



Systems Engineering at MITRE

SERVICE-ORIENTED ARCHITECTURE (SOA) SERIES

# Service-Oriented Acquisitions

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## Executive Summary

With the increase of Service-Oriented Architecture (SOA) as a popular approach for managing large information technology (IT) portfolios, interdisciplinary teams across the Federal Government are embarking on acquisitions for SOA-based services, components, and supporting infrastructure.

**Enterprise SOA—A collection of services**—Federal organizations are large enterprises, and creating an SOA in this context generally suggests a complex collection of software services to implement a series of capabilities. Implementing an enterprise SOA is comprised of many smaller efforts, where a portfolio of services is ultimately created for an organization to utilize. In contrast with traditional single system acquisition, which can frequently be acquired with a singular acquisition approach, the portfolio of IT services most often requires many different implementation approaches. For example, some services may be commercially available in the marketplace as pre-existing capabilities to be purchased. Some services may require the custom development of software, and the integration of hardware for a holistic solution. Some services will be run in-house by Government staff and may require the licensing of products, while others may be externally managed. In all these cases, different types of procurement actions and documents will be required to implement some portion of the SOA vision for an organization. For each service, the procurement, technical, and management staff must work together to pick the best acquisition approach for the Government that balances trade-offs in program risk and cost.

**What do you procure for an SOA**—There are several general cases that define the broad types of procurements most often required to implement elements of an enterprise SOA:

- **Commercial managed service provider’s (MSP) service offering:** A key driver of cost for the MSP

is the service-level agreement (SLA) that defines the service offering and the promised performance levels. The SLA becomes a key portion of the legal framework between the Government as a consumer, and the MSP as a provider.

- **Government MSP service offering:** In this option, one Government organization acts as a service provider to another.
- **Custom services: System integrator’s (SI) experience and labor**—Many times the Government’s needs are not fully met by an existing commercial offering. Another widely used option for creating service offerings in the Federal Government is to hire an integrator firm with knowledge of software and hardware systems to build and operate a custom service “internally.” In this case, the Government is essentially hiring the expertise and experience of the vendor in creating and operating large multi-tiered IT software systems.
- **Infrastructure: Product vendor’s market offerings**—A final general category of procurement related to an SOA is the procurement of software and hardware infrastructure, most often in direct support of services. Items in this category can include software licenses for components such as Enterprise Service Buses (ESBs) or universal description, discovery and integration (UDDI) service repositories, and hardware to provide Web servers, application servers, and database tiers in contemporary service offerings.

**Defining requirements**—Successful acquisitions have always relied on strong requirements definition; and when acquiring elements of an SOA, this continues to be a driving factor. Fortunately, services have natural interface definition points and performance specifications that translate into contract requirements, though the dynamic “composability” of services requires extra effort to bound some types of service requirements such as expected throughput and demand. In specifying the

requirements for a service, several areas that should be considered to ensure that the operational service meets the Government's expectations include: interface specifications, performance measurement methods, SLAs, installation on a Government-provided network topology, lifecycle governance, data rights, and options for graceful increased and decreased service usage. These topics represent key elements that will provide a foundation for successful consumer/provider relationships. In most cases, when the Government contracts with commercial vendors, it is important that these topics are contractually specified. If the relationship is between two Government entities, a detailed memorandum of understanding (MOU) may suffice, though it should be well documented.

**Incentives For Service Characteristics**—Vendor performance can be encouraged by incentives defined in the formal contractual relationship. Contract performance in an SOA context, such as the allowable downtime for the operational service or the quantity of service calls supported in a period of time, can be defined in staggered, stair step, or banded levels, where performance levels ranging from substandard to exceptional can be priced, and appropriately rewarded or penalized by the buyer, separately from routine or expected performance. The service orientation of an SOA lends itself well to these approaches.

### **Recommendations**

- Break up the overall strategy for the SOA into a set of individual tactical procurements for pieces of the IT portfolio, based on the types of items or services being acquired. Some services may be internal, some commercial, some off-the-shelf, and some custom. Adjust your procurement actions to accommodate each portfolio piece, while maintaining an overall acquisition strategy that recognizes the dependencies across implementation components.
- Take the time to define the requirements for services as completely as possible. Useful requirements categories can include interface requirements, service demand expectations, and performance management requirements. Use smaller requirements definition tasks to explore and refine requirements, and to reduce uncertainty in implementation.

- Make contract documents adaptable to degrees of change common in dynamic enterprise SOAs, such as changes in service demand, by defining and pricing ranges of service demand.
- Define robust SLAs with unambiguous measurement strategies for service providers. If common instrumentation is required for performance measurement across the SOA portfolio, clarify those requirements to service providers.
- Consider the performance of all the providers in an enterprise SOA, including the network, and define methods to instrument and measure individual provider performance. Have formal performance agreements in place for all providers, whether they are internal or external organizations.
- Regarding contracting style, be performance based, not implementation based. Use performance-based service contracting (PBSC) frameworks and document templates to acquire SOA services in a Federal context. Strive to define how the service should perform, not how it is to be implemented. Valid exceptions to this goal can include implementation requirements for areas such as security, mission assurance, or performance measurement. Note, however, that if special requirements drive the implementation far from commercial approaches for providing a service, risk and cost implications must be duly analyzed and understood.
- Spend a good deal of time analyzing if the SOA service can be bought commercially or if the service is a one-of-a-kind creation for the Government. Custom development of large software systems brings with it unique risks. Often custom requirements cannot be avoided due to a particular organizational policy or rule, but when possible, go with a truly commercial offering.
- Take a critical look at the business model for the service. If the Government is the predominant or only consumer of the SOA service to be acquired, consider the capitalization model from everyone's point of view. How long does the vendor have to make back the capitalization costs? The Government group creating the request for proposal (RFP) should understand how providing the service to the Government leads to a profitable outcome.

