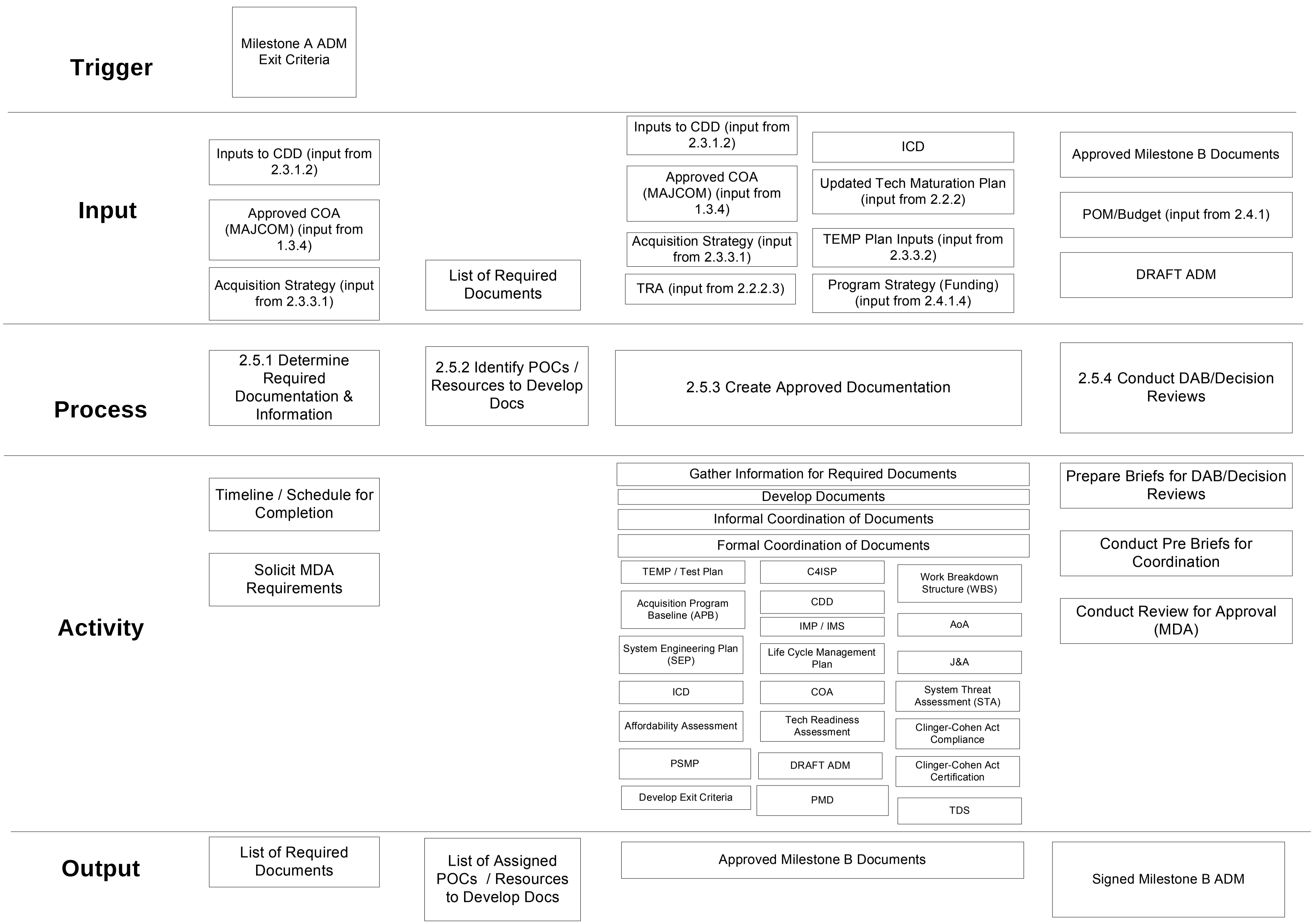
2.1.2 Identify Technologies for Maturation

