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# Title of Paper:

Accelerated Decision Making, Data Integration, and Software Development using a Service-Oriented Architecture Foundation (SOAF)

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Abstract - As the military machine continues to evolve in the Information Age, it is facing an enemy who is proving adept at quickly leveraging "off-the-shelf" technology and exploiting it in creative ways. Unfortunately, after decades of building the acquisition processes for Information Technology (IT) projects, the DoD's ability to identify requirements and develop and deploy IT solutions is well behind its adversaries. This is happening even while it is well known that the key to success in the Information Age is to have the right data, at the right place, at the right time. Fortunately, the military systems almost always have the data; the problem is the time required to ensure correct data integration and secure distribution. A Service-Oriented Architecture Foundation (SOAF) project has developed a solution to speed the development, integration, and secure distribution of data sources across the enterprise. This paper will describe how a SOAF solution provides a standards-based approach for quickly integrating data sources for immediate local consumption, yet also makes them available for enterprise distribution. This solution will be demonstrated with a typical logistics use case integrating six global data sources across the spectrum of military systems.

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## 1. INTRODUCTION

As the military machine continues to evolve in the Information Age, it is facing an enemy who is proving skillful at quickly leveraging "offthe-shelf" technology and exploiting it in creative ways. Unfortunately, after decades of building and refining the acquisition processes for Information Technology (IT) projects, the DoD's ability to document requirements and develop and deploy IT solutions is well behind its adversaries. This is happening even while it is well known that the key to success in the Information Age is the right data, at the right place, at the right time. Fortunately, military systems almost always have the data; the problem is the time required to ensure correct data integration and secure distribution. This problem is a result of well-established technology and military processes used to maintain existing command and control systems. Technologically, systems are generally not limited in their ability to share information. Rather, it is the acquisition and sustainment structures that limit the ability to modernize existing systems and fund integration efforts. At the same time, the well-established practice to limit data distribution in order to ensure security is hampering the adoption of new software techniques. These new software development techniques that enable secure data distribution are not being readily accepted into the military because of the established culture to horde information under the guise of security concerns. These fundamental issues in the military are slowing the integration of data systems, limiting data distribution, and hamper the military's ability to have the highest level of information superiority possible, even while engaged in numerous military operations around the world. **Unfortunately, the warfighter on the ground is the one who ultimately suffers from the policy and cultural issues limiting data sharing.** 

To address this problem, a Service-Oriented Architecture Foundation (SOAF) project developed a solution specifically to speed the development, integration, and secure distribution of data across the enterprise for the warfighter. By developing a solution specifically designed to fit within the existing technological ecosystem of today's command and control systems, a SOAF solution is

positioned to provide a capability to enable rapid data integration and distribution for the warfighter. In addition to providing an integration solution a SOAF also provides a path for continuous transformation. Figure 1: SOA Transformation Path shows where a SOAF fits within an enterprise and how it provides an integration solution. This paper will describe how a SOAF project provides a standards-based approach for quickly integrating data sources for immediate local consumption by the warfighter while also making them available for wider enterprise distribution. The SOAF solution enables warfighters to quickly find, integrate, and distribute information as required for each particular mission. Additionally, the SOAF solution provides a software package that enables continuous IT transformation by using a standardsbased. service-oriented approach to software development.





## **Figure 1: SOA Transformation Path**

for both the warfighter and the IT program managers, two use cases were developed. The first use case demonstrates the integration of six different data systems, including both tactical and business systems, to answer a typical logistics question asked in preparation for an upcoming convoy operation. The second use case illustrates how a business system could integrate several data sources to rapidly develop a commander's dashboard, which also doubles as a data collection point. Both of these use cases illustrate how the technical capabilities of the SOAF solution are used to integrate heterogeneous IT systems, quickly develop customized dashboard views, and ensure end-to-end security of the data.

# 2. PROBLEM – IT CHALLENGES RESULT IN WARFIGHTER CONSEQUENCES

The warfighter ends up paying for IT challenges with either time, over-committed staff, or simply lack of information. For example, due to the acquisition process used for funding and sustaining individual systems, economic and technical silos have emerged around each system, each with their own mission requirements, advocates, and funding. However, should the warfighter need to integrate information between any of those systems, he or she will have to resort to manual integration efforts, which takes time and introduces errors. The acquisition process that created this problem was developed over decades in order to support traditionally independent systems, tanks, planes, and ships, which are orchestrated together using combined arms tactics. These independent (siloed) systems (tanks, planes, and ships) are incredibly expensive and necessitate the development of a complex acquisition process, which works well

for multi-billion dollar purchases taking years to develop, but it hampers the ability to rapidly develop, test, and deploy a much less timeintensive software solution in time to support an new mission. Often, when IT systems do make it through the acquisition process, they produce information in formats that are no longer valid or common and lack the necessary funding flexibility to make modifications after they are fielded. This results in the warfighter again paying for the delay by having to manually conduct analysis on the resulting reports. Today, with software technology rapidly changing, IT systems are becoming the most rapidly developed and deployed systems but they are still being developed generally as siloed systems because of the established acquisition process.

Figure 2: IT Challenges and Warfighter Consequences summarizes the connections between IT challenges and how they affect the warfighters. Ironically, the value of the IT network is in the number of interactions, or as described later in the paper, usage, and these siloed systems are still being developed only addressing the minimal formal integration requirements. Even with these factors well known, it is also equally well known that the key to success in the Information Age is access to the right data at the right time. The SOAF project studied the information integration challenge and realized that, for a data integration solution to be successful, four key questions the warfighters consistently ask needed to be addressed. These are: 1) Does the data I need exist, and do I have access to that data? 2) Will I get my data in time? 3) Can I understand the data





and quickly apply it to my problem? 4) Is the information secured, and can I trust the data users?

## 2.1 DOES THE DATA I NEED EXIST, AND DO I HAVE ACCESS TO THAT DATA?

This first question seems the most obvious, but unfortunately the warfighters generally do not have enterprise perspective nor the time to search and find the systems that hold the data they are looking for. If they happen to identify the system that has the needed data, they often receive it in human readable format that may not be suitable for forwarding to another system, thereby forcing the warfighters to conduct heavy manual manipulation of the data. Just as often, once the right data is identified, the requesting warfighter is denied access to the data for any number of reasons, most often because of security concerns. As a result, warfighters and commands often resort to building their own systems and databases just so they don't have to depend on others. Additionally, even if they get access to the data, there are few mechanisms in place to ensure that the data is correct, accurate, and up to date. All of these issues hamper data sharing and the realization of net-centric warfare promises.

# 2.2 WILL I GET MY DATA IN TIME?

The second question is not as obvious as the first, since once an IT connection is established, the warfighter expects the data to be provided consistently. However, many of the decisions the warfighters must make are extremely time sensitive, and as the data gets closer to the combat environment, the useful lifespan of that data gets shorter and shorter. For example, when planning for a deployment at the Corps level, the required information can be several weeks old and still be relevant. On the other hand, in a combat zone, when planning for a convoy for the next day, relevant information can only be a few hours old. Without mechanisms to ensure that the data is delivered on time, warfighters could be severely limited, and missions may be in jeopardy.

## 2.3 CAN I UNDERSTAND THE DATA AND QUICKLY APPLY IT TO MY PROBLEM?

The third question is often not even considered until the data arrives. At that point, warfighters begin to find out what form the data is in and often end up getting engaged in considerable manual manipulation in order to make it useful. This is often a result of incompatible software programs simply delivering batch files in order to "check the box" indicating that data distribution from their system is occurring. However, warfighters are frequently inundated with data that must be efficiently managed and related with other data. Data provided in a format that does not allow layering, mash-ups, association, or automated analysis will often get left aside and hardly used. Warfighters need to be able to automatically manipulate new data to compare or combine it with other data sets in order to gain insight from it.

