FAA SWIM Program

SOA Governance Best Practices
Industry Input

September 2008

Acknowledgments

The Federal Aviation Administration has requested industry input on best practices of implementing SOA Governance for the FAA SWIM program. The Information Technology Association of America's GEIA Group includes many industry partners who support the FAA, and ITAA/GEIA formed a working group to prepare this whitepaper in response to the FAA request.

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About the GEIA Group

The GEIA Group within ITAA develops and distributes forecasts of the Federal marketplace, creates best-practice industry standards, and maintains a committee structure through which its member companies work with representatives of FAA and other Federal agencies on matters of mutual concern. Previously a separate organization, in 2008 GEIA merged with the Information Technology Association of America (ITAA) and assumed the ITAA name. GEIA Group contact:

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1 FAA Introduction

While current economic conditions, heightened security concerns, and higher energy costs have temporarily dampened the growth in demand for air transportation, air traffic is still expected to double or triple within the next twenty plus years. This projected growth in demand is and will continue to be increasingly problematic for the National Airspace System (NAS). Not only are airport, runway, and terminal resources limited, but NAS legacy Air Traffic Control (ATC) systems, still based largely on 1950s technology and point-to-point communication interfaces, will be incapable of handling the projected increase in air traffic operations.

In recognition of the increasing urgency for more rapid modernization of the Nation's air traffic control system, the FAA has recently created a new leadership position, Senior Vice President of NextGen and Operations planning. To better coordinate the efforts of several Federal Departments and Agencies and to ensure more rapid implementation of critical near- to mid-term NextGen-enabling programs, the FAA has also incorporated the Joint Planning and Development Office (JPDO) into the new organization. Among those programs identified as critical NextGen enablers is SWIM (System Wide Information Management).

1.1 The Role of System Wide Information Management (SWIM)

The NAS is an assembly of intricate systems that has been independently structured and has multiple users with varying needs and access requirements. An orderly evolution from today's sum-of-systems to a system-of-systems approach is a key to NextGen. SWIM is a foundational element and key enabler of that evolution.

Through widespread information sharing and access within a modern and efficient networked infrastructure, SWIM can make Air Traffic Management (ATM) information ubiquitous and timely. By ensuring that users and service providers share a common operating picture and immediate access to all information required to make effective decisions, SWIM will provide a basis for enhanced NAS agility, increased operating efficiency, and improved system safety. Through virtual collaboration and intelligent automation, this shared awareness will in turn enable the NextGen operations transformation.

The FAA has developed the SWIM concept to support loosely coupled, many-to-many data exchange interfaces of the type that NextGen operations will require. The specific goals of SWIM include improved sharing of information (leading to better decision-making and operational effectiveness), improved systems integration (reducing functional redundancy and improving information quality), and greater flexibility to accommodate the system and operational changes required for NextGen.

The economic benefits to the FAA can be substantial. For example, managing air traffic requires the skills of many people and the capabilities of many software applications (programs). Each of these applications requires information from one or more sources to perform its task and may in turn provide information for others. Over time, it has become

increasingly necessary to integrate new combinations of applications for improved air traffic management capability and increased NAS capacity. Historically, application integration has been a very labor-intensive (expensive) process involving modifications to each of the applications being integrated. For example, if an existing integrated group of five applications were to have a sixth application added; this could require modifications to all six applications. As the number of applications requiring integration grows, this integration process rapidly becomes infeasible.

SWIM can play a significant role in reducing FAA costs by addressing this scalability issue. Instead of developing and implementing specific solutions for securely sharing data between application pairs, SWIM implements a common infrastructure and set of processes for sharing and managing data within the NAS. Once data is published on SWIM, the data is made available for any authorized application to discover and use.

SWIM employs modern enterprise application integration patterns that are based on an underlying set of technologies allowing applications to be integrated without modification. These technologies consist of a common hardware and software infrastructure, coupled with extensible application interfaces that allow the integrated applications to interact. New applications can be developed that have these interfaces and existing applications can be augmented by an adapter that provides the necessary interface without modifying the original application itself.

1.2 A Brief Description of FAA's Vision for SOA

The FAA's vision for Segment 1 of SWIM includes the concept of a "Service Container (SC) that will provide certain SOA capabilities and will be distributed in nature – located at each of the SWIM Implementing Programs (SIPs).

As described in an earlier GEIA Group white paper [i], this raises several "boundary" questions:

1. Which SOA elements will reside inside the Service Container?

2. Which SOA elements will reside in the SIPs but outside their Service Containers?

3. Which SOA elements will the FAA provide centrally?

4. Which SOA elements will the FAA provide in a federated fashion – by the SIPs?

Answers to these questions may change over time as the FAA gains experience from "early adopters" of SWIM services and adjusts the solution to deliver maximum value to FAA stakeholders.