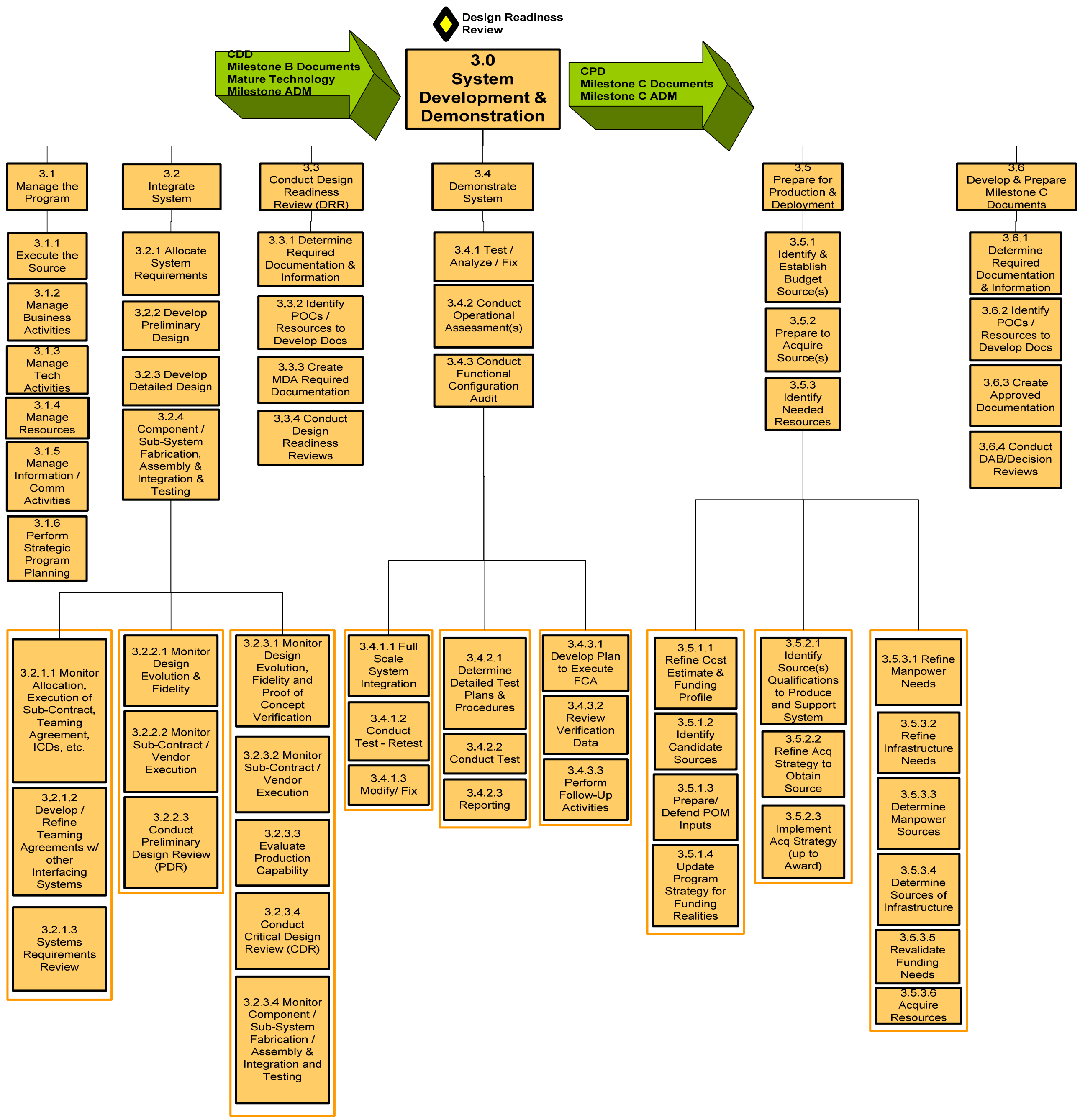
Trigger	Milestone A ADM			
Input	Approved CoA (input from 1.3.4) *(Acq Lead)* TDS (input from 1.5.1) *(Acq Lead)* ICD *(MAJCOM)*	Library of Historical TRAs *(OSD AT&L)* Approved CoA (input from 1.3.4) TDS (input from 1.5.1) *(Acq Lead)* ICD *(MAJCOM)* Candidate Technology (Abilities & Shortfalls) *(Sponsor Agency, IPT)*	Political Influence Approved CoA (input from 1.3.4) *(Acq Lead)* TDS (input from 1.5.1) *(Acq Lead)* ICD *(MAJCOM)* Initial Set of Candidate Technologies *(Sponsor Agency, IPT)*	Selected Tech Option(s)/ Alternative(s) *(IPT, Industry, Labs, etc.)*
Process	2.1.2.1 Analyze & Model Tech Vs. Capability Needs *(IPT from 2.1.1)*	2.1.2.2 Perform Market Research on Candidate Technologies *(IPT)*	2.1.2.3 Eval Tech Option(s)/ Alternative(s) *(IPT)*	2.1.2.4 Perform Initial Tech Risk Assessment *(IPT)*
Activities	Id Thresholds & Objectives Address Tech Integration Challenges & Dependencies	Eval Industrial-base (includes foreign) Eval Gov't Market Share Eval Maturity & Viability	Selection of Technology Balanced Technology Against Other Issues (Systems Engineering, etc.)	Id & Prioritize Tech Risk Down select Tech Options & Alternative(s) Id Risk Mitigation Activities Dependencies
Output	Candidate Technology Abilities & Shortfalls *(Sponsor Agency, IPT)*	Initial Set of Candidate Technologies *(Sponsor Agency, IPT)* Market Research Report *(Sponsor Agency, IPT)*	Selected Tech Option(s)/ Alternative(s) *(IPT, Industry, Labs, etc.)* Tech Readiness Assessment *(Acq Lead, MDA, IPT)*	Initial Technical Risk Mgmt Plan *(Acq Lead)*
Mechanisms	Mechs - None Identified		TRL(s)	
Metrics	Metrics - None Identified			

