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Using a Modular Open Systems Approach in Defense Acquisitions: Implications for the Contracting Process

30 January 2006

by

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Graduate School of Business & Public Policy

Prepared for: PEO IWS 7.0 and
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Abstract

This research paper explores the use of the modular open systems approach (MOSA) as a method for implementing an evolutionary acquisition strategy and investigates the implications of using the MOSA on the contracting process. First, a background on evolutionary acquisition is presented from a perspective of current DoD acquisition regulations. Next, basic concepts of open systems are discussed, along with applications of the open systems approach to defense systems development and acquisition. The implications of using a modular open systems approach on the contracting process is then presented, with a focused discussion on the various contracting activities and documents related to each phase of the contracting process. The report uses the generally accepted phases of the contracting process—procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout to discuss the contracting activities and documents that should be affected by using a modular open systems approach. Additionally, a brief highlight of intellectual property issues is provided, along with a review of the applicable major regulatory provisions. The research concludes with the identification of the characteristics of a successful MOSA program procurement and resulting contract and provides areas for further study.

Key Words: evolutionary acquisition, contract management, open systems, procurement, systems engineering.

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Dr. Rene G. Rendon is on the faculty of the Graduate School of Business and Public Policy at the Naval Postgraduate School in Monterey, California, where he teaches acquisition and contract management courses in the MBA and Master of Science programs. Prior to his appointment at the Naval Postgraduate School, he served for more than 22 years in the United States Air Force, retiring at the rank of lieutenant colonel.

Rendon's Air Force acquisition career included assignments as the Director of Contracting for the Air Force Evolved Expendable Launch Vehicle (EELV) rocket program and the Space-based Infrared Systems (SBIRS) program at the Air Force Space and Missile Systems Center. Previous assignments also included warranted contracting officer positions for the Air Force F-22 Advanced Tactical Fighter program at the Air Force Aeronautical Systems Center and the Peacekeeper ICBM program for the Air Force Systems Command. His acquisition experience also includes an assignment as a Contracting Squadron Commander for an Air Force pilot training base, as well as a supply-chain manager with the NCR Corporation in Dayton, Ohio.

Rendon earned a Bachelor's of Business Administration degree from Angelo State University, a Master's of Business Administration degree from the University of North Dakota, and a Doctorate in Business Administration from Argosy University's Orange County, California campus. He has taught contract management courses for the UCLA Government Contracts Certificate program and is also a senior faculty member for the Keller Graduate School of Management where he teaches MBA courses in project management and contract management.

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He has received the prestigious Fellow Award from the NCMA, and he was recognized with the United States Air Force Outstanding Officer in Contracting Award. He has also received the NCMA National Education Award and the NCMA Outstanding Fellow Award. Dr. Rendon is co-author of *Contract Management Organizational Assessment Tools*, published by NCMA in 2005, and has also published articles in *Contract Management* magazine, *Program Manager* magazine, *Project Management Journal*, and the *PM Network* magazine. Rendon is a frequent speaker at universities and professional conferences.

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Table of Contents

Executive Summary

This research explores the use of the modular open systems approach (MOSA) as a method for implementing an evolutionary acquisition strategy as well as the implications of using such an approach on the contracting process.

A background on evolutionary acquisition is provided highlighting the benefit of rapid development and production of weapon systems incrementally, with each increment providing an increasing level of capability. The modular open systems approach (MOSA) is identified as an enabler for the evolutionary acquisition strategy, and a brief discussion on open systems is provided.

The contractual implications of using a modular open systems approach is then discussed, focusing on each of the six phases of the procurement process. Examples of MOSA-specific contracting activities and documents are taken from recent US Navy weapons systems acquisition programs such as the Navy's Common Enterprise Display System (CEDS) program, Anti-Submarine Warfare (ASW)/Undersea Warfare (USW) Test Information Management System program, Multi-mission Maritime Aircraft (MMA) program, Littoral Combat Ship (LCS) Mission Package Integrator program, Littoral Combat ship (LCS) Flight 0 Preliminary Design program, and the Navy's Mobile User Objective System (MUOS) program. Additionally, a brief highlight of intellectual property issues is provided, along with a review of the applicable major regulatory provisions.

The research identifies the following characteristics of a successful MOSA program procurement and resulting contract: Early involvement and participation of industry in the development of requirements and acquisition strategy; shared roles between the government and contractors in the development of the system specification and statement of work; the use of a best-value contract strategy consisting of the evaluation of offeror's technical, schedule, and past performance, as well as the offeror's cost and management approach; the use of a contract structure consisting of contractor incentives for meeting higher levels of "openness";

the documentation of contractor's past performance in meeting "openness" requirements, as well as the documentation of lessons learned and best practices on open systems.

Finally, the report recommends that further research be conducted on the following areas: Other DoD acquisition programs to evaluate the extent to which the identified MOSA contracting best practices and characteristics have been implemented in those departments; the effectiveness of award fee and award term provisions in incentivizing contractors to achieve higher levels of openness in designing and developing weapon systems, given the recent GAO findings concerning the use of award fees in DoD contracts; an analysis of current major weapon system acquisition programs status of MOSA implementation that is a required milestone review briefing point to the program's Milestone Decision Authority; the results of any OSJTF Program Assessment Rating Tool (PART) internal MOSA assessments on current defense acquisition programs; and, finally, the type and extent of training that is currently provided to contracting officers in the area of MOSA-based acquisition strategies.

Introduction

Department of Defense (DoD) weapon system acquisition programs continue to suffer from cost and schedule overruns, as well as operational performance deficiencies (GAO, 2005, November 15). In its many attempts to reinvent, reform, and transform what some consider a "broken acquisition process" (Johnson & Johnson, 2002), the DoD has been continuously implementing various initiatives within and policy changes to its acquisition and procurement processes (Rogers & Birmingham, 2004). Faced with the challenges of the Global War on Terrorism and the fiscal battles of budget cuts and resource constraints, the DoD is ambitiously trying to improve its weapon system acquisition policies and practices in order to more effectively and efficiently develop weapon systems with technological superiority and enhanced lethality.

The most recent and probably the most unprecedented change to the DoD acquisition policy has been the issuance of the latest revision to the DoD 5000 series of acquisition policy regulations (Under Secretary of Defense (AT&L), 2003, May 12a; 2003, May 12b). These revised regulations, which took the place of those previously cancelled for not being conducive to an acquisition environment that fosters flexibility, efficiency, creativity, and innovation (Rogers & Birmingham, 2004), provide acquisition managers a significant amount of flexibility in structuring and managing weapon system development programs. One method of providing flexibility into weapon system development has been the DoD preference for the use of evolutionary acquisition strategies in the development process. Consistent with the evolutionary approach is the use of modular open systems in the design and development of defense weapons and related systems. Using a modular open systems approach (MOSA) has significant implications for the various aspects of the acquisition program, such as requirements management, systems engineering, contract management, and logistics management, just to name a few.

The purpose of this research paper is to explore the use of the modular open systems approach (MOSA) as a method for implementing an evolutionary

acquisition strategy, and then to investigate the implications of using the MOSA approach on the contracting process. First, some background on evolutionary acquisition will be presented from a perspective of the current DoD acquisition regulations. Next, basic concepts of open systems will be discussed, along with applications of the open systems approach to defense systems development and acquisition. The implications of using a modular open systems approach on the contracting process will then be presented, with a focused discussion on the various activities and contractual documents related to each phase of the contracting process. The research will then conclude with the identification of characteristics of a successful MOSA program procurement and resulting contract.

Evolutionary Acquisition

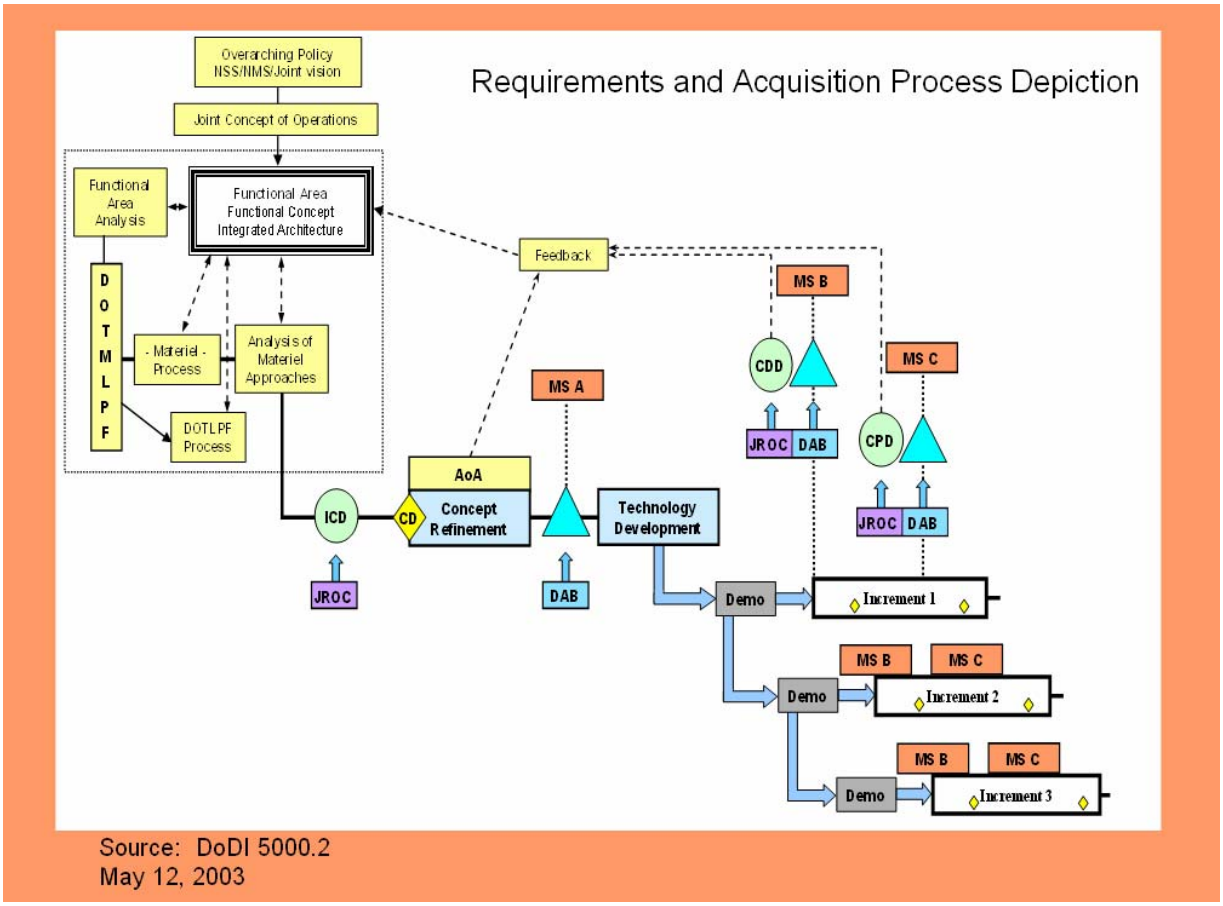
On 30 October, 2002, Deputy Undersecretary of Defense for Acquisition, Technology and Logistics [DUSD (AT&L)] Paul Wolfowitz issued a memo canceling the DoD 5000 series of acquisition policy documents stating they were, “Overly prescriptive and do not constitute an acquisition policy environment that fosters efficiency, creativity, and innovation” (Wolfowitz, 2002). On May 12, 2003, the DUSD (AT&L) officially implemented the revised DoD 5000 series documents with a policy focus on flexibility, responsiveness, innovation, discipline, and streamlined and effective management (Under Secretary of Defense (AT&L), 2003, May 12a; 2003, May 12b). Included in the updated DoD acquisition policy directive is a preference for evolutionary acquisition. The Defense Acquisition University’s (DAU) *Glossary of Defense Acquisition Acronym and Terms* (*Glossary*, 2003) defines evolutionary acquisition as the following:

> **Evolutionary Acquisition (EA)** The preferred DoD strategy for rapid acquisition of mature technology for the user according to DoDI 5000.2. An evolutionary approach delivers capability in increments, recognizing up front the need for future capability improvements. There are two approaches to achieving an EA: Spiral Development and Incremental Development as noted below:
>
> **Spiral Development**: In this process, a desired capability is identified, but the end-state requirements are not known at program initiation. Requirements are refined through demonstration, risk management, and continuous user feedback. Each increment provides the best possible capability, but the requirements for future increments depend on user feedback and technology maturation. According to DoDD 5000.1, spiral development is the preferred process for executing an EA strategy.

Incremental Development: In this process, a desired capability is identified, an end-state requirement is known, and that requirement is met over time by developing several increments, each dependent on available mature technology.

Evolutionary acquisition, then, is focused on rapidly developing and producing weapon systems, hardware or software, incrementally, with each increment providing an increasing level of operational capability. Evolutionary acquisition allows the development and acquisition of weapon systems to evolve over time, as technologies are matured and proven in the field. With evolutionary acquisition, weapon systems can be fielded in a more timely manner, albeit, with an initial increment of capability (for example, an 80% solution), as opposed to a fully capable system (100% solution) from the outset. The traditional acquisition strategy is based on developing and fielding a weapon system that attempts to accomplish the mission (100% solution) at the initial deployment. As described in the DoD Directive 5000.2 and Figure 1, the evolutionary acquisition strategy can be approached using either a spiral development or incremental development method.

Figure 1. Requirements and Acquisition Process Depiction



Source: DoDI 5000.2
May 12, 2003

The difference between the two approaches is that in the Spiral Development method, the end-state requirements are not known at program initiation. Each increment provides the best possible capability, but the requirements for future increments depend on user feedback and technology maturation. In the Incremental Development method, the end-state requirement is known, and that requirement is met over time by developing several increments, each dependent on available mature technology (Under Secretary of Defense (AT&L), 2003, May 12a; 2003, May 12b). The Air Force Global Hawk program is considered to be the leading pioneer in implementing evolutionary acquisition using a spiral development approach (Novak et al., 2004).

Thus, evolutionary acquisition is aimed at reducing acquisition cycle-time and reducing risk in the development of operationally effective systems. Evolutionary

acquisition is the preferred approach, and spiral development is the preferred process for executing evolutionary acquisition (Under Secretary of Defense (AT&L), 2003, May 12a; 2003, May12b).

A key enabler for implementing evolutionary acquisition strategies is the use of a modular open systems approach (MOSA) in the design and development of weapons and related systems. MOSA will allow for a more efficient and effective method for increasing the technological capability of developed systems, thus supporting an incremental or spiral development evolutionary acquisition strategy. The next section of this paper will introduce the modular open systems approach and discuss the basic concepts of open systems as well as the applications of the modular open systems approach to defense systems development and acquisition.

The Open Systems Approach

DoD 5000.1 states that “a modular open systems approach shall be employed where feasible” (Under Secretary of Defense (AT&L), 2003, May 12a). Furthermore, in April 2004, the USD (AT&L) issued a memorandum stating, “all programs subject to milestone review shall brief their program’s MOSA implementation status to the Milestone Decision Authority (MDA) to determine compliance” (Under Secretary of Defense (AT&L), 2004, April 5). Later that year, the Office of the USD(AT&L), Director of Defense Systems, issued instructions for MOSA implementation and identified the Open System Joint Task Force (OSJTF) as the DoD lead for MOSA. This memo also identified MOSA as “an integral part of the toolset that will help DoD achieve its goal of providing the joint combat capabilities required in the 21st century, including supporting and evolving these capabilities over their total life-cycle” (Under Secretary of Defense (AT&L), 2004, July 7).

The OSJTF identified the modular open systems approach as being an enabler to achieving the following objectives (*OSJTF guide*, 2004):

- Adapt to evolving requirements and threats
- Promote transition from science and technology into acquisition and deployment
- Facilitate systems integration
- Leverage commercial investment
- Reduce the development cycle-time and total lifecycle cost
- Ensure that the system will be fully interoperable with all the systems with which it must interface, without major modification of existing components
- Enhance commonality and reuse of components among systems
- Enhance access to cutting edge technologies and products from multiple suppliers
- Mitigate the risks associated with technology obsolescence
- Mitigate the risk of a single source of supply over the life of a system

- Enhance lifecycle supportability
- Increase competition

OSJTF has developed the Program Assessment Rating Tool (PART) for conducting internal MOSA implementation assessments (Undersecretary of Defense (AT&L), 2004, July 7). These recent policy directives are reflective of the increased emphasis the DoD is placing on using an open-systems approach.

It should be noted that various terms have been used to describe various aspects of "open systems." The following is an initial explanation of key terms and definitions that will be referred to in this study:

> **Modular Open Systems Approach (MOSA):** An integrated business and technical strategy that employs a modular design and, where appropriate, defines key interfaces using widely supported, consensus-based standards that are published and maintained by a recognized industry standards organization. (*OSJTF guide*, 2004)
>
> **Open Architecture:** An architecture that employs open standards for key interfaces within a system. (*OSJTF guide*, 2004)
>
> **Open Standards:** Standards that are widely used, consensus based, published and maintained by recognized industry standards organizations. (*OSJTF guide*, 2004)
>
> **Open System:** A system that employs modular design, uses widely supported and consensus-based standards for its key interfaces, and has been subjected to successful validation and verification tests to ensure the openness of its key interfaces. (*OSJTF guide*, 2004)
>
> **Open Systems Acquisition of Weapons Systems:** An integrated technical and business strategy that defines key interfaces for a system (or a piece of equipment under development) in accordance with those adopted by formal consensus bodies (recognized industry standards bodies) as specifications

and standards, or commonly accepted (de facto) standards (both company proprietary and non-proprietary) if they facilitate utilization of multiple suppliers. (*Glossary*, 2005)

Open Systems Environment (OSE): A comprehensive set of interfaces, services, and supporting formats, plus aspects of interoperability of application, as specified by Information Technology (IT) standards and profiles. An OSE enables information systems to be developed, operated, and maintained independent of application-specific technical solutions or vendor products. (*Glossary*, 2005)

As can be seen from the above definitions, there are unique differences within the various "open-related" terms. The unique differences noted, for the basis of this research, focus on the distinction between *strategy* and *system*. The *Modular Open Systems Approach* (MOSA) term focuses on the *strategy*, specifically, an integrated business and technical strategy that employs the various components of an *open system.* The *Open System* term focuses on the technical aspects of the system and its components, such as modular design, open standards, open architecture. This seems to be effectively delineated in the Definitions section of the OSJTF Program Manager's Guide to a Modular Open Systems Approach (MOSA) to Acquisition. The DAU *Glossary*'s unique terms are not as clear in this delineation. It is this author's interpretation of the DAU *Glossary* that *Open Systems Acquisition of Weapons Systems* refers to the integrated strategy focus, while the *Open Systems Environment (OSE)* refers to the technical aspects of open systems, specifically interfaces services and formats. For the purpose of this research, the term *Modular Open Systems Approach (MOSA)* will refer to the integrated strategy, which involves the use of open systems, and the term *Open Systems* will refer to the technical aspects of developing and using an open system. The following section will discuss open systems, the modular open systems approach (MOSA), and its applications in defense systems development and acquisition.