In Segment 1, SWIM will not create many central resources for implementing programs. There will not be a central ESB providing messaging, security, and similar functions; instead – for the most part – the responsibility of implementing these core (infrastructure) capabilities will belong to NAS programs such as ERAM and TFM-M. There are two areas where the FAA does envision creating centralized services during Segment 1: (a) a

design-time registry to assist in common service access; and (b) test bed capabilities to support interoperability testing.

Keeping an eye toward the future – beyond Segment 1 – is important, however. While Segment 1 may not create a large number of centralized services, it is possible that future Segments will expand this pool of services. The Service Container can play a key role in delivering this flexibility to FAA programs by acting as a service wrapper to provide attachment points for security, messaging, service management, and interface management capabilities (and possibly other SWIM services in future Segments). The lightweight SC will not provide these capabilities, but will provide a standard mechanism for connecting them to services.

As SWIM architecture evolves, the SC will help enable interoperability in future FAA Segments. It is likely that the distribution of services will change over time –possibly gravitating toward the centralized pool. The SC can help provide continuity for FAA programs as this re-distribution of service-fulfillment occurs. Even in Segment 1, services will need infrastructure capabilities, and during Segment 1 those services will likely be fulfilled via existing FAA programs for services such as for authentication and authorization, service monitoring and management, message queue management, etc.

The SC will provide a wrapper that supports a seamless transition from program-provided infrastructure to SWIM-provided infrastructure in the future. The key is flexibility: while the SC construct does not obligate the FAA to changing the location of services, it provides the FAA with the ability to re-locate certain services in the future if such relocation would be beneficial.

In many cases the SOA Framework components can be decentralized and federated to support the Service Container concept. However, since decentralized, federated components tend to add complexity and risk over centralized solutions, consideration should be given to architectures that include centralized components where consistent with the FAA's operational needs.

Since the Service Container concept by itself permits, but does not require, centralized hosting of services, FAA stakeholders will need to consider an appropriate balance between an enterprise-wide SOA and a federated model. The best solution for the FAA may well lie somewhere in between, with some services centralized and others federated. The choices to be made will in some measure determine and be determined by the SOA benefits the FAA decides it must provide through SWIM to support NextGen operations: just system-interfaces, or others such as Workflow Orchestration, Business Process Modeling, and Business Activity Monitoring. These choices can be facilitated through use cases and trade studies.

1.3 The Need for a Governing Process Providing the Required Checks and Balances to Assure Success

This white paper is not intended to address the broad topics of either enterprise governance or IT governance but is instead confined to consideration of SOA governance. SOA Governance may be viewed as an augmentation of IT governance

since it is primarily focused on business services strategy and on the lifecycle management of services (single services as well as the network of services) to ensure their business value to the enterprise [ii].

Moving to SOA represents a substantial challenge for organizations. Besides introducing new technologies and responsibilities, SOA requires a change from application-based thinking to an enterprise-wide perspective intended to control how workflows are accomplished and how services and a portfolio of services are developed, deployed and managed throughout their lifecycle to accomplish enterprise business objectives.

SOA governance certainly should include elements of enforcement, control and policing, but it needs to be much more. Since a primary SOA objective is the identification, development, deployment and lifecycle management of services (and portfolios of services), SOA governance cannot be rigid or autocratic but must become a collaborative effort involving centralized IT management with the active participation of internal (and external, if required) communities of interest (COIs).

The importance of involving Communities of Interest in the SOA Governance process cannot be overestimated. Many of the benefits of SOA are based on the sharing of services, as well as the sharing of information, best practices architectures and business processes and objectives. For this reason, strong consideration should be given to the early adoption of a federated SOA Governance model. This should include the early establishment of a Core SOA team, or SOA Center of Excellence (COE), whose role is one of collaboration with the SWIM Program Office to share needs, services, and resources for the good of the enterprise.

Collaboration between semi-autonomous, interconnected business units is often difficult. To overcome this natural institutional friction, SOA Governance can begin informally and on even an ad hoc basis, but it should naturally progress over time to more formalized oversight with standards, best practices, and enterprise alignment as its ultimate goal. A key element in making this collaborative process work is, of course, executive level buy-in. Without the commitment of both leadership and enterprise communities of interest, the potential benefits of SOA can be easily lost.

2 Governance Introduction

Good governance is all about transparency - ensuring that everyone involved in an activity clearly understands their individual roles and responsibilities, what expectations the other team members have of them, and how they personally contribute to the overall goals. In this section we examine the importance of governance and we define SOA governance and its relationship with Enterprise as well as IT Governance.

2.1 Why Governance

One definition of governance is "the set of rules, practices, roles, responsibilities and agreements – whether formal or informal – that control how we work". In another words, for each activity we need to define:

- What needs to be done
- How it should be done
- Who should do it
- How it should be measured

As obvious, trivial and self-evident the above may be, in many cases these precepts are not being followed. They are either eliminated or compromised in the name of SPEED, ("Just do it").

The key phrase in the above definition is "control how we work". This level of control can be at a level anywhere from very light and unobtrusive control (guidance) to a very tight and bureaucratic level of control (policing). Neither does the work of governance mean management, per se. Governance determines who has the authority to make decisions. Management is the process of making and implementing the decisions.