2.1.3 Define Technology Maturation Plan

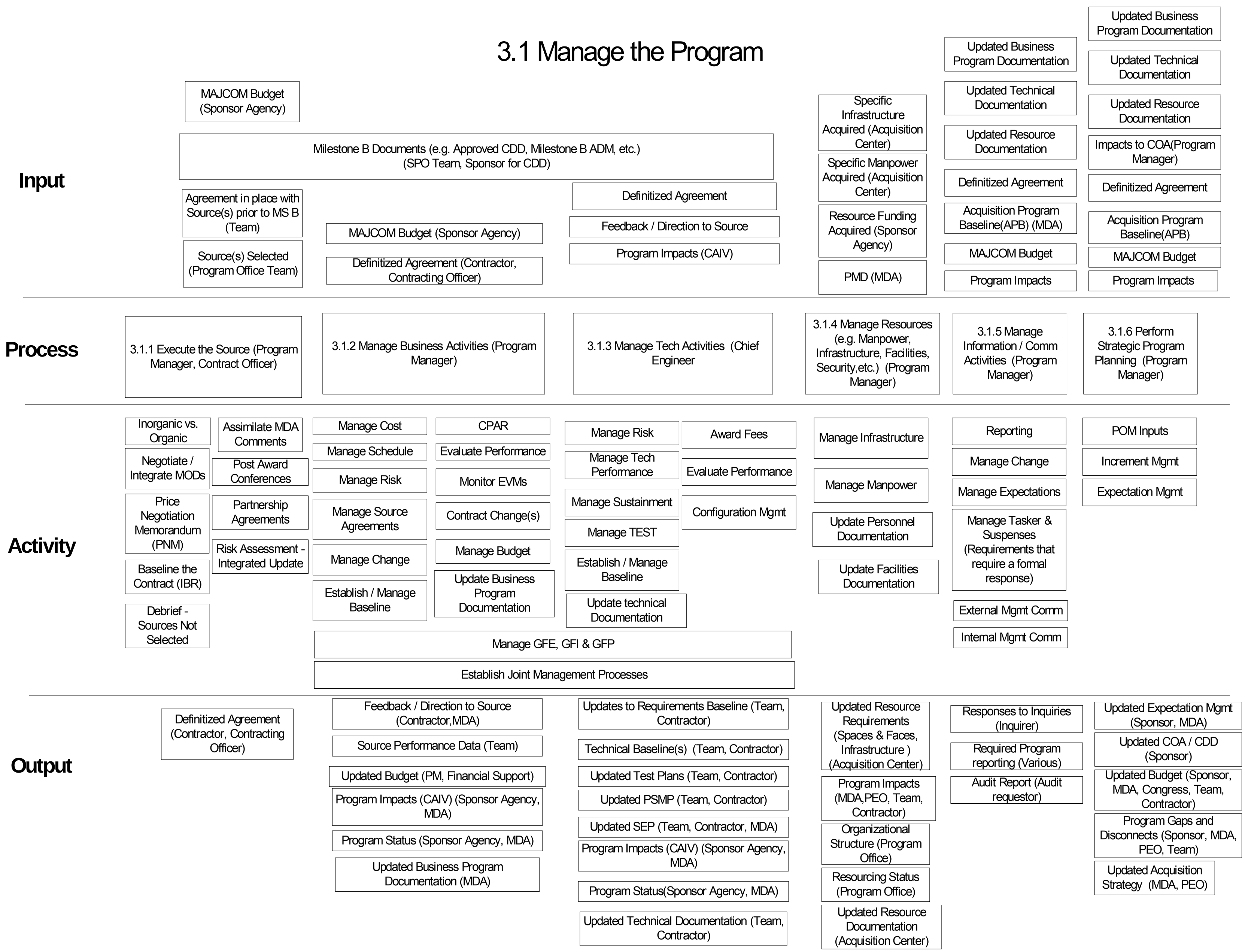
Trigger	Milestone A ADM			
Input	ICD *(MAJCOM)* TDS (input from 1.5.1) *(Acq Lead)* Selected Tech Option(s)/Alternative(s) (input from 2.1.2.3) *(IPT, Industry, Labs, etc.)* Initial Technical Risk Mgmt Plan (input from 2.1.2.4) *(Acq Lead)*	Market Research Report (input from 2.1.2.2) ICD *(MAJCOM)* TDS (input from 1.5.1) *(Acq Lead)* Selected Tech Option(s)/ Alternative(s) (input from 2.1.2.3) Initial Technical Risk Mgmt Plan (input from 2.1.2.4)	Budget *(Sponsor Agency)* Personnel & Infrastructure for Maturation (	Personnel & Infrastructure for Maturation Performance Rqmts & Attributes Budget Resolution (POM or no $$) Exit Criteria
Process	2.1.3.1 ID Tech Performance Rqmts & Attributes *(IPT)*	2.1.3.2 ID Resources for Maturation *(Acq Lead, IPT)*	2.1.3.3 Revise/ Refine Budget *(IPT)*	2.1.3.4 Build Initial Tech Maturation Plans (includes Transition Plans) *(IPT)*
Activities	Define Detailed Objectives, Thresholds, & Metrics	Personnel ID Infrastructure ID Make Organic/ Contractor Decisions	Revise/ Refine Cost Estimate(s) Compare & Resolve Cost Estimate vs. Budget	Id Tech Sources Allocate Acquisition Responsibilities per Technology (Lead Exec Agency) Conduct Industry Day(s) & Other Outreach Activities
Output	Performance Rqmts & Attributes	Personnel & Infrastructure for Maturation *(Acq Lead)*	Budget Resolution (POM or no $$) *(Acq Lead, Sponsor Agency)*	Initial Tech Maturation Plan *(Sponsor Agency, Acq Lead)*
Mechanisms	TRL Level			