*For more information on SOA, see <http://www.mitre.org/soa>.*

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**THE BIG PICTURE:** The acquisition of SOA-based services, components, and supporting infrastructure presents a number of challenges. Different types of procurement actions and documents will be required to implement the SOA vision. Procurement, technical, and management staff must work together to pick the best acquisition approach that balances tradeoffs in program risk and cost.

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# Service-Oriented Acquisitions— Implementing an SOA in a Federal Organization

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## SOA Acquisitions

**The challenge**—With the increase of SOA as a popular approach for managing large IT portfolios, interdisciplinary teams across the Federal Government are embarking on acquisitions for SOA-based services, components, and supporting infrastructure. They will face several challenges in these efforts:

- **Coordinating many moving parts:** SOA implementations, which comprise a number of interoperating components, are often realized in an enterprise through a series of procurement actions, mixing new and legacy capabilities and commercial and Government-run services, and crossing organizational boundaries. Consequently, while the service-based approach can add significant value for the enterprise by leveraging past IT investments, it can also add complexity to the procurement process. SOA implementations may be procured, operated, and funded across many parts of an organization, with a multi-faceted set of interdependencies. Solving the enterprise SOA challenge will require a portfolio approach, with many moving parts, and the acquisition strategy will reflect the complexity of the underlying portfolio. Looking at the collection of services in an enterprise SOA implementation as a portfolio suggests considering each service in terms of its individual program ownership and funding, development

schedules, operational interdependencies, and value to the consumer, thus clarifying the service's relationship to the whole and impacting enterprise SOA procurement planning.

- **Tailoring traditional procurement documents:** Many of the governing procedures and rules for these acquisitions were established years before the existence of IT service-orientation as a concept, and therefore thoughtful structuring of procurement documents and processes is useful and required to achieve optimal results.
- **Getting the requirements correct and as complete as possible:** Al Grasso writes, “The initial [program] requirements definition and tradeoff phase is rarely performed with sufficient rigor. ... The importance of spending sufficient time and resources in this initial phase cannot be overemphasized.”<sup>1</sup> Successful acquisitions have always relied on strong requirements definition; this continues to be a driving factor when acquiring elements of an SOA. Fortunately, services have natural interface definition points and performance specifications that translate into contract requirements, though the dynamic “composability” of services requires extra effort to bound some types of requirements, such as throughput and demand. Capturing these varied aspects of a service's expected operational characteristics is not trivial and is necessary for robust procurement actions.

- **Getting the right skill sets:** Acquisitions for SOA elements require at least two separate skill sets. On one hand, the acquisition team includes experts in procurement who are wholly familiar with the Federal Acquisition Regulations (FAR), and local policies and procedures practiced within an organization, and certified in the Acquisition Professional Development Program. A member of this group is going to be a certified contracting officer and will hold a warrant to obligate the Government for contract actions. On the other hand, the team will include experts in a relatively new set of IT technologies used to specify and implement services in an SOA. This group should understand the functional requirements for the services being created, including their business purpose and their role in a larger enterprise architecture. The IT group will focus on service definition, interface or interface standards specification, enterprise architecture alignment, and requirements or objectives specification. These two groups, IT and procurement, often speak in two entirely different sets of specialist jargon, and the difficulty in team communication adds to the challenge.

This paper discusses various approaches to providing the series of elements most often required for a comprehensive enterprise SOA portfolio acquisition. The paper is meant to bridge the experience of the diverse worlds of procurement, the IT software service providers, and the Government IT program manager. We do not assume the reader has extensive experience in procurement.

## Important Concepts—Background

***The Federal Acquisition Regulation and beyond***—Most service acquisitions must comply with a combination of three elements: the FAR, agency-defined extensions such as the Defense Federal Acquisition Regulation Supplement (DFARS) for the Department of Defense, and agency-defined local contracting practices. Writing a general paper on procurement is difficult because while the FAR codifies the Federal approaches to procurement, there is enough variety in local practice and interpretation to offer an exception to many blanket statements. To compensate, this paper will use terms that apply in general to most Federal

agencies and will discuss the most likely approaches that are common across organizations.

***Types of contract documents***—Fundamentally, procurements are focused on definition, negotiation, and exchange of legal documents. In the context of this paper, the parties involved include the Government buying a capability and a vendor providing or supporting a capability. Regardless of the acquisition vehicle, whether a “full and open” competed contract or a small task on an existing indefinite delivery/indefinite quantity (IDIQ) contract vehicle, and regardless of the variety of names used by different agency document formats, a few essential elements must be present to produce a competitive bid.

Historically, in a procurement package, Section C held a description of the statement of work (SOW) and described requirements in terms of what needs to be accomplished. More recent trends and direction from the Office of Management and Budget (OMB) have replaced this SOW with a statement of objectives (SOO) in many organizations. The SOW and SOO are different approaches to defining the capability being procured. Historically, SOWs tended to specify many details of “how” the work was to be performed, while SOOs are a more recent attempt to specify endpoint objectives, leaving implementation details out of the contract and theoretically leaving room for better efficiencies by the vendor. (Performance-based contracting approaches use variations of these document types to define a contract for a vendor service offering. The concepts of performance contracting are further discussed below.) In either case, the outcomes of the procurement are specified in what we will generically term a Section C. It is not unusual for a Section C to specify technical details for procurement, such as standards to be used, required interfaces and data exchanges, progress reporting, expected service levels, commercial-off-the-shelf software or hardware products to be integrated, and operational environments for software systems. Most often this is done by reference in an additional series of technically oriented attachments.