If we think about the What, How, Who, and measurement of the standard IT project, we see that these functional attributes are not always well defined either. The business reasons for having an Information Technology (IT) function has come about to bring agility to what the business does. But IT implementation has always faced the dilemma of not being a fast and agile process itself. Therefore, IT projects are very much prone to temptations of cutting corners and eliminating and bypassing vital steps. Many times, the "What" of an IT Project, in the form of functional and non-functional requirements, are not complete and it is left to the imagination of the IT individual(s)/department on what should be created. The "How" is normally influenced by individual styles and preferences. The "Who" could end up with whoever is available. Measurement of the project results will usually not happen as the development team moves onto the next project.

So while the state of IT Governance leaves something to be desired, we are now faced with the challenge of migrating to a services approach with SOA. Moving to SOA represents a considerable challenge for any organization, especially since: SOA introduces new technologies, roles and responsibilities; SOA requires new patterns of

thought – taking an enterprise-wide viewpoint, rather than focusing on any one department, or specific Line of Business (LOB) area.

The potential benefits of SOA may not be achieved without the enforcement rigor around development, deployment and operational management of services across the enterprise. Lessons learned from past attempts at SOA indicate that the mere proliferation of services in the absence of governance policies will not realize a Service Oriented Architecture. Lack of SOA governance impacts any organization's ability to realize the potential benefits of service orientation, by allowing inconsistencies, gaps and overlaps in the software development process that makes reuse and business agility difficult, if not impossible. Thus, without governance, the SOA journey is likely to fail.

Implementing SOA successfully at FAA will create new and additional challenges to people, process and technology that must be addressed through sound and effective governance. Without such governance, business agility is impossible, service ownership will remain locked within silos, portfolio management will remain balkanized and ineffective, and security will be in islands instead of achieving a more holistic, enterprise-wide view.

2.2 Enterprise, IT and SOA Governance

SOA governance extends, or augments IT governance further aligning IT and business by governing the lifecycle of business services as manifested in IT systems. Deploying SOA should serve as a catalyst for an organization to start thinking about improved corporate and IT governance in general, as well as how to best implement SOA governance practices specifically. Adoption of SOA raises new issues in IT decision rights, measurement and control.

SOA governance augments IT governance as enterprises focus further on Service-Orientation adoption. SOA provides a distinctive enterprise-level approach for designing and delivering cross functional initiatives, closely involving both business and IT in the collective pursuit of the enterprise's strategy and goals. This form of SOA governance introduces the use of business policies, both enterprise-level and department level policy invocation, which provides the discipline referenced above.

Establishing SOA Governance should also be seen as providing another opportunity to bridge any gaps between enterprise and IT governance. SOA governance would benefit from existing IT and Enterprise governance. However, lack of existing IT and Enterprise governance, or "operationalizing" the IT & Enterprise governance practices should not stop enterprises from establishing SOA governance. In many cases, the need for SOA governance has encouraged enterprises to revisit and reinvigorate their IT and Enterprise governance.