2.5 Develop and Prepare Milestone B Documents

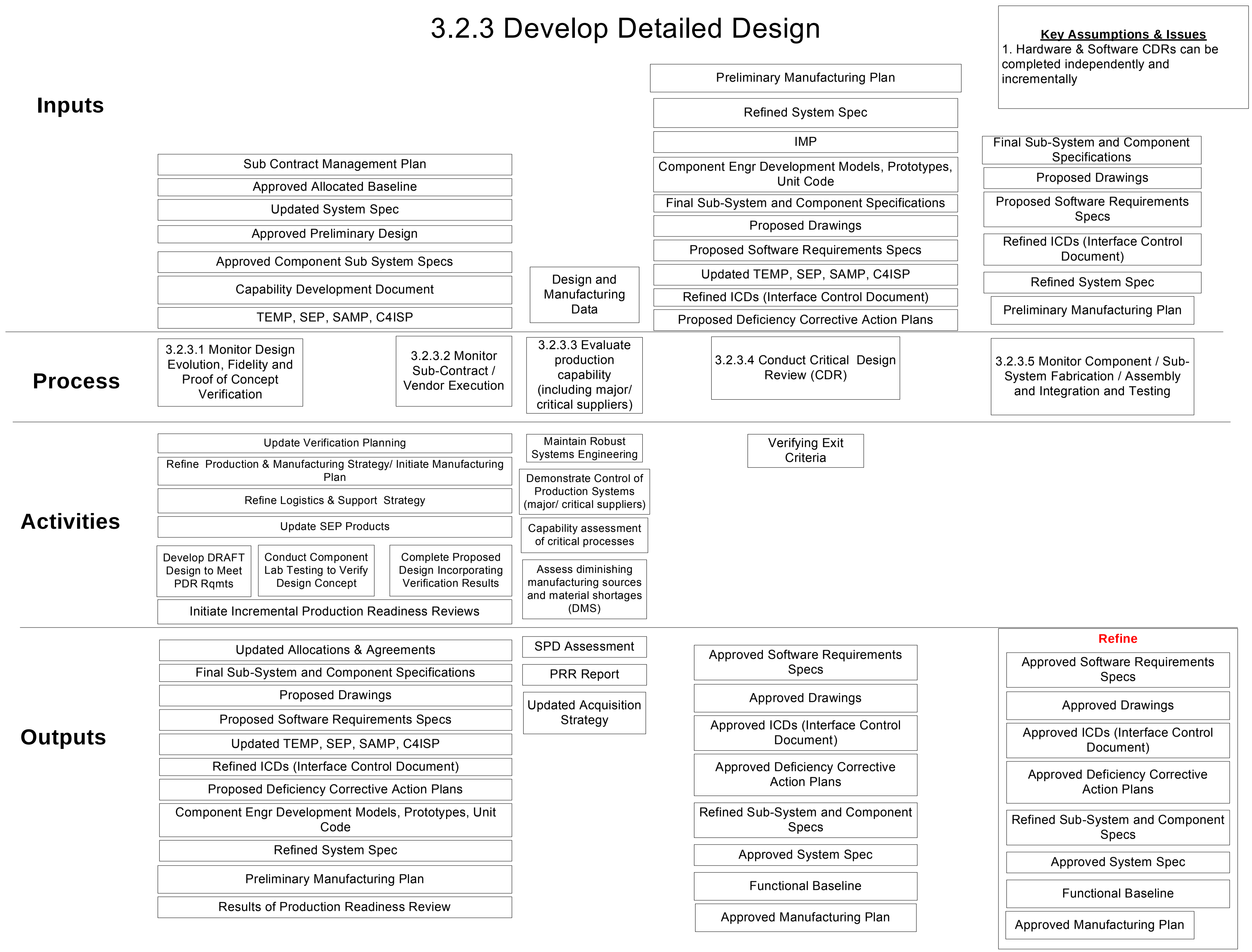


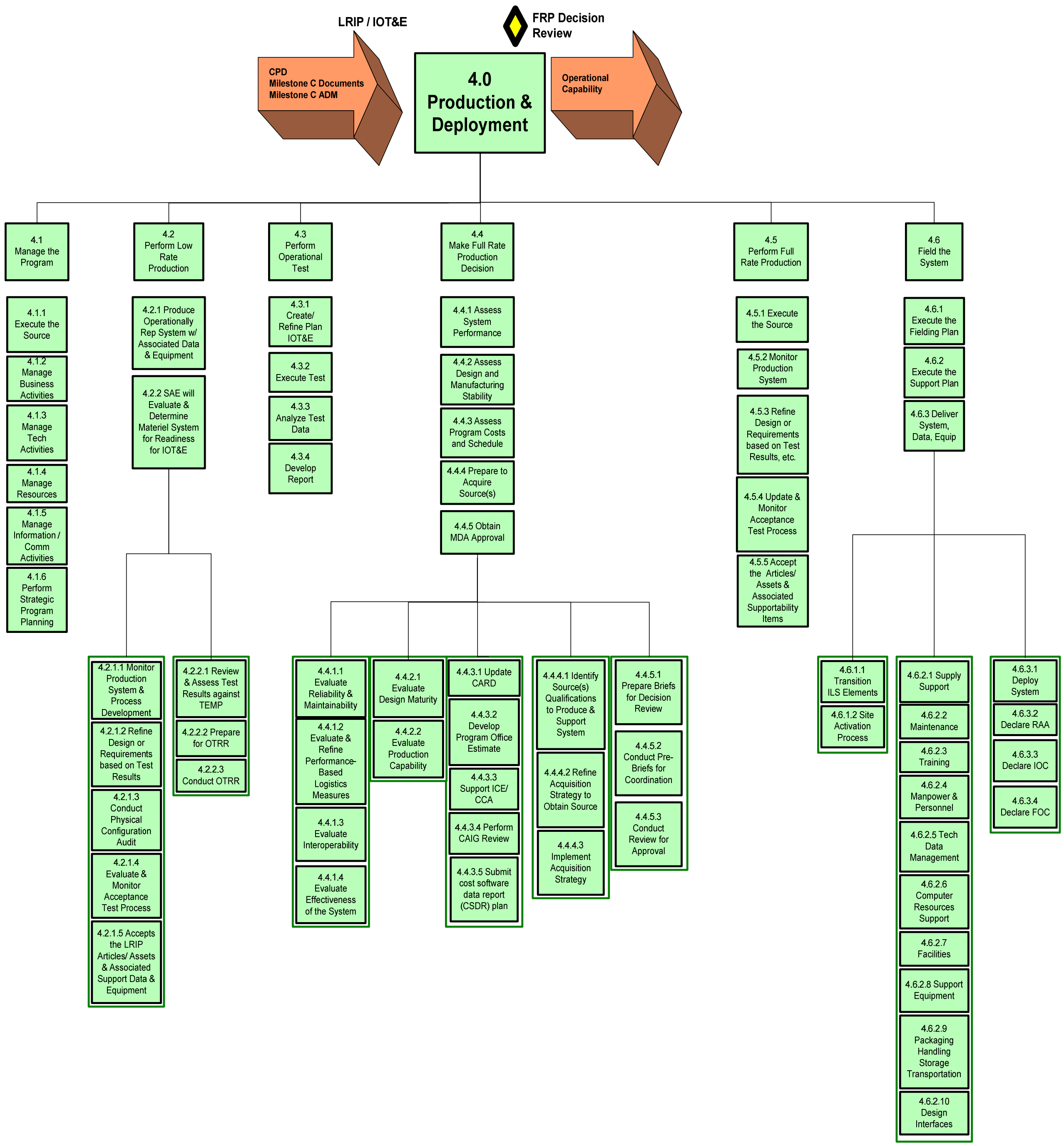

Design Readiness Review
CDD
Milestone B Documents
Mature Technology
Milestone ADM
3.0 System Development & Demonstration
CPD
Milestone C Documents
Milestone C ADM
3.1 Manage the Program
3.1.1 Execute the Source
3.1.2 Manage Business Activities
3.1.3 Manage Tech Activities
3.1.4 Manage Resources
3.1.5 Manage Information / Comm Activities
3.1.6 Perform Strategic Program Planning
3.2 Integrate System
3.2.1 Allocate System Requirements
3.2.2 Develop Preliminary Design
3.2.3 Develop Detailed Design
3.2.4 Component / Sub-System Fabrication, Assembly & Integration & Testing
3.3 Conduct Design Readiness Review (DRR)
3.3.1 Determine Required Documentation & Information
3.3.2 Identify POCs / Resources to Develop Docs
3.3.3 Create MDA Required Documentation
3.3.4 Conduct Design Readiness Reviews
3.4 Demonstrate System
3.4.1 Test / Analyze / Fix
3.4.2 Conduct Operational Assessment(s)
3.4.3 Conduct Functional Configuration Audit
3.5 Prepare for Production & Deployment
3.5.1 Identify & Establish Budget Source(s)
3.5.2 Prepare to Acquire Source(s)
3.5.3 Identify Needed Resources
3.6 Develop & Prepare Milestone C Documents
3.6.1 Determine Required Documentation & Information
3.6.2 Identify POCs / Resources to Develop Docs
3.6.3 Create Approved Documentation
3.6.4 Conduct DAB/Decision Reviews