In addition to the work definition and technical information in Section C, Section L describes instructions on how the offer is to be constructed, and Section M describes how the offer will be evaluated. (Note that there are a number of other usual components to the legal framework for the contract,



but we will skip those for expediency.) Sections L and M can often be thought of as a pair because the considerations that are used in the M evaluation should be asked for in the L instructions. For example, if Section M defines an intention to assess a vendor's performance monitoring strategy for a service, then Section L would ask the vendor to provide the information sufficient for the evaluation, such as the performance monitoring architecture and the products to be used in the proposed solution.

Though there have been many agency variations on the titles of these key contract elements, procurement teams generally find themselves turning their service-oriented requirements into collections of documents that can ultimately be memorialized in a binding contract with a successful offeror. Should there be a problem with the execution of the contract, these documents, supported by precedent, will be the source for the definition of successful contract performance in a legal dispute.

#### **Well-written documents define procurements**—

As with most engineering processes, a key driver of a successful procurement is a comprehensive set of well-articulated requirements. Requirements will drive the structure of Section C, either as a SOW or SOO, and the technical attachments in the final contract. When implementing the collections of services that comprise an SOA service portfolio, there are many types of requirements that can be specified, such as service function, service interfaces and standards to be employed, service response times, service failure mechanisms, and support strategies. (This topic is more fully explored below.) It is important to note that these requirements directly drive cost for the provider, and therefore they must be defined with sufficient attention since once the binding contract is in place, they cannot be changed unilaterally without unpleasant consequences. IBM states, "The success of your SOA project rests heavily on your team's ability to capture [technical] requirements

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*"The success of your SOA project rests heavily on your team's ability to capture [technical] requirements accurately and realistically."*<sup>2</sup>

—Kunal Mittal

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accurately and realistically."<sup>2</sup> Changing technical requirements once the contract is in place requires a formal contract modification process, often with new contract terms and costs, and given that the multi-vendor competition will be concluded at that time, the result can be expensive. "The SLAs and Operational-Level Agreements (OLAs) are the most difficult set of technical SOA requirements because everyone wants the service to respond as quickly as possible, to be available 24/7, to support an infinite number of users, and so on."<sup>3</sup> There is significant advantage to the Government in taking the time to get the requirements as correct as possible up front.

**Incentives for service characteristics**—Contract performance in an SOA context, such as the allowable downtime for the operational service or the quantity of service calls supported in a period of time, can be defined in staggered, stair-step, or banded levels. Performance levels ranging from substandard to exceptional can be priced and appropriately rewarded or penalized by the buyer, separately from routine or expected performance. Defined incentives can be placed in the contract for varied levels of performance as clarified in the FAR Subpart 16.4, which says, "Performance incentives may be considered in connection with specific product characteristics (e.g., a missile range, an aircraft speed, an engine thrust, or vehicle maneuverability) or other specific elements of the contractor's performance. These incentives should be designed to relate profit or [award] fee to results achieved by the contractor, compared with specified targets."<sup>4</sup> For example, a quarterly profit/award fee assessment of 5 percent might be used for nominal operation of a software service, while a profit/award fee of 6 percent could be applied for a service that exceeded defined operational up-time goals.

The FAR further states, "To the maximum extent practicable, positive and negative performance incentives shall be considered in connection with service contracts for performance of objectively measurable tasks when quality of performance is critical and incentives are likely to motivate the contractor."<sup>5</sup> Note that incentives are defined in exact contractual text with measurement mechanisms by the time the contract is memorialized, so Government team members should not associate "incentives" with assessing intangible vendor motivations. Requirements and associated award fee levels at any level of performance are overt, budgetable,

predictable, and documented. When and how incentives are to be measured should also be defined in the contract. The FAR states, “Performance tests and/or assessments of work performance are generally essential in order to determine the degree of attainment of performance targets. Therefore, the contract must be as specific as possible in establishing test criteria (such as testing conditions, instrumentation precision, and data interpretation) and performance standards (such as the quality levels of services to be provided).”<sup>6</sup> Taking the time to carefully define this structure will avoid potentially large roadblocks later in the contract execution. Both the vendor and the Government benefit from predictable financial projections related to the contract.

## Procuring an SOA Portfolio

**Enterprise SOA—A collection of services—** Federal organizations are large enterprises, and creating an SOA in this context generally suggests a complex collection of software services to implement a series of capabilities. Implementing an enterprise SOA comprises many smaller efforts in

which a portfolio of services is ultimately created for an organization to utilize. The portfolio of IT services most often requires many different implementation approaches. For example, some services may be commercially available in the marketplace as pre-existing capabilities to be purchased. Some services may require the custom development of software and the integration of hardware for a holistic solution. Some services will be run in-house by Government staff and may require the licensing of products, while others may be externally managed. In all these cases, different types of procurement actions will be required to implement some portion of the SOA vision for an organization. For each service, the procurement, technical, and management staff must work together to pick the best approach for the Government that balances trade-offs in program risk and cost.