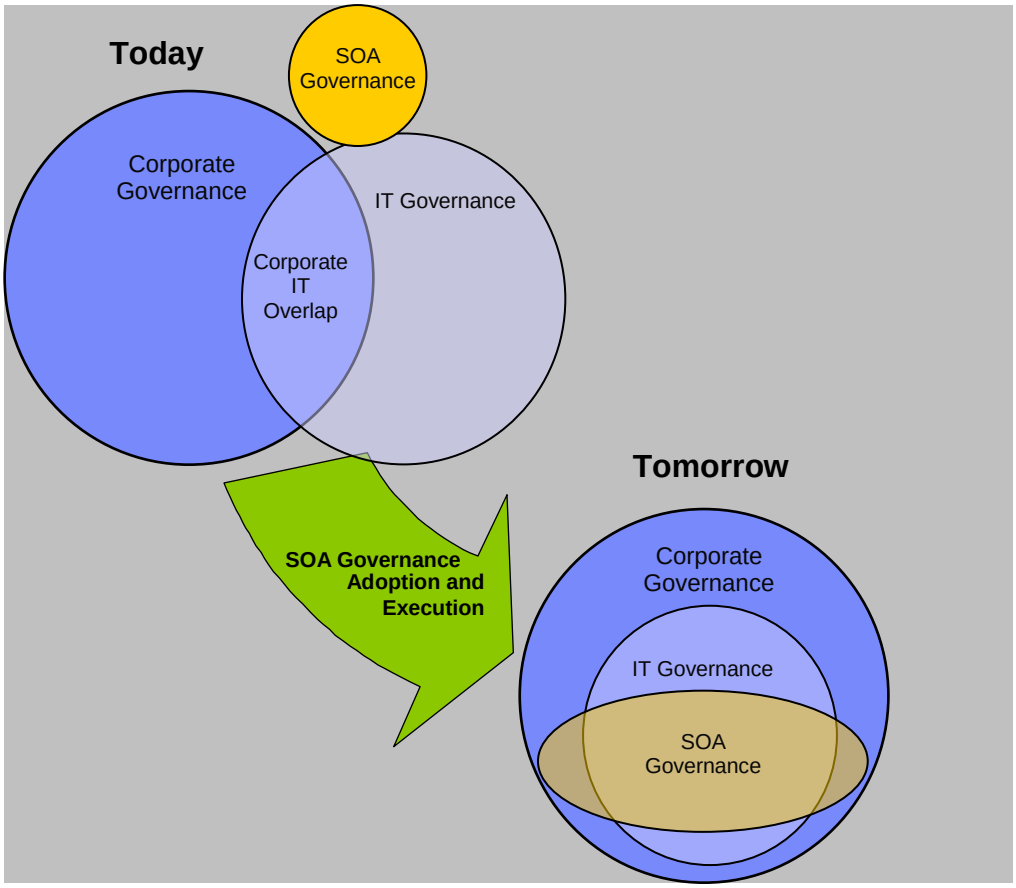

Figure 2.1- Enterprise, IT and SOA Governance

Conceptually, the way that the relationship between Enterprise, IT, and SOA governance changes over time is shown in figure 2.1 above.

Initially, SOA governance has limited scope and concerns itself mainly with a fairly limited area where IT and Business interests overlap.

As the organization increases its level of SOA maturity, the scope of SOA governance will expand significantly. The business and IT communities should gradually increase their degree of overlap until eventually an expanded SOA governance role merges with IT governance, and IT governance itself is subsumed into an overall corporate approach to governance.

Generally speaking, enterprise level governance establishes the rules and the manner in which an enterprise conducts its business. Enterprise governance includes establishing compliance goals, its strategy within the marketplace, according to its principles of doing business. IT governance represents a significant portion of enterprise governance, due to the horizontal nature of IT and the broad reliance on IT around the world. Since almost everyone in an enterprise uses IT assets to complete their responsibilities, and all persistent information is stored in IT systems, the impact of effective IT governance is highly visible.

SOA Governance typically defines additional nuances and changes to IT Governance to ensure that the concepts and principles for Service Orientation are managed appropriately and that the organization is able to deliver on the stated business goals for SOA. In addition, SOA Governance drives organizational change for better partnering between business and IT in order to achieve a higher degree of business value by optimizing return on investments and improving business agility. This is done by associating business requirements with business services instantiation. This association, if conducted rigorously, results in better risk management and predictability in all phases of IT system implementation.

Since SOA is a distributed approach to architecture that may span multiple lines of business domains (internal and external) as well as IT domains there is a greater need for effective SOA governance. In addition SOA Governance provides a framework for the reuse and sharing of services, a key value derived from leveraging SOA.

2.2.1 IT Governance

IT Governance can be defined as:

- Establishing and implementing decision making rights associated with IT.
- Establishing mechanisms and policies used to control and measure the way IT decisions are made and carried out.

One of the most important aspects of IT Governance is Architecture Governance, which is defined below.

2.2.2 Architecture Governance:

Architectures are controlled at an enterprise-wide level by practicing architecture governance. Enterprise Architecture (EA) plays a significant role in governance as the EA discipline defines and maintains the architecture models, governance and transition initiatives needed to effectively coordinate semi-autonomous groups towards common business and/or IT goals.[iii]

2.2.3 SOA Governance

SOA governance is an augmentation of IT governance focused on:

- Business services strategy
- Lifecycle of services to ensure the business value of SOA
- Enablement of the services approach
- Aligning business and IT governance towards the goal of achieving business objectives.

SOA Governance is frequently a catalyst for improving overall IT governance, particularly in large organizations with a reliance on legacy IT infrastructure.

2.3 Mechanics of the governance model

SOA governance ensures successful Business and IT alignment. It enforces agreed upon Policies and Standards. These policies and standards guide the governed processes that are managed and monitored by governing processes, standards and metrics; and implemented by procedures.

Figure 2.2 points out Compliance, Communication, Vitality and Exceptions/Appeals. These are the most important mechanisms in governance. We address each of them separately.