## 2.4 IS THE INFORMATION SECURED, AND CAN I TRUST THE DATA USERS?

The fourth and final question is often asked by data providers. In the Information Age, information is power. This simple little truth is further reinforced by the acquisition process, which rewards program managers by how well they keep their individual system alive and well. As a result, the number one reason for not sharing data is that the data providers claim there is no mechanism for them to control who is going to see their data and what they will do with it. Data providers do not like the idea of unanticipated users and, furthermore, they do not like unanticipated user load. This attitude is understandable, but again, the system is ultimately not reinforcing a net-centric architecture.

These four fundamental questions are prudent concerns and do not represent any wrongdoing; however, the underlying issues do hamper the realization of net-centric warfare promises. The motivation for a SOAF is to address these issues for the warfighter.

## 3. SOLUTION - SOAF

Having studied and experienced multiple IT misfires resulting in incompatible, overly expensive, vendor-driven efforts has ensured that our approach for developing the SOAF was to deliver a technology solution that is standards based and able to grow with time. These past experiences has caused design decisions to favor the underlying priorities illustrated in Figure 3: Preferences for a Visionary Solution. Although we understand the value of traditional principles (on the right side of the scale), we emphasize the agility and mission value that comes with visionary principles (on the left side of the scale). By emphasizing warfighter value and addressing strategic goals, Booz Allen drives intrinsic interoperability and encourages organizations to reward sharing of flexibly created services to ensure that the enterprise can continue to evolve and react to change over time.

In the process of helping various organizations within the Department of Defense (DoD) adopt Service-Oriented Architecture (SOA) principles, we have learned to respect the internal structure of each organization and adopt the technology to the existing hierarchy and organizational constraints. We also know that technology is only one small part of overall success, and it is just as important to bring change at other levels. We attempt to keep each effort manageable



Figure 3: Preferences for a Visionary Solution

and carefully scope the effort in order to quickly deliver results, thus preventing costly detours. We identify services through collaboration with business and technology stakeholders while emphasizing service usage through collaboration and careful consideration of future scopes and missions. We establish a thorough process for validating warfighter value, introduce early testing, and transfer key knowledge to as many members of the stakeholder organization as possible.

When developing the foundation, we divided it into three layers depicted in Figure 4: SOAF Components:

- Development and Education This layer encompasses all aspects of how services are developed. including how requirements and specifications evolve, and how service developers and their stakeholders verify service functionality and certification benchmarks.
- Infrastructure This layer provides all the essential SOA infrastructure that enables services to function. It includes—but is not limited to—Security, Portal, Enter discovery.



### **Figure 4: SOAF Components**

includes—but is not limited to—Security, Portal, Enterprise Service Management (ESM), workflow, messaging, directory, and discovery.

Governance and Operations – This layer takes encompasses how services are deployed and onboarded, and how data is
governed to facilitate smooth deployment and operation.

The goal of such functional decomposition is to align the SOAF with organizational components of People, Process, and Technology. The sections below provide high-level descriptions of each capability, its impetus for existence, and some product details. Each component is described with reasons for its existence and, most importantly, with some indication of the direct or indirect impact it can provide to the warfighter.

## 3.1 SOAF DEVELOPMENT AND EDUCATION CAPABILITIES

Part of the reason SOA adoption has not gained full steam in the DoD and in the Army is a significant learning curve that many developers face when developing mature services and integrating existing services into new solutions. Part of the value offered by the SOAF is the significant amount of knowledge and skill gained and shared in developing services and the ability to provide the information to support training organizations to sustain their own SOA development efforts. These capabilities and their impact are described below.

### 3.1.1 Service Development

<b>Description:</b> Capability to develop sound	Dev	elopment and Educati	on			
deployable on the DoD networks	Service Development	Requirements and Specifications	Testing and Certification			
Common Enterprise Challenges	Benefits of as part of a SO	AF				
<ul> <li>Services that are not compliant to common SOA standards cause interoperability issues.</li> <li>Services that are either too fine or too coarse grained will not be used.</li> <li>General-purpose services lack value.</li> </ul>	<ul> <li>Services are aligned with Warfighter needs and validated by use cases resulting in immediate warfighter value.</li> <li>Services are designed based on core standards, resulting in interoperable reusable capabilities.</li> <li>Services are governed according to the latest DoD guidance and follow a clear life cycle, leading to predictable, repeatable process and speeding testing and certification.</li> </ul>					
Warfighter Benefits						
<ul> <li>Agile development produces useful services faster, resulting in meaningful, secure software.</li> <li>Because the warfighter is involved in the use case development, priorities are set by actual needs.</li> </ul>						

- Services are developed with understanding of current Concept of Operations (CONOPS) and often make existing processes more efficient.
- Service reuse allows for new applications and systems to be created faster.

### **3.1.2** Requirements and Specifications

<b>Description:</b> A process for collecting user	De	on			
service specifications package	Service Development	Requirements and Specifications	Testing and Certification		
Common Enterprise Challenges	Benefits of as part of a SOAF				
<ul> <li>Lengthy requirements process divorced from the actual users leads to inconsistent, unrealistic requirements or requirements that are not implementable.</li> <li>Inconsistent specification packages lack ties to existing standards or lead to the development of a poorly designed interface.</li> </ul>	<ul> <li>A mature specification package is a pre-requisite to a service that is a good citizen in the enterprise and provides lasting value.</li> <li>Services and workflows are rooted in use cases vetted with the user and are more likely to provide meaningful functionality.</li> <li>Thorough governance of specifications ensures consistent versioning and encourages reuse.</li> <li>Good specifications may lead to multiple implementations, allowing for best or breed to emerge</li> </ul>				
Warfighter Benefits					

- A specification rooted in requirements that are based on warfighter needs leads to useful capabilities and immediate value.
- Mature specifications include elements like Service Level Agreement (SLA) and usage policies that lead to faster deployment and higher run-time value, giving warfighters needed tools.

## 3.1.3 Testing and Certification

<b>Description:</b> A process for verifying functional value, compliance with	De	Development and Education				
specifications, and security and performance criteria of a service	Service Development	Requirements and Specifications	Testing and Certification			
Common Enterprise Challenges	Benefits of as part of a SOAF					
<ul> <li>Services that are not thoroughly tested in their functionality, security, or specification compliance end up being a potential weak spot in a large enterprise.</li> <li>Services that are developed without built-in awareness of security will either slow down the certification process or result in a vulnerability.</li> </ul>	<ul> <li>Testing is integrated in all stages of service development, allowing for automated workflows in service standards and certification criteria compliance, code weaknesses, and common vulnerability analysis, leading to shortened certification time and a much more mature product.</li> <li>Thorough testing requirements allow developers to create future versions of the service faster and react to changing user requirements more swiftly.</li> <li>The SOAF allows for thorough Stress and System tests, preventing surprises in later stages, reducing risk, saving time, and saving money.</li> </ul>					
Warfighter Benefits						
<ul> <li>Comprehensive testing infrastructure leads to accelerated certification, giving warfighters more robust, more secure functionality more quickly.</li> </ul>						

## 3.2 SOAF INFRASTRUCTURE COMPONENTS

The infrastructure components of the SOAF provide the core capabilities that allow developers to focus on business and mission requirements and simply rely on the foundation to provide the capabilities essential to most SOA efforts. Such aspects of architecture as security and discovery are present in every organization and can often be done better as a dedicated utility. Similarly to how the military relies on a telephone or electricity utility provider, the Army can outsource its common SOA infrastructure concerns to the SOAF. Moreover, the foundation provides non-trivial integration to the higher-level Army and DoD Enterprise-level services.