3.2.1.1 Monitor Allocation, Execution of Sub-Contract, Teaming Agreement, ICDs, etc.
3.2.1.2 Develop / Refine Teaming Agreements w/ other Interfacing Systems
3.2.1.3 Systems Requirements Review
3.2.2.1 Monitor Design Evolution & Fidelity
3.2.2.2 Monitor Sub-Contract / Vendor Execution
3.2.2.3 Conduct Preliminary Design Review (PDR)
3.2.3.1 Monitor Design Evolution, Fidelity and Proof of Concept Verification
3.2.3.2 Monitor Sub-Contract / Vendor Execution
3.2.3.3 Evaluate Production Capability
3.2.3.4 Conduct Critical Design Review (CDR)
3.2.3.4 Monitor Component / Sub-System Fabrication / Assembly & Integration and Testing
3.4.1.1 Full Scale System Integration
3.4.1.2 Conduct Test - Retest
3.4.1.3 Modify/ Fix
3.4.2.1 Determine Detailed Test Plans & Procedures
3.4.2.2 Conduct Test
3.4.2.3 Reporting
3.4.3.1 Develop Plan to Execute FCA
3.4.3.2 Review Verification Data
3.4.3.3 Perform Follow-Up Activities
3.5.1.1 Refine Cost Estimate & Funding Profile
3.5.1.2 Identify Candidate Sources
3.5.1.3 Prepare/ Defend POM Inputs
3.5.1.4 Update Program Strategy for Funding Realities
3.5.2.1 Identify Source(s) Qualifications to Produce and Support System
3.5.2.2 Refine Acq Strategy to Obtain Source
3.5.2.3 Implement Acq Strategy (up to Award)
3.5.3.1 Refine Manpower Needs
3.5.3.2 Refine Infrastructure Needs
3.5.3.3 Determine Manpower Sources
3.5.3.4 Determine Sources of Infrastructure
3.5.3.5 Revalidate Funding Needs
3.5.3.6 Acquire Resources