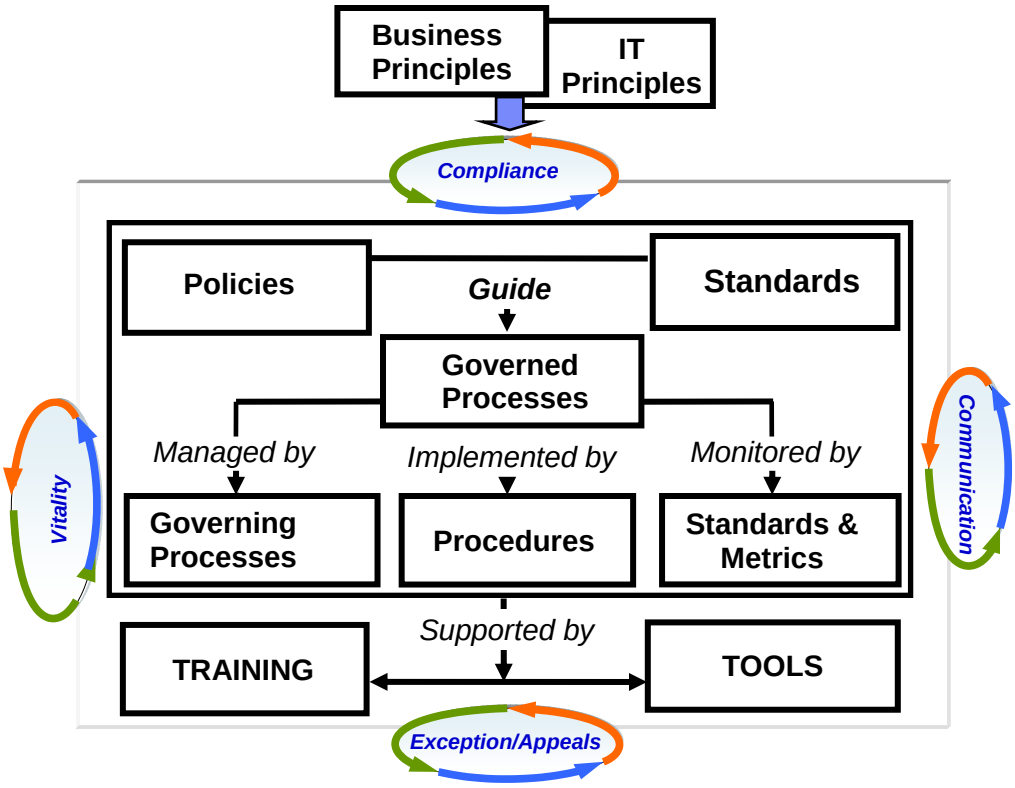

Figure 2.2 Mechanics of Governance

2.3.1 Compliance

Governed processes are guided by policies and standards. Defining policies and identification of standards have a significant importance for governance best practices. However, policies and standards without compliance marginalizes their value. To this end, concepts such as control points, Policy Decision Points and Policy Enforcement points are essential in governance. Section 2.4 is dedicated to policies and policy management for this purpose.

2.3.2 Communications

Clear communication is essential to governance. Communication is needed within the enterprise as well as with partners, providers/suppliers and clients. Communication is about delivering the right message, to the right people, at the right time. It is a key enabler to moving people through the various stages of any process requiring awareness, understanding, commitment and adoption.

Air Traffic Services are governed by the International Civil Aviation Organization (ICAO) Convention under which states commit to providing ATS services in their airspace over their territory and the surrounding oceans.

On a day to day basis civil aviation authorities communicate with each other and with airlines and airports for the exchange of operational messages such as flight plans, weather messages etc. The current legacy messages are exchanged through AFTN (Aeronautical Fixed Telecommunication Network).. AFTN is created by the Air Traffic services providers, following ICAO standards, and has a messaging address structure based on ICAO codes. It now comprises some 150 national networks with connections to their national terminals and those in adjacent countries. AFTN traffic consists of NOTAMS, Flight Plans and Slot Allocations, and operational meteorological data. It circulates on the internal AFTN network, between different ATS providers, and between providers and airlines. Within FAA this is achieved through the FAA Telecommunications Infrastructure (FTI) Network

A new generation of ICAO messaging referred to as the Aeronautical Message Handling System (AMHS) is finalized in 2002 as part of the ICAO standard for the Aeronautical Telecommunications Network (ATN). The AMHS uses a set of protocols derived from the ITU X.400 standard. AMHS systems can interconnect using the X.25 protocol, or the planned ATN networks that will use OSI protocols or to use AMHS over TCP/IP using RFC1006. The deployment of AMHS is slow due to its questionable aging technology.

While AFTN messaging has served the ICAO community well, it is not extensible to meet the needs of more demanding newer applications with much more complex data. Additionally it remains an aging technology that requires serious replacement. AMHS which is based on X.400 has been recommended to replace AFTN. However it remains yet another outdating technology with high cost of deployment, scare expertise and products. And while there are AFTN and AMHS approaches that leverage the benefits of IP networks, current implementations in the industry are still constrained to using costly network technologies such as X.25 or CLNP routers.

Airline exchanges are governed by IATA/ATA standards. The current industry reliable messaging for business critical exchanges use an IATA standard referred to as TypeB. Gateways are also developed to bridge AFTN to TypeB and consequently enable seamless message communications between ATSOs and airlines.