## 3.2.1 Security

Description: A family of dynamic robust modules with configurable policies each responsible for a single aspect, such as authentication, authorization, certificate validation, or vulnerability detection	Infrastructure         Security       Portal       ESM       Workflow       Messaging       Directory       Discovery
	Technical Benefits as part of a SOAP
<ul> <li>Custom security mechanism leads to confusing and unsustainable software.</li> <li>Tight coupling of security precludes dynamic policy adjustment.</li> <li>Non standard-based security makes it harder to address new vulnerabilities.</li> </ul>	<ul> <li>A common security model based on standards allows for quick updates and ease of understanding, making software safer and cheaper.</li> <li>Dedicated security enforcement infrastructure makes security less time consuming and more traceable.</li> <li>Dynamic security components allow for security policies to be updated easily, leading to an up-to-date, proactive security posture.</li> <li>A declarative, attribute-based security model allows for consistent, transparent enforcement .</li> </ul>
Standards	Products
<ul> <li>Web Services (WS) Security (WS-Security)</li> <li>WS-Trust</li> </ul>	<ul> <li>Layer 7 Extensible Markup Language (XML) Gateway</li> <li>Jericho</li> </ul>

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- Public Key Infrastructure (PKI)
- Security Assertion Markup Language (SAML)

Data Power

# Warfighter Benefits

WS-Policy

- Separation of concerns in security architecture allows for a more robust and agile enterprise, resulting in less security compromises and making warfighter data and systems safer and more productive.
- Dynamic security policies reflect the realities of the battlefield.
- A common security infrastructure saves development time, allowing more useful applications to support the warfighter.
- Faster processing due to dedicated encryption and compression devices leads to quicker response time on critical missions,

# 3.2.2 Portal

<b>Description:</b> A web application that allows				In	frastructu	ire			
embedded in one presentation environment		Security	Portal	ESM	Workflow	Messaging	Directory	Discovery	
Common Enterprise Challenges	Т	echnical Benefits as part of a SOAF							
<ul> <li>Lack of common portal platform leads to many, often competing, poorly designed or badly supported solutions.</li> <li>Lack of portal results in a proliferation of custom interfaces, requiring users to learn new ways to interact with systems.</li> </ul>	•	<ul> <li>All applications are deployed as web parts, allowing for a consistent interface, deployment mechanism, and governance model, thus shrinking time to market.</li> <li>Focused effort to improve and streamline one common portal platform reduce cost and support needs,</li> <li>Reuse barriers are eased, allowing new hybrid applications to emerge quicker.</li> </ul>				⊧ r.			
Standards	Ρ	roducts							
<ul> <li>Web Parts (Microsoft .NET)</li> <li>Java Specification Request 168 (JSR-168)</li> <li>Web Services for Remote Portlets (WSRP)</li> </ul>	•	<ul> <li>Microsoft SharePoint 2007</li> <li>Liferay</li> <li>RedHat Exo Portal</li> </ul>							
Warfighter Benefits									
<ul> <li>A consistent user interface shrinks the learning curve for the warfighter.</li> <li>Familiarity and tool support allows for innovation to happen in the battlefield with soldiers creating needed apps themselves.</li> </ul>									

Common platform and enterprise licensing reduces support costs, giving more funds to new development.

# 3.2.3 Enterprise Service Monitoring (ESM)

<b>Description:</b> A set of components that enable monitoring of service performance,		Infrastructure						
sharing of service metrics, and management of service states	t	Security	Portal	ESM	Workflow	Messaging	Directory	Discovery
Common Enterprise Challenges	Technical Benefits as part of a SOAF							
<ul> <li>Lack of any ESM capabilities leads to complete unawareness of usage or trouble spots in services, making bad systems more likely.</li> <li>Non-standard service metrics prevent SLA enforcement and cross-enclave service dependency, which can lead to redundancy.</li> </ul>	•	Comprehe robust, all Detailed r mechanis rewarding Depender over mech Policy cre	ensive Serv lowing for n netrics on s m allow the good deve ncy and wo nanisms, m ation and e	rice monitor nore consist ervice perfo possibility elopers. rkflow analy aking transa	ing and ma cent user ex ormance an of a cross-e rsis can lea actions safe makes it p	nagement r cperience. Id a robust o enclave reus d to run-time er and even ossible to en	nakes the s disseminations se, saving c e adjustmer guaranteec nforce SLA:	ystem more on costs and nt and fail- d. s and reward

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	system owners based on performance and usefulness.				
Standards	Products				
<ul> <li>Joint ESM Specifications</li> <li>WS-Management</li> <li>Web Services Distributed Management (WSDM)</li> <li>WS-Eventing</li> </ul>	<ul> <li>Microsoft Managed Service Engine</li> <li>Progress Software</li> <li>AmberPoint</li> <li>SOA Software</li> </ul>				
Warfighter Benefits					
Instrumentation and situational awareness allow for systems to stay operational and perform faster.					

- SLAs and their enforcement allow for meaningful "reality checks" based on warfighter usage and feedback.
- Improved policy enforcement allows for more secure, agile enterprise, preventing paralyzing security leaks.

#### 3.2.4 Workflow

<b>Description:</b> Component of the infrastructure that allows for service composition and complex business logic to be assembled out of discrete functional modules	Security Portal ESM Wor	rkflow Messaging Directory Discovery					
Common Enterprise Challenges	Technical Benefits as part of a SOAF						
<ul> <li>Custom developed, non-standard workflows complicate maintenance and prevent reuse.</li> <li>Inability to include human in the loop prevents complicated workflows from becoming reality.</li> </ul>	<ul> <li>Analyst-friendly, high-level language for workflow definitions allows workflows to be vetted by the end user.</li> <li>web services are utilized as elemental blocks, leveraging an ever-growing ecosystem of capabilities exposed as web services.</li> <li>Workflow is exposed as a web service end-point, making composite workflows possible and leading to cross-organizational automation.</li> <li>"Human in the loop" scenarios are supported, relegating complex life-or-death decisions to humans.</li> </ul>						
Standards	Products						
<ul> <li>Business Process Execution Language (BPEL)</li> <li>Business Process Modeling Notation (BPMN)</li> <li>XML Process Definition Language (XPDL)</li> </ul>	<ul> <li>BizTalk</li> <li>WebMethods</li> <li>Oracle Business Process Management (BPM)</li> <li>Tibco</li> <li>Lombardi BluePrint</li> <li>JBoss BPM</li> </ul>						
Warfighter Benefits							
<ul> <li>Automation of complex or repetitive tasks allows warfighters to focus on more critical tasks.</li> <li>Reuse of web services across the enterprise in workflows reduces development redundancy and cost.</li> <li>Best-of-breed practices are implemented as workflows and are institutionalized quicker.</li> </ul>							

Tedious tasks are automated to reduce human errors.