**What do you procure for an SOA?—**The following general cases define the broad types of procurements most often required to implement an enterprise SOA:

- **Commercial MSP service offering:** A true MSP exists in the commercial marketplace, with or

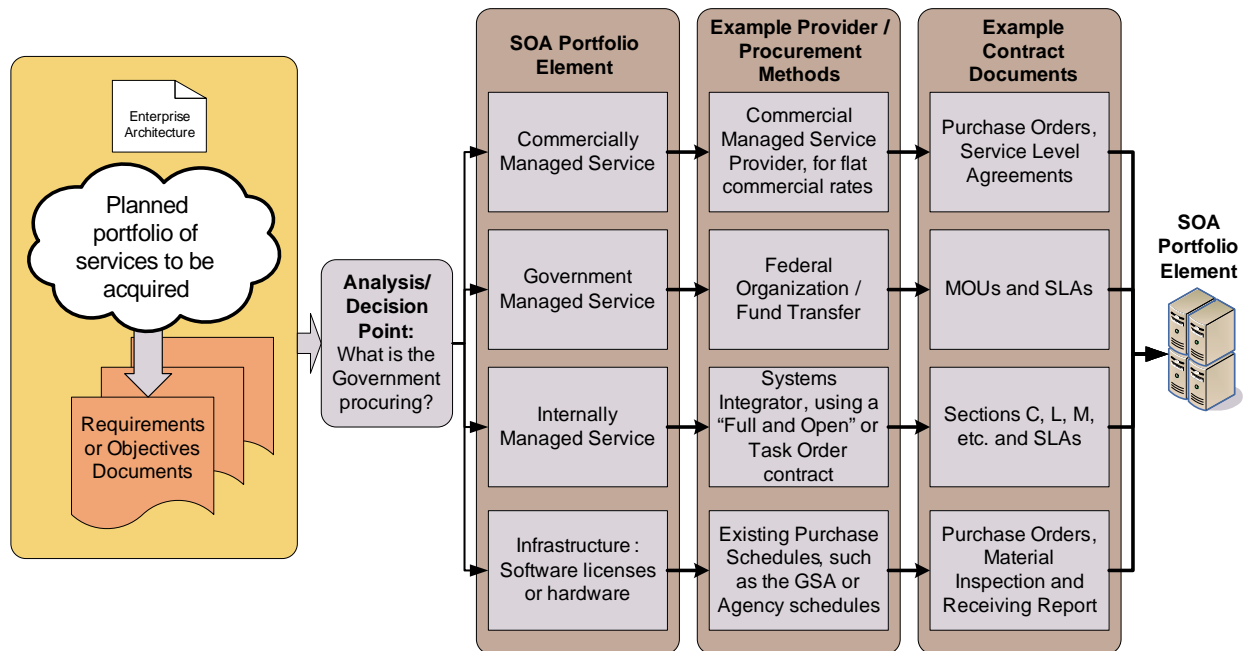


Figure 1. Many Paths for an SOA Portfolio Element Procurement

without the Government. In other words, the MSP offers commercial services at rates determined by the commercial marketplace and does not require the Government to capitalize its existence. A key driver of cost for the MSP is the SLA that defines the service offering and the promised performance levels. The SLA becomes a key portion of the legal framework between the Government as a consumer and the MSP as a provider.

- **Government MSP service offering:** In this option, one Government organization acts as a service provider to another. Over time we can expect the prevalence of Government-to-Government service offerings to increase. An example of this model includes the National Business Center of the Department of the Interior, which offers services through a series of lines of business to other Federal Government consumers, including services in the financial management and budget, human resource and payroll, and information technology areas.<sup>7</sup>
- **System integrator’s experience and labor:** Many times the Government’s needs are not fully met by an existing commercial offering. Another widely used option for creating service offerings in the Federal Government is to hire an integrator firm with knowledge of software and hardware systems to build and operate a custom service “internally.” In this case, the Government is essentially hiring the vendor’s expertise and experience in creating and operating large multi-tiered IT software systems. These services tend to be specific to the procuring agency, and when successful rely in large part on well-defined requirements, as does any software-intensive system development process. Unlike the MSP that tends to be driven by the overall marketplace, in this case the Government has wide latitude to build services that meet only its needs.
- **Infrastructure: Product vendor’s market offerings**—A final general category of procurement related to an SOA is the procurement of software and hardware infrastructure, most often in direct support of services. Items in this category can include software licenses for components such as ESBs or UDDI repositories and hardware to provide web servers, application servers, and database tiers in contemporary service offerings. Procuring commercial products is a well-understood and common Government

practice and therefore does not require a further SOA-specific discussion in this paper. Integration of these commercial products into a system of systems brings us back to the system integrator discussion above.

Determining which generalized type of SOA procurement is required for each portion of an SOA implementation is a key piece of analysis that must be done by the technical staff implementing SOA services in conjunction with the overall procurement strategy. The process is requirements driven. If the Government’s needs are sufficiently unique, then truly commercial MSPs will often not be adequate. Most often, security requirements are inflexible and unique enough to drive the Government away from truly commercial offerings to custom-built options available from system integrators. Unique requirements can also drive the Government away from externally hosted services to services that are operated in Government space by Government or security-approved hired staff. As shown in Figure 1, making these decisions for each service to be offered in an SOA portfolio will determine which contract types will be used, and which contractual documents need to be prepared.