Leveraging open standards such as XML based messaging and using the Web Services communication framework has the potential to transform how business class messaging is accomplished in the industry through new technology use. For air transport operational messaging a new standard called TypeX is under finalization with the related IATA Work Group that specifies the use of industry standard addresses and compliant with

IATA and ICAO codes is emerging to support XML messaging and industry business practices. TypeX has been implemented by SITA and ARINC and some users. TypeX is SOAP based and can be used in a SOA environment and plugged into ESB. TypeX makes use WS-* security specifications for security functions

The use of TypeX by FAA for communication with the other civil aviation authorities and airlines meets the directions defined within the scope of SWIM. It facilitates communications by the use of a single protocol that meets ICAO and IATA messaging and addressing requirements while making use of a widely supported open technology. Communications with AFTN and airlines TypeB is facilitated by gateways that are simple to build due to similarity in addressing and some other industry related technical principles.

2.3.3 Exceptions and Appeals

Governance should not be a set of static processes without any flexibility. As part of the governance life cycle, governance processes may be appealed, or waived as exceptions require. In managing and monitoring policies and standards compliance, an appeal, or waiver process needs to be built for cases where achieving compliance is either temporarily or permanently impossible. Appeals, or waivers are a very sensitive topic, because on the one hand it has to be flexible enough to accommodate these exceptions, while on the other be stringent enough prevent unnecessary exceptions that may set uncontrollable precedence.

2.3.4 Vitality

As time goes by things will change and governance processes must adapt. This is called vitality. We have dedicated section 7 to governance Vitality.

2.4 Governance policies and policy management

Business process management (BPM) drives the creation of services through the identification, definition and creation of service operations. Compliance with the many rules and laws becomes a key driver behind governance. These service operations have design time and run time business processes that should be mapped, and benchmarked with key performance indicators established to enable service level agreements, based on Quality of Service (QoS) parameters.

Policy management provides a mechanism to allocate IT resources according to defined policies, or rules established by the enterprise. Policies dictate the data quality, integrity and retention requirements. Policies allow rules to take the form of if, then conditional statements, where actions are executed to account for a given condition. Within the context of SWIM, specific policies must be established by the NAS application program (the individual enterprise). The application program best understands the NAS requirements used to establish data integrity, retention and accessibility requirements. Hence, the application program must be empowered to establish their formal program policies into procedures which are implemented into systems, tools for execution. Policies are built into systems establishing policy decision points (PDPs), where events are defined and decisions made. The PDP's are configured to support various conditions and react accordingly. PDP's are synchronized with policy enforcement points (PEPs),

which monitor for events, and execute the policies as defined by the NAS Application Program in the FAA, within the context of the PDP. The monitoring and control function, discussed in the next paragraph, provides a centralized PEP capability designed to collaborate with decentralized PDP's. To support the many application programs within the NAS, the Internet Engineering Task Force (IETF) has defined standards for localizing policy decision points, enabling a decentralized enterprise support structure, while integrating into a higher level policy management system.

Policy enforcement points exist within the network and IT infrastructure used for monitoring events. A myriad of tools are required to provide the proper IT governance and access control at a macro level. Each application program must support their own infrastructure; however, the key to a service-oriented architecture is the agility of data transport to new communities of interest. Tools for web services management, including service registries, repositories and metadata catalogs, asset tracking and fault/performance monitoring are required to enable the policy enforcement function. The IT Infrastructure Library (ITIL) standards define a configuration management database (CMDB) which hosts these data elements that require tracking. The IT tools are required to collect and report on the many data transactions, tracked to individual users, along with key performance indicators, and then report them accurately to the NAS Application Program.

Here are some policy examples:

- Policies might start at the business level:
    - Projects must comply with Internal Architecture guidelines
    - Security and regulatory compliance policy reviews are mandatory for all IT projects

- Policies could represent more specific regulatory compliance issues:
    - Patient personal identifiable information must be communicated and stored securely. (HIPPA)
    - All financial transactions must provide traceability and tamper proof mechanisms for mandatory audit records. (Sarbanes Oxley)

- Project outsourcing initiative might represent its policy as:
    - Outsourced company must create same service lifecycle deliverables as are created in house.

- Higher level policies will often need to be translated to technical policies that can be effectively enforced by active policy enforcement tools.
- Information security examples:
    - Messages must contain an authorization token
    - Password element lengths must be at least 6 characters long and contain both numbers and letters
    - Every operation message must be uniquely identified and digitally signed

- There are also design related technical policies that are needed to ensure interoperability and reuse:
    - Do not use RPC encoded style web services
    - Do not use Solicit-Response style of web service operations
    - Do not use XML 'anyAttribute' wildcards

- Each organization, as part of the strategy and planning process for SOA, should think about and create its set of standards and policies for its SOA program and the SOA service development lifecycle. Specific policy service examples follow.
- The Service Specification **should** contain:
    - Descriptions of what function is performed by each service operation
    - Input/output message formats, and sample data for each service operation
    - A definition of the corresponding task in the Component Business Model (CBM)

- The Service Specification **should NOT** contain:
    - Any information on how the service will be implemented (provided the service contract is maintained, the provider may change the implementation of the service at any time, e.g. when retiring an obsolete IT system)
    - Any reference to a sequence or order in which operations should be executed. Each operation call should be considered as a discrete task, and sequences of tasks should be defined as business processes/automated business processes) in separate documentation