#### 3.2.5 Messaging

<b>Description:</b> Component that enables for messages to flow between systems and		Infrastructure						
applications, regardless of format, routes, protocols or network		Security	Portal	ESM	Workflow	Messaging	Directory	Discovery
Common Enterprise Challenges	Т	echnical B	enefits as	part of a S	OAF			

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<ul> <li>Adapters for mainstream Enterprise Resource Planning (ERP)</li> <li>New adapter is needed for every new connection, potentially leading to (n-1)<sup>2</sup> adapters to satisfy all needed message channels</li> </ul>	<ul> <li>Federation of various messaging protocols on a message bus.</li> <li>Central place to configure routing, transformation.</li> <li>Ability to set up reliable messaging.</li> <li>Mediation between various formats.</li> <li>Only one adapter is required for a new messaging format or protocol.</li> </ul>					
Standards	Products					
<ul> <li>WS-ReliableMessaging</li> <li>WS-Eventing</li> <li>Java Message Service (JMS)</li> </ul>	Oracle Service Bus     IBM WebSphere     Tibco     WebMethods     Apache Mule     WSO2 Service Bus					
Warfighter Benefits						
<ul> <li>Loose coupling and location transparency among services lead to more agile systems and faster composition.</li> <li>Lessened impact of competing or incompatible formats.</li> <li>Fast integration of legacy applications and formats.</li> <li>Central place to control the flow of information.</li> <li>Improved ability to detect react to system wide events.</li> </ul>						

- More effective ways to ensure reliability of messages flowing between systems.
- Improved service orchestration and federation of message buses are signs of agility.

#### 3.2.6 Directory

<b>Description:</b> One or several components that allow for resources and persons on the network to be uniquely identified and located	Security       Portal       ESM       Workflow       Messaging       Directory       Discovery								
Common Enterprise Challenges	Technical Benefits as part of a SOAF								
<ul> <li>Proprietary databases requiring custom ways of integration often result in higher maintenance costs and lack of enterprise features.</li> </ul>	<ul> <li>All enterprise users and resources are accessible through a single directory access point in a consistent, secure way, reducing time to market for new systems and apps.</li> <li>Standard attributes stored in a directory make authoring security policies easier, leading to more robust software.</li> <li>The combination of local and global attributes allows for finer-grain control closer to the system administrators.</li> <li>Consistent management of users and their metadata leads to quicker onboarding of users, allowing warfighters to identify and use needed applications.</li> <li>Directory federation allows cross-enclave trust to occur.</li> </ul>								
Standards	Products								
<ul> <li>LDAP</li> <li>WS-Trust</li> <li>SAML/XACML</li> <li>PKI</li> </ul>	<ul> <li>Microsoft Active Directory</li> <li>Joint Enterprise Directory Service</li> <li>OpenLDAP</li> </ul>								
Warfighter Benefits	urfighter Benefits								
<ul> <li>Consistent user attributes speed up onboarding, giving soldiers guicker access to needed systems.</li> </ul>									

 Directory federation allows for cross-enclave security to function, allowing cooperation and trust between defense organizations. · Locally managed attributes allow for finer-grain security policies and a more agile enterprise by giving the appropriate warfighter access to all the necessary systems while securing all the other systems for unnecessary users.

## 3.2.7 Service Discovery

<b>Description:</b> An Enterprise-wide resource for finding needed capabilities along with	Infrastructure									
developers as web services	Security Portal ESM Workflow Messaging Directory Discovery									
Common Enterprise Challenges	Technical Benefits as part of a SOAF									
<ul> <li>Capabilities are developed but not advertised to others who may need them, leading to the development of redundant services .</li> <li>Point-to-point interaction between consumer and provider introduces fragility.</li> </ul>	<ul> <li>All developed and consumed assets managed in a rich repository allowing easy discovery of needed capabilities</li> <li>Actual endpoint of a service may be discovered at run-time allowing for such enterprise features as geo-location of services, fail over and choosing of services based on their performance metrics or advertised performance targets</li> </ul>									
Relevant Standards	Sample Products									
<ul> <li>Universal Description, Discovery, and Integration (UDDI) 3.0</li> <li>XML</li> <li>Web Service Definition Language (WSDL)</li> <li>XML Schema</li> </ul>	<ul> <li>MuleSoft Galaxy</li> <li>Software AG Centrasite</li> <li>HP Systinet Registry/Repository</li> </ul>									
Warfighter Benefits										
<ul> <li>Easy discovery of available capabilities allows new applications and workflows to be created more quickly, thus improving the responsiveness to warfighter needs.</li> <li>Service metadata allows for identification of super- and under-performers, thus allowing funds to be allocated to more critical needs.</li> </ul>										

Management of service versions and metadata leads to the availability of more reliable, more useful software.

# 3.3 SOAF GOVERNANCE CAPABILITIES

In order to accelerate and standardize the service life cyle and its utilization, the SOAF also tackles such complex issues as Data, Technical, and Operational governance. In the case of the SOAF, Strategic Governance, which addresses service portfolios and alignment with Enterprise Architecture goals, is accomplished by a different entity and is not addressed as part of our effort, but in a typical SOAF, it can also be included in the set of core capabilities.

## 3.3.1 Data Governance

<b>Description:</b> Capability to shepherd development, maintenance, and usage of		Governance and Operations								
data artifacts like schemas, ontologies, and taxonomies		Data Governance         Operational Governance         Technical Governance								
Common Enterprise Challenges	Benefits of a SOAF									
<ul> <li>Ungoverned emergence of new divergent, inconsistent, or redundant data artifacts leads to incompatible or even competing implementations and ultimately affects usability and maintainability of the enterprise.</li> <li>Unclear data policies can also result in the above described situation.</li> </ul>	•	All artifacts related to dat Consequently, schemas community, and future ve efforts, benefitting the wh Consistent governance o interoperability and capal	a are governed in the foun and ontologies are more lil ersions can harvest the les tole enterprise. f data artifacts is one of the pility reuse.	dation's repository. kely to be vetted by the sons learned of previous e critical elements of						

## Warfighter Benefits

- Healthy data governance results in better data, and better data leads to better decision making.
- Mature data artifacts allow for higher-order data processing, opening the door for semantic technologies that are critical to the next-generation warfighter's systems.

## 3.3.2 Operational Governance

<b>Description:</b> A process for deploying operational capabilities, completing certification and accreditation packages, and supporting the operational environment users	Go Data Governance	Governance and Operations Governance Operational Governance Technical Governa						
Common Enterprise Challenges	Benefits of a SOAF							
<ul> <li>Lack of consistent guidance for the deployment and operation of operational capabilities leads to confusion, waste, and unmet warfighter needs.</li> <li>Absent or insufficient user support interrupts mission execution.</li> </ul>	<ul> <li>Clear, documented procedures result in smooth service deployment.</li> <li>Assistance with certification package generation and navigation of the process accelerates service deployment.</li> <li>Performance metrics and the full suite of ESM capabilities detect issues, help prevent problems, and allow for quicker resolution of found defects.</li> <li>Negotiation and enforcement of SLAs helps to establish trust between operational partners.</li> </ul>							
Warfighter Benefits								
<ul> <li>Faster certification and more tools during operation allow critical capabilities to deploy faster and stay in operation longer.</li> <li>Instrumentation and metrics allow new composite capabilities to emerge more rapidly.</li> </ul>								

3.3.3 Technical Governance

Description: Management of architecture,	G	Governance and Operations								
implementation, and integration activities	Data Governance	Data Governance Operational Governance Technical Govern								
Common Enterprise Challenges	Benefits of a SOAF									
<ul> <li>Inconsistent processes across the service life cycle lead to confusion and subpar service implementations.</li> <li>Lack of emphasis on standards creates silos.</li> </ul>	<ul> <li>Consistent service onbo faster deployment and d</li> <li>Strict standard complian capabilities.</li> <li>Thorough documentation partners and eases supp</li> <li>Best practices are captu exchange.</li> </ul>	tilization easy, leading to and cross-enclave use of capabilities exposed by ster, accelerating knowledg	е							
Warfighter Benefits										
<ul> <li>Better documentation, a wider range of software solutions, and more efficient support all give warfighters a more potent arsenal of capable systems.</li> </ul>										