## SOA Procurement Vehicles

Once the service requirements and an assessment of the marketplace have determined the type of SOA elements in a portfolio to procure, the Government team must determine the best vehicles with which to perform the procurements. Though there are many variations, three broadly generalized approaches apply:

- **“Full and open” procurements:** In this process, an RFP is drafted of many document parts and is released to the full marketplace for bids. This is a time-consuming process, with several potential schedule risks. First, the RFP is often released on a service such as [www.fbo.gov](http://www.fbo.gov),<sup>8</sup> where it is accessible to more than 400,000 vendors in the Central Contractor Registry.<sup>9</sup> While there can be criteria that limit the number of responses, an undetermined quantity of proposals may be received from the open marketplace, adding schedule risk to the evaluation process. Recent trends suggest that protests are becoming more common in this type of procurement,

also adding to the schedule risk.<sup>10</sup> Given this, 18 months is a reasonable planning factor for completing this type of procurement.

- **Task orders on an existing IDIQ contract:** IDIQ contracts offer agencies pre-qualified discrete lists of vendors, often with pre-negotiated labor rates. Many agencies have one or several IDIQ contracts already in place, with sufficient contract ceiling available to support SOA service implementation tasks. Contract ceiling refers to the total dollar limit remaining to be spent on the contract. Task orders can be developed and issued to these pre-qualified vendors for competitive bids. In general terms, these contracts use smaller task order and bid response formats, with a smaller number of vendors, allowing for a much quicker turnaround time on a procurement. The vendor list must be examined to assess if the pre-qualified vendors have sufficient experience, both in building custom IT systems and operating live service infrastructures. Also, the scope of the IDIQ must be examined to ensure that the role of service implementer or service provider is appropriate for the contract's scope. In general, the organization that directly runs the IDIQ also takes a known fee from others using the vehicle. Planning factors for using IDIQs can range from two to five months, which varies based on local contract administration practices and procedures. This can be a reasonably fast method to acquire Government-specific services that the open market does not supply off the shelf.
- **Schedule buys:** This choice is most appropriate for software licenses or hardware infrastructure for SOA implementation, or for services that are available off the shelf in the commercial marketplace, such as those offered by a commercial MSP. In general, physical products will then be "accepted" by the Government and will be Government-owned. This option assumes that the vendors of interest to the SOA team have negotiated a Government schedule *a priori*.

## Defining Your Service Contract Requirements

As described above, every Federal procurement team must fundamentally define what the Government is buying and determine an optimum

strategy for acquisition. For an SOA service portfolio and its supporting infrastructure, several acquisitions can be done iteratively, or in parallel, in concert with an overall acquisition strategy for the enterprise capability. Performing a Federal acquisition for a portion of an SOA implementation brings with it some unique considerations, including the following:

- **24/7 service or software product?** Buying or licensing commercial products is a well-understood process within Federal acquisition communities. In contrast, buying network-based services from an MSP does not have the same precedent, especially if the SOA service is provided from a wholly vendor-owned infrastructure. Buying services requires the careful delineation of service behaviors and expected service levels, and requires a good deal of advance planning and requirements definition from the purchaser, especially when the needed services are customer-unique. Using vehicles with long procurement times also exacerbates the difficulty in predicting the service definitions accurately. Last year's interface requirement may be obsolete by this year's award.
- **Unique security requirements:** For some agencies, unique Federal security requirements can make it difficult for vendors to successfully offer the Government their commercial services. Commercial providers may apply security measures they feel are sufficient in the marketplace, though they do not completely fulfill Federal needs or policies. Changing the commercial offering for one potential customer, the Government, may not always be advantageous to the vendor.
- **Prior templates and examples?** One can quickly scan the Government's FedBizOpps website and see many examples of successful templates for traditional software acquisitions and support contracts. They can be downloaded by Federal staff and reused as needed. In fact, most agencies and Federal professionals have an archive of prior tried-and-true material to borrow acquisition text from. This text often has been improved by decades of lessons learned and comes with an implied set of language-specific prior case law. Currently, service-oriented acquisitions do not have the same legacy resources to draw from.



**Specifying requirements**—In specifying the requirements for a service, there are several aspects that should be covered to ensure that the operational service meets the Government’s expectations, including interface specifications, SLAs, pricing, lifecycle governance, data rights, and options for graceful increased and decreased service usage. These topics represent the key elements that will provide a foundation for successful consumer/provider relationships. In most cases, when the Government contracts with commercial vendors, it is essential that these topics be contractually specified. If the relationship is between two Government entities, a detailed memorandum of understanding may suffice, though it should be well documented.

As with any large systems development or integration endeavor, the Federal staff must decide how much effort to spend on requirements definition. Large systems development and/or integration efforts often involve an enterprise consisting of a network of interdependent people, processes and technologies, and multiple services. The interdependencies generate uncertainties in both the requirements and the effects of system design activities. The complete requirements are not always known or knowable prior to initiating a procurement. There are mitigations for this traditional problem. For example, in a task order (TO) environment, it is possible to construct a TO for the discovery, research, and elucidation of requirements (“adaptive development”). Generally this is a shorter duration task compared to the main body of work, and it gives the Government a chance to replan should unexpected requirements issues arise before procuring the full SOA element. Depending on the complexity, this early requirements work can then give rise to a better due diligence effort for vendors bidding on the main body of work. Better proposals will result from better assumptions, or additional TOs can be issued for contractors to further refine the requirements.

The following paragraphs give examples of the categories of requirements that are generally of key interest for SOA elements.

**Interface requirements**—To lower risk in a service procurement, there should be a mutual definition of the service interface, to include shared interface semantics, protocols, and technologies between the provider and consumer. Semantics can include many data details such as units of measure,

element definitions, boundary cases, and data types. Contemporary interface protocols and technologies, such as Web Services Description Language (WSDL), can support definition of a service interface, and this representation can be codified in the contract as well.<sup>11</sup> For example, specifications with WSDL can be appended as technical attachments to the SOW. There are innumerable contemporary technical options for specifying a service’s interface standards, such as SOAP,<sup>12</sup> representational state transfer (REST), or Java Messaging Service.<sup>13</sup> In addition, an interface may have information assurance requirements specifying important items such as the identity of the user of the service.