2.5 Governance standards

A **standard** is a rule or requirement that controls the service lifecycle. The governed service must adhere to the standard. Standards change very infrequently and a violation is not allowed or requires an explicit exception. In case an organization decides to deploy web services, the following table could be example of standards they may designate to follow:

Standard	Recommended	Proposed Alternatives	
Orchestration	BPEL	WS-Choreography	WS-CDL
Management		WS-DistributedManagement WS-Provisioning	WS-Management
Security	WS-Security	WS-Trust WS-Federation	WS-SecureConversation WS-SecurityPolicy
Transaction	WS-Transaction WS-Coordination	WS-CompositeApplicationFramework (WS-CAF)	WS-Context (WS-Ctx) WS-CoordinationFramework (WS-CF)
Reliability	WS-ReliableMessaging	WS-Reliability	
Description	WSDL UDDI	WS-Inspection Disco WS-Discovery	WS-PolicyFramework WS-MetaDataExchange
Messaging	XML SOAP	WS-Addressing WS-Notification WS-ResourceFramework	ES-Eventing WS-Policy SOAP with Attachment MTOM DIME
Transport	HTTP JMS RMI-IIOP	TCP UDP	Jabber SMTP
Interoperability	WS-1 Basic Profile		

Table 2.1 – Examples of Standards for Web Services

SOA borrows concepts such as Policy, Service Level Agreement and Quality of service from other aspects of Information Technology such as network management and managing IT infrastructure. Since at this time there is no SOA policy management and policy related standards in place, reference to standards defined by IETF (Internet Engineering Task Force) and or ITIL (Information Technology Infrastructure Library) is highly recommended.

3 Services lifecycle and Governance

Services are the heart of the Service Oriented Architecture. Therefore, SOA governance has a special focus on governing services. In this section we define the lifecycle of services and we discuss the fundamental tasks for establishing governance.

3.1 The Service Lifecycle Overview

All services go through a consistent set of steps, starting from the creation of an original concept, all the way through analysis, design, development, testing, deployment then eventual retirement, as shown in figure 3.1 below:

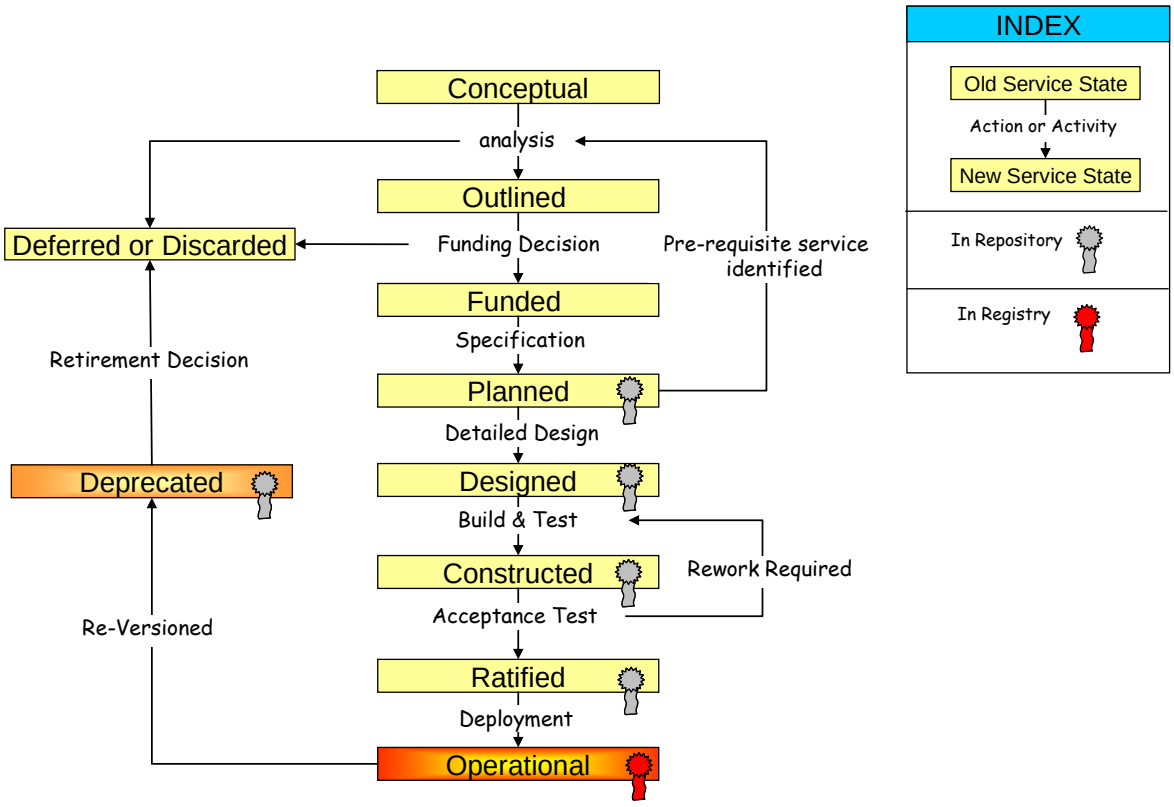

Figure 3.1 - The Service Lifecycle State Diagram

This is actually a state-transition diagram in which each valid state is well-defined, and a specific activity has to be performed in order to move from one state to the next.