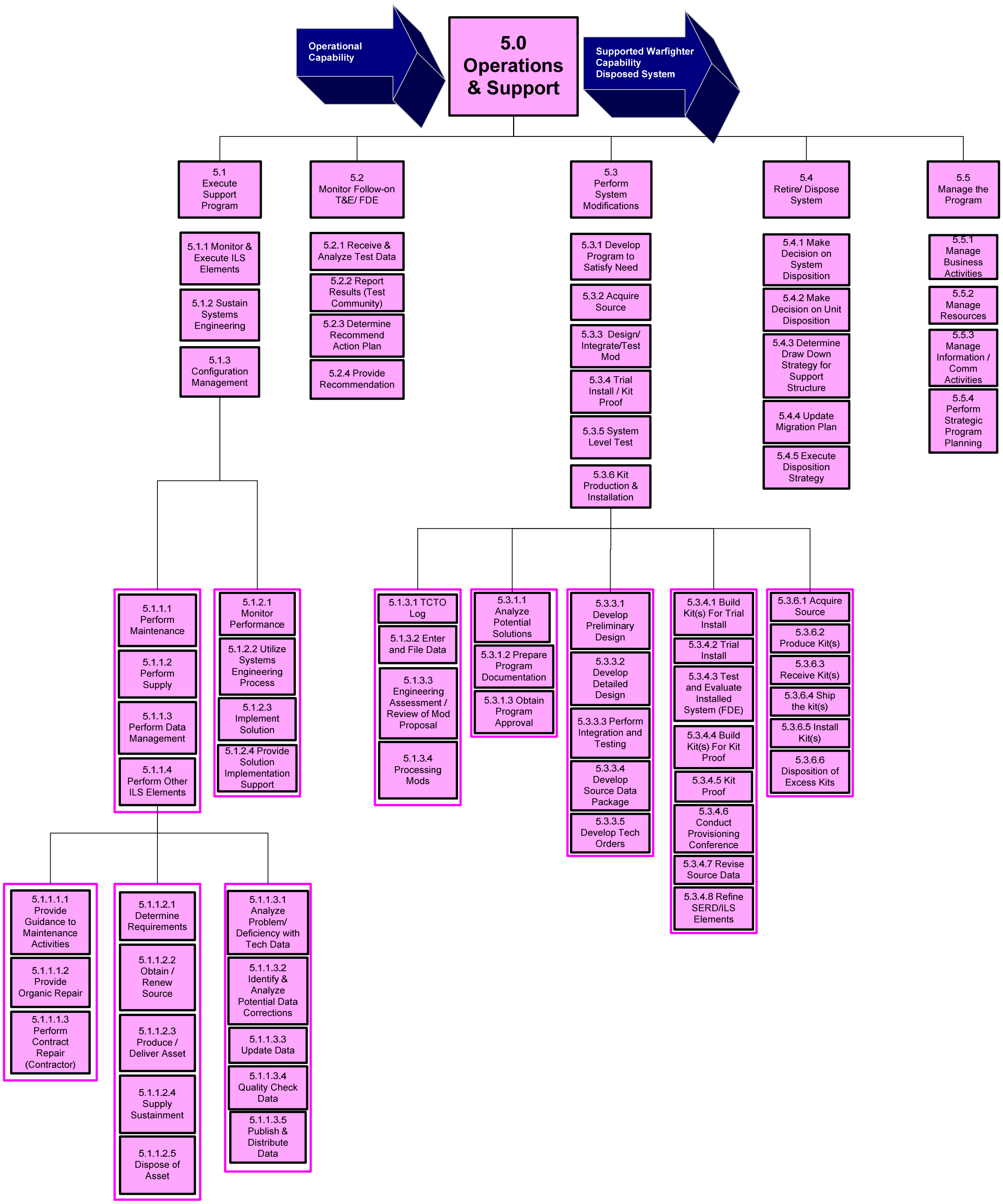
3.1 Manage the Program



3.2.3 Develop Detailed Design




LRIP / IOT&E
FRP Decision Review
CPD Milestone C Documents Milestone C ADM
4.0 Production & Deployment
Operational Capability
4.1 Manage the Program
4.1.1 Execute the Source
4.1.2 Manage Business Activities
4.1.3 Manage Tech Activities
4.1.4 Manage Resources
4.1.5 Manage Information / Comm Activities
4.1.6 Perform Strategic Program Planning
4.2 Perform Low Rate Production
4.2.1 Produce Operationally Rep System w/ Associated Data & Equipment
4.2.2 SAE will Evaluate & Determine Materiel System for Readiness for IOT&E
4.2.1.1 Monitor Production System & Process Development
4.2.1.2 Refine Design or Requirements based on Test Results
4.2.1.3 Conduct Physical Configuration Audit
4.2.1.4 Evaluate & Monitor Acceptance Test Process
4.2.1.5 Accepts the LRIP Articles/ Assets & Associated Support Data & Equipment
4.2.2.1 Review & Assess Test Results against TEMP
4.2.2.2 Prepare for OTRR
4.2.2.3 Conduct OTRR
4.3 Perform Operational Test
4.3.1 Create/ Refine Plan IOT&E
4.3.2 Execute Test
4.3.3 Analyze Test Data
4.3.4 Develop Report
4.4 Make Full Rate Production Decision
4.4.1 Assess System Performance
4.4.2 Assess Design and Manufacturing Stability
4.4.3 Assess Program Costs and Schedule
4.4.4 Prepare to Acquire Source(s)
4.4.5 Obtain MDA Approval
4.4.1.1 Evaluate Reliability & Maintainability
4.4.1.2 Evaluate & Refine Performance-Based Logistics Measures
4.4.1.3 Evaluate Interoperability
4.4.1.4 Evaluate Effectiveness of the System
4.4.2.1 Evaluate Design Maturity
4.4.2.2 Evaluate Production Capability
4.4.3.1 Update CARD
4.4.3.2 Develop Program Office Estimate
4.4.3.3 Support ICE/ CCA
4.4.3.4 Perform CAIG Review
4.4.3.5 Submit cost software data report (CSDR) plan
4.4.4.1 Identify Source(s) Qualifications to Produce & Support System
4.4.4.2 Refine Acquisition Strategy to Obtain Source
4.4.4.3 Implement Acquisition Strategy
4.4.5.1 Prepare Briefs for Decision Review
4.4.5.2 Conduct Pre-Briefs for Coordination
4.4.5.3 Conduct Review for Approval
4.5 Perform Full Rate Production
4.5.1 Execute the Source
4.5.2 Monitor Production System
4.5.3 Refine Design or Requirements based on Test Results, etc.
4.5.4 Update & Monitor Acceptance Test Process
4.5.5 Accept the Articles/ Assets & Associated Supportability Items
4.6 Field the System
4.6.1 Execute the Fielding Plan
4.6.2 Execute the Support Plan
4.6.3 Deliver System, Data, Equip
4.6.1.1 Transition ILS Elements
4.6.1.2 Site Activation Process
4.6.2.1 Supply Support
4.6.2.2 Maintenance
4.6.2.3 Training
4.6.2.4 Manpower & Personnel
4.6.2.5 Tech Data Management
4.6.2.6 Computer Resources Support
4.6.2.7 Facilities
4.6.2.8 Support Equipment
4.6.2.9 Packaging Handling Storage Transportation
4.6.2.10 Design Interfaces
4.6.3.1 Deploy System
4.6.3.2 Declare RAA
4.6.3.3 Declare IOC
4.6.3.4 Declare FOC