**Service demand**—Given that reuse of service offerings is a central concept for successful SOA implementations, and since the exact demand for a particular service will be dynamic and possibly unknowable when the contract is ratified, specifying requirements for service demand or throughput can be challenging. A common approach for specifying dynamic service demand is to use a set of staggered ranges of expected service demand values, as shown in Figure 2. Further requirements can also specify the time periods and methods allowed for switching between performance bands, defining how “graceful” that transition to increased or decreased service usage needs to be. While the required range of demand would suggest the need for a scalable underlying architecture, the vendor may still need to price different technologies, or the addition of some physical devices, as the scale of operations passes certain thresholds, thus adapting to uncertainty in demand without requiring contract modifications.

For the purpose of an independent Government cost estimate, note that the costing of each service demand range is most often not linear because the program management, administration, licensing, or infrastructure overhead associated with providing the service at various demand levels may not change in direct proportion to the number of service invocations. However, using ranges of demand values allows the Government to specify, and the contractor to price, demand beyond the present planning expectations for the service. The Government may use the current expected demand as a central value in the table. Operational values that greatly exceed these ranges may still require new contract negotiations.

Service Calls Per Hour	Price Per Call (From Vendor)
0-200	1.20
201-250	1.25
251-300	1.29
301-400	1.33
>401	1.35

Figure 2. Example Service Demand Defined in Ranges

**Pricing**—The use of services allows potentially novel billing or pricing models. For example, a contract with an MSP could be based upon the monthly quantity of service calls requested and transaction types. Various quantities or types of service request transactions could be priced differently. In practice this technique can be useful to the vendor who needs to provide certain minimum capabilities, regardless of how many service requests come in. Having a graduated service pricing structure allows varied overhead costs to be amortized against the total quantity of calls coming in. A firm-fixed-priced “floor” can be created for potential low-volume situations to retain a minimal capability. In any case, the provider and consumer organizations should have a clear, documented understanding of their expected pricing models.

**Service granularity requirements**—When acquiring a portfolio of services, it is important to consider the services in terms of business requirements and operational work flows. Using this information, the procurement team needs to determine the optimal level of service granularity. Services designs that are too coarse will impede later component flexibility and reuse. An extreme example would be implementing an entire business process as one monolithic service. Alternatively, service definitions that are too fine grained can add considerable overhead cost to acquisition, development, and management, due to the number of services that need to be specified, procured, measured, and tested. These types of trade-offs create challenges for procurement teams because, as Forrester Research writes, “SOA’s focus on business and application services changes the definition of an application because

services are more granular than complete business solutions. This creates a mismatch between the way an application architect may try to solve a business problem and the processes that are entrenched in the Government procurement model.”<sup>14</sup>

**Network topology requirements**—Network topology, including the implementation of the backbone of the current network, will have an impact on how the services perform as measured from a distributed consumer’s perspective. For example, if users are geographically distributed around the country, it is often important to have the service available at multiple locations. In this situation, the SOW should include requirements for a multi-site implementation and what is often termed “global load balancing,” a method for balancing service load across distributed sites. With network-based services, the Government wants to specify an offering with a minimum number of network hops between the majority of distributed consumers and the provider locations. This can shorten the average time between service requests and service responses.

Multi-site load balancing also positively impacts total system availability. Having multiple sites can provide continuity of operations and inherent support for contingency planning if a given location has a significant outage such as a fire, power failure, or natural disaster. While it is true that temporarily routing consumer requests to a more distant network site is not optimal for the consumer, operating in a lower performing state is better for many missions than the service’s being completely unavailable. Forrester’s Stan Schatt explains, “Best practices include using these devices [global server load balancers] to enhance server failover, overcoming high availability limitations of a single data center, improving the efficiency and availability of multi-homed links to more than one service provider, and localizing Web content for clients.”<sup>15</sup>

**Performance measurement**—Often the contracted service provider cannot be held accountable for the network to which the service is being attached. While the network impacts the consumer-perceived performance of the service, the service provider contractor has no control or management responsibilities for the wide area networking infrastructure, and they may consider the network as a Government-provided capability. In this case, the service provider will rightly require that service performance characteristics, such as response time,



be measured at the service provider's entry point(s) on the Government's network.

It can be advantageous for the Government to "instrument" key points on the network to measure performance of service providers. For example, contemporary commercial tools can report back to a centralized data store on a service's performance, and instrumentation agents can be placed with participating consumers and at the entry point of the service provider on the network, as shown in Figure 3. By gathering data across providers on the performance of pre-planned instrumented service calls throughout typical work periods, service managers can better judge where performance bottlenecks arise. The Government should include requirements for service instrumentation to support broader performance engineering efforts.