Open Systems and Modular Open Systems Approach (MOSA)

The modular open systems approach is considered an enabler to successfully implementing an Evolutionary Acquisition strategy. While Evolutionary Acquisition focuses on rapidly developing and producing weapon systems incrementally, with each increment providing an increasing level of operational capability, the modular open systems approach ensures access to the latest technologies and products and facilitates affordable and supportable system development and modernization of fielded assets (*Defense acquisition guidebook*, 2004).

The *Defense Acquisition Guidebook* (*DAG*) states that "an open system is a system that employs modular design tenets, uses widely supported and consensus based standards for its key interfaces, and is subject to validation and verification tests to ensure the openness of its key interfaces" (*Defense acquisition guidebook*, 2004). The OSJTF defines modular open systems approach (MOSA) as:

> An integrated business and technical strategy that employs a modular design and, where appropriate, defines key interfaces using widely supported, consensus-based standards that are published and maintained by a recognized industry standards organization (*OSJTF guide,* 2004).

This definition focuses on the key aspect of "an integrated business and technical strategy," thus, using an open systems approach is as much about business strategy as it is about technical strategy and requirements.

A technical definition of an open system is provided by Meyers and Oberndorf:

> a collection of interacting software and hardware component implementations, and users designed to satisfy stated needs, having the interface specification of components fully defined, available to the public, and maintained according to group consensus, in which the component implementations conform to the interface specification. (2001, p. 12)

Key to this definition of open systems is the “fully defined interface specification,” “available to the public,” and “maintained according to a group consensus,” since these aspects of open systems provide the desired results of portable implementation and interoperability. Other advantages of using an open system approach include lower costs, less reliance on proprietary solutions, shorter development schedule, better tested products, and more stable technology insertion. Of course, some of the disadvantages of using an open system approach include higher cost, higher risk, inability to meet special requirements, and conformance and support problems (Meyers & Oberndorf, 2001).

Given these advantages and disadvantages of using an open systems approach, and not withstanding the USD(AT&L) policy, the *Defense Acquisition Guide* (*DAG*) stresses that program managers should employ an open systems approach only after conducting a business case analysis considering trade studies, cost models, and market research. This business case analysis should focus on analyzing technology and open standard trends, as well as the level of market support for these needed technologies and standards (*Defense acquisition guidebook*, 2004). More specifically, the *DAG* states:

> Program managers should employ an open systems design strategy only after careful analysis of required capabilities and strategies for technology development, acquisition, test and evaluation, and product support. They should also analyze the impacts of information assurance, systems safety and security, commercial, off-the-shelf availability, and other design considerations before finalizing their open systems design strategy. (2004)

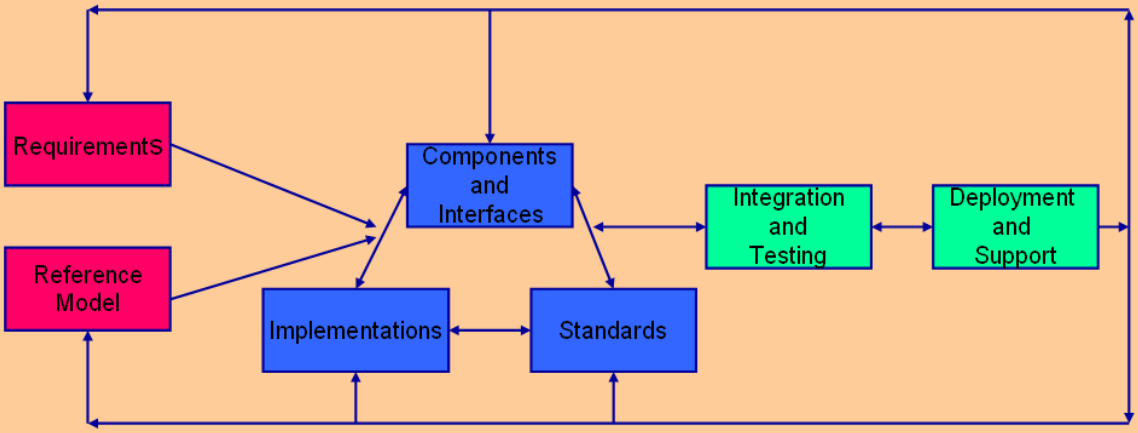
Meyers and Oberndorf identify seven elements of an open systems approach. They describe these seven elements as follows (2001):

1. **Requirements:** Establishing a system baseline in terms of standards and commercial-of-the-shelf (COTS) products, specifying system requirements and prioritizing requirements.

2. **Reference Models:** Creating a high-level system model that defines terminology and concepts.
3. **Components and Interfaces:** This involves documenting the architecture to reflect the evaluation of architectural approaches, as well as the identification of components, the survey of technology, and prototyping.
4. **Standards:** Documenting standards coordination reflecting the evaluation and selection of standards, establishing liaisons with standards bodies and users groups, as well as resolving inconsistencies between standards.
5. **Implementations:** Implementing selected standards resulting from the evaluation, selection, procurement, and testing of these standards.
6. **Integration and Testing:** This involves the integration of component implementations and the testing of the integrated system.
7. **Deployment and Support:** The distribution and maintenance of the system, including all related lifecycle maintenance.

Meyers and Oberndorf describe these seven elements as having an iterative and interactive relationship. Specifically, the components and interfaces, standards, and implementation elements have an iterative relationship with each other, as well as with the other four elements. Figure 2 reflects the iterative and interactive nature of all seven elements of the open system approach (2001).

Figure 2. Iteration and Interaction of Open System Approach Elements



Source: Adapted from *Managing Software Acquisition: Open Systems and COTS Products*. Meyers and Oberndorf, Addison-Wesley, 2001.

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MOSA and Evolutionary Acquisition

As previously stated, the open systems approach is considered an enabler to successfully implementing an evolutionary acquisition strategy. The use of an open systems approach is just one consideration which the program manager must make in developing an acquisition strategy. In developing an acquisition strategy, the program manager must consider a variety of topics and activities to include in the acquisition. The *Defense Acquisition Guidebook* (*DAG*) lists eighteen different areas to consider in developing an acquisition strategy—a modular open systems approach is one of those considerations. The *DAG* also identifies the use of an open systems approach as a best practice that avoids imposing Government-unique restrictions that significantly increase industry compliance cost or unnecessarily deter qualified contractors, including non-traditional defense firms, from submitting a proposal. The open systems approach is also identified as an example of a robust systems engineering process that ensures that systems are designed to easily and affordably accommodate additive capabilities in subsequent increments (*Defense acquisition guidebook*, 2004).

Specifically, the *DAG* states that the program manager should plan for MOSA implementation and include a summary of such planning as part of the overall acquisition strategy and, to the extent feasible, the technology development strategy. The summary of the MOSA planning should describe:

1. How MOSA fits into a program's overall acquisition process and strategies for acquisition, technology development, and T&E;
2. What steps a program will take to analyze, develop, and implement a system or a system-of-systems architecture based on MOSA principles, and
3. How such a program intends to monitor and assess its MOSA implementation progress and ensure system openness. (2004)

A business case analysis for using an open systems design should be conducted by the program manager. This analysis should include market research,

dynamic cost models, and trade studies. Furthermore, if program managers decide to implement an open systems approach, their MOSA plan should consider the five MOSA principles listed below, and also described in the Open Systems Joint Task Force Guide to MOSA (*Defense acquisition guidebook*, 2004; *OSJTF guide*, 2004).

Establish an Enabling Environment

This involves establishing supportive requirements, business practices, and strategies for technology development, acquisition, test and evaluation and product support needed for the effective development of open systems. Also included are the following: assigning responsibility for MOSA implementation, ensuring appropriate experience and training on MOSA, continuing market research and proactive identification, and overcoming of barriers or obstacles that can potentially slow down or even, in some cases, undermine effective MOSA implementation.

Employ Modular Design

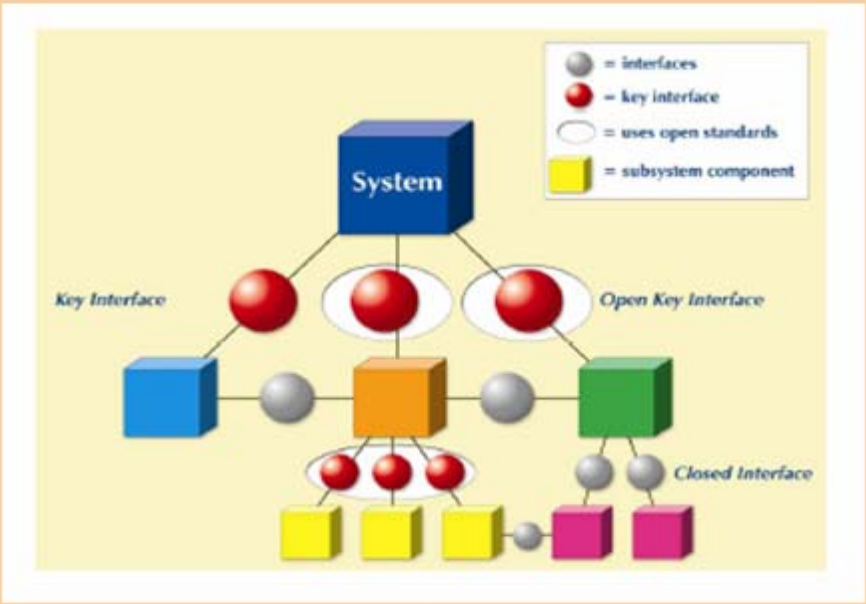
Effective modular design refers to the four major modular design tenets of Cohesiveness (the module contains well-focused and well-defined functionality), Encapsulation (the module hides the internal workings of its behavior and its data), Self-Containment (the module does not constrain other modules), and Highly Binded (the modules use broad modular definitions to enable commonality and reuse). This principle states that by following these four tenets, each module will be designed for change, and the interface to each module will be defined in such a way as to reveal as little as possible about its inner workings which facilitate the standardization of modular interfaces.

Designate Key Interfaces

This principle stresses that designers should group interfaces into two categories—key and non-key interfaces. Such distinction enables designers and configuration managers to distinguish among interfaces that exist between technologically stable and volatile modules, between highly reliable and more frequently failing modules, between modules that are essential for net-centricity and

those that do not perform net-centric functions, and between modules that pass vital interoperability information and those with least interoperability impact. Employing this principle will help acquisition managers effectively manage hundreds and, in some cases, thousands of interfaces that exist within and among systems. Figure 3 illustrates how the MOSA approach distinguishes between key and non-key interfaces, with the key interfaces utilizing open standards in order to reap the most lifecycle cost benefits (*OSJTF guide*, 2004).

Figure 3. Types of System Interfaces



Source: *Program Managers Guide: A Modular Open Systems Approach (MOSA) to Acquisition.* Open Systems Joint Task Force, September 2004

Use Open Standards

This principle stresses that standards should be selected based on maturity, market acceptance, and allowance for future technology insertion. Since interface standards must be well defined, mature, widely used and readily available, the principle refers to the order of priority given to the use of open interfaces**.** Preference is given to the use of open interface standards first, the de facto interface standards second, and finally, government and proprietary interface standards. Basing design strategies on widely supported open standards increases the chance that future changes will be able to be integrated in a cost effective manner.

Certify Conformance

This principle focuses on the verification and validation of a system's openness through the use of such mechanisms as interface control and management as well as proactive conformance testing and certification. Using these mechanisms, the program manager ensures that the system and its component modules conform to the external and internal open interface standards allowing plug-and-play of modules, net-centric information exchange, and re-configuration of mission capability in response to new threats and evolving technologies. A preference is made for the use of the MOSA Program Assessment and Review Tool (PART) developed by the Open Systems Joint Task Force (OSTJ) to assess the compliance with open systems policies and ensure that acquisition programs are properly positioned to reap the open systems benefits (*Defense acquisition guidebook*, 2004).

Program offices should follow these five MOSA principles to guide their efforts in ensuring access to the latest technologies and products, achieving interoperability, and facilitating affordable and supportable modernization of fielded assets. Following these principles will also be needed to ensure delivery of technologically superior, sustainable, and affordable increments of militarily useful capability within an evolutionary acquisition strategy context. As program offices use these five MOSA principles to guide their implementation of a modular open system

approach in their acquisition programs, the implications of these principles should permeate throughout all aspects of the acquisition process. One major area in which the MOSA strategy should have a significant influence is the contracting process. The implications of using a MOSA approach to acquisition and contracting will be discussed in the next section of this paper.

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Contractual Implications

The defense acquisition process consists of an integrated framework involving many different functional areas—including engineering, test and evaluation, manufacturing and production and logistics, to name just a few. The various functional areas are integrated, typically through the formation of multi-functional teams, or integrated product teams (IPTs), to facilitate the delivery of a specific supply or service to the ultimate user (Engelbeck, 2002). One of the most critical, yet frustrating and convoluted functional area within acquisition is the contracting process. The contracting process, with its intricate web of statutory policies, rules, and procedures is already a challenging area of any traditional acquisition program. Given the dynamics and twists of an evolutionary acquisition program, complete with increments and spirals, the use of an open systems approach will only make the contracting process that much more challenging. This is the focus of the remainder of this paper—to identify what are the implications on the contracting process of using a MOSA approach in an evolutionary acquisition program. A specific focus will be on MOSA implications on the six phases of the contracting process—procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout. This section will first discuss the policy and guidance provided in the Federal Acquisition Regulation (FAR) for use by contracting officers in an acquisition program using a modular open systems approach. Then the various approaches to determining the roles and responsibilities of the government and contractor in a MOSA-based acquisition will be discussed. The research will then identify any specific contracting activity or documents that should be impacted by pursuing a modular open systems approach to a weapon system acquisition. Finally, the research will conclude with the identification of characteristics of a successful MOSA program acquisition and resulting contract.

Contracting Policy and Guidance

In July 1996, Executive Order (EO) 13011, Federal Information Technology, was issued to improve information system acquisition management. Specifically, Section 2(e) of E.O. 13011 requires:

> (e) where appropriate, and in accordance with the Federal Acquisition Regulation and guidance to be issued by the Office of Management and Budget (OMB), structure major information systems investments into manageable projects as narrow in scope and brief in duration as practicable, consistent with the Information Technology Act, to reduce risk, promote flexibility and interoperability, increase accountability, and better correlate mission need with current technology and market conditions. (Federal register, 1996)

It was not until February 1998 that the Federal Acquisition Regulation (FAR) added specific guidance concerning using a modular contracting approach. With Federal Acquisition Circular (FAC) 97-04, the FAR incorporated “modular contracting” into FAR Part 39, Acquisition of Information Technology, as a preferred method for acquiring major systems of information technology. Defining “modular contracting” as “using one or more contracts to acquire information technology systems in successive interoperable increments,” the FAR states that modular contracting is “intended to reduce program risk and to incentivize contractor performance while meeting the government needs for timely access to rapidly changing technology” (FAR, 39.103). The FAR also states that when using modular contracting, the acquisition of an information technology system may be divided into several smaller acquisition increments that:

1. Are easier to manage individually than would be possible in one comprehensive acquisition;
2. Address complex information technology objectives incrementally in order to enhance the likelihood of achieving workable systems or solutions for attainment of those objectives;

3. Provide for delivery, implementation, and testing of workable systems or solutions in discrete increments, each of which comprises a system or solution that is not dependent on any subsequent increment in order to perform its principal functions;
4. Provide an opportunity for subsequent increments to take advantage of any evolution in technology or needs that occur during implementation and use of the earlier increments; and
5. Reduce risk of potential adverse consequences on the overall project by isolating and avoiding custom-designed components of the system. (FAR, 39.103)

In providing guidance on the characteristics of an increment acquired in using a modular contracting approach, the FAR states that:

(1) To promote compatibility, the information technology acquired through modular contracting for each increment should comply with common or commercially acceptable information technology standards when available and appropriate, and shall conform to the agency's master information technology architecture.

(2) The performance requirements of each increment should be consistent with the performance requirements of the completed, overall system within which the information technology will function and should address interface requirements with succeeding increments. (FAR, 39.103)

Finally, the FAR guidance concerning contract type and method for use in modular contracting directs contracting officers to choose an appropriate contracting technique that facilitates the acquisition of subsequent increments. The FAR states that contracting officers shall select the contract type and method, pursuant to FAR Parts 16 and 17, appropriate to the circumstance. These contract types include indefinite delivery/indefinite quantity contracts, single contract with options, successive contracts, multiple awards, and task order contracts (FAR, 39.103).

It should be noted that the FAR Part 39 guidance on modular contracting is specifically geared to the acquisition of commercial information technology systems and not necessarily to weapon system acquisitions or even DoD software intensive systems. Although information technology systems are an integral part of the DoD

infrastructure, this research paper will focus on the contractual implications of using a modular open systems approach in the acquisition of defense weapon systems and specifically, the acquisition of software-intensive weapon systems. In conducting this research, a specific emphasis will also be placed on the roles and responsibilities of the government and industry during the acquisition program and the specific procurement processes consisting of procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout.

In addition to the Federal Acquisition Regulation (FAR), there are other sources of contracting guidance for using a modular open systems approach in an acquisition program. These sources include (see List of References):

Open Systems Joint Task Force (OSJTF) Program Manager's Guide to a Modular Open Systems Approach (MOSA) to Acquisition (2004)

Office of the Undersecretary of Defense (OUSD) (AT&L) DRAFT Guide for Contracting for Systems Engineering (2005)

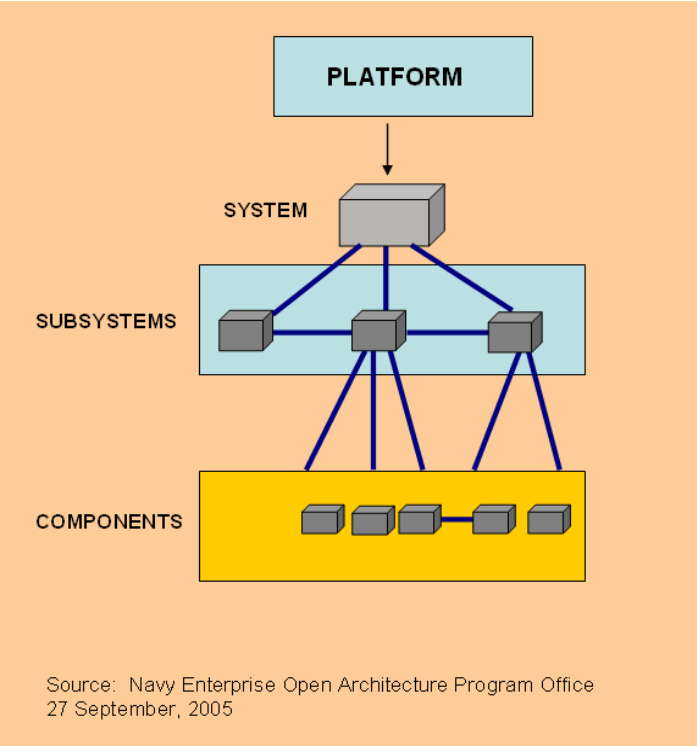
Netcentric Enterprise Solutions for Interoperability (NESI) Net-Centric Implementation, Part 6: Acquisition Guidance (2005)

These sources of guidance provide the users with more detailed information on the contracting aspects of using a modular open systems approach to contracting. They provide examples, checklists, and recommended language for the various contractual documents used in the acquisition process. This research has determined that these sources are proving to be very beneficial in helping develop successful contracts for acquisition programs using a modular open systems approach.