## 3.4 APPLICATION OF THE SOAF

Throughout the planning and development of the SOAF, it has been important to identify the SOAF's likely users and address their needs. Initially, the SOAF will appeal to those organizations that simply lack the budgets and the "know how" to stand up their own SOA capability by allowing them to leverage an already established SOAF solution. These customers can quickly take advantage of the enterprise capabilities included in the foundation and reuse only the needed capabilities. Onboarding their services on the foundation will also give

them additional exposure and quick integration with the Army enterprise. Secondly, organizations that are looking to accelerate navigation through the often slow acquisition and accreditation processes will find the foundation most useful since the SOAF is already accredited for use on the network. For this audience, the foundation will provide a quick and easy way to test prototypes, utilize already accredited infrastructure, and streamline their own web service development and certification process, even if they plan to eventually utilize their own infrastructure for operational deployment. Thirdly, the foundation will bring value to organizations that are looking to integrate and make accessible new standards with their existing systems. In such cases, the SOAF will bring a wide set of integration capabilities and will make the data visible in a secure, discoverable, standards-abiding way.

## 3.5 Why the Foundation is Important for the Warfighter and the Army Enterprise

In order to assess the value of a SOAF, it is important to do so in light of the warfighter questions outlined in Section 12:

- Does the data I need exist, and do I have access to that data? *Discovery* of data and services is a critical element of a SOAF and, when coupled with sound and consistent *data governance* process, a SOAF helps address this question by allowing systems and people to find the right data. By streamlining the *security* aspects, a SOAF also makes it easier to give appropriate access to data to the right people while also making it possible to dynamically address the constantly changing environment.
- Will I get my data in time? A SOAF helps to tackle this question in utilizing industry best practices in choosing products to implement the various standards, and provides guidance on how to configure the software and hardware for operation while also providing the ability to scale. A SOAF also enables establishment of expectations and agreements between parties through its *ESM* and *governance* capabilities and makes sure all possible scenarios are addressed early in the *specification, development*, and *testing* stages.
- Can I understand the data and quickly apply it to my problem? In order to deliver meaningful data to the users, a SOAF follows best practices in *specifications* and *requirements* stages and enforces a comprehensive *data governance* process. Data is transformed and routed by the foundation's *messaging* component, and complex, composite problems are solved by the foundation's *workflow* capability.
- Is the information secured, and can I trust the data users? By structuring the foundations security component as a collection of
  dynamic configurable elements, a SOAF is able to ensure that the most flexible, reliable security measures are in place. By
  automating and integrating the latest guidance in its certification work flows, such as attribute-based access control or the latest
  vulnerability data, a SOAF is better suited to address the security question than most individual organizations, especially those just
  setting out on a SOA path.

## 4. SOAF USE CASES

The following two use cases demonstrate how a SOAF solution addresses the integration problems warfighters face. These use cases will illustrate how SOAF capabilities provide the mechanisms for rapid development, integration, and security of data between siloed systems. The use cases also illustrate how the current acquisition model can support net-centric acquisition needs while still maintaining the oversight and control necessary for the military. The use cases also illustrate how reuse of existing data sources and systems brings additional value to those systems by expanding the user base without significant effect on the current systems' architectures.

The first use case describes a capability developed to address a well-established mission question. It leverages the established Standard Operating Procedure (SOP) used to answer that question as inputs to the requirements for the use case. The data sources used in the use case are well-known sources in the SOP, and the most significant change for the warfighters using the SOAF solution is the elimination of manual input and analysis of the data. The second use case is an example of a dashboard developed to address a critical commander's need to answer a new mission question. The requirements for the new dashboard are taken entirely from an existing Excel spreadsheet and a PowerPoint presentation used to brief the commanders today. Both of the use cases illustrate the ability to rapidly develop, integrate, secure, and deploy solutions to provide information to commanders at a fraction of the time it takes to develop comparable capability using traditional SDLC) methods.

## 4.1 THE LOGISTICS USE CASE

**Background** – Before a Task Force <sup>1</sup>(TF) conducts a convoy operation, it reviews the maintenance status of the units and vehicles needed for the next mission. At the TF level, this is not a trivial question, since units are not always organically assigned to the TF. This assignment variance happens because TF composition changes as missions change, often on a weekly basis. To handle this challenge, maintenance warrant officers are charged with tracking the equipment status at the TF level. While there are well trained maintenance warrant officers available to leverage the existing maintenance information systems to ensure that parts are ordered and tracked, the ability to quickly integrate the vehicle's maintenance status/location, parts' status, mechanic's status, and operational situation does not exist today. To provide such a comprehensive picture of the equipment status and operational situation, the TF Maintenance Officer (MO) employs a large number of staff, utilizing a well-



Figure 5: Logistic Use Case Challenges

established SOP to manually analyze the data and develop a PowerPoint picture to brief to the TF Commander. This is a classic example of how siloed systems require the warfighter to conduct extensive manual integration in order to analyze the results and make an informed decision. This is a time-consuming, labor-intensive process. It normally takes between 72-96<sup>2</sup> hours to complete and is repeated with each new mission. This challenge is illustrated in Figure 5: Logistic Use Case Challenges**Error! Reference source not found.**.

**Objective** – The SOAF project looked at this mission problem defined by the SOP and then leveraged the SOAF components and processes to quickly develop a customized commander's dashboard which combines all of the necessary data. The objective of the use case was to use the exact SOP, data sources, and the familiar PowerPoint formats to develop a customized dashboard to significantly reduce the amount of time it takes for the TF MO to answer the maintenance status question for the TF Commander. The goal was not to change the existing process, the data sources, or formats of the information but only to integrate the data and automate the presentation. The ultimate objective was to accelerate the decision-making process.

Solution – The SOP required the integration of six different data sources from six different systems resulting in the user interface shown in Figure 6: Logistics Use Case Screenshot. The first data source provides task organization information and serves as the navigation aid to the user. The second data source displays operational graphics by using the mapping component of the SOAF portal. It enables mashing of location data with mission data, giving the commander a new enhanced view of previously manually correlated data. Once the user selects the Task Organization, a property book data service-the third data source-returns all the vehicle types required for the particular mission. A web service call to the fourth data source, a maintenance status database, weaves in the parts' status information. Now the commander can view four data points in a



Figure 6: Logistics Use Case Screenshot

single view. Vehicle location information is plotted on the map, along with parts that have location information. Finally, the sixth data source, also exposed as a secure web service, identifies soldiers with the necessary skills to put the parts on the vehicles.

These six data sources, two integration components, and the SOAF presentation capabilities enabled the resulting dashboard as illustrated in Figure 6. The map provides the backdrop, which allows the vehicle, parts, and soldier locations to be layered together, giving the TF MO

<sup>&</sup>lt;sup>1</sup> task force (TF) (JP 1-02, NATO) - 1. A temporary grouping of units, under one commander, formed to carry out a specific operation or mission. 2. Semipermanent organization of units, under one commander, formed to carry out a continuing specific task. 3. (Army) - A battalion-sized unit of the combat arms consisting of a battalion control headquarters, with at least one of its major organic subordinate elements (a company), and the attachment of at least one company-sized element for another combat support arm. (See also task organization.) A component of a fleet organized by the commander of a task fleet or higher authority for the accomplishment of a specific task or tasks. See FMs 1-111, 6-20, 7-20, 7-30, 17-95, 71-100, 71-123, 100-15, 100-40, and 101-5 (Source FM 101-5-1)

<sup>72-96</sup> hours was established after 18 months of on-the-ground experience in a Task Force TOC in theatre.

the operational picture needed to understand where the vehicle, parts, and soldiers are, all in real time and with no manual help. he TF Commander also has a summary chart of the type and number of vehicles for the next mission. There are also Interactive Icons with percentages of vehicle Fully Mission Capable (FMC) or Non Mission Capable (NMC) generated based on the specific units of interest to give the commander even richer situational awareness. This capability is important because the existing maintenance systems do not have this capability readily available to the TF MO or Commander. Finally, the bottom table displays the equipment information, automatically aligned next to the maintenance status, the parts status, and the location. This automatic association, coupled with conditional formatting, allows the TF MO to quickly identify and focus on specific vehicles without requiring his staff to spend hours reviewing numerous reports.