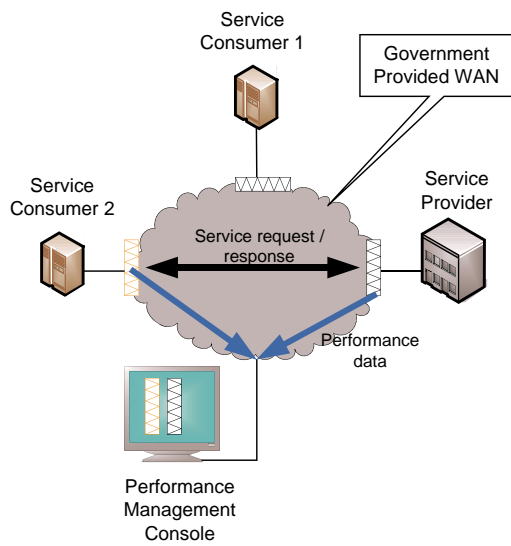


Figure 3. Isolating Network and Service Performance

In enterprise SOA implementations, performance engineering investigations can cross Government organizational boundaries, contractor support teams, networks, and commercial products. Consequently, it is important for the Government staff to have SLAs with every organization, internal or external, that contribute to the total "system of systems." The SLA should have clearly defined and instrumented performance measurement points. In this comprehensive view, even the network itself is a "service" for transport, enabling the SOA portfolio as a whole, with enforceable service levels.

Performance engineering, like security, is a topic that requires the Government to go beyond a traditional SOA "black-box" approach, to understand and monitor select internal service implementation details and dependencies.

**Service-level agreements**—SLAs are necessary because they specify many aspects about the delivery of the service that are essential for mission success. Contractual terms for SLAs should include characteristics such as:

- Response time
- Hours of operation
- Service availability
- Expected throughput and utilization ranges
- Maximum permitted down time
- Performance measurement and reporting requirements
- Performance-based pricing
- Problem resolution thresholds
- Problem escalation and priorities

The SLA should specify the support steps the consumer can take when the service is failing to meet the terms specified in the SLA. These support steps should include points of contact, contact information, and escalation procedures. The time-to-resolve performance should be specified in the contract based on the severity of the problem.

As mentioned above, it is important to be precise in the definition of metrics and to specify when and where they will be collected. For example, performance is different when measured from the consumer or provider due to the propagation delay of the network. Metrics should measure characteristics under the control of the vendor or they will be unenforceable. Finally, the SLA should describe a mutual management process for the service levels, including periodic reporting requirements and meetings for management assessments.

**Governance**—Governance specifies how a service is put into operation, including associated activities such as configuration control, integration and acceptance testing, certification and accreditation, and registering service information in Government service repositories. Specifying governance in the requirements for the service is primary to the relationship between the Government and service provider.

**Data rights**—Specifying data rights is another important element of a successful service acquisition. Service requirements should detail privacy restrictions, security requirements for data when in motion and at rest, and who owns the data and its structure when the contract terminates. The FAR is explicit with regard to data rights requirements, stipulating, “All contracts that require data to be produced, furnished, acquired, or used in meeting contract performance requirements, must contain terms that delineate the respective rights and obligations of the Government and the contractor regarding the use, reproduction, and disclosure of that data.”<sup>16</sup>

## Assessing Risks

**Government and vendor risk considerations**—Contracting officers have long recognized that risk drives cost. Contract cost is increased not only in the actual realization of risk in operations, but also in the perception of potential for risk during the bidding process. The best scenarios share risk between the contractor and the Government, without either partner assuming all the risk in an endeavor. NASA writes in its Award Fee Contracting Guide, “Selecting the proper contract type requires the exercise of sound judgment. The objective is to negotiate a contract type that fairly allocates performance risk between the contractor and the Government and incentivizes the contractor to perform effectively, efficiently and economically. FAR 16.104 lists some factors to consider when selecting the proper contract type.”<sup>17</sup>

Consequently, depending on the nature of the work, particular contract types were established that shift the emphasis of risk between the two contracting parties (Government and vendor). For example, in general terms, time-and-materials contracts are known to be riskier for the Government<sup>18</sup> and are currently actively discouraged by Federal senior leadership,<sup>19</sup> while firm-fixed-price contracts are riskier for the vendor.<sup>20</sup> For the most part, and despite impressions to the contrary, Government professional services contracting is a low margin industry. For example, according to a 2008 Grant Thornton survey, more than 75 percent of Government contractors reported less than a 10 percent profit, and more than 40 percent reported less than a 5 percent profit.<sup>21</sup> In this context, vendors will

price risk back into their bids to the Government, rather than absorb it. Given this, the procurement team should define a contracting method that equitably distributes risk between the service consumer and provider, depending on the type of service being acquired. Contractual risk in providing a service cannot be placed solely on the vendor, or the costs to the Government will be unreasonable.

Of course, risk is not confined to the selection of contract type alone. If the Government asks for a unique service not widely available in the commercial marketplace, and the Government will be the provider’s only major consumer, there is unique risk for the vendor in creating that new service.

- **Whose capital?** Mission-essential service infrastructures are expensive. If they run 24/7 and offer mission-essential services to an organization, a good deal of capital is required to establish them. In a truly commercial setting, capital investment is recouped by having a group or marketplace of paying customers who buy a service. In many Government scenarios, the Government is the only customer of a service due to unique legal requirements, unique mission, or unique security requirements. In essence, the capital required to create Government-unique services becomes the Government’s investment, whether purchased through a vendor or not.
- **Recouping cost:** Currently, many Federal IT contracts are written with five-year durations. Of these five years, often only one or two years are considered a “base period,” with the rest being contract “option” years. Option years do not have to be exercised and can be cancelled at the Government’s discretion for reasons that have nothing to do with vendor performance. In practice, this means that the vendor cannot be sure the contract will be in force beyond the base period, and if major capital investment is required for performance of the contract, the only sure way to recoup the cost is to receive this payment in the base period. If the Government is one of many customers, this is a less significant issue. But if the Government is the only service customer, or the dominant customer, for a custom service, risk increases. Uncertainty results in higher costs to the buyer. The Federal approach of using “short” duration contracts is contrary to a commercial services model, where recouping

service infrastructure costs can exceed contract base periods.