Before proceeding any further with a discussion of the contractual implications of using an open systems acquisition approach, a distinction must be made concerning the various levels of applications of open systems. Care must be taken to ensure that any discussion of the application of open systems takes into consideration the various reference points in terms of the overall weapon system structure. As weapon system technologies continue to advance and emerge, these

systems are becoming more complex and complicated; thus, it is important to identify the specific reference point of discussion. Weapon systems can be viewed as containing four different levels—platform, system, subsystem, and component, as illustrated in Figure 4 (US Navy, 2005, September 27). For example, open system applications may be discussed at the platform level referring to the Littoral Combat Ship (LCS), or at the system level referring to the sonar system, or at the subsystem level, referring to the passive sonar subsystem, or even at the component level referring to the sonar data processor.

Figure 4. Open-systems Approach Application Levels



Roles and Responsibilities during the Acquisition Process

A major consideration in developing the contracting strategy for an acquisition using an open systems approach is the determination of roles and responsibilities of the buyer and the contractor(s). The determination of roles and responsibilities will have a significant impact on the resulting contracting strategy for the acquisition program and will most likely influence the level of "openness" achieved in the design and development of the weapon system. This determination basically centers on the degree of control of the requirements—that is, the *degree* of control of the interface standards within and between any of the four application levels (platform, system, subsystem, component) and the *source* of that control. Meyers and Oberndorf describe five different approaches to allocating roles and responsibilities in an open systems acquisition program (2001). These five approaches are differentiated by the degree of control allocated to the buyer and the contractor during the selected steps in the acquisition process. The selected steps in the acquisition process include Specifying the Requirements, Selecting the Standards, Profiling the Standards, Conducting Conformance Qualifications, Selecting Standards-based COTS Products, and Integrating the System. These different approaches are labeled as Control, Direct, Guide, Initiate, and Joint, and reflect the varying degrees of control between the buyer and the contractor. They are illustrated in Figure 5 and described below.

Figure 5. Strategies for Determining Roles and Responsibilities

Acquisition Step	Control	Direct	Guide	Initiate	Joint
Specify Requirements	Buyer	Buyer	Buyer	Buyer	IPT
Select Standards	Buyer	Buyer	Contractor	Contractor	IPT
Profile Standards	Buyer	Buyer	Contractor	Contractor	IPT
Conduct Conformance Qualification	Buyer	Contractor	Contractor	Contractor	IPT
Select Standards-Based COTS Products	Buyer	Contractor	Contractor	Contractor	IPT
Integrate System	Contractor	Contractor	Contractor	Contractor	Contractor

Source: Adapted from *Managing Software Acquisition: Open Systems and COTS Products*. Meyers and Oberndorf, Addison-Wesley, 2001.

On one end of the continuum is the Control strategy. In the Control strategy, the buyer's roles and responsibilities include specifying the system requirements, selecting the standards, profiling the standards, conducting the conformance qualifications, and selecting the standards-based COTS products. The role of the contractor is that of the system integrator. Thus, the buyer has the most control during these select steps of the acquisition process.

In the Direct or Guide strategies, there is a mixture of roles and responsibilities and a sharing of control between the buyer and the contractor. In the Direct strategy, the control of the selected acquisition steps is equally shared between the buyer and contractor. The buyer specifies the system requirements, selects the standards, and profiles the standards. The contractor conducts the conformance qualifications, selects the standards-based COTS products, and performs as the systems integrator. In the Guide strategy, the control begins to shift to the contractor. The buyer specifies the system requirements and selects/recommends the standards set, while the contractor selects and

recommends the standards, profiles the standards, conducts the conformance qualifications, and selects/recommends the standards-based COTS products, as well as performs as the systems integrator.

On the opposite side of the continuum is the Initiate strategy, where most of the control belongs to the contractor. The buyer specifies the requirements, but the contractor then selects/recommends the standards, profiles the standards, conducts the conformance qualifications, and selects/recommends the standards-based COTS products, as well as performs as the systems integrator.

A Joint strategy is also an optional strategy for determining roles and responsibilities in the acquisition of open systems-based products. This strategy is basically the application of the Integrated Product Team (IPT) approach to the acquisition process. In this process, the roles and responsibilities for the acquisition steps are shared between the buyer and contractor using IPTs, with the contractor ultimately taking on the role of the systems integrator (Meyers & Oberndorf, 2001).

Contracting Strategy

The Federal Acquisition Regulation (FAR) Part 34 describes policy and guidance for major systems acquisition. The FAR states that agencies acquiring major systems shall:

> (a) Promote innovation and full and open competition as required by Part 6 in the development of major system concepts by
>
> > (1) Expressing agency needs and major system acquisition program objectives in terms of the agency's mission and not in terms of specified systems to satisfy needs, and
> >
> > (2) Focusing agency resources and special management attention on activities conducted in the initial stage of major programs; and
>
> (b) Sustain effective competition between alternative system concepts and sources for as long as it is beneficial. (FAR, 34.002)

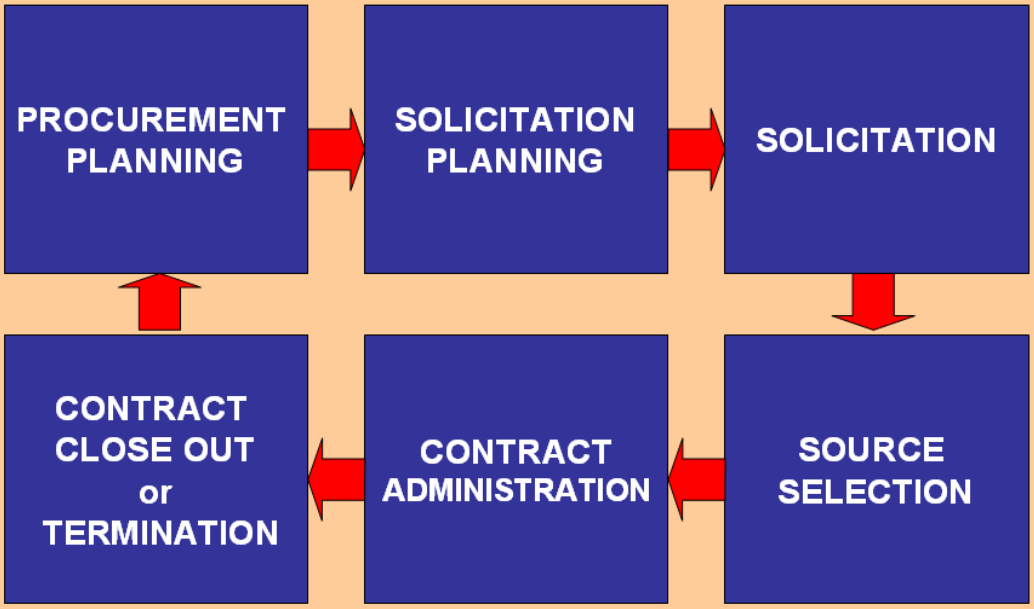
Thus, the program acquisition strategy should describe agency needs and objectives using mission-related or performance-based terms. In addition, the contracting strategy should flow from the acquisition strategy, and both should be consistent in goals and objectives. An acquisition strategy using a modular open systems approach should be focused on critical areas such as adopting evolving requirements, promoting technology transfer, facilitating system integration, leveraging commercial investment, reducing cycle-time and lifecycle cost, ensuring interoperability, enhancing commonality and reuse, enhancing access to cutting edge technologies and products from multiple suppliers, mitigating technology obsolescence risk, mitigating single source of supply risk, enhancing lifecycle supportability, and increasing competition. Using a modular open systems approach will enable the acquisition to reach these objectives (*OSJTF guide*, 2004). Therefore, the contracting strategy supporting a MOSA-based acquisition strategy should be structured to achieve these MOSA objectives. This research will discuss

how the contracting strategy should be structured to achieve these MOSA objectives.

As previously stated, the determination of roles and responsibilities has a significant impact on the resulting contracting strategy for the acquisition program. This determination of roles and responsibilities centers on the degree of control of the requirements—that is, the *degree* of control of the interface standards within and between any of the four application levels and the *source* of that control. We will return to this discussion on degree of control on the interface standards, specifically as it relates to the contractual documents used in the acquisition, later in this research report.

The desired alignment of roles and responsibilities in an acquisition program using a modular open systems approach should be properly reflected in the various contracting documents and contractual language developed during the contracting process. The next section of this research will focus on the various contractual documents prepared, contractual language developed, and contracting activities performed during the acquisition process, as well as on the implications of using a modular open systems approach on those documents, language, and activities. This discussion will follow the generally accepted contracting process as a construct for discussing the contracting activities that are or should be affected by an acquisition pursuing a modular open systems approach. This contracting process consists of the following phases—procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout as illustrated in Figure 6 (Garrett & Rendon, 2005). Each of these contracting phases will be discussed, along with key practice activities. The implications for using a modular open systems approach will be addressed as it relates to each contracting phase. References will be made to recent or ongoing acquisition programs to amplify the discussion of these phases.

Figure 6. The Procurement Process



Source: Adapted from *Contract Management: Organizational Assessment Tools*. Garrett and Rendon, NCMA, 2005.

Procurement Planning

Procurement planning is the first contracting phase and involves identifying which business needs can be best met by procuring products or services outside the organization. This process involves determining whether to procure, how to procure, what to procure, how much to procure, and when to procure. Key practice activities included within the procurement planning phase include determining the initial scope of work or the description of the product in the acquisition, conducting market research to analyze the level of technologies and types of products and services available in the marketplace, determining funds availability, and developing initial cost and schedule estimates as well as manpower resources. Developing an initial Statement of Work (SOW) and Work Breakdown Structure (WBS) are also included in the procurement planning phase. Conducting an initial integrated assessment of contract-type selection, risk management, and an initial analysis of potential contract

terms and conditions is also part of the procurement planning process (Garrett & Rendon, 2005). It should be noted that many of the contractual documents developed in the procurement planning phase are initial draft documents, such as SOWs, WBSs, project scope statements, and funding and manpower estimates. These are initial draft documents simply because they are typically modified and revised as the acquisition program office becomes more knowledgeable of the business and technical aspects of the program. Industry business and technical knowledge are typically acquired through the use of market research activities, industry conferences, and Requests for Information (RFIs).

Market Research

Market research is a critical step in the acquisition of open systems-based programs. The Federal Acquisition Regulation (FAR) states that agencies must conduct market research appropriate to the circumstances before developing new requirements documents for an acquisition by that agency and before soliciting offers for acquisitions with an estimated value in excess of the simplified acquisition threshold (FAR 10). It is during this process that the buyer determines the availability of COTS products and open systems-based products, as well as determines if these available products will meet the specified acquisition requirements. Market research activities focus on acquiring knowledge of current market practices, technologies, capabilities, products, and future trends in areas related to the acquisition. Given the objectives of using a modular open systems approach, market research is extremely critical in leveraging commercial investment, enhancing access to cutting-edge technologies and products and increasing competition. Market research should also be used in an open systems-based acquisition to determine the capabilities of contractors to use open systems approaches and to comply with contractual requirements for using open systems approaches. A market research technique is the benchmarking of industry best practices related to the development and use of open systems in product development (Garrett & Rendon, 2005).

Industry Conferences

Industry conferences are also used for obtaining industry knowledge related to the development of the solicitation (as well as the acquisition in general). Industry conferences can provide valuable information in the areas of state of technologies and market practices concerning the use of open systems and the development of open systems architectures in product development and acquisition. Industry conferences serve two main purposes—to inform industry about the technical requirements and acquisition planning of the program and to solicit industry inputs for the pending program (Office of the Undersecretary of Defense (AT&L), 2005). A list of systems engineering-related suggested topics for industry conferences is provided in *The Guide for Contracting for Systems Engineering (Draft)* and is found in Appendix A.

An example of the use of industry conferences is the Navy's Common Enterprise Display System (CEDS) acquisition program. The Common Enterprise Display System (CEDS) program establishes a family of common display systems that will be implemented across platform systems on Navy surface ships, submarines, and aircraft. CEDS will be designed to be compliant with Open Architecture Computing Environment (OACE) requirements and will implement a common presentation using Human Systems Integration (HSI) design techniques. Through multi-mission functionality, CEDS will enhance survivability and re-configurability by allowing watchstanders access to their applications at any platform display workstation. These CEDS systems will support Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR), as well as Hull, Mechanical and Electrical systems (HM&E) display requirements (US Navy, 2005, September 9c). The CEDS program conducted an industry conference for the purpose of obtaining information from industry to improve the Request for Proposal (RFP) and to provide information to industry on the basic requirements of the acquisition (US Navy, 2005, August 30). The use of the Industry Conference results in increased and enhanced communication between the program office and interested offerors. This communication provides long-term benefits to the program and greatly adds to the success of the acquisition.

Request for Information

Requests for Information (RFIs) are used as a market research technique for the purpose of gathering information from industry to be used in planning an acquisition. Government agencies typically use RFIs as a source of information for understanding, developing, defining and refining the acquisition requirement. It should be noted that RFIs are not solicitation notices, nor do they commit the government to issuing a solicitation or even continuing with the acquisition. RFIs are also used as a method for identifying potential offerors for an upcoming acquisition. These types of RFIs are also known as Sources Sought Synopses. RFIs typically have the following language as part of the posted notice:

> THIS IS A REQUEST FOR INFORMATION ONLY. The Government does not intend to award a contract or any other type of agreement on the basis of this synopsis or to otherwise pay for the information solicited under this synopsis. This is NOT a request for a proposal or an invitation for bid, merely a request for information only. The information provided through the responses will be used to aid in requirements definition for future acquisitions. (Appendix B)

Given the objectives of managing an acquisition using a modular open systems approach, RFIs, along with other market research techniques, are extremely valuable for acquiring knowledge of current market practices, technologies, capabilities, products, and future trends in areas related to the acquisition. This information will effectively support the MOSA objectives of leveraging commercial investment, enhancing access to cutting edge technologies and products, and increasing competition. RFIs can be effective in determining the capabilities of contractors to use open systems approaches and to comply with contractual requirements for using open systems approaches. RFIs can also provide information on a potential offeror's past performance in integrating technical and management processes in prior programs (Office of the Undersecretary of Defense (AT&L), 2005).

An example of an RFI is included in Appendix B. This specific RFI is for the purpose of determining the interest and capability of industry for development and integration of an Anti-Submarine Warfare (ASW)/Undersea Warfare (USW) Test Information Management System. The system will provide information management, data processing, and instrumentation resources. The Government is interested in obtaining information from industry to identify existing commercial off-the-shelf test information management systems, or ongoing or planned development efforts for test data modernization studies. The information provided through the responses will be used to aid in requirements definition for future acquisitions (US Navy, 2004).

Solicitation Planning

The second phase of the procurement process is Solicitation Planning, which involves the process of preparing the solicitation documents needed to support the acquisition. This is a critical phase of the procurement process since it is during this phase that the work statements, specifications and other exhibits, standard terms and conditions, as well as special contract requirements are developed, revised, and finalized. Key practice activities within the solicitation planning process include using standard procurement forms and documents such as solicitation templates, model contracts, specifications and item descriptions, solicitation provisions, and contract terms and conditions (Garrett & Rendon, 2005). Federal Acquisition Regulations (FAR) require contracting officers to prepare solicitations and contracts using the FAR-specified uniform contract format to the maximum extent possible, as well as the required solicitations provisions and contract clauses. Figure 7 provides a description of the FAR Uniform Contract Format.

Figure 7. Uniform Contract Format

Part I — The Schedule

A Solicitation/contract form.
B Supplies or services and prices/costs.
C Description/specifications/ statement of work.
D Packaging and marking.
E Inspection and acceptance.
F Deliveries or performance.
G Contract administration data.
H Special contract requirements.

Part II — Contract Clauses

I Contract clauses.

Part III — List of Documents, Exhibits, and Other Attachments

J List of attachments.

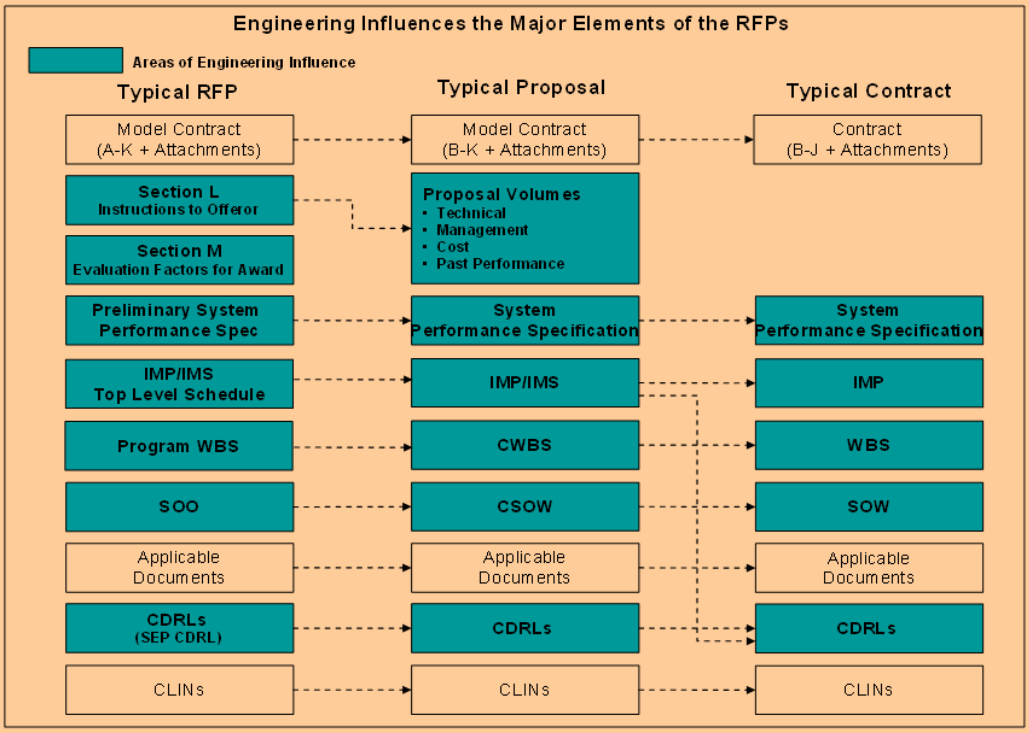
Part IV — Representations and Instructions

K Representations, certifications, and other statements of offerors or respondents.
L Instructions, conditions, and notices to offerors or respondents.
M Evaluation factors for award.

Source: Federal Acquisition Regulation, 15.204-1

The solicitation for an acquisition program using an open systems approach will require specific language unique to the use of a modular open systems approach. Thus, the procurement documents that make up the solicitation should incorporate the specific language that reflects the preference or mandated use of a modular open systems approach in the acquisition program. Section C (Description/Specification/Statement of Work), Section L (Instructions, Conditions, and Notices to Offerors or Respondents), and Section M (Evaluation Factors for Award) are the primary parts of the solicitation that are influenced by the particular engineering approach to the acquisition program. These sections are the core of the solicitation and directly influence the offeror's proposal and the resulting contract, as illustrated in Figure 8 (Office of the Undersecretary of Defense (AT&L), 2005).

Figure 8. Engineering Influences the Major Elements of the RFPs



Source: Draft Guide to Contracting for Systems Engineering, 2005.