**Results** – While all of the technical SOAF capabilities were used in the use case, several of them are particularly important. Testing and Certification is of critical importance because the systems touched by this use case are already certified, and it is important to not affect their Information Assurance (IA) posture. This capability is also supported by the extensive security capabilities of the SOAF infrastructure. The ease of integration is mostly dependent on the robustness of the messaging bus, and in the logistics use case, several of the SOAF messaging capabilities are key in the efficient flow of information. The SOAF portal is also an important part of this use case, as it allows integration of maps, and many of the information web parts in a seamless fashion. The success of this use case is also dependent on the operational characteristics of the user experience. The SOAF operational governance ensures that all of the web services and web parts that are part of this use case operate at their optimal rate.

The resulting dashboard capability significantly benefits both the warfighter and the IT program managers. The most obvious impact for the warfighters is the significant reduction in time to get the critical information, illustrated in Figure 7: Logistics Use Case Results. The commander can answer questions quicker, limiting the potential for human errors. His staff can engage in activities to support the mission

rather than moving and correlating documents. The most significant benefit for the IT program managers is the increased customer base and visibility into their data. Having the data utilized in other systems, reinterpreted, and enriched with related information makes it even more valuable. It also makes discrepancies more evident. For example, an important point in the area of integration and association is the problem with "data algebra." Data algebra is the association of related data elements between two different data sources For example, two different sources could provide National Stock Number (NSN) numbers but the data algebra challenge is how to associate those NSNs with a Vehicle Identification Number (VIN) number and then associating that with a Bumper Number, and the document number. When



Figure 7: Logistics Use Case Results

these elements are accurately presented between different data sets, it allows information such as the property book data to be correctly correlated between the vehicle data and the corresponding part information. After such correlation is established, only small amounts of needed information are returned with every web service call, reducing the overall bandwidth consumption, sometimes by ten times. For example, the complete maintenance data set for a unit is around 3 megabytes (MB), yet all the data pulled to answer the TF MO question was only 300 kilobytes (kB), or 1/10 of the whole. This is a significant reduction in bandwidth use in a Tactical Operation Center (TOC) and is another benefit of the SOAF solution. For IT PMs, another benefit is the ability to use the SOAF ESM capability to gather metrics on system usage. ESM allows the programs of record to better measure customer activities and service usage so that they can plan future development and sustainment needs and closely monitor interdependencies and inform system and service governance.

## 4.2 STAFFING DASHBOARD USE CASE

**Background** – A typical problem in today's Army is managing the constantly changing staff levels required to support the various missions. In the Army medical field, staffing requirements depend upon the number, rate, and type of incoming injuries. The challenge is in how to optimally care for wounded soldiers while not overstaffing the facilities. Additionally, the staff comes from different organizations that all have their own data systems. The commanders making the staffing decisions require a dedicated team of more than 30 staff members to work a whole week in order to present a 93-slide PowerPoint presentation each week. The goal is to drastically reduce the time required to create this report and improve the accuracy of the information. However, this project is different from the logistics use case because, in addition to having numerous siloed systems and unrelated data reports, this solution requires an acquisition for the dashboard as well. These



Figure 8: Staffing Dashboard Challenges

challenges are illustrated in Figure 8: Staffing Dashboard Challenges. The goal of this staffing dashboard project is to integrate multiple data sources, automate the integration, provide a level of analysis, and include data capture and reporting as well as research. The ultimate question addressed by the dashboard is to know how many staff of what type and where they are located.

**Objective** – The objective of this use case is to develop a dashboard that automatically collects the data necessary to answer all of the questions raised in the weekly staffing status report and take the solution from development to production in the shortest time possible. Another key objective is not just to automate the creation of a 92-slide report, but also to design the dashboard in a way that enables any data element provided in the original 92-slide report to be found in four mouse clicks or less. Additionally, this dashboard requires the integration of civilian, reserve, and active duty staff information. Integration of these three types of information has never before been achieved because a system of record cannot mix civilian and non-civilian information. If integration of this information via the web services can be achieved, a significant hurdle to data sharing would be cleared. This capability, in turn, could open the path to more cross-organizational integration possibilities. As in the previous use case, the staffing dashboard would not change the current staffing reporting SOP or change any of the formats or information fields from the original report. This is important to speed the acceptance and adoption, and reduce the learning curve for using these dashboards.

**Solution** – After a requirements review was conducted, only three data sources were required; however, they were from different business domains and all used different technologies. Web services were used to expose the data from two such systems. However, the third, for various non-technical reasons, was only made available as a monthly file exchange. The solution required a significant amount of workflow capabilities, since a large percentage of the report information was free text reporting from the various commanders. To address both the staff data integration part of the dashboard and the commander notes, the solution was broken down into two parts.

The first part of the solution focused on collecting the staff data broken down into a number of layers from 12<sup>3</sup> regions with 50 offices and 7 types of staff in each. There are up to a 100 staff for each type in each office. In order to track this information, the dashboard allows the users to interact with a chart to view each level down to the individual staff member. The chart contains information from the three different data sources and the information on the individual staff member. It also has a side-by-side comparison of two different data sets that provide conditional highlighting of any conflicting data fields. This capability is shown in Figure 9: Staffing Dashboard Screenshot, which shows how the user interface was created to address all of the user needs. The presentation of the data as show in Figure 9 was necessary because redundant information exists in several of the underlying data sources, and it is often conflicting information. Today,



Figure 9: Staffing Dashboard Screenshot

this discrepancy requires significant time from the staff to verify and correct. The ability to provide real-time data comparison and analysis

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The numbers were changed for security concerns.

in the dashboard reduces the time spent reviewing the data manually, allowing the staff to focus on the culprits of inaccuracy. Additionally, this solution requires advanced security capabilities to ensure that only the correct people have the ability to see Social Security numbers or other Health Information Privacy Act (HIPA) information.

The second part of the solution used a workflow to help the various commanders add, collect, and verify status comments for the dashboard. Comments are used to explain issues in the dashboard, and they allow senior commanders with the ability to request lower level commanders to submit a comment when an explanation is needed. This workflow solution allows commanders to input comments in one of two ways. First, the commander can go to the dashboard and directly add comments at any reporting level to provide a summary status report or provide specific notes on an individual staff member. For example, if the staff member is attending training for six months and will not be caring for soldiers at that time, the commander can explain the absence. If a higher-level commander reviews the dashboard and needs additional comments about a specific subordinate command's status, a request can be sent via the dashboard to the subordinate commander. The subordinate commander can then respond directly to the e-mail sent from the higher-level commander, and that information will be automatically populated into the dashboard for that specific field. This solution utilizes an additional benefit of an integrated SOA infrastructure solution since the e-mail and dashboards can be seamlessly integrated, using web services and workflow, to significantly reduce the time soldiers need to spend logging into and out of different systems to report information. Additionally, the by-product of this integrated data collection approach is that is requires significantly fewer mouse clicks to provide the requested information.