In summary, the seller's risks become factored into the buyer's price, so it is to the Government's advantage to understand how the use of the various contract types, and how custom, one-off requirements drive risk higher. Awareness of risk offers opportunities to lower risk for everyone's benefit.

## Performance-Based Contracting and SOA

Many of the current trends in performance-based contracting sponsored by the OMB work well with the acquisition of SOA services. For example, according to the OMB, "Performance-based service contracting (PBSC) emphasizes that all aspects of an acquisition be structured around the purpose of the work to be performed as opposed to the manner in which the work is to be performed. It is designed to ensure contractors are given freedom to determine how to meet the Government's performance objectives, appropriate performance quality levels are achieved, and payment is made only for services that meet these levels."<sup>22</sup> This performance-based approach is true to the underlying spirit and architecture of an SOA's service, which focuses on the result of the service, not on specifying an implementation or "how" the service accomplishes its task. Note that there can be valid exceptions that require the Government to specify implementation details for reasons such as security, mission assurance, or performance measurement, as described above.

As a consumer of a service, an organization would tend to focus on a service's interface and its performance characteristics. Similarly, PBSC also focuses on the performance characteristics of the vendor's service to the Government. OMB states, "The key elements of a PBSC Performance Work Statement (PWS) are: a statement of the required services in terms of output; a measurable performance standard for the output; and an acceptable quality level (AQL)."

PBSC and SOA both use the term "service." Given that the term is drawn from two different contexts, a useful parallel can be made. For PBSC, the service is a vendor offering being acquired by the Government that provides utility for the Government; in an SOA context, the service is a function or capability, typically run across the network, that provides

utility for the consumer. In both cases the service has a defined behavior or outcome that provides value that can be measured, and has defined service performance levels of some type. Consequently, defining SOA services to be acquired in a PBSC contracting framework is easier than proscriptive SOWs of the past, because we focus on the interface, not the implementation (with limited exceptions noted above). In the past we might have been tempted to define how exactly the service is to be accomplished, which is contradictory to the component-based concepts of an SOA. Typical SOA services are a black box, providing a capability to the consumer.

OMB writes, "Performance-based contracting methods are intended to ensure that required performance quality levels are achieved and that total payment is related to the degree that services performed meet contract standards."<sup>23</sup> The key is that service outcomes are to be measured and expectations are defined. OMB states further, "The definitions of standard performance, maximum positive and negative performance incentives, and the units of measurement should be established in the solicitation." Both these ideas have a parallel in an SOA service. As an SOA service provider, a vendor carefully defines the offering to the enterprise. Service performance requirements drive the quantity of underlying infrastructure run by the service provider and therefore drive the provider's cost. If a contract is crafted to provide an SOA service to the enterprise, the expected service levels will drive the estimated cost of the service and should be considered carefully.

Forrester Research states, "SOA changes the definition of an application, breaking it up into a composite of discrete, reusable services. Thinking of an application as a set of services throws a significant monkey wrench into the vision for SOA adoption. Should procurement practices support smaller, discretely defined processing components?"<sup>24</sup> While SOA improves the clarity of the items to be acquired by unambiguously defining their behavior and service levels, getting to this level of detail requires the Government to have a very firm concept of the service to be procured, as defined above. Given the extended timelines that many procurements have, anticipating these service definitions can be a challenge.

## Recommendations Summary

Consider the following recommendations when acquiring SOA services:

- Break up the overall strategy for the SOA into a set of individual tactical procurements for pieces of the IT portfolio, based on the types of items or services being acquired. Some services may be internal, some commercial, some off-the-shelf, and some custom. Adjust your procurement actions to accommodate each portfolio piece, while maintaining an overall acquisition strategy that recognizes the dependencies across implementation components.
- Take the time to define the requirements for services as completely as possible. Useful requirements categories can include interface requirements, service demand expectations, and performance management requirements. Use smaller requirements definition tasks to explore and refine requirements and to reduce uncertainty in implementation.
- Make contract documents adaptable to degrees of change common in dynamic enterprise SOAs, such as changes in service demand, by defining and pricing ranges of service demand.
- Define robust SLAs with unambiguous measurement strategies for service providers. If common instrumentation is required for performance measurement across the SOA portfolio, clarify those requirements to service providers.
- Consider the performance of all the providers in an enterprise SOA, including the network, and define methods to instrument and measure individual provider performance. Have formal performance agreements in place for all providers, whether they are internal or external organizations.
- Regarding contracting style, be performance based, not implementation based. Use PBSC frameworks and document templates to acquire SOA services in a Federal context. Strive to define how the service should perform, not how it is to be implemented. Valid exceptions to this goal can include implementation requirements for areas such as security, mission assurance, or performance measurement. Note, however, that if special requirements drive the implementation far from commercial approaches for providing a service, then risk and cost implications must be duly analyzed and understood.
- Spend a good deal of time analyzing if the SOA service can be bought commercially or if it is a one-of-a-kind creation for the Government. Custom development of large software systems brings with it unique risks. Often custom requirements cannot be avoided due to a particular organizational policy or rule, but when possible, go with a truly commercial offering.
- Take a critical look at the business model for the service. If the Government is the predominant, or only, consumer of the SOA service to be acquired, consider the capitalization model from everyone's point of view. How long does the vendor have to make back the capitalization costs? The Government group creating the RFP should understand how providing the service to the Government leads to a profitable outcome.

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