It is the documents in this section that will be most effective in communicating the government's requirements for using an open systems approach in the acquisition. Thus, acquisitions that are using a modular open systems approach should have specific and unique documents and language within these solicitation sections and documents. The procurement documents and specific solicitation language that will be discussed in this solicitation planning phase include Section C documents such as the Statement of Objective (SOO)/Statement of Work (SOW) and Preliminary System Specification, and Section L documents which consist of the Instruction to Offerors (ITOs). The discussion of the Source Selection phase of the contracting process will address Section M, Evaluation Factors for Award.

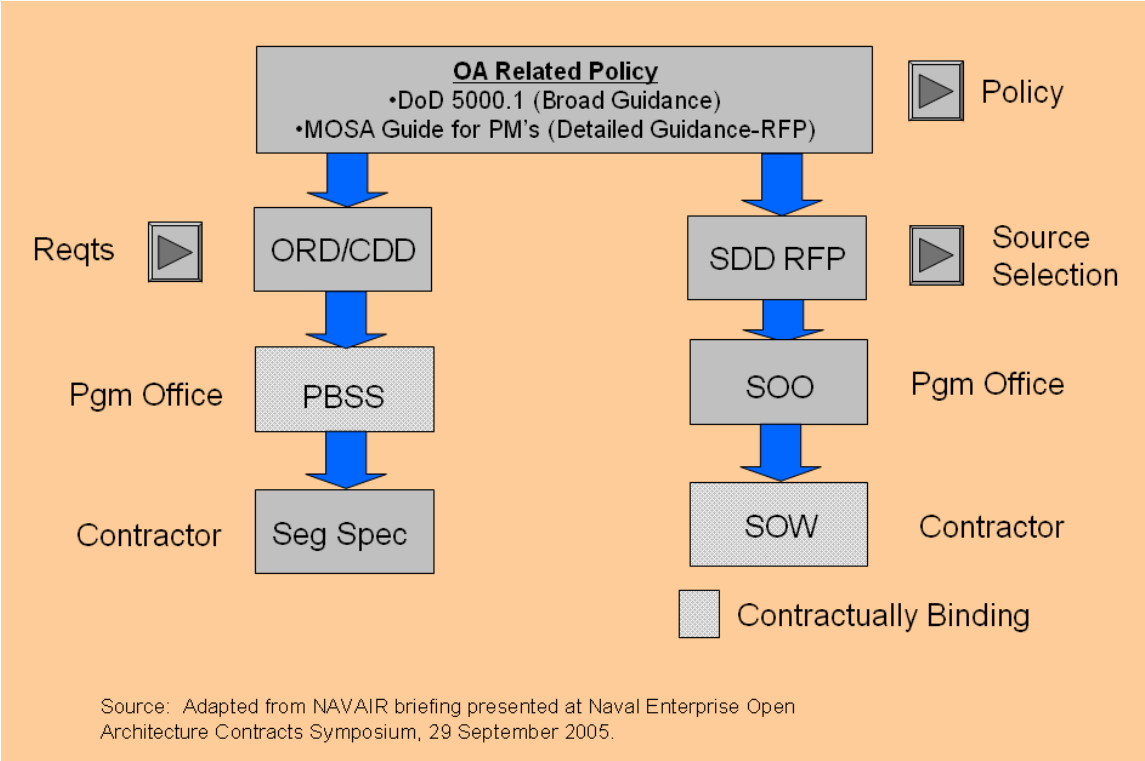
Section C of the solicitation consists of descriptions, specifications, and statements of work for the acquisition program. This section of the solicitation

contains the detailed description of the products to be delivered or the work to be performed under the contract.

System Performance Specification

A critical Section C document is the performance specification. The system performance specification defines the government's performance requirements for the system and should reference any industry and approved military specifications and standards. Typically, the system performance specification in the solicitation is considered a "preliminary system performance specification," and the offeror responds to the solicitation with a formal system performance specification in its proposal. The solicitation must be clear in delineating whether the government will consider offeror-proposed revisions to the preliminary performance requirements that may be cost effective. The offerors run the risk of being declared non-responsive to the solicitation for proposing revised performance requirements (Office of the Undersecretary of Defense (AT&L), 2005). In acquisition programs using a modular open systems approach, the system performance specification plays a critical role in communicating the government's requirement for communicating "openness" and delineating requirements for open systems. Typically, the performance specification is developed using the requirements document that was the basis for initiating the acquisition. These requirements documents, such as the Operational Requirements Documents (ORD) or Capability Development Document (CDD), will be extensively used in developing the performance specification. An example of the relationship between the requirements documents (ORD/CDD) and the system performance specification is found in the Multi-Mission Maritime Aircraft (MMA) Program. The Navy's MMA is the replacement for the P-3C Orion with primary roles of antisubmarine and antisurface warfare. The MMA is one element of the Navy's Broad Area Maritime Surveillance (BAMS) family of systems, along with the BAMS Unmanned Aerial Vehicle (UAV) and Aerial Common Sensor programs. The MMA is manned, and it will sustain and improve armed maritime and littoral intelligence surveillance and reconnaissance capabilities of the US Navy (GAO, 2005, March 31).

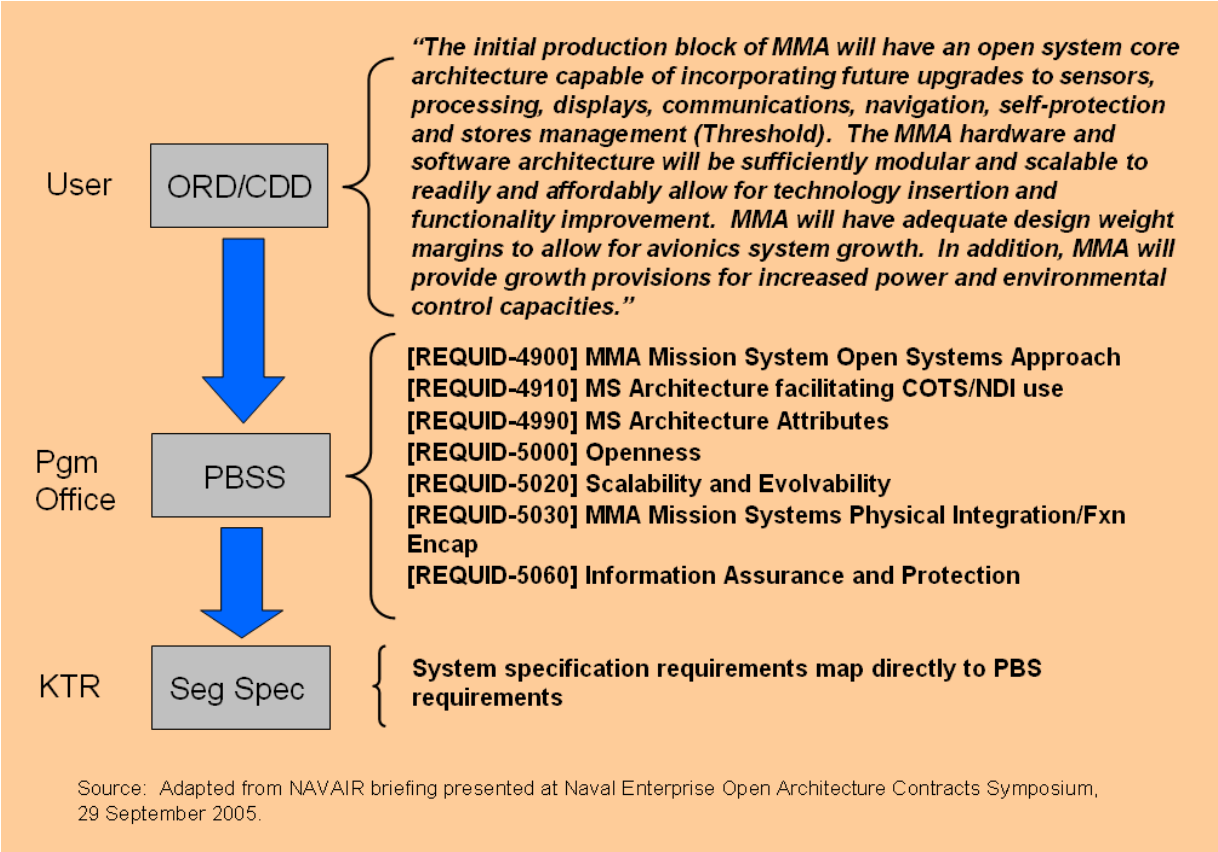
Figure 9. Linking OA Policy to Contractual Documents



As Figure 9 illustrates, the language from DoD 5000.1 and the OSJTF MOSA Guide influenced the open systems language in ORD/CDD. The ORD/CDD language influenced the development of the MMA Performance-based System Specification (PBSS), which was then decomposed into the multiple requirements that are on contract. The Contractor then decomposed those requirements into segment specification.

Figure 10 illustrates the open systems language that was used in the MMA ORD/CDD and the related open systems requirements listed in the Performance-based System Specifications (PBSS) and the relation of the PBSS to the lower level segment specification developed by the contractor.

Figure 10. MMA Open Systems Requirements



Source: Adapted from NAVAIR briefing presented at Naval Enterprise Open Architecture Contracts Symposium, 29 September 2005.

Statement of Work

Another critical document in Section C of the Solicitation is the Statement of Work (SOW). Traditionally, the government has used a SOW in its major acquisition programs. The solicitation Statement of Work (SOW) describes the actual work to be done by means of specifications or other minimum requirements, quantities, performance date, and requisite quality (Garrett & Rendon, 2005). The offerors propose their management, technical, and cost approach to meeting the requirements of the SOW in their proposal. Already a critical part of the solicitation package, the SOW takes on even more of a significant role in an acquisition using an open systems-based approach. In these acquisition programs, the SOW must be clear and concise in communicating the requirements that contractors must comply with in terms of meeting open systems standards and incorporating open system components in the development of the total system.

Referring once again to the Navy's Common Enterprise Display System (CEDS) Program, the CEDS SOW provides an excellent example of effective language related to the use of an open systems-based acquisition approach. Appendix C reflects an extract from the CEDS SOW, specifically referring to the use of open systems and a modular open systems approach. SOW 3.1.3.2 language specifically communicates the contractor's requirement to comply with the PEO IWS Open Architecture Computing Environment Design Guidance, PEO IWS Open Architecture Computing Environment Technologies and Standards, and the PEO C4I Rapid Application Integration and Development Standards in the development of the CEDS equipment. Thus, the SOW is clear and exact in describing the contractor's requirement to comply with the specific open architecture guidance documents. It should be noted that the SOW refers to these specific documents: PEO IWS Open Architecture Computing Environment Design Guidance, PEO IWS Open Architecture Computing Environment Technologies and Standards, and the PEO C4I Rapid Application Integration and Development Standards (US Navy, 2005, September 9c).

CEDS SOW 3.1.3.3 also requires the contractor to use a modular open systems approach in implementing a modular design strategy for building the system and refers to the Under Secretary of Defense Memorandums: *Amplifying DoDD 5000.1 Guidance Regarding Modular Open Systems Approach (MOSA) Implementation* and *Instructions for Modular Open Systems Approach (MOSA) Implementation*. This section of the SOW specifically tells the contractor that a primary consideration in selection of equipment shall be the impact to the overall modular open systems architecture. Additionally, the SOW stresses the importance of long-term supportability, interoperability, and growth for future modifications as major factors in the contractor's selection of equipment. Furthermore, the SOW is specific in requiring the contractor to use an architectural approach that will provide a viable technology insertion methodology and refresh strategy as well as to maximize commonality of components used in the CEDS equipment across all product baselines. Finally, the contractor is required to develop metrics to measure

the degree of success in achieving the commonality goals (US Navy, 2005, September 9c).

The Littoral Combat Ship (LCS) Mission Package Integrator contract in support of the LCS Mission Module program is another example of incorporating open-systems-related language into the SOW. The Navy's Littoral Combat Ship is to be a fast, maneuverable, shallow draft, surface combatant optimized for littoral warfare. LCS will employ innovative hull designs and reconfigurable mission packages to counter anti-access threats in three mission areas: mine, antisubmarine, and surface warfare (GAO, 2005, March 31). SOW paragraph 3.1.1.2, under the Requirements section of the SOW, states that the Contractor shall propose a process for identifying and selecting new technologies for inclusion in future Mission Package spirals. Specifically, the SOW states the following:

Four principles which shall be inherent in developing this process are 1) the practice of including all applicable foreign and domestic governments, industry and academia, in the search for new technology candidates, and technology projection 2) employment of Open Systems Architecture (OSA) modularity and industry standards, 3) the inclusion of a Mission Package Decision Board (MPDB), under the leadership of PMS 420, for selecting material solutions for inclusion in spirals, and 4) the capture and inclusion of Fleet input (US Navy, 2005, June).

Also stated in the SOW, under paragraph 3.1.2, Mission Package Development, Engineering, Integration, Test & Evaluation and Certification Support Agent, all contractor-developed software shall be open source to the government and all other activities, and that the contractor shall design and develop a hardware baseline for the Mission Package Computing Environment (MPCE), which complies with the Navy open architecture requirements to support all Mission Package configurations. Appendix D provides an extract of the LCS Mission Package Integrator SOW (US Navy, 2005, June).

As can be seen, the SOW in solicitations and resulting contracts for acquisition programs using an open systems approach is a critical tool for

delineating the contractor's requirements and responsibilities in performing the contract.

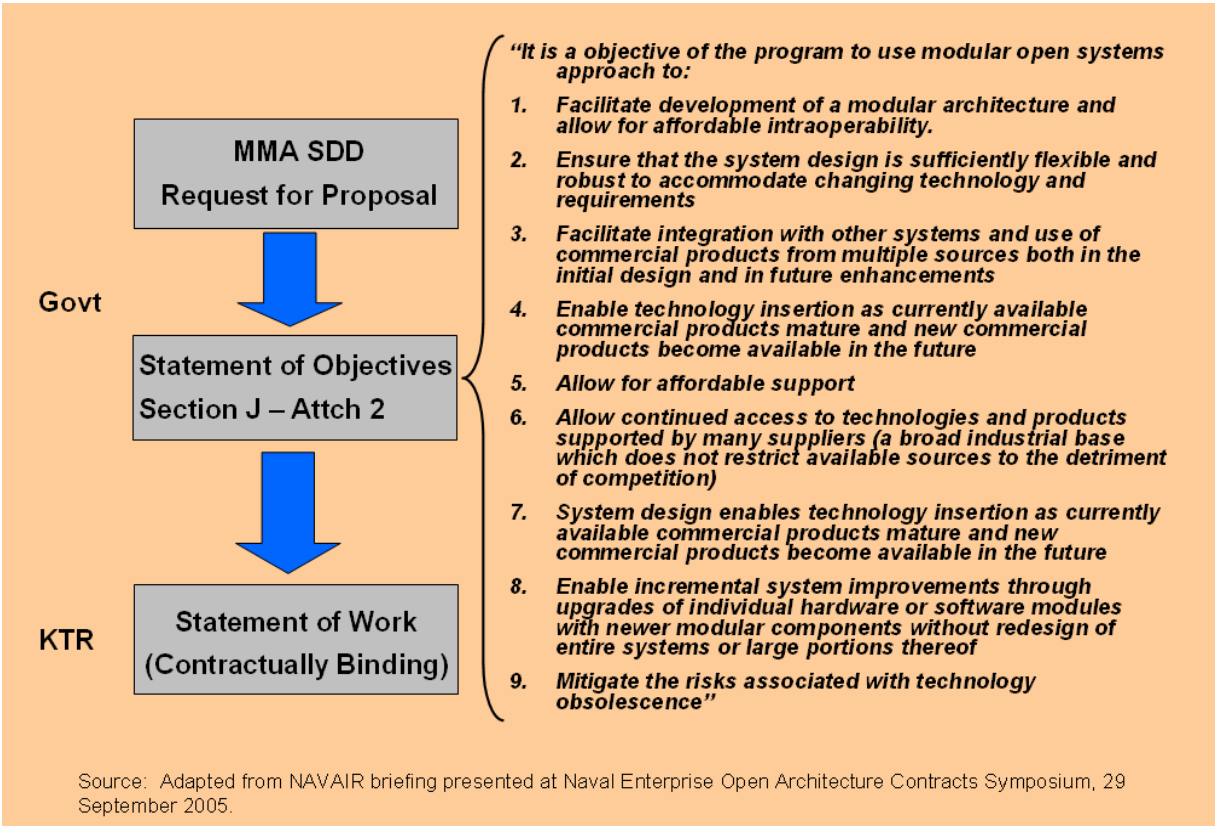
Statement of Objectives

With the continued emphasis on Acquisition Reform and the streamlining of the acquisition process, many government agencies are now using a Statement of Objectives (SOO) instead of a SOW in the solicitation. The SOO is a government-prepared document incorporated into the RFP that states the overall objectives of the solicitation. Typically, the SOO is a very short document, usually under 10 pages, that clearly delineates the program objectives and the overall program approach of the acquisition. The purpose of the SOO is to provide the maximum flexibility to each offer to propose an innovative development approach (Garrett & Rendon, 2005). The offerors respond to the government's SOO with a SOW providing the details of its proposed management, technical, and cost approach for delivering the requirements of the acquisition. Therefore, instead of the government developing the SOW with detailed instructions and requirements, the government provides the SOO with only the top level objectives of the acquisition; the offerors then respond with the proposed detailed approach in their SOW. Thus, the use of the SOO by the government encourages offerors to propose innovative approaches and flexible design solutions (Meyers & Oberndorf, 2001). With this in mind, it can be clearly seen how SOOs definitely support the use of a modular open systems approach acquisition program.

Referencing the Multi-Mission Maritime Aircraft program and Figure 9 again, one can see how the DoD 5000.1 and the OSJTF MOSA Guide language was used in the MMA System Development and Demonstration (SDD) solicitation, which contained a Statement of Objectives (SOO), and the Contractor responded with a Statement of Work in its proposal, with the finalized SOW becoming contractually binding in the contract. Figure 11 illustrates the MOSA language used in the MMA SOO and reflected in the contractor's contractually binding SOW. It should be noted that the MMA SOO open systems language was adapted from the *OSJTF MOSA Guide*. The SOO supports MOSA objectives of leveraging commercial investment,

enhancing access to cutting-edge technologies and products from multiple suppliers, and increasing competition (US Navy, 2005, September 29b). The *OSJTF Guide* provides examples of MOSA-related objectives that would be appropriate for SOOs as a method for conveying the main objectives of the acquisition. These are listed in Appendix E.

Figure 11. MMA Open-systems Contract Documents



Source: Adapted from NAVAIR briefing presented at Naval Enterprise Open Architecture Contracts Symposium, 29 September 2005.

Contract Data Requirements List (CDRL)

Another critical document in the solicitation is the Contract Data Requirements List (CDRL), DD Form 1423. The CDRL is a list of all authorized data requirements for a specific procurement that forms a part of the contract. CDRLS should be linked directly to the required tasks in the Statement of Work (SOW) (Office of the Undersecretary of Defense (AT&L), 2005). In relation to open systems and using an open systems approach in the acquisition, the government can request certain data or even demonstrations from the contractor, as part of the contract

performance requirements. Referring back to the Navy CEDS program, CDRLs are being used to require the contractor to obtain government approval of its proposed open systems profile for each CEDS configuration. The CDRL requires that the contractor's open systems profile be revised for each technology to reflect the obsolescence/infusion change as it affects the external or internal interfaces of the product baseline. Appendix F provides an extract from a CDRL (US Navy, 2005, September 9a).