Operational Capability
5.0 Operations & Support
Supported Warfighter Capability Disposed System
5.1 Execute Support Program
5.2 Monitor Follow-on T&E/ FDE
5.3 Perform System Modifications
5.4 Retire/ Dispose System
5.5 Manage the Program
5.1.1 Monitor & Execute ILS Elements
5.1.2 Sustain Systems Engineering
5.1.3 Configuration Management
5.2.1 Receive & Analyze Test Data
5.2.2 Report Results (Test Community)
5.2.3 Determine Recommend Action Plan
5.2.4 Provide Recommendation
5.3.1 Develop Program to Satisfy Need
5.3.2 Acquire Source
5.3.3 Design/ Integrate/Test Mod
5.3.4 Trial Install / Kit Proof
5.3.5 System Level Test
5.3.6 Kit Production & Installation
5.4.1 Make Decision on System Disposition
5.4.2 Make Decision on Unit Disposition
5.4.3 Determine Draw Down Strategy for Support Structure
5.4.4 Update Migration Plan
5.4.5 Execute Disposition Strategy
5.5.1 Manage Business Activities
5.5.2 Manage Resources
5.5.3 Manage Information / Comm Activities
5.5.4 Perform Strategic Program Planning
5.1.1.1 Perform Maintenance
5.1.1.2 Perform Supply
5.1.1.3 Perform Data Management
5.1.1.4 Perform Other ILS Elements
5.1.2.1 Monitor Performance
5.1.2.2 Utilize Systems Engineering Process
5.1.2.3 Implement Solution
5.1.2.4 Provide Solution Implementation Support
5.1.3.1 TCTO Log
5.1.3.2 Enter and File Data
5.1.3.3 Engineering Assessment / Review of Mod Proposal
5.1.3.4 Processing Mods
5.3.1.1 Analyze Potential Solutions
5.3.1.2 Prepare Program Documentation
5.3.1.3 Obtain Program Approval
5.3.3.1 Develop Preliminary Design
5.3.3.2 Develop Detailed Design
5.3.3.3 Perform Integration and Testing
5.3.3.4 Develop Source Data Package
5.3.3.5 Develop Tech Orders
5.3.4.1 Build Kit(s) For Trial Install
5.3.4.2 Trial Install
5.3.4.3 Test and Evaluate Installed System (FDE)
5.3.4.4 Build Kit(s) For Kit Proof
5.3.4.5 Kit Proof
5.3.4.6 Conduct Provisioning Conference
5.3.4.7 Revise Source Data
5.3.4.8 Refine SERD/ILS Elements
5.3.6.1 Acquire Source
5.3.6.2 Produce Kit(s)
5.3.6.3 Receive Kit(s)
5.3.6.4 Ship the kit(s)
5.3.6.5 Install Kit(s)
5.3.6.6 Disposition of Excess Kits
5.1.1.1.1 Provide Guidance to Maintenance Activities
5.1.1.1.2 Provide Organic Repair
5.1.1.1.3 Perform Contract Repair (Contractor)
5.1.1.2.1 Determine Requirements
5.1.1.2.2 Obtain / Renew Source
5.1.1.2.3 Produce / Deliver Asset
5.1.1.2.4 Supply Sustainment
5.1.1.2.5 Dispose of Asset
5.1.1.3.1 Analyze Problem/ Deficiency with Tech Data
5.1.1.3.2 Identify & Analyze Potential Data Corrections
5.1.1.3.3 Update Data
5.1.1.3.4 Quality Check Data
5.1.1.3.5 Publish & Distribute Data

Appendix B. Acquisition Networks

A. Concept Refinement Network

	(2) MAJCOM Requirements	(3) AFMC	(4) Lead Acquisition Organization	(5) Milestone Decision Authority (MDA)	(6) Federally Funded Research and Development Centers (FFRDC)	(7) Other Service Programs	(8) Joint Programs	(9) Allied Programs	(10) Industry	(11) Defense Intelligence Agency (DIA)	(12) Combatant Commanders (COCOM)	(13) MAJCOM Budget	(14) SAF/AQ	(15) SAF/FM	(16) AF/XP	(17) Air Force Research Lab (AFRL)	(18) Center Contracting (PK)	(19) Acquisition Center of Excellence (ACE)	(20) AFMC/DO	(21) AF/TE	(22) DOT&E	(23) OSD	(24) AF	(25) Joint Staff	Total
(2) MAJCOM Requirements	0	0	1	1	0	1	1	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	1	1	11
(3) AFMC	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3
(4) Lead Acquisition Organization	1	1	0	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	1	0	1	0	18
(5) Milestone Decision Authority (MDA)	1	0	1	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	8
(6) Federally Funded Research and Development Centers (FFRDC)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
(7) Other Service Programs	1	0	1	1	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	10
(8) Joint Programs	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	7
(9) Allied Programs	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	6
(10) Industry	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
(11) Defense Intelligence Agency (DIA)	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3
(12) Combatant Commanders (COCOM)	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
(13) MAJCOM Budget	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	4
(14) Service Acq Exec (SAF/AQ)	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	6
(15) SAF/FM	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	3
(16) AF/XP	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	4
(17) Air Force Research Lab (AFRL)	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4
(18) Center Contracting (PK)	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
(19) Acquisition Center of Excellence (ACE)	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
(20) AFMC/DO	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	3
(21) AF/TE	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	4
(22) DOT&E	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	3
(23) OSD	0	1	0	1	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	8
(24) AF	1	1	1	0	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	1	9
(25) Joint Staff	1	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	8