**Results** – Although the majority of the components in the SOAF foundation were utilized for this use case, the workflow and messaging capabilities provided by the Enterprise Service Bus (ESB) and the workflow engine were particularly important. The ESB allows for smooth integration of the disparate system formats and their delivery mechanisms, while the workflow engine makes possible long-running processes that include human decisions. In order to carefully align these capabilities with existing processes, the requirements and specifications capabilities also play a critical role. Moreover, to satisfy the inter-organizational nature of this solution, the data governance capability has to be engaged from the onset of specification design thru the operational governance and for planning future evolution.

The resulting dashboard and workflow capability took 4 months from the day the report was provided to the day the Initial Operating Capability was demonstrated. The reuse of the infrastructure capabilities to provide secure integration and distribution of the information and the reliance on the existing development, deployment, and governance processes allowed the solution to emerge much quicker than if

all of it had to be created anew. Another huge time saver is the ability to certify only the new pieces of the solution, such as web parts and web services, instead of accrediting a completely new system. This ability alone can generally shave off 6 months of accreditation work. Using Attribute-Based Access Control (ABAC) saved a considerable amount of time to secure personal and medical information by ensuring that the data from the web services would only be viewed by authorized staff. Additionally, the workflow mechanism gives the high-level commanders a streamlined method for requesting and viewing comments as needed. The time it takes to complete that task is shown in Figure 10: Staffing Dashboard Results. The automation of the manual processes helps optimize staff utilization by allowing them to work on higher-order problems, which translates into additional monetary savings. When this project was started, the medical staff was 120

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Figure 10: Staffing Dashboard Results

percent staffed. With this dashboard in place, the over- and understaffing occurrences become much more obvious. If a very conservative 5 percent reduction in staff occurs over one month, the cost savings in salary is equal to \$500,000. If that same conservative estimate is maintained, in one year, it is estimated that nearly \$6 million in staff salary savings could be realized or better utilized. The \$400,000 spent on the project provides a rather significant return on investment.

## 5. LESSONS LEARNED

There were a significant number of lessons learned during the execution of the SOAF project. Normally those lessons learned would be identified here. However, the majority of those lessons learned were symptoms of a larger problem with the Army/DoD acquisition model. Numerous articles have been written about the need to reform the acquisition process, with most focusing on the need for more policy, guidance, or directives. The directive approach makes sense because, in the military, it is expected that it would be conditioned to follow

guidance and directives. However, when directives to support net-centric operations, data sharing, and distribution are produced, there seems to be little enterprise adoption, less the programs specifically funded to support net-centric operations. When we identified programs and data sources across the DoD in which were offering to give away net-centric and SOA support at no cost, they encountered the same interaction pattern. The Program Managers (PMs) showed initial interest in learning about the project and provided additional applications where this approach would be beneficiation. However, when it was time to ask for participation in supporting the project, the PMs could not support the request to expose and share data for the enterprise for numerous reasons. We grouped the reasons for not supporting enterprise data sharing efforts and found that they fell into three categories of People, Process, and Technology. The PMs always sited that either Cost, Performance, and Schedule (CPS) would be negatively affected if they supported the net-centric SOA approach. This led us to look at the system effects of having the PMs focus entirely on CPS as the measures of success.

We realized that the Army PMs have been trained to always focus on CPS as the measure of success, and anything that detracts from that is an undesired activity. Additionally, since programs are given very specific planned targets for CPS, there is little incentive to significantly

improve planned performance metrics and beat those targets. (There are some programs for that, but they are not widely used). This approach creates an artificial, narrow band of success that is generally plus or minus 10 percent of the projects plan. As long as those key metrics are within the success band, the individual system and the PMs are successful. All of these metrics focus only on the individual program, and extremelv program-specific view this provides no reasons why a PM should consider supporting the enterprise. As shown in Figure 11: New Metric for Measuring Program Success, this approach results in the CPS metrics reinforcing a siloed project view.



Figure 11: New Metric for Measuring Program Success

A service-oriented approached to software development provides the technical approach needed to support the net-centric vision, and its value is in reuse and in working across silos in order to facilitate enterprise-wide data sharing. Ironically, the DoD and Army directives for data sharing and integration are fundamentally contradictory to the acquisition and program management process because they direct data sharing without providing a process or putting incentives in place to support a change across the PMs. Due to this lack of process and incentives, the wide-scale DoD transition to net-centricity is stalled because PMs do not have an incentive to take a risk that possibly negatively affects CPS. To change this deadlock between CPS and net-centric transformation, the Army and DoD need a new success metric that supports data sharing and promotes an enterprise perspective. There needs to be a metric that supports the objectives of net-centricity, a metric that promotes data sharing and cross-silo information integration—a usage metric. Figure 11 illustrates this point.

A SOAF solution provides a robust ESM capability to support a new usage metric. As shown in the table, while CPS metrics all focus on individual project metrics, adding a new Usage metric that measures the amount of cross-system data sharing and other enterprise-level metrics reinforces the Army and DoD goals for increased data sharing and reuse. Usage is different than performance because, while performance focuses on meeting SLAs and providing the functionality at prescribed levels, usage looks at any number of metrics associated with a system to measure warfighter value in quantifiable terms. It also allows comparisons between systems providing similar information in order to have warfighter usage influence sustainment decisions.. For this and many other reasons usage should become the key metric of choice for supporting a net-centric, data-sharing culture across the enterprise. Logically, the next step is to determine how to capture the usage metrics. As mentioned previously, a SOAF provides an array of quantifiable usage metrics to provide a new measure of success for programs and break the stalemate between the need for change and the struggle to maintain existing systems. Through the SOAF project, enough information on the subject of usage has been learned to write another paper, however introducing the concept here is only to highlight the importance to providing PMs with both the tools(SOAF) and incentives(Usage Metrics) to support a new culture focusing on enterprise wide data sharing.

The fundamental lesson learned from the SOAF project is that the current acquisition process is optimized to ensure that individual programs meet very specific targets, but the new focus on data sharing and enterprise capabilities requires both the desire by PMs to support the new vision as well as incentives to take the challenge. A SOAF solution provides all the technical components necessary to

support an enterprise-level shift from a siloed system view to an enterprise data sharing system, while also providing the mechanism to support a new success metric to encourage PMs to look beyond their systems.

## 6. CONCLUSION

Current IT systems need to be transformed in order to support rapidly emerging mission needs and to facilitate rapid data integration and data sharing across the Army. The warfighter encounters a number of concerns when trying to access and use data from across the enterprise, and addressing these concerns is essential for the success of the data integration effort. The Army created the SOAF project to address the data integration needs, and the capabilities embedded in the SOAF solution address the warfighter questions and needs. The Logistics and Staffing Dashboard use cases further demonstrate the technology and illustrate how the SOAF supports existing Army processes to provide net-centric solutions. For there to be widespread support of net-centric solutions in the DoD, a new usage metric needs to be provided to give PMs the necessary incentives to support this new enterprise view instead of a siloed program view. And finally, there are existing SOAF solutions for use today that are comprehensively validated.

Particularly in a time of tightening budgets and increasing operational demands, the real value and savings of a SOAF approach to software development is in the reuse of established programs of record and the quick integration of data in new and creative ways. SOAF solutions are available now and represent one of the most significant contributions to reusable software in the Army today.

For additional information of the status, owners, and technical information on the SOAFs discussed in this paper, please feel free to contact the authors.