The Multi-Mission Maritime Aircraft (MMA) Program made excellent use of CDRLs when it required the contractor to demonstrate the "openness" of its mission suite prototype that it constructed during the Component Advancement Development phase of the acquisition. During the demonstration, the contractor was required to show how its mission suite prototype complied with open architecture principles in response to various scenarios that challenged the openness of the system. This demonstration requirement, using the CDRL, was effective in ensuring that the openness requirements were being flowed down to the lower subsystems (US Navy, 2005, September 29b).

Instructions to Offerors

In addition to the documents in Section C of the Solicitation, such as the System Performance Specification, SOO/SOW, and CDRL, specific language should also be included in Section L of the solicitation as well. Section L provides the Instructions to the Offerors (ITOs) for developing the proposals in response to the solicitation.

Section L of the solicitation specifies the format and content of proposals, as well as information or proposal preparation instructions that are not included elsewhere in the solicitation (Engelbeck, 2002). Acquisitions using a modular open systems approach have a critical need for providing specific instructions to offerors concerning the development of proposals and the offeror's adherence to the use of open systems in the development process. Typically, the ITOs reference other documents in the solicitation package such as system technical architecture

requirements and design guidance and standards for open architectures. The ITO typically specifies the factors to be used in the proposal evaluation phase of the source selection. These evaluation factors are traditionally categorized as technical, cost, and management. In acquisitions using a modular open systems approach, usually the technical evaluation factor specifies the ITO requirements related to the acquisition's open-systems requirements.

An example of an ITO language for an open-systems-based acquisition is found in the Section L of the Littoral Combat ship (LCS) Flight 0 Preliminary Design solicitation (US Navy, 2003). The LCS ITO is divided into three parts—administrative requirements, technical volume requirements, and price volume requirements. The language specific to meeting the program's open systems requirements are found in Part II, Technical Volume Requirements, under System Architecture Development and Implementation Approach. In this part of the RFP's ITO, the prospective contractor is required to present its understanding of the scope and overall approach to providing the required effort. It is interesting to note that the LCS solicitation requires the offeror's technical proposal to include a matrix that shows traceability from the specific requirements of Section L to the offeror's technical proposal. Appendix G reflects an extract from the LCS Instructions to Offerors, referring to the use of open systems and a modular open systems approach. Specifically in terms of meeting the open systems approach requirements, the LCS ITO requires the offeror to describe its approach for developing and implementing a wide use of open systems for mission module interfaces, C4I systems, FORCEnet and HM&E systems in accordance with the Design Guidance For The Navy Open Architecture Computing Capability, the Navy Open Architecture Computing Environment Technologies, Standards and Products, and the Mission System Technical Architecture Requirements (US Navy, 2003).

Solicitation

Solicitation is the third phase of the procurement process and is the process of obtaining bids and proposals from prospective sellers on how to meet the objectives of the project. The solicitation phase is critical to the overall acquisition

strategy because it is this phase that executes the procurement planning strategy for a full and open competition or a sole source procurement. Some key practice activities within the Solicitation phase include conducting market research and advertising to identify new sources of supplies and services for the purpose of developing a list of interested offerors (Garrett & Rendon, 2005). These offerors will receive the solicitation requesting the proposal. Another key practice activity in the Solicitation phase includes conducting a pre-solicitation or pre-proposal conference to ensure that all prospective contractors have a clear, common understanding of the technical and contractual requirements of the acquisition (Garrett & Rendon, 2005). In this section on the Solicitation process, the use of Draft RFPs during the solicitation process and the implications of using a full and open competition or a sole source procurement strategy for open systems-based acquisitions will be discussed.

Draft RFPs

Typically, the process of issuing a solicitation and then later amending the solicitation to incorporate corrections, updated specifications, and revised language results in an extended and prolonged acquisition schedule. One of the goals of the solicitation process is to develop and structure a current and complete solicitation that will result in accurate, complete, and competitive proposals from prospective contractors in the shortest amount of time. The use of Draft RFPs has become a proven best practice in the solicitation planning process (Garrett & Rendon, 2005). Issuing a Draft RFP to interested offerors allows for additional industry feedback on any aspect of the proposed acquisition. With this “early and up-front” feedback from interested offerors to the contracting office, the contracting office can continue to improve and enhance the solicitation while it is still being developed, thus saving time and shortening the acquisition schedule. Referring back to the CEDS program, the CEDS program’s use of a Draft RFP reflects this best practice in the solicitation planning process. The CEDS program office issued a Draft RFP that was posted to the program office website. The Draft RFP consisted of Sections B through M, and

the interested offerors were given a 21-day period to review and provide comments back to the program office (US Navy, 2005, August 30).

Procurement Strategy

In developing a procurement strategy for an acquisition program, the traditional options include conducting a full and open competition or a sole source procurement. Statutory requirements, specifically 10 U.S.C. 2304 and 41 U.S.C. 253, require that contracting officers promote and provide for full and open competition in soliciting offers and awarding contracts (FAR, 6.101). There are certain statutory authorities permitting contracting without providing for full and open competition (sole source), as discussed in FAR 6.302. The benefit of full and open competition includes obtaining quality goods and services at a fair and reasonable price. Allowing all responsible offerors to compete also allows the government to leverage the forces of the marketplace to include leading technologies and innovative management approaches in developing solutions. Obviously, the benefits of pursuing a full and open competition fully support the objectives of managing an acquisition program using an open systems approach. Since the underlying concepts of an open systems-based acquisition focus on the ability to insert cutting-edge technology as it evolves, the commonality and reuse of components among systems, the enhanced access to emerging technologies and products from multiple suppliers, the increased ability to leverage commercial investment, and an increase in competition, it would seem appropriate to pursue a full and open competition strategy for the acquisition. It should be noted that in some cases, especially at the platform level, the use of a full and open competition strategy is not possible.

The acquisition of the Virginia Class Submarine is an example of the need for other than full and open competition strategies.

A unique procurement strategy is the use of a “rolling down-select” procurement strategy approach. In this approach, a full and open competition is initially conducted, and multiple contracts are awarded. These contracts are typically used early in the acquisition lifecycle, such as for the development of

preliminary designs. Once the designs have been submitted and evaluated, a down-select of the initial contractors to a single contractor is conducted for the development and production of the actual system. The acquisition strategy may involve multiple "down-selects," depending on how many evaluation phases the buyer desires. For example, there may be an initial full and open competition for conceptual development contracts, a down-select to a smaller number of the original contractors for preliminary designs, another down-select to even a smaller number of contractors for prototype development, and finally, a final down-select to a single contractor for full development and production of the actual system.

A version of this down-select strategy is used by the Navy's Common Enterprise Display System (CEDS) acquisition program. According to the CEDS acquisition strategy, the program will be divided into two phases. Phase 1 will be for the Preliminary design, and Phase 2 will be for the Development, Qualification, and Production. Both of these phases will apply to the Display Consoles (DC) and Remote Display (RD) systems. The Phase 1 strategy will consist of an initial full and open competition strategy resulting in up to four awarded contracts—two for the DC and two for the RD systems. The award criteria for the Phase 1 contracts include Management Approach, Capability to Execute, Past Performance, and Cost. Based on a best value evaluation contract award strategy, the deliverables for this contract include a Preliminary Design of the system and a successful Preliminary Design Review (PDR), as well as estimated Lifecycle Costs, and a cost and technical proposal for the Phase 2 part of the acquisition. The Phase 2 portion of the acquisition will be limited to only the initial contractors that successfully completed the Phase 1 requirements. Phase 2 will consist of a contract award each for the DC and the RD systems, with a best-value award based on the technical approach presented at the PDR, management, technical, and production capability, among other factors. After a successful Production Readiness Review, the production Contract Line Item Numbers (CLINs) will be exercised to execute the production portion of Phase 2 (US Navy, 2005, August 30).

The Multi-Mission Maritime Aircraft (MMA) also used a rolling, down-select type of procurement strategy. During the MMA Component Advanced Development (CAD) contract phase of the acquisition, the result was a competitive source selection, with contract awards to Boeing and Lockheed Martin. Boeing had proposed its 737 Next Generation, and Lockheed Martin had proposed its Orion 21. After the Milstone B review, the System Development and Demonstration contract was awarded to Boeing (US Navy, 2005, September 29b).

As previously stated, the benefits of pursuing a full and open competition fully support the objectives of using an open systems approach in an acquisition program. Opening the acquisition to allow all qualified offerors to participate enables the government to enhance access to cutting-edge technologies and products from multiple suppliers, to have the ability to insert cutting-edge technology as it evolves, and to have the increased ability to leverage commercial investments in technology. Of course, at some point in time, the government will need to establish a relationship with one contractor; otherwise having multiple contractors producing the same system may be cost prohibitive. The major issue is determining how many contracts to award following a full and open competition and how to structure the "down-select" process to determine the single production contractor.

Source Selection

Source Selection is the fourth phase of the contracting process and involves the process of receiving proposals and applying evaluation criteria to select the contractor. Key practice activities within the source-selection process include using evaluation criteria focusing on management, technical, and cost, tailoring the basis for award to either lowest cost/technically acceptable or best value, and taking into consideration an offeror's past performance in evaluating proposals (Garrett & Rendon, 2005).

Evaluation Factors

Section M of the solicitation specifies how the buyer will evaluate the factors identified in the Instructions to Offerors (ITO) in Section L. As previously stated,

Section L specifies the factors to be used in the proposal evaluation phase of the source selection, while Section M specifies how the factors will be used in the proposal evaluation process. These evaluation factors are traditionally categorized as technical, cost, and management. In acquisitions using a modular open systems approach, it is usually the technical evaluation factor that specifies the ITO requirements related to the acquisition's open system requirements. The relationship between cost and non-cost factors (such as quality, technical, and past performance), as well as how they will be used in the source-selection decision, are described in Section M. The two major evaluation strategies are Lowest Price/Technically Acceptable (LPTA) or best value. Best value refers to an evaluation strategy where trade-offs are made in relation to cost and other factors. Thus, in an LPTA source selection, the offeror proposing the lowest price, technically acceptable offer will be awarded the contract. However, in a best-value source selection, the contract award may be made to "other than the lowest priced, technically acceptable offeror," based on a trade-off among cost, technical, and past performance factors. It is important that the proposal evaluation strategy should be tailored to meet the objectives of the acquisition strategy (Garrett & Rendon, 2005). The use of the best-value evaluation strategy is appropriate for acquisitions that involve requirements that are less definitive, require more development work, or the acquisition has greater performance risk, and where more technical or past performance considerations play a dominant role in the source-selection decision (FAR, 15.101). Obviously, an acquisition that involves the use of a modular open systems approach in the development of the system would involve a less definitive requirement, require more development work, have greater performance risk, and involve more technical or past performance considerations playing a dominant role in the source-selection decision. Thus, the use of a best value evaluation approach is desired for these types of acquisitions (Meyers & Oberndorf, 2001).

When using the best-value trade-off process, it is important for all evaluation factors and significant sub-factors that will affect contract award and their relative importance to be clearly stated in the solicitation; and the solicitation should state whether all evaluation factors other than cost or price, when combined, are

significantly more important than, approximately equal to, or significantly less important than cost or price. This process permits trade-offs among cost or price and non-cost factors and allows the government to accept other than the lowest priced, technically acceptable proposal (FAR, 15.101-1).

The evaluation factors for contract award listed in the Section M of the Littoral Combat Ship (LCS) Flight 0 Preliminary Design solicitation reflects the government's intention to award based on best value. Specifically, the solicitation states, "the contract will be awarded to the responsible Offeror(s) whose proposal represents the best value to the Government after evaluation in accordance with the factors and sub factors in the solicitation. 'Factors' and 'subfactors' shall include all of the evaluation factors and subfactors that are described in this Section M" (US Navy, 2003). As previously referenced, the LCS evaluation factors consist of two categories, Technical and Price, with each category consisting of various factors. The Technical category includes two factors—Management and Technical. The Technical factor includes three subfactors as listed below:

- *2.1 Preliminary Design and Systems Analysis Approach to Meet LCS PD-IRD Requirements*
- *2.2 Systems Engineering Approach to accomplish LCS Preliminary Design and follow on design and construction*
- *2.3 System Architecture Development and Implementation Approach*

The subfactor 2.3 System Architecture Development and Implementation Approach specifically references the offeror's approach for developing and implementing a wide use of open systems for mission module interfaces.

The Price category criteria in the LCS Section M of the solicitation simply states that the government will evaluate each Offeror's pricing proposal to confirm that the Offeror's proposed Firm-fixed Price for the performance of the Statement of Work identified in the Technical Volume of the Offeror's proposal does not exceed the maximum possible award price. The solicitation also states that the Contracting Officer shall consider the reasonableness of the Offeror's proposed price by reviewing the pricing data submitted by the Offeror in response to the solicitation and

comparing such pricing data against the Offeror's technical proposal (US Navy, 2003).

Basis for Award

Even more critical in acquisition programs using a MOSA approach is the language used for the basis for award. The basis for award describes the government's method for selecting the contractor. The most critical part of the basis for award language is the weight, or relative importance, given to the various proposal evaluation factors. It is this specific language in which the buyer communicates to the offerors the priority, or relative importance, of the evaluation factors. Acquisition of modular open systems approach-based programs should be specific in communicating the relative importance of the evaluation factors. In addition, and more importantly, acquisition of modular open systems approach-based programs should place greater importance on proposal evaluation factors related to technical-related factors. In the case of the LCS Flight 0 Preliminary Design solicitation, the following is an extract of Section M of the solicitation:

> (a) The Government intends to award up to (3) three contracts for Preliminary Design effort set forth in this solicitation to the Offerors whose proposals are determined to offer the best value to the Government. In determining which proposals are deemed to offer the best value, the Government will evaluate the strengths and weaknesses noted in each factor identified in section M.2 of this solicitation, with due consideration being given to the relative importance of the factors, as set forth below:
>
> (1) The Technical Category (consisting of Management and Technical factors) is significantly more important than the Price Category.
>
> (2) Within the Technical Category, the Management factor is equal to the Technical factor.
>
> (3) Within the Management factor, subfactor 1.1 is significantly more important than the remainder of the Management subfactors. Subfactors 1.2,

> 1.3 and 1.4 are of equal importance to each other, and each is more important than subfactor 1.5. Within the Technical factor, subfactor 2.1 is significantly more important than 2.2 and 2.3, which are of equal importance to each other. (US Navy, 2003)

The source-selection process is obviously critical to the overall acquisition program. It is in this phase where the offeror's proposal is evaluated to determine the best value for the government. It should be noted that the Instructions to Offerors (ITOs) in Section L and the evaluation factors and criteria stated in Section M of the solicitation must be consistent and interrelated. These are the areas carefully scrutinized by offerors in making their bid/no bid determination, as well as in developing their proposals. In addition, the evaluation factors and criteria should be tailored to meet the objectives of the acquisition strategy (Garrett & Rendon, 2005). In acquisition strategies that are based on the use of a modular open systems approach, it is critical that Sections L and M are carefully crafted and structured to communicate and incentivize the offerors to develop management, technical, and cost approaches appropriate for achieving the open systems goals of the acquisition.

Once the contract is awarded, the government and contractor relationship then shifts to a performance measurement and management focus in which the government manages the contractor's performance to ensure that acquisition objectives are achieved. One way of ensuring the contractor meets these acquisition objectives is through the use of appropriate contract types and contract incentives, which are administered during the contract administration phase of the acquisition. This is discussed in the next section of this report.

Contract Administration

Contract Administration is the fifth phase of the contracting process and entails managing the relationship with the contractor and ensuring that each party's performance meets the contract requirements. During contract administration, the government's focus is on managing the contractor's cost, schedule, and

performance. Key practice activities within the contract administration process include using an integrated team approach for monitoring the contractor's cost, schedule, and performance, and having an established process for administering incentive and award-fee provisions (Garrett & Rendon, 2005). These incentives and award fees are tools used to motivate and incentivize the contractor to meet specific performance standards of the contract. These incentive techniques will be discussed in more depth later in this section.

Although the purpose of this report is not to present a full discussion on the various contract types and contract incentives, a brief description of the major categories of contract types and related contract incentives will be presented. The purpose here is to briefly identify which contract types and contract incentives have been previously used in acquisition programs pursuing a modular open systems approach. References will be made to a recent assessment of acquisition programs by the Navy Open Architecture Enterprise Team (OAET) in support of the Navy Program Executive Office-Integrated Weapon System (PEO-IWS) (US Navy, 2005, September 27).

Contract Types

The Federal Acquisition Regulation (FAR) identifies two major contract categories: cost reimbursement contracts and fixed-price contracts (FAR, 16). These contract-type categories refer to the method of compensation due to the contractor for the performance of the contract.

In the Fixed-price Contract category, the contractor agrees to provide specified supplies or services in return for a specified price, either a lump sum or a unit price. In addition, the price is fixed and is not subject to change regardless of the contractor's actual cost experience. Only if the contract is modified is the price subject to change (Garrett & Rendon, 2005). There are various types of fixed-priced contracts such as Firm Fixed Price (FFP), Fixed Price with Economic Price Adjustment (FP-EPA), and Fixed Priced Incentive (FPI).

In the Cost Reimbursement contract category, the contractor agrees to provide a best effort in performing the requirements of the contract, which is typically broadly defined in terms of specifications. In return, the contractor is reimbursed for all allowable costs up to the amount specified in the contract. Cost allowability is governed by the FAR (FAR, 31). Various types of Cost Reimbursement contracts include Cost Sharing (CS), Cost Plus Fixed Fee, (CPFF), Cost Plus Incentive Fee (CPIF), and Cost Plus Award Fee (CPAF).

Contract Incentives

Contracts may include incentives to provide additional motivation to the contractor for meeting or exceeding certain cost, schedule, or performance objectives. Contract incentives are basically of two types—objectively based incentives and subjectively based incentives.

Objectively based incentives use a pre-determined formula to determine the rewards (increase of profit or fee) or the penalties (reduction of profit or fee) due to the contractor. Examples of objectively based incentives include Fixed-priced Incentive and Cost Plus Incentive contracts.

Subjectively based incentives include Award Fee or Award Term contracts. These incentives use a subjective evaluation to determine if any additional fee or term (for service contracts) is due to the contractor. Based on a subjective evaluation of the contractor's effort to exceed specific requirements in terms of cost, schedule or performance as specified in the Award Fee Plan or Award Term Plan, the contractor may be entitled to earn additional fee or term on the contract.

The biggest challenge in using incentive contracts and award fee/term contracts is the ability to structure an effective incentive tool that will successfully motivate the contractor to perform in specified areas and exceed the performance requirements. It is particularly important to structure appropriate incentive arrangements that will result in the contractor applying additional emphasis in the areas important to the government. In acquisition programs using a modular open

systems approach, the government will want to incentivize the contractor to meet higher levels of “openness” in the design and development of the system.