B. Technology Development Planning/Milestone Network

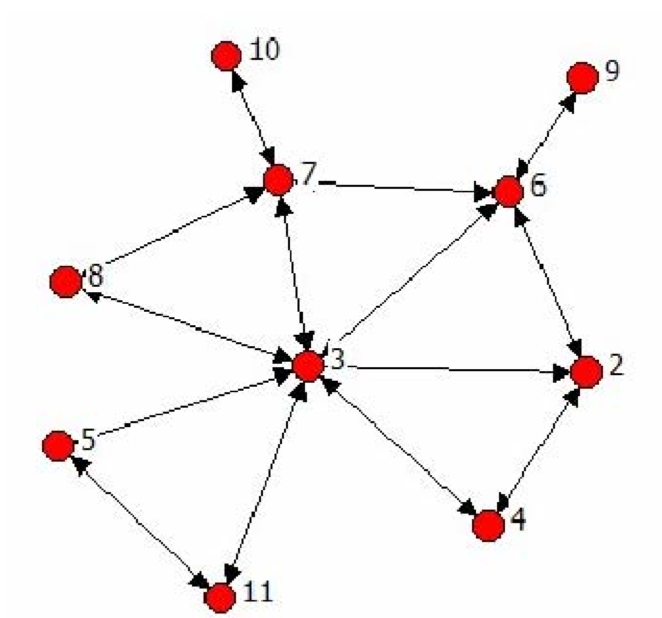
	(2) MAJCOM Requirements	(3) PEO	(4) Lead Acquisition Organization	(5) Milestone Decision Auth (MDA)	(6) OSD/NII	(7) AFMC/LG	(8) MAJCOM LG	(9) OSD (AT&L)	(10) Industry	(11) Defense Intelligence Agency (DIA)	(12) Combatant CCs	(13) MAJCOM Budget	(14) SAF/AQX	(15) SAF/FM	(16) AF/XP	(17) Air Force Research Lab (AFRL)	(18) Center Contracting (PK)	(19) Acq Center of Excellenc	(20) AFMC/DO	(21) AF/TE	(22) DOT&E	(23) OSD	(24) SECAF/ CSAF	(25) Joint Staff	(26) DAB Participants	(27) DARPA	(28) AF Acq Exec	
(2) MAJCOM Requirements	0	0	1	1	0	1	1	0	0	1	1	1	0	0	0	0	0	0	1	1	1	0	1	1	1	0	0	13
(3) PEO	0	0	1	1	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	1	0	1	9
(4) Lead Acquisition Organization	1	1	0	1	1	1	1	1	1	0	0	1	1	0	0	1	1	1	1	1	1	0	0	0	1	1	1	19
(5) Milestone Decision Authority	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	0	1	12
(6) OSD/NII	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	10
(7) AFMC/LG	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
(8) MAJCOM LG	1	0	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
(9) OSD (AT&L)	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	10
(10) Industry	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	4
(11) Defense Intelligence Agency	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
(12) Combatant Commanders	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	6
(13) MAJCOM Budget	1	0	1	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	6
(14) SAF/AQX	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	6
(15) SAF/FM	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	4
(16) AF/XP	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	5
(17) Air Force Research Lab (AFRL)	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
(18) Center Contracting (PK)	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
(19) Acquisition Center of Excellence	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
(20) AFMC/DO	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	4
(21) AF/TE	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	7
(22) DOT&E	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	1	0	1	11
(23) OSD	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	8
(24) AF	1	0	0	1	1	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	0	1	0	0	1	12
(25) Joint Staff	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	9
(26) DAB Participants	1	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	11
(27) DARPA	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
(28) AF Acq Exec	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	1	0	1	1	1	0	0	12

C. System Development and Demonstration Management/Design Network

	(2) MAJCOM Requirements	(3) PEO	(4) Program Office	(5) Milestone Decision Authority (MDA)	(6) Congress	(7) AFMC/LG	(8) MAJCOM LG	(9) OSD (AT&L)	(10) Contractor	(11) Sub Contractor	(12) Vendor	(13) MAJCOM Budget	(14) SAF/AQX	(15) SAF/FM	(16) AF/XP	(17) OSD(C)	(18) Center Contracting (PK)	(19) Center FM	(20) Test Ranges	(21) AFOTEC	(22) Center CE	(23) Center HR	(24) DCMA	(28) AF Acq Exec	
(2) MAJCOM Requirements	0	0	1	1	0	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	9
(3) PEO	0	0	1	1	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	9
(4) Program Office	1	1	0	1	0	1	1	0	1	1	0	1	1	0	0	0	1	1	1	1	1	1	1	1	17
(5) Milestone Decision Authority	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
(6) Congress	0	1	0	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	7
(7) AFMC/LG	1	0	1	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	6
(8) MAJCOM LG	1	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5
(9) OSD (AT&L)	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	6
(10) Contractor	1	1	1	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	1	0	11
(11) Sub Contractor	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	5
(12) Vendor	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
(13) MAJCOM Budget	1	1	1	0	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	8
(14) SAF/AQX	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	6
(15) SAF/FM	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	4
(16) AF/XP	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	3
(17) OSD(C)	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
(18) Center Contracting (PK)	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
(19) Center FM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	3
(20) Test Ranges	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4
(21) AFOTEC	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3
(22) Center CE	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
(23) Center HR	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
(24) DCMA	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
(28) AF Acq Exec	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6

D. Persistent Relationships from Concept Refinement Through System Development and Demonstration

	(2) MAJCOM Requirements	(3) Program Office	(4) Milestone Decision Authority	(5) Contractor	(6) MAJCOM Budget	(7) SAF/AQX	(8) Service Acq Exec (SAF/AQ	(9) SAF/FM	(10) AF/XP	(11) Center Contracting
(2) MAJCOM Requirements	0	1	1	0	1	0	0	0	0	0
(3) Program Office	1	0	1	1	1	1	1	0	0	1
(4) Milestone Decision Authority (MDA)	1	1	0	0	0	0	0	0	0	0
(5) Contractor	0	1	0	0	0	0	0	0	0	1
(6) MAJCOM Budget	1	1	0	0	0	1	0	1	0	0
(7) SAF/AQX	0	1	0	0	1	0	1	0	1	0
(8) Service Acq Exec (SAF/AQ)	0	1	0	0	0	1	0	0	0	0
(9) SAF/FM	0	0	0	0	1	0	0	0	0	0
(10) AF/XP	0	0	0	0	0	1	0	0	0	0
(11) Center Contracting	0	1	0	1	0	0	0	0	0	0



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