## **APPENDIX A – About the Authors**

#### Kevin M. Brown

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Mr. Brown is a Senior Associate with Booz Allen Hamilton and is actively involved in system integration development work on numerous command and control systems. Mr. Brown specializes in applying leading-edge technology solutions for integrating information systems for military decision-makers. Mr. Brown provides thought leadership in technical, tactical, and strategic integration decisions for the military and provides operational insight into high-level system architecting decisions. Mr. Brown is the program manager for several SOA projects and focuses on supporting activities utilizing his Army and Iraq combat experiences to ensure SOA enabled technological solutions directly support warfighter needs. Mr. Brown has significant experience in the identification,



selection and implementation of SOA web services which support operational use cases. Mr. Brown provides a unique ability to bridge technology capabilities with various warfighter missions, having worked as a military engineer in combat engineering, demolitions, explosives, construction, force stabilization, division level planning and infrastructure repair operations. Mr. Brown holds a Bachelors of Science in Aerospace Engineering from Embry-Riddle Aeronautical University, Masters of Science in Engineering Management from University of Missouri, Rolla, and Master of Science in Systems Design and Management from Massachusetts Institute of Technology.

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Mr. Galkovsky is an Associate with Booz Allen Hamilton and is currently providing technical assistance to the DoD as it moves towards net-centric operations. He has 11 years of experience in software development and IT architecture design. Currently, Mr. Galkovsky is supporting military clients with the implementation of Service-Oriented Architecture. As a technology innovator, Mr. Galkovsky strives to leverage new and emerging technologies to improve the human-computer interaction. He has successfully championed the charge to "operationalize SOA" by providing the needed technical, operational and strategic insight in areas of software design and hardware utilization. Mr. Galkovsky has eleven years of experience in software architecture and development. His focus is currently on Enterprise SOA architecture and instantiation. His skill set

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includes: Enterprise Java and .NET technologies, XML and Web Services, in addition to a wide array of databases and application servers. Mr. Galkovsky is an expert software developer, has extensive experience in database and user interface design, in addition to possessing a rich background from a wide range of commercial and government projects. Mr. Galkovsky also has extensive knowledge in agile and test-driven software development practices and has been an avid advocate and contributor to various open source projects. He has presented to both small audiences and large crowds while also authoring several articles and white papers for industry and firm publications. Mr. Galkovsky holds a Bachelor's degree in Computer Science and Mathematics from Freed Hardeman University.

## APPENDIX B – Best Practices for Starting SOAF Projects

SOAF projects are often considered a deviation from standard development processes and are sometimes considered more risky then established processes. To mitigate this risk, Booz Allen recommends starting small in order to develop the technical skills, carefully manage the scope and expectations, and better plan for future iterations.

When starting SOAF projects, Booz Allen recommends using a two-phased approach to determine if the enterprise should develop a fullfunction, enterprise-level SOAF solution:.

- Phase I: Requirements, Architecture, and Prototype the activities for this phase are described below. This task should be scoped for approximately three months, and the activities completed in the first three months will determine the success of the long-term project that should be started in Phase II.
- Phase II: Full Development of a Production SOAF Solution Starting Phase II should be determined by the findings from Phase
  I. Once a production decision has been made, development should following an agile/iterative process for developing
  capabilities. Describing this process is beyond the scope of this appendix.

The following sections will focus on the steps and activities required to develop Phase I of a SOAF project.

## 1. TASKS

Phase I should employ a 3-month, four-step approach to developing an initial prototype capability of the SOAF. This approach consists of four steps as depicted in : Step 1 – Analyze Requirements, Step 2 – Create Functional Database Prototype, Step 3 – Define High-Level Architecture and Technical Solution Roadmap, and Step 4 – Task Management.

Task Name	Duration		May				June				Ju	ily				Au
		4/25	5/2	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8
Step 1: Analyze Requirements	22 days															
Step 2: Create Functional DB Prototype	44 days						- Č									
Step 3: Define High-Level Architecture and Technical Solution Roadmap	44 days						•									-
Step 4: Task Management	66 days		L <mark>e</mark>													



### 1.1 STEP 1 – ANALYZE REQUIREMENTS

Analyze the strategy and recommendations to establish an integrated solution. This analysis will include analyzing the technical solution that supports the business/mission problem that the SOAF will be addressing. This task often can be generalized into improving process visibility and reducing human data entry (and errors) to establish, produce, report, and distribute data.

Step 1 Requires:

- Collaborating with stakeholders to gain an understanding of operational mission, strategy, objectives and critical relationships as they relate to defining, assessing, tracking, and managing the data associated with the problem.
- Conducting interviews with stakeholders and developing functional and technical requirements to meet management requirements and key leader needs.
- Assisting all stakeholders in defining, documenting, and tracing operational and functional requirements.
- Analyzing external systems (e.g., data sources) to understand existing data structures and the potential for web service integration.

At the completion of Step 1, Booz Allen will provides documentation on the scope of the integration that can be achieved for the prototype, identify the initial data sources and sets required for the prototype, and complete the first iteration of the prototype mock-ups in order to start development work.

## 1.2 STEP 2 – CREATE FUNCTIONAL DATABASE (DB) PROTOTYPE

The purpose of this task is to create the opportunity to test and evaluate the integration of the database to ensure that the services will be able to be integrated with external systems. In general, it is good to have the prototype demonstrate integration with two existing systems.

This task will consist of providing an IT test environment, development and loading of a demonstration dataset, user training for prototype participants, facilitated feedback sessions, and requirements collection, analysis, and documentation to be included in the technical solution and roadmap used in determining the cost and plan for moving forward with a Phase II option.

Completion of Step 2 will provide a prototype solution to validate the technical integration solution and validate the user interface design. The prototype will initially be deployed in a development environment that can be accessed via the internet to enable remote review and feedback on the functionality.

#### 1.3 STEP 3 – HIGH-LEVEL ARCHITECTURE AND TECHNICAL SOLUTION ROADMAP

During the high-level architecture and technical solution roadmap task, Booz Allen will use information discovered through the Analyze Requirements and Functional Prototype tasks to define the solution architecture for determining if a production level solution in Phase II can be achieved. This high-level architecture and technical roadmap will define the structure and behavior of the proposed system and provide the blueprint for what should be implemented. Booz Allen reviews system-level requirements and specifications to evaluate the key business drivers and ensure that the solution architecture is aligned with the business goals for the system. This review also helps determine what is in scope and what is out of scope.

Completion of Step 3 will allow the designers to provide a recommended roadmap on how to take the prototype to production. This roadmap should also include cost estimates for a full-production solution as well as highlight key risk areas and recommended mitigation activities. The documentation provided at the completion of Step 3 will be used to support decisions and planning for consideration for Phase II of the project.

#### **1.4** STEP 4 – TASK MANAGEMENT

Task management ensures client satisfaction and tracks daily operations to ensure that the project moves forward as scheduled and helps keep track of the overall project. In addition to standard PM tasks for a SOAF project, tracking data access activities and creating Memorandums for Record or SLAs with various PMs will be essential. Additionally, the PM will have to work closely with government sponsors to ensure that the appropriate level of advocacy is provided to keep the project moving forward.

In general, there should be a single PM responsible for the total performance of the integrated Project Team. The PM is directly responsible for all deliverables and will ensure that the Project Team delivers the program and technical quality required and is responsive to changing requirements and priorities.

### 2.ASSUMPTIONS

There are three key assumptions for a SOAF project that need to be met, or the overall project could miss the scheduled completion dates. These are:

- Availability of government personnel
- Access to government personnel, facilities, and systems
- Availability, completeness, usability, and accuracy of required data