As previously discussed, the performance requirements for meeting the “openness” objectives of the acquisition are typically identified and described in the various documents of the solicitation and resulting contract, such as the Statement of Work (SOW), Statement of Objectives (SOO), Performance Specifications or Standards, Instruction to Offerors (ITOs) and Evaluation Factors. This section will discuss the various contract types and contract incentives used for incentivizing the contractor. This report will specifically look at how some recent acquisition programs have attempted to incentivize contractors to meet higher levels of “openness” and how these contract incentives were structured.

Acquisition programs using a modular open systems approach are challenged with incentivizing the contractor to achieve the required levels of “openness” by meeting or exceeding the technical requirements of the contract, as well as cost and schedule requirements. The Award Fee type of incentive has been traditionally used for motivating the contractor to excel in technical performance. All of the programs referenced in conducting this research used the Award Fee process as a tool for incentivizing the contractor to achieve a certain level of openness in the design and development of the weapon system. The Littoral Combat Ship (LCS) Mission Package Integration contract included a Cost Plus Award Fee (CPAF) with evaluation categories of Technical Performance (40%), Schedule (20%), Management (20%), and Cost Performance (20%). The language incentivizing “openness” could be found in the Technical performance category—which focused on the effectiveness of the Contractor’s process for technology insertion for LCS Mission Packages, to include identifying technology candidates (US NAVY, 2005, June).

The Multi-mission Maritime Aircraft (MMA) system development and demonstration program also uses a Cost Plus Award Fee (CPAF) contract with approximately 30% of the award fee pool tied to technical evaluation criteria. This

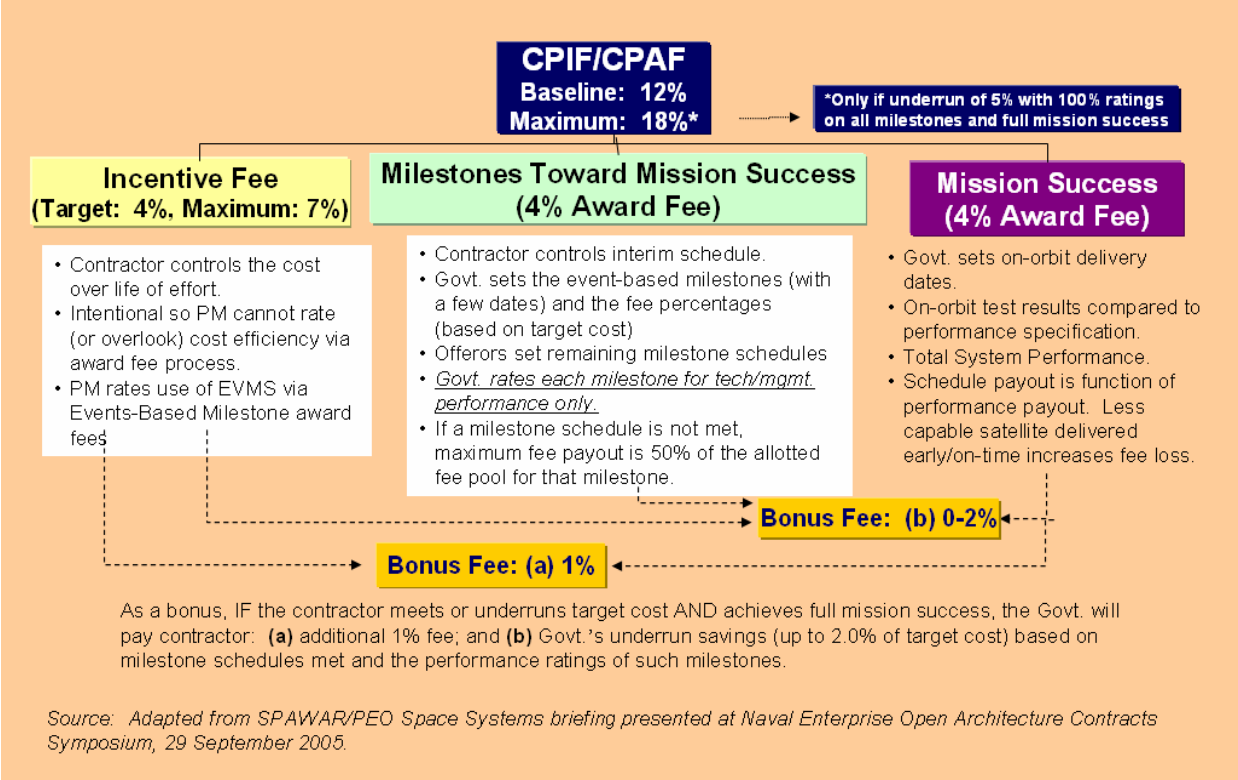
technical criteria includes systems engineering, identified program risks, Key Performance Parameters (KPPs), and overall approach to reducing total ownership costs (TOC) (US Navy, 2005, September 29b).

The Common Display Enterprise System (CEDS) Draft RFP also included CPAF contract line items (CLINS) as well as Fixed Price Incentives (FPI). The CEDS award fee evaluation categories included Technical Performance (30%), Schedule Performance (25%), Management Performance (20%), and Cost Performance (25%). The "openness" language in the CEDS Award Fee is referenced in the Technical Performance and described in the CEDS System Requirements Documents (SRD). The CEDS DRFP also includes FPI line items for the production units for Year 1 (US Navy, 2005, August 30).

Another example of incentives and award fees supporting an open systems approach is the US Navy's Mobile User Objective System (MUOS) program. The Navy's MUOS system is designed to replace the Ultra High Frequency (UHF) Follow-on satellite system currently in operation and to provide support to worldwide, multi-service, mobile, and fixed-site terminal users. MUOUS will be a satellite communication system that is expected to provide low-data rate voice and data communications capable of penetrating most weather, foliage, and manmade structures. MUOS consists of a network of advanced UHF satellites and multiple ground segments (GAO, 2005, March 31). The MUOS contract contains Cost Plus Incentive Fee (CPIF), Fixed-price Incentive (FPI), and Cost Plus Award Fee (CPAF) incentives. This elaborate fee arrangement is designed to balance, integrate, and incentivize cost, schedule, and performance (US Navy, 2005, September 29a). The MUOS contract consists of four different types of fees. The Mission Success Fees (CPAF) constitute one-third of all fees and are paid only after successful on-orbit delivery of satellites. Milestone Fees (CPAF) also constitute one-third of all fees and are interim payments pending successful on-orbit delivery of both first and second satellites. Target Fees (CPIF) constitute one third of all fees and serve as a "fee cash flow" between event-based milestones. An additional Bonus Fee (CPAF) is available after completion of Risk Reduction Design Development (RRDD) if the

contractor earns 100% Mission Success, and final costs are less than target costs. Also included in the MUOS contract is an FPIF/AF for the remaining satellites of the constellation (US Navy, 2005, September 29a). Figure 12 provides additional details on the MUOS contract incentive structure.

Figure 12. Contracting Approaches—Incentive Structure (CPIF/AF Portion)



Source: Adapted from SPAWAR/PEO Space Systems briefing presented at Naval Enterprise Open Architecture Contracts Symposium, 29 September 2005.

The MOUS incentive award fee approach is unique in that it maximizes the benefits and minimizes the risks of implementing an open systems architecture. This incentive/award fee approach is designed to empower the contractor with responsibility for using an open systems approach and for measuring the costs and benefits of "openness" against the contractor's bottom line. If the costs and benefit analysis results in executing an open systems approach, both the contractor and government save money. If the costs and benefits to executing an open systems approach are not executable, the contractor and government avoid schedule delays and cost growths. Once again, the MUOS program is buying a networked constellation of satellites that is leveraging the open systems approach in

development and maintenance, and not buying separate satellites that must meet individual or separate open systems requirements. Thus, the contractor is responsible for total system performance and constellation performance, is given control of over 80% of Mission Success Fee and profit, and is responsible for managing cost control and interim schedule. This forces the contractor to have a long-term perspective when it comes to using open systems and the use of Commercial Off-the-Shelf (COTS) versus developmental systems (US Navy, 2005, September 29a).

A new type of incentive tool that is currently very successful is the Award Term incentive. Award Term is similar to Award Fee; it differs only in that an Award Term contract ties the length of the contract's period of performance to the performance of the contractor. Contractors with good performance may have the term of the contract extended, or contractors with poor performance may have the contract term reduced (Garrett & Rendon, 2005). The Littoral Combat Ship (LCS) Mission Package Integrator contract included an Award Term incentive as well as an Award Fee incentive, previously discussed. The Award Term incentive consisted of the following evaluation categories: Technical Performance (40%), Schedule (20%), Management (20%), and Cost Performance (20%). An element of the Technical Performance category included the effectiveness of the Contractor's process for technology insertion for LCS Mission Packages including identifying technology candidates (US Navy, 2005, June).

The selection of contract types and contract incentives requires careful planning, implementation, management, and measurement to ensure its success in incentivizing contractors and improving performance (Garrett & Rendon, 2005). Programs that are encouraging the use of a modular open systems approach in the development of the system should incorporate Award Fee and Award Term incentives. This is especially true when a Statement of Objectives (SOO) is used to describe the government's required outcomes and overall objectives and when the contractor has the flexibility to be innovative in proposing its management and technical approach towards meeting those outcomes and objectives.

Contract Closeout

The final phase of the contracting process is Contract Closeout. Contract Closeout is the process of verifying that all administrative matters are concluded on a physically complete contract. This involves accepting final deliveries and making final payment to the contractor, as well as completing and settling the contract and resolving any open items. Key practice activities within the contract closeout phase include using checklists and forms for ensuring proper documentation of closed contracts and maintaining a "lessons learned and best practices" database for use in future contracts and projects (Garrett & Rendon, 2005). The contract closeout phase is often forgotten and has traditionally been considered an administrative burden or relegated to a clerical or non-essential task. An important aspect of completing and closing out the contract is conducting a final evaluation of the contractor's performance on the contract in terms of meeting cost, schedule, and performance objectives. This final contractor evaluation will be used as a past-performance evaluation of the contractor in future contract competitions and source selections.

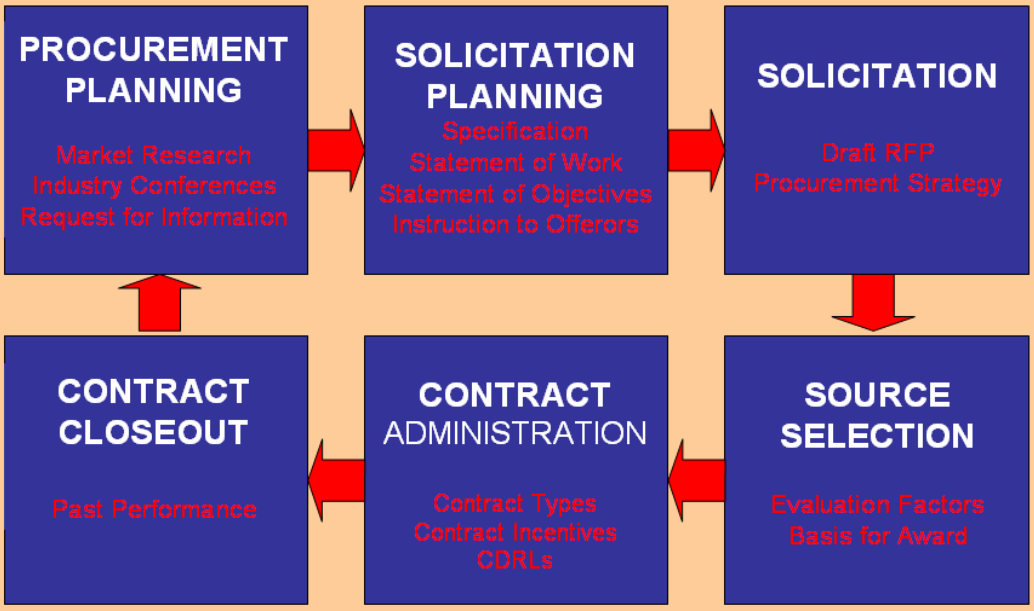
As previous stated, contractor past performance is a critical evaluation factor for major source selections and is listed as an evaluation factor under Section M of the solicitation. Ensuring the final contractor performance evaluation is completed during the contract closeout process is critical in ensuring that information is available for use in a future source selection. In acquisitions using a modular open systems approach, a critical proposal evaluation factor listed in Section M of the solicitation should be the contractor's past performance and recent experience in working in an open systems approach environment. Past performance is a mandatory proposal evaluation criterion for major source selections in accordance with FAR 15.304. The Department of Defense (DoD) uses the Contractor Performance Assessment Report (CPAR) to conduct periodic and final evaluation of the contractor's performance. Systems engineering is a major contractor past-performance assessment element, and the CPAR should be used to evaluate the contractor's adherence to open systems standards and MOSA requirements on

open systems-based acquisitions. Using the CPAR evaluation tool, the government can document excellent or poor contractor performance in terms of meeting contract "openness" requirements, and this documentation can then be used in future source selections (Office of the Undersecretary of Defense (AT&L), 2005).

Summary of Contracting Process

As can be seen from the discussion on the contracting implications of using a modular open systems approach, there are critical areas in which the government must be specific and clear in communicating the "openness" requirements to the contractor. During each of the six phases of the contracting process—procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout, there are specific activities, documents, and practices that the government must leverage in order to require, mandate, encourage, motivate, or incentivize the contractor to push for openness in the design, development, and acquisition of the procured system. It should be noted that the areas discussed in this research do not encompass the totality of the contracting process or each of the specific phases, only the most critical and significant areas within each contracting phase that may be affected by using a modular open systems approach. Figure 13 summarizes the main areas that were discussed in identifying the MOSA implications on the procurement process.

Figure 13. MOSA Implications on the Procurement Process



Source: Adapted from *Contract Management: Organizational Assessment Tools*. Garrett and Rendon, NCMA, 2005.

As can be seen from Figure 13 and the discussion on the contracting process and the various activities and documents used in the process, the processes, activities, and documents are basically consistent with many acquisitions. That is, most acquisition programs will start with an Initial Capabilities Documents (ICD), a system specification, a requirements document such as a SOO or SOW, and a solicitation document. Although these processes, activities, and documents are established and consistent, there are some options in how the government conducts these processes. The government's method for conducting these processes has an impact on the level of flexibility and innovation used by the contractor in designing and developing its proposed solution. Earlier in this research, we discussed the different strategies for determining the roles and responsibilities of the government and the contractor in conducting an acquisition based on using open systems. We referred to Meyers and Oberndorf's work (2001) on the various approaches to determining the roles and responsibilities of the government and contractor and their

effect on the degree of control of the interface standards and the source of that control (See Figure 5). This discussion is now extended as we relate the degree and source of control of the interfaces and standards to the contractual documents that determine and develop those interfaces. The degree and source of control of the interfaces and standards is based on the degree and source of control required by the contractual documents that determine and develop those interfaces. The degree and source of control shared between the government and contractor has an impact on the level of flexibility and innovation used by the contractor in designing and developing its proposed solution. The more control given to the contractor in determining the type of interfaces and standards in designing and developing its solution will be a critical factor in achieving the objectives of a MOSA-based acquisition. Figure 14 is adapted from the Defense Acquisition University (DAU) Systems Engineering Fundamentals guide and describes four options available to the government for managing the contracting process in support of an acquisition program using a modular open systems approach (*Systems engineering fundamentals*, 2001). Each option provides a different level of opportunity for the contractor to have flexibility and use innovation in developing its proposed solution.

Figure 14. Options for Determining Roles and Responsibilities

Option	Government Developed			Contractor Developed	
1	Initial Capabilities Document	System Specification		Statement of Work	Contract Signed
2	Initial Capabilities Document	System Specification	Statement of Objectives	Statement of Work	Contract Signed
3	Initial Capabilities Document	System Specification		Statement of Work	Contract Signed

Source: Adapted from *Systems Engineering Fundamentals*, DAU, 2001.

For example, in Option 1, the government develops the Initial Capabilities Documents (ICD) (which kicks off the acquisition), the systems specification (which is based on the ICD), and the Statement of Work (SOW) (which reflects the system specification). The specification and SOW are released to the offerors, along with the Instructions to Offerors (ITOs) and Evaluation Factors. The offerors then respond with a proposal for developing a solution that satisfies the SOW and specification. Obviously, this option provides the offerors very little flexibility for developing the proposal and, thus, limits the degree of innovation the offeror can use in developing its solution. This limited flexibility and innovation is definitely an obstacle to meeting the objectives of an open systems approach. Without flexibility and allowance for innovation in developing proposals, the offerors would be significantly challenged to leverage commercial investment, reduce development cycle-time and total ownership costs, ensure system interoperability, enhance commonality and reuse of components, enhance access to cutting-edge technologies and products from multiple suppliers, enhance lifecycle supportability, and increase competition (*OSJTF guide*, 2004).

In Option 2, the government uses a Statement of Objectives (SOO) to communicate the end-results and overall objectives of the acquisition to the offerors and allows the contractor flexibility in developing the Statement of Work to fulfill the objectives and end-results of the Statement of Objectives (SOO). This approach provides a little more leverage in achieving the objectives of using a MOSA approach by allowing the contractor more input in determining the details of designing and developing the system being acquired.

Option 3 provides the approach with the greatest degree of flexibility and innovation on the part of the offeror. In this approach, the government provides the ICD to the offerors, and allows the offerors to propose the system specification, Work Breakdown Structure, and Statement of Work. Thus in this approach, the offerors are involved up front and early in the acquisition process to allow them the flexibility to be innovative in proposing design solutions in response to the government's needed capability. It should be noted that the government always

maintains control of the ICD capability requirement, and in each option, the government communicates to the offerors proposal instructions (Section L), and the government identifies its areas of concern through the use of evaluation factors (Section M).

Acquisition programs using a modular open systems approach should select an approach that will allow the offerors the maximum flexibility in using innovative and leading edge technologies in proposing the development and design of their solution. This will then enable the government to achieve the objectives of using a MOSA approach in the management of the acquisition program.

Intellectual Property Issues

Although this research was specifically focused on the implications on the contracting process from using a modular open systems approach, and not necessarily on any specific contract legal provision, mention should be made about one of the most discussed legal issues related to using an open systems approach—the implications on intellectual property rights. This issue concerns the rights that contracting parties have to intellectual property developed under a government contract. In this discussion, "Intellectual Property" means patents, copyrights, trademarks, and trade secrets (Under Secretary of Defense (AT&L), 2001, October 15). Furthermore, the DoD categorizes IP into two main categories—patent rights and technical data and computer software rights (2001, October 15). As the defense acquisition process continues to give preference for commercial off-the-shelf (COTS) items and the use of open systems in the development of its weapon systems, there will continue to be much discussion on the rights of intellectual property and the extent of those rights in government acquisitions. This section of this report is not intended to resolve the legal question of intellectual property rights (that would be best left to specialized attorneys), but will provide an overview of the DoD policy, core principles pertaining to Intellectual Property, and some key Intellectual Property implications during the contracting process.

Government Policy

FAR Part 27 specifies the policies and contract clauses concerning copyrights and rights in data. Specifically, FAR 27 provides the following general guidance:

> (a) The Government encourages the maximum practical commercial use of inventions made while performing Government contracts.
>
> (b) Generally, the Government will not refuse to award a contract on the grounds that the prospective contractor may infringe a patent.

(c) Generally, the Government encourages the use of inventions in performing contracts and, by appropriate contract clauses, authorizes and consents to such use, even though the inventions may be covered by US patents and indemnification against infringement may be appropriate.