Like all models, this represents a simplified view of reality: there are no intermediate states like 'under development' for example, since the definitions of such states are subjective and ambiguous.

This development model, however, is an excellent model to define a SOA development approach:

- Each activity that causes a transition from one state to another can be well defined, and then assigned to a suitably-skilled individual or team to be performed repetitively and to a continuously high standard.
- Since the stable states can be well-defined, it is practicable to have Quality Assurance (QA) reviews (sometimes known as 'control gates' or 'control points') to determine that each activity has been performed to sufficient quality for migration to the target state to be confirmed reliably
- Since the activities are repeatable, it is possible to both predict and monitor the development work efforts of an IT solution that requires a significant number of services to be deployed

The main stages in the service lifecycle are:

- **Identification** – When the initial need is recognized and the requirements are specified
- **Specification** – When the detailed requirements and high-level design are captured
- **Realization** – When the service is constructed and deployed
- **Operation** – When the service is managed through the rest of its lifetime until it is eventually re-versioned or retired

It is important to notice that not everything can be made into a service, and not all services could, or should be exposed. As part of governing the SOA lifecycle, candidate services need to conform to a service litmus test, whose answers can establish a set of criteria to qualify a service. This litmus test contains questions such as: Is this service reusable and how many consumers will it have? Is this service in line with the goals of the enterprise?, and so on.. Once a candidate service is selected, then the next step is to decide if it should be exposed. Exposure of a service means availability for consumption by others in a visible manner, such as through a registry. There are many reasons for not exposing a service. For example, infrastructure services may not be required enterprise-wide and, therefore, not exposed; or, security restrictions and policies may drive the enterprise to expose a service for visibility to only a select set of users.

The service lifecycle is consistent with software/system development methodologies (SDM), like rapid application development (RAD), Rational Unified Process® (RUP®), iterative, spiral and even agile development methods. For example, the Rational Unified Process® (RUP®) consists of the following four incremental phases:

- Inception
- Elaboration
- Construction
- Transition

Effectively, these phases are performed for each service being created. The phases are not an exact match because the operation stage of the service lifecycle extends somewhat beyond the RUP transition phase.

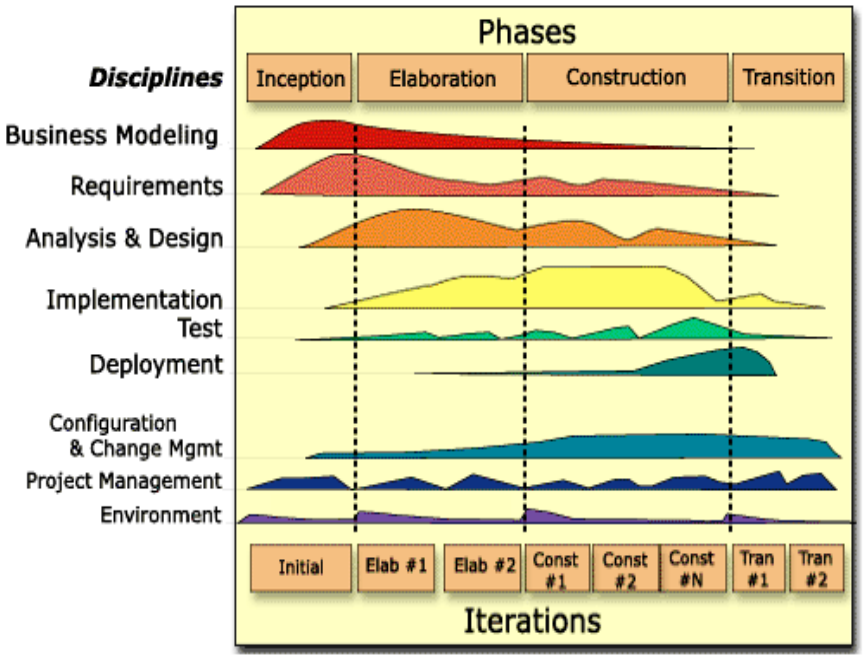

Figure 3.2 - RUP Phases

The following diagram depicts the service lifecycle in detail. As indicated, the orange boxes are QA-related steps to ensure effective governance of the SOA development process. The orange boxes could be considered Policy Enforcement Points (PEP). For example, we could have a policy stating that acceptance testing must have 95% success rate prior to exposing the service enterprise-wide. Also, please notice that the bottom part of figure 3.3 shows activities that are not part of an SDM, meaning current methodologies should be extended, or augmented to embrace SOA.