(d) Generally, the Government should be indemnified against infringement of US patents resulting from performing contracts when the supplies or services acquired under the contracts normally are or have been sold or offered for sale by any supplier to the public in the commercial open market or are the same as such supplies or services with relatively minor modifications.

(e) The Government acquires supplies or services on a competitive basis in accordance with Part 6, but it is important that the efforts directed toward full and open competition not improperly demand or use data relating to private developments.

(f) The Government honors the rights in data resulting from private developments and limits its demands for such rights to those essential for Government purposes.

(g) The Government honors rights in patents, data, and copyrights, and complies with the stipulations of law in using or acquiring such rights.

(h) Generally, the Government requires that contractors obtain permission from copyright owners before including privately-owned copyrighted works in data required to be delivered under Government contracts. (FAR, 27.104)

In addition, FAR 27.402 provides the general policy on data rights:

(a) It is necessary for the departments and agencies, in order to carry out their missions and programs, to acquire or obtain access to many kinds of data produced during or used in the performance of their contracts. Agencies require such data to: obtain competition among suppliers; fulfill certain responsibilities for disseminating and publishing the results of their activities;

ensure appropriate utilization of the results of research, development, and demonstration activities including the dissemination of technical information to foster subsequent technological developments; and meet other programmatic and statutory requirements. Further, for defense purposes, such data are also required by agencies to meet specialized acquisition needs and ensure logistics support.

(b) At the same time, the Government recognizes that its contractors may have a legitimate proprietary interest (e.g., a property right or other valid economic interest) in data resulting from private investment. Protection of such data from unauthorized use and disclosure is necessary in order to prevent the compromise of such property right or economic interest, avoid jeopardizing the contractor's commercial position, and preclude impairment of the Government's ability to obtain access to or use of such data. The protection of such data by the Government is also necessary to encourage qualified contractors to participate in Government programs and apply innovative concepts to such programs. In light of the above considerations, in applying these policies, agencies shall strike a balance between the Government's need and the contractor's legitimate proprietary interest. (FAR, 27.402)

The DoD FAR Supplement, at Parts 227.71 and 227.72, provides the specific DoD policy and guidance for data rights. The DoD policy specifically states:

(a) DoD shall acquire only the technical data customarily provided to the public with a commercial item or process, except technical data that—

(1) Are form, fit, or function data;

(2) Are required for repair or maintenance of commercial items or processes, or for the proper installation, operating, or handling of a commercial item, either as a stand alone unit or as a part of a military system, when such data are not customarily provided to commercial

users or the data provided to commercial users is not sufficient for military purposes; or

(3) Describe the modifications made at Government expense to a commercial item or process in order to meet the requirements of a Government solicitation.

(b) To encourage offerors and contractors to offer or use commercial products to satisfy military requirements, offerors and contractors shall not be required, except for the technical data described in paragraph (a) of this subsection, to—

(1) Furnish technical information related to commercial items or processes that is not customarily provided to the public; or

(2) Relinquish to, or otherwise provide, the Government rights to use, modify, reproduce, release, perform, display, or disclose technical data pertaining to commercial items or processes except for a transfer of rights mutually agreed upon. (Defense FAR Supplement, 227.71)

In addition, the DoD has specific policy and guidance for the acquisition of commercial computer software and commercial computer software documentation, which is found in DFARS 227.2, where the specific policy states:

(a) Commercial computer software or commercial computer software documentation shall be acquired under the licenses customarily provided to the public unless such licenses are inconsistent with Federal procurement law or do not otherwise satisfy user needs.

(b) Commercial computer software and commercial computer software documentation shall be obtained competitively, to the maximum extent practicable, using firm-fixed-price contracts or firm-fixed-priced orders under available pricing schedules.

(c) Offerors and contractors shall not be required to—

(1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public except for information documenting the specific modifications made at Government expense to such software or documentation to meet the requirements of a Government solicitation; or

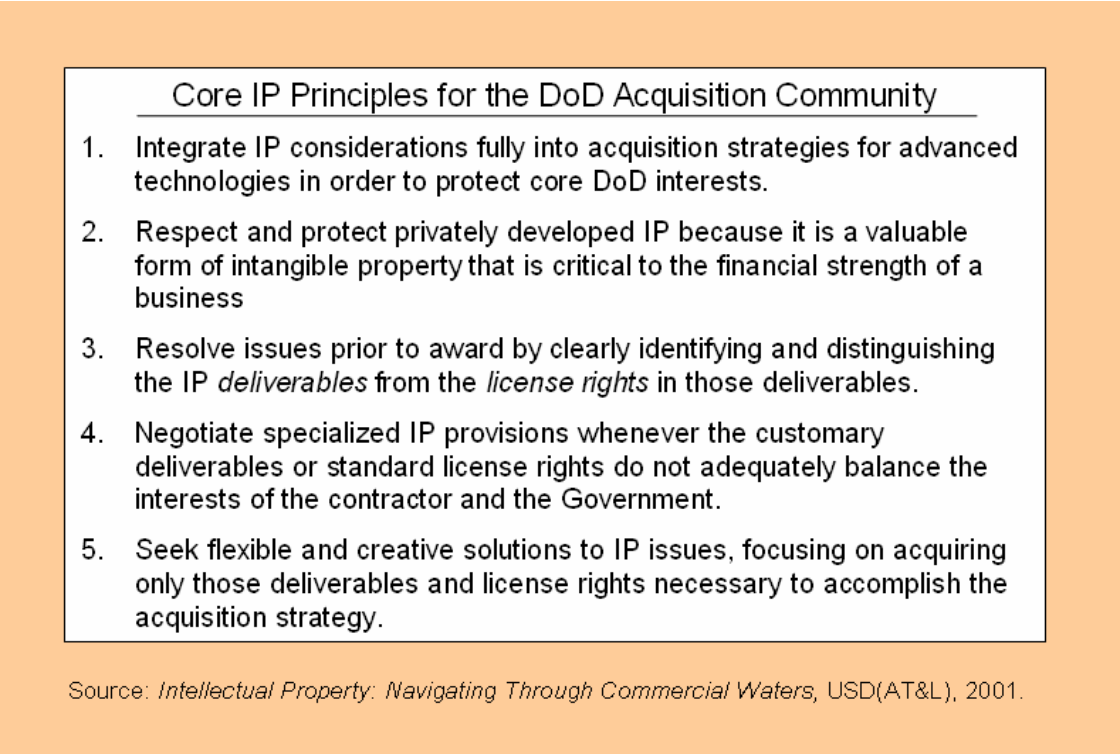
(2) Relinquish to, or otherwise provide, the Government rights to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation except for a transfer of rights mutually agreed upon. (Defense FAR Supplement, 227.72)

As can be seen from the FAR and DFARS policy, for work that is performed under a government contract, the government acquires (subject to negotiations) certain IP rights. It should be noted that a distinction should be made between *IP deliverables* and the *license rights* in those deliverables. The IP deliverables are those physical deliverables (containing pre-determined content and format) which the contractor is obligated to provide to the government in accordance with the contract requirements. "The government may own the delivered physical medium on which the IP resides, but generally it will not own the IP rights" (Under Secretary of Defense (AT&L), 2001, October 15). Unless the government has negotiated license rights with the contractor, it will not have the ability to use, reproduce, modify, and release the delivered IP. As stated before, the government negotiates and acquires certain IP rights for work that is performed under a government contract. In general, contractors are permitted to retain title of the IP rights for technical data and computer software that is developed or delivered under a DoD contract. Also, the DoD will receive a nonexclusive license to use that IP, based on the commerciality of the technology, and negotiations between the contracting parties (Under Secretary of Defense (AT&L), 2001, October 15).

Core Principles for Intellectual Property Rights

With the preference for using COTS and open systems in developing software-intensive weapon systems, there are certain core principles of Intellectual Property that DoD contracting officers should understand. These core principles, identified by the Under Secretary of Defense, Acquisition, Technology, and Logistics (USD(AT&L)) are listed in Figure 15 (Under Secretary of Defense (AT&L), 2001, October 15).

Figure 15. Core IP Principles for Intellectual Property



Source: *Intellectual Property: Navigating Through Commercial Waters,* USD(AT&L), 2001.

These five core principles are directly applicable to the previously discussed phases of the contracting process.

During procurement planning, it is important to integrate IP considerations into all phases of the systems' lifecycle (concept development, system development and demonstration, production and deployment, and disposal), as well as in interoperability and technology transfer. When conducting market research, IP issues should be considered, e.g., technology maturity level, adaptability of

technologies, commercial approaches to data and license rights, trade-offs between buying established technology from competitive sources and buying state-of-the-art technologies from non-competitive sources, the receptiveness of firms to comply with standard data rights and patent clauses, the current pace of technology, and the government's relative power in the market (Under Secretary of Defense (AT&L), 2001, October 15).

Using the results of the market research findings, the DoD contracting officer should make good use of the FAR guidance at 1.102 (d) that states:

> (d) The role of each member of the Acquisition Team is to exercise personal initiative and sound business judgment in providing the best value product or service to meet the customer's needs. In exercising initiative, Government members of the Acquisition Team may assume if a specific strategy, practice, policy or procedure is in the best interests of the Government and is not addressed in the FAR, nor prohibited by law (statute or case law), Executive order or other regulation, that the strategy, practice, policy or procedure is a permissible exercise of authority. (FAR, 1.102(d))

The solicitation should include the standard FAR and DoD FAR Supplement clauses, in addition to any other specialized IP provisions whenever the standard clauses do not adequately balance the interests of both contracting parties. In addition, source selection decisions should consider IP issues and costs as well as their implications on total cost of ownership. Finally, during contract administration and contract close-out, it is important for the government to protect privately developed intellectual property, as this will support the foundation for future open systems. Contractors invest significant amounts of time and resources in developing advanced, innovative technologies and rely on IP rights as the primary means to recoup these costs (Under Secretary of Defense (AT&L), 2001, October 15). If contractors do not believe their investment in innovative technology will be rewarded in DoD acquisition, they will no longer seek government contracts.

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Characteristics of a Successful MOSA-based Contract

This research began with a discussion of the open-systems concept and a description of a modular open systems approach (MOSA). The DoD preference for using a modular open systems approach was also referenced, along with the premise that the MOSA approach is an enabler to achieving the following objectives identified in the *OSJTF guide* (2004):

- Adapt to evolving requirements and threats
- Promote transition from science and technology into acquisition and deployment
- Facilitate systems integration
- Leverage commercial investment
- Reduce the development cycle-time and total lifecycle cost
- Ensure that the system will be fully interoperable with all the systems with which it must interface, without major modification of existing components
- Enhance commonality and reuse of components among systems
- Enhance access to cutting edge technologies and products from multiple suppliers
- Mitigate the risks associated with technology obsolescence
- Mitigate the risk of a single source of supply over the life of a system
- Enhance lifecycle supportability
- Increase competition

In order for an acquisition strategy to achieve these objectives, the contracting officer must structure the contracting strategy to be consistent with and support the acquisition objectives. This research has identified the various aspects of the contracting strategy that lead to the achievement of these MOSA objectives. Based on this research, successful contracts supporting a modular open systems approach (MOSA) will have the following characteristics:

1. Early involvement and participation of industry in the development of requirements and acquisition strategy pertaining to the contracted effort. This early involvement and participation includes conducting Market research and the use of Request for Information (RFIs), Industry Conferences, and Draft RFPs for the purpose of obtaining input and recommendations from industry on the structure of the contracting strategy and the resultant contract.
2. Shared roles between the government and contractors in the development of the System Specification and Statement of Work (SOW) for the contracted effort. This may include releasing the Initial Capabilities Document (ICD) to the offerors and allowing the offerors the flexibility to submit innovative plans for the development and design of the system.
3. A best-value contract award strategy in which an offeror's proposals are evaluated based on technical performance, schedule performance, and past performance as well as on cost and management approaches. Higher weights are given to non-cost factors such as technical performance and past performance during the source selection so the contract may be awarded to other than the lowest priced offeror.
4. A contract structure that includes incentives to the contractor for meeting higher levels of "openness" standards. These incentives may include Incentive Fees (CPIF, FPIF), Award Fees (CPAF, FPAF), and Award Term incentives.
5. Documentation of the contractor's performance in meeting "openness" requirements and using this documented past-performance evaluation in future source selections for contracts that are using a modular open systems approach. Also included here is the establishment of lessons learned and best practices on open systems practices and procedures.

Summary and Conclusion

The purpose of this research was to explore the use of the modular open systems approach (MOSA) as a method for implementing an evolutionary acquisition strategy as well as the implications of using such an approach on the contracting process. A background on evolutionary acquisition was provided highlighting the benefit of rapid development and production of weapon systems incrementally, with each increment providing an increasing level of capability. The modular open systems approach (MOSA) was identified as an enabler for the evolutionary acquisition strategy, and a brief discussion on open systems was provided. The contractual implications of using a modular open systems approach were then discussed, focusing on each of the six phases of the procurement process. Examples of MOSA-specific contracting activities and documents were taken from some recent weapons systems acquisition programs such as the Navy's Common Enterprise Display System (CEDS) program, Anti-submarine Warfare (ASW)/Undersea Warfare (USW) Test Information Management System program, Multi-mission Maritime Aircraft (MMA) program, Littoral Combat Ship (LCS) Mission Package Integrator program, Littoral Combat ship (LCS) Flight 0 Preliminary Design program, and the Navy's Mobile User Objective System (MUOS) program.

Finally, a brief highlight of intellectual property issues was provided along with a review of the applicable major regulatory provisions.

As previously stated, the MOSA is as much about business strategy as it is about technical approach. The modular open systems technical approach involves elements such as requirements, reference models, components, interfaces, standards, integration and testing, and deployment and support, as described by Meyers and Oberndorf (2001) and is further defined and expanded on by the various systems engineering guides and open systems handbooks. These technical approaches continue to be defined and refined and successfully implemented by various defense organizations.

The business strategy aspect of using a modular open systems approach is considered to be in a developmental phase of understanding, development, and refinement within the DoD acquisition community. Although the phases of the contracting process are the same for MOSA-based programs as they are for non-MOSA-based programs, this research found that the specific activities conducted and documents developed during the execution of these contracting phases have a direct influence on the success of a MOSA-based program. For example, the various options for allocating roles and responsibilities between the government and the contractor for the various steps in the acquisition process (such as the development of the initial capabilities documents, system specification, and SOW) will influence the amount of "openness" in the program and the contractor's motivation for meeting the desired level of openness. This study indicates that the greater degree of jointness in acquisition roles and responsibilities, as well as the greater degree of contractor-developed acquisition documents, will lead to a higher level of openness.

This study also identified early involvement and participation by industry in developing requirements and acquisition strategy as a key factor in successful MOSA-based programs. Program offices managing a MOSA-based program should conduct extensive market research and industry conferences to achieve this contractor involvement. A best-value contract strategy that is tailored to emphasize technical performance in open-based systems and COTS systems is also a critical factor in meeting higher levels of openness in MOSA-based programs. A contract strategy which involves developing source selection evaluation factors specifically weighted to emphasize an open systems approach will be critical for MOSA-based programs.

As important as the acquisition strategy is the structure of the contract of a MOSA-based program. This study identified the use of incentive fees, award fees, and award term contract incentives as integral to the success of MOSA-based programs. These incentives, if structured appropriately, are effective tools for

motivating and incentivizing contractors to achieve higher levels of openness in the design and development of systems.

Finally, the consistent and aggressive use of the contractor past-performance information system, as well as the development and establishment of lessons-learned programs and best practices will be essential as more and more MOSA-based programs are initiated. As contractors performing work on MOSA-based programs begin to realize that the DoD is insistent on using open systems in developing its major weapon systems, they should begin to dedicate the required resources to this method of developing weapon systems.

A short note should be added about the effectiveness of the current contracting regulations supporting the open systems approach. As stated earlier in this report, FAR Part 39 is specifically focused on modular contracting—but only as it relates to the acquisition of commercial information technology systems and not to weapon systems acquisition. The specific contracting activities conducted and procurement documents developed that support a successful MOSA-based program are addressed in other parts of the FAR and should be used as often, if not more so, than FAR Part 39. There is no need to add additional guidance to FAR Part 39, as contracting officers and acquisition managers are trained to use their business judgment and apply the various tools from this contracting tool box, such as acquisition strategies, contract types, incentive types, evaluation strategies, and so forth. What is needed is more training and education in the development and structuring of acquisition strategies as well as contracts that are conducive to MOSA-based programs—not additional regulatory requirements supporting open-systems approaches. The various guides (such as the *OSJTF Guide* and the OUSD (AT&L)'s *Draft Guide for Contracting for Systems Engineering*) will prove to be more valuable and beneficial than additional regulatory requirements.

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Recommendations for Further Research

This research explored the implications of using a MOSA-based approach on the contracting process, focusing on each of the six phases of the contracting process. The research identified the best practices and characteristics of successful MOSA-based contracts by analyzing various contracts such as the Navy Common Enterprise Display System (CEDS) program, Littoral Combat Ship (LCS) Mission Package Integrator program, LCS Flight 0 Preliminary Design program, Multi-mission Maritime Aircraft (MMA) program, and the Mobile User Objective System (MUOS) program. Thus, this research was limited to these current Navy acquisition programs. Although all DoD acquisition programs follow the same FAR and DFARS regulations (as well as the MOSA and systems engineering guides referenced in this research), further research should be conducted on other DoD acquisition programs (Army and Air Force) to evaluate the extent to which the identified best practices and characteristics have been implemented in those departments.

In addition, further detailed investigation should be conducted on how effective award fee and award term provisions are in incentivizing contractors to achieve higher levels of openness in designing and developing weapon systems. Although the use of award fee and award term contracts were identified as a best practice in MOSA-based contracts and were used in the contracts referenced in this research, given the recent GAO findings concerning the use of award fees in DoD contracts, this further investigation would prove beneficial and timely (GAO, 2005, December 19).

A more extensive research on the legal aspects of intellectual property rights provisions and their effect on contractors' willingness to pursue open systems-based programs would also be beneficial to developing best practices and success factors in this area. As previously stated in this research, the issue concerning the rights that contracting parties have to intellectual property developed under a government contract is one of the most discussed issues and often cited obstacles to using a MOSA-based approach in DoD acquisitions.

An analysis of current major weapon system acquisition programs should also be conducted—one specifically related to the status of MOSA implementation that is a required milestone review briefing point to the program's Milestone Decision Authority (Under Secretary of Defense (AT&L), 2004, April 5).

Another potential research focus should be the results of the OSJTF Program Assessment Rating Tool (PART) internal MOSA assessments. This research would identify current best practices (what works) and lessons learned (what does not work) in terms of implementing MOSA initiatives in weapon systems (Under Secretary of Defense (AT&L), 2004, July 7).

Finally, further investigation is needed on the type and extent of training that is currently provided to contracting officers in the area of MOSA-based acquisition strategies. A review of the current Defense Acquisition University and its contracting curriculum should be conducted to determine the extent of coverage of MOSA acquisition principles as well as the appropriate skill sets being emphasized. This review should also determine if specialized courses, designed for all acquisition management professionals (specifically systems engineers and contracting officers) should be developed to specifically focus on using a MOSA-based acquisition approach.

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Appendix A:

Suggested Topics for Industry Conferences

- The Government should continually emphasize the importance of the overall technical approach. The Government prepared SEP should be made available to industry.
- The Government and industry should discuss trades and analyses that have been conducted during the requirements generation process. While solution alternatives are studied during this phase of the program, the emphasis should remain on the resulting performance requirements, not on the specifics of the alternatives. Government trades and analyses should be made available to industry as appropriate.
- While it is necessary to investigate potential design solutions that are responsive to the requirements, the Government team should avoid becoming "fixated" with the solutions. The user sometimes becomes enamored with what he "likes," the acquisition team focuses on the one that "works," and industry has one it wants to "sell." The team should focus on establishing the cost-effective performance requirements that deliver the necessary operational capability—not picking the design solution.
- The Government should emphasize that potential offerors must have technical and management processes implemented during the program. The Government team should have a clear understanding of program requirements, encourage the offerors to discuss their technical approach to the program, and encourage the potential offerors to document their approach in a SEP.
- The Government briefings should address the program acquisition approach and how it was established. This is an excellent opportunity to reinforce the importance of the technical processes for the program and for the Government to describe its technical approach to the program
- The Government team should recognize that prospective offerors exercise extreme caution during open sessions for fear of compromising a "competitive advantage" or revealing a "perceived weakness." During one-on-one sessions, the discussions are more open and free, but be sure contractor proprietary data is always protected.
- The Government acquisition team should identify areas of interest and encourage prospective offerors to provide data, insights, and suggestions that facilitate the transition into SDD with sound performance requirements and a well structured technical approach. The agenda and topics should not be solely left to the discretion of the offerors; the Government should initiate discussions of topics addressed above.

Source: *Draft Guide for Contracting for Systems Engineering*, 2005

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Appendix B:

Example of Request for Information (RFI)

70–Anti-Submarine Warfare (ASW)/Undersea Warfare (USW) Test Information Management System

Modification 01 – Posted on Jan 26, 2004

General Information	
Document Type:	Sources Sought Notice
Solicitation Number:	N0025304Q0057
Posted Date:	Jan 12, 2004
Original Response Date:	Feb 02, 2004
Current Response Date:	Feb 02, 2004
Original Archive Date:	
Current Archive Date:	
Classification Code:	70 – General purpose information technology equipment

Contracting Office Address N00253 610 Dowell Street Keyport, WA

Description

The Naval Undersea Warfare Center Division Keyport is conducting market research to determine the interest and capability of industry for development and integration of an Anti-Submarine Warfare (ASW)/Undersea Warfare (USW) Test Information Management System. The system will provide information management, data processing, and instrumentation resources. The ASW/USW Test Information Management structure shall be compliant with DOD Directive 5015.2, Design Criteria Standard for Electronic Records Management-Software Applications, and the relevant Security Classification Guide. This effort encompasses all classes of

information associated with life cycle ASW/USW test and evaluation, including prototyping, Developmental Test, Operational Test, Proofing, and In-Service Engineering phases. Information elements are categorized as either programmatic information or test data, where: (1)Test Programmatic Information includes Test Plans, Test/Work Requests, and Test Reports; and the supporting documentation such as ADCAP and MK54 torpedo and Unmanned Underwater Vehicles (UUV) Specification Documentation, Test Parameter Requirements (TPR) documents, and instrumentation configuration load files. (2)Test data is raw, processed, and analyzed range test data available in engineering unit format from a variety of instrumentation or analysis sources throughout the ASW/USW test infrastructure, which includes fixed, portable, and simulation facilities. It includes digital, analog, video, and audio source data items. Two categories of users are anticipated (1)High Demand Users: Four primary geographically separated locations: NUWC Division Keyport; NUWC Division Keyport, Hawaii Detachment, Oahu, HI; NUWC Division Keyport, San Diego Detachment; NUWC Division Newport. (2)Lower Demand Users: Government and contractor sites in and around the greater Puget Sound area; Distributed test and training sites throughout the DOD MRTFB infrastructure; Fleet units pier side or underway. The ASW/USW Test Information Management architecture shall satisfy the following seven objectives. The technical approach will integrate, to the extent feasible and affordable, each objective. Solutions proposed may include hardware and software-based upgrades, modification of procedures, and/or any combination of these that clearly integrates each objective area into the over arching Information Management architecture. Objective 1: Information Exchange, Users will have the ability to exchange, transmit, and receive, programmatic and test data information elements necessary for mission execution. The capacity and bandwidth of the Test Information Management System must simultaneously support all end-users using existing Government internet access. The system will facilitate the test business process in a manner that has been approved by the Government to meet information assurance, and security requirements. Objective 2: Information Access (1) Within the Test Information Management System, users will have the ability to access and retrieve programmatic and test data information for planning, operations, analysis, and reporting purposes. All information will be in digital format (where practical), accessible from engineering workstations with Government Internet access. Search capability will employ DTIC keyword standards and formats; current and archived information will be accessible using standard Government PC software products (i.e.; MS Office Suite, Adobe, Matlab...etc). Specialized and tailored products will be available from long-term archives within 24-48 hours; server side processing will be maximized to support data requests within minutes subject to bandwidth restrictions. Server side processing must fully comply with Government Information Technology (IT) security and assurance guidelines as approved by local implementing agencies. Role-based privileges will provide the necessary security and integrity for the system. (2)Operational Availability and Reliability must exceed 95%; local and national backup protocols must be in-place to support downtime periods. (3) Emerging information management concepts, namely “Data Merging” and “Data Mining” are highly desirable attributes if economically achievable within the projected

schedule guidelines. Objective 3: Data Storage (1) Within the Test Information Management System, both test programmatic information and test data must be accessible within stated timelines therefore the architecture must have the capability to retain information in both an “immediately accessible” state, and an archived state for long term access. (2)Based on end-state data management policy; the storage capacity must be readily expandable as further data is collected and legacy information is converted to digital format. Data storage devices and interfaces must fully comply with Government Information Technology (IT) security and assurance guidelines as approved by local implementing agencies. (3)The Test Information Management System seeks to comply, within an acceptable schedule and if proved economically practical and feasible, with common format standards currently in use for ASW/USW systems. Objective 4: Magnetic and Optical Storage Mediums Within the Test Information Management System, an on-demand capability to retrieve archived legacy and near term test data from magnetic or optical media will be available to support data requests. Support turn-around time must not exceed 72 hours from date/time of request. Conversion and storage of all media must fully comply with Government Information Technology (IT) security assurance guidelines as approved by local implementing agencies. Objective 5: Legacy Non-Digital Data Products. Within: the Test Information Management System, on-demand conversion of legacy ASW/USW programmatic information and test data to digital format is required. That data must be accessible as described in Objectives 1-3 above. Keyword search files will be created in MS Word and/or Adobe PDF formats with links to the referenced documents using DTIC guidelines. Conversion and storage of all paper products must fully comply with Government Information Technology (IT) security and assurance guidelines as approved by local implementing agencies. Objective 6: Standardization of Data Products. Within the Test Information Management System, standard data packages will be defined and coordinated with managers and engineers for completeness and quality. Scripting or other automation mechanisms will be required to support standard data package publication and distribution. Objective 7: Instrumentation and Data Processing Support. The Test Information Management System will require integration of many diverse tools, some in use, some being developed, including but not limited to: (a) Mathworks MatLab with Government sponsored toolkits (e.g. Data Insight) (b) Real time sensor acquisition systems and associated display applications (c) Test/Exercise resource management, planning, and scheduling tools (d) Standard office and publishing tools (Excel, Word, Project, Adobe PDF, etc.) (e)Document management tools (f) Acoustic and video image processing tools (g)Data Probe/Probe and its derivatives (Charon Probe) (h)Interoperability gateways to accommodate disparate distributed environments. Schedule Objectives are: (1) FY 2005. Requirements Definition with parallel Proof-of-Concept Studies; Acquisition, Integration, and Deployment of Tools and Resources. (2) FY 2006. Integration into the ASW/USW Business Process. Provide a schedule and/or comments regarding the schedule objectives. All packages submitted in response to the Request for Information (RFI) should include the following information: Name and address of company, business size, company point of contact, telephone number, fax number, e-mail address, statement of capability, and estimated cost. The capability package

must be clear, and concise. Capabilities packages must be received no later than 3:00 P.M. PST, 2 February 2004. THIS IS A REQUEST FOR INFORMATION ONLY. The Government does not intend to award a contract or any other type of agreement on the basis of this synopsis or to otherwise pay for the information solicited under this synopsis. This is NOT a request for a proposal or an invitation for bid, merely a request for information only. The Government is interested in obtaining information from industry to identify existing commercial off the shelf test information management system, or ongoing or planned development efforts for test data modernization studies. The information provided through the responses will be used to aid in requirements definition for future acquisitions. If a solicitation is released, it will be synopsized on the Navy Electronic Commerce Online (NECO) web link www.neco.navy.mil and on the Keyport Acquisition homepage at http://kpt-eco.kpt.nuwc.navy.mil

Point of Contact

Melanie A. Powers, Ph: (360) 315-3384, Fax: (360) 396-7036, Naval Undersea Warfare Center Division Keyport, Attn: Supply Department, Code 182, Building 944, 610 Dowell Street, Keyport, WA 98345-7610

Email your questions to Melanie A. Powers, Contracting Officer at powersm@kpt.nuwc.navy.mil

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Appendix C

Extract from CEDS Statement of Work (SOW)

3.1.3.2 Compliance To Open Architecture (OA) Requirements.

The Contractor shall maintain a profile of OA interfaces and data regarding OA compliance for CEDS equipment developed under this contract using PEO IWS Open Architecture Computing Environment Design Guidance, V1.0 23 August 2004, Open Architecture Computing Environment Technologies and Standards, V1.0 23 August 2004 and PEO C4I Rapid Application Integration and Development Standards, V1.5 (Draft) 24 Feb 02 open architecture guidance documents.

The Contractor shall define, document, and follow an open systems approach utilizing modular design and standards-based interfaces. The Contractor shall present the open systems plan to the Government during all design reviews. The following design approach characteristics shall be utilized:

a. Open Architecture—The Contractor shall ensure that all requirements are accounted for by tracing them to one or more modules.

b. Open Modular Design—The Contractor shall provide the rationale for the modularization choices made to generate the design. The Contractor's rationale shall explicitly address any tradeoffs performed, particularly those that compromise the modular and open nature of the system. These designs shall be documented and modeled using industry standard formats, (e.g., unified modeling language (UML).), and using tools that are capable of exporting model information in a standard format (e.g., extensible markup language (XML) metadata interchange (XMI) format).

c. Interface design and management—The Contractor shall clearly define the component and system interfaces. The Contractor shall define and document all subsystem and configuration item (CI) level interfaces to provide full functional, physical and electrical specifications.

d. Treatment of Proprietary Elements—The Contractor shall identify and justify the use of proprietary or closed interfaces, code modules, hardware, firmware, or software. It is the Contractor's responsibility to protect the open elements of the system from being intertwined with the proprietary elements.

e. Open Business Practices—The Contractor shall demonstrate that the modularity of the system design promotes the identification of multiple sources of supply and/or repair, and supports flexible business strategies that enhance subcontractor competition. The Contractor shall identify any pre-existing alternative for solutions they have proposed to custom build. The Contractor shall identify those pre-existing items it intends to reuse. Exceptions to reuse must be accompanied by justification, such as cost, schedule, etc.

f. Peer Review Rights—The Government intends to procure open architectures, designs, and corresponding software components. For designs or software the Government has Government purpose rights (GPR), the Government intends to receive third party reviews on an ongoing basis. Proprietary elements, which the Government has approved into open designs and code, will not be subject to this review.

g. Technology Refresh Method—The Contractor's architectural approach shall provide a viable technology refresh process.

Standards that are not specified within this contract must be approved by the Government prior to their use.

3.1.3.3 <u>Modular Open Systems Approach (MOSA).</u>

The Contractor shall use a modular open systems approach (MOSA) to evaluate the appropriateness of implementing a modular design strategy for building systems IAW Under Secretary of Defense Memorandums: *Amplifying DoDD 5000.1 Guidance Regarding Modular Open Systems Approach (MOSA) Implementation* and *Instructions for Modular Open Systems Approach (MOSA) Implementation*. A primary consideration in selection of equipment to meet the design functionality shall be the impact to the overall modular open systems architecture. A modular open systems approach and analysis of long term supportability, interoperability, and

growth for future modifications shall be major factors in the Contractor's final selection of equipment and integration approach.

The architectural approach shall provide a viable technology insertion methodology and refresh strategy that supports application of a modular open systems approach and is responsive to changes driven by mission requirements and new technologies.

The Contractor shall maximize commonality of components used in CEDS equipment across all product baselines. The Contractor shall develop metrics to measure the degree of success in achieving commonality goals. The Contractor shall report the degree of commonality success at program and design reviews.

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Appendix D

Extract from LCS Mission Package Integrator Statement of Work (SOW)

3.1.1.2—The Contractor shall propose to PMS 420 a process for identifying and selecting new technologies for inclusion in future Mission Package spirals. Technology insertion solutions shall trace directly to and satisfy a Warfighting Capability Gap, either to improve existing functionality (e.g. technology refresh) or to satisfy a new requirement as a result of the Navy's continued Capability Gap Analysis. PMS 420 desires technology insertion opportunities to be driven by "user pull" not "technology push." Four principles which shall be inherent in developing this process are 1) the practice of including all applicable foreign and domestic governments, industry and academia, in the search for new technology candidates, and technology projection 2) employment of Open Systems Architecture (OSA) modularity and industry standards, 3) the inclusion of a Mission Package Decision Board (MPDB), under the leadership of PMS 420, for selecting material solutions for inclusion in spirals, and 4) the capture and inclusion of Fleet input. The process shall include provisions for the Contractor to prepare Mission Area Gap Analyses at an engineering level, leveraging Navy's Centers of Excellence capabilities, and to provide recommended solutions, either materiel (new/upgraded systems) or non materiel (e.g., MP employment concepts). The Contractor shall document this process in a Spiral Development Plan and submit to PMS 420 for approval.

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Appendix E

Recommended Language for Statements of Objectives (SOO)

If a SOO is being used, the following examples of objectives may be used.

The Offeror shall use modular open systems approach to:

1. Facilitate development of a modular architecture and allow for affordable intraoperability

2. Ensure that the system design is sufficiently flexible and robust to accommodate changing technology and requirements

3. Facilitate integration with other systems and use of commercial products from multiplesources both in the initial design and in future enhancements

4. Enable technology insertion as currently available commercial products mature and new commercial products become available in the future

5. Allow for affordable support

6. Allow continued access to technologies and products supported by many suppliers (a broad industrial base which does not restrict available sources to the detriment of competition)

For systems that tend to evolve and improve with time:

S*ystem design enables technology insertion as currently available commercial products mature and new commercial products become available in the future.*

Or

Enable incremental system improvements through upgrades of individual hardware or software modules with newer modular components without redesign of entire systems or large portions thereof.

If technology obsolescence is a risk that must be managed:

Mitigate the risks associated with technology obsolescence, being locked into proprietary technology, and reliance on a single source of supply over the life of the system.

An overall objective to take advantage of the benefits of MOSA:

Build the system based on modular hardware and software design, choosing commercially supported specifications and standards for selected interfaces (external, internal, functional, and physical) products, practices, and tools.

Source: (*OSJTF guide*, 2004)

Appendix F

Extract from CEDS CDRL

CONTRACT DATA REQUIREMENTS LIST
(1 Data Item)

Form Approved
OMB No. 0704-0188

A. CONTRACT LINE ITEM NO.	B. EXH/ATCH NO.	C. CATEGORY
CLINs 0002, 0008	**A**	TDP ___ TM ___ OTHER _X_ 1

D. SYSTEM/ITEM	E. CONTRACT/PR NO.	F. CONTRACTOR
CEDS	**N00024-PR-05-NR-46527**	**Selected Prime Contractor**

1. DATA ITEM NO	2. TITLE OF DATA ITEM	3. SUBTITLE
012	**SCIENTIFIC AND TECHNICAL REPORTS**	**OPEN ARCHITECTURE (OA) PROFILE DOCUMENT**

4. AUTHORITY (Data Acquisition Doc. No)	5. CONTRACT REFERENCE	6. REQUIRING OFFICE
DI- MISC-80711A 00JAN21		***PEO IWS6.0***

7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF 1st SUBMISSION
LT	**F**	**ONE/R**	**SEE BLK 16**

8. APP CODE	11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION
A	**N/A**	**SEE BLK 16**

16. REMARKS

BLK 4: PARAGRAPH 10.2 DOES NOT APPLY. CONTRACTOR FORMAT OF PROFILE MATRIX IS ACCEPTABLE.

BLK 8: APPROVAL OF OPEN SYSTEM PROFILE IS REQUIRED FOR EACH PART OF THE CDR. APPROVAL IS REQUIRED FOR EACH CEDS CONFIGURATION. APPROVAL IS FOR TECHNICAL CONTENT AND ACCURACY. APPROVAL IS REQUIRED BEFORE DESIGN IS APPROVED. GOVERNMENT RESPONSE TIME IS 60 DAYS. ANY REJECTED SUBMISSION SHALL BE CORRECTED AND RESUBMITTED WITHIN 30 DAYS OF THE DATE OF REJECTION.

BLK 9: DISTRIBUTION STATEMENT F: FURTHER DISSEMINATION ONLY AS DIRECTED BY PROGRAM EXECUTIVE OFFICE FOR INTEGRATED WARFARE SYSTEMS (PEO IWS6.0), WASHINGTON NAVY YARD, DC AS OF JULY 8, 2005 OR HIGHER DOD AUTHORITY.

BLK 12: DUE 30 DAYS BEFORE PRELIMINARY DESIGN REVIEW (PDR).

BLK 13: THE CONTRACTOR'S OA PROFILE SHALL BE REVISED FOR EACH TECHNOLOGY TO REFLECT THE OBSOLESCENCE/INFUSION CHANGE AS IT AFFECTS THE EXTERNAL OR INTERNAL INTERFACES OF THE PRODUCT BASELINE.

BLK 14: DELIVERY TO BE IN DIGITAL FORMAT TO THE GOVERNMENT'S SPECIFIED WEBSITE.

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Appendix G

Extract From LCS Instruction to Offerors (ITOs)

2.4 System Architecture Development and Implementation Approach The Offeror shall describe its approach for developing and implementing a wide use of open systems for mission module interfaces, C4I systems, FORCEnet and HM&E systems in accordance with Attachments J-5, and J-10. The following will be considered in evaluating this subfactor:

Technical Architecture: The Offeror shall describe its technology insertion methodology and refresh strategy that supports a long-term open systems application and that is adaptable to changes driven by mission requirements and new technologies. The Offeror shall describe how the modular architecture integrates with the ship's core C4ISR and combat systems.

Navy Open Systems Architecture Conformance: Describe the Offeror's total ship computing environment design approach including description of conformance to Navy Open Architecture standards and guidelines in Attachment J-10. Describe the Offeror's approach to re-use open architecture software system component/code within the LCS design. The Offeror shall identify how the Offeror intends to incorporate OA technical standards into its overall design. In addition, identify how the Offeror's proposed design will address the elements of the functional architecture framework, which includes IWS Integrated Architecture, OA re-usable applications and definitions of critical systems interfaces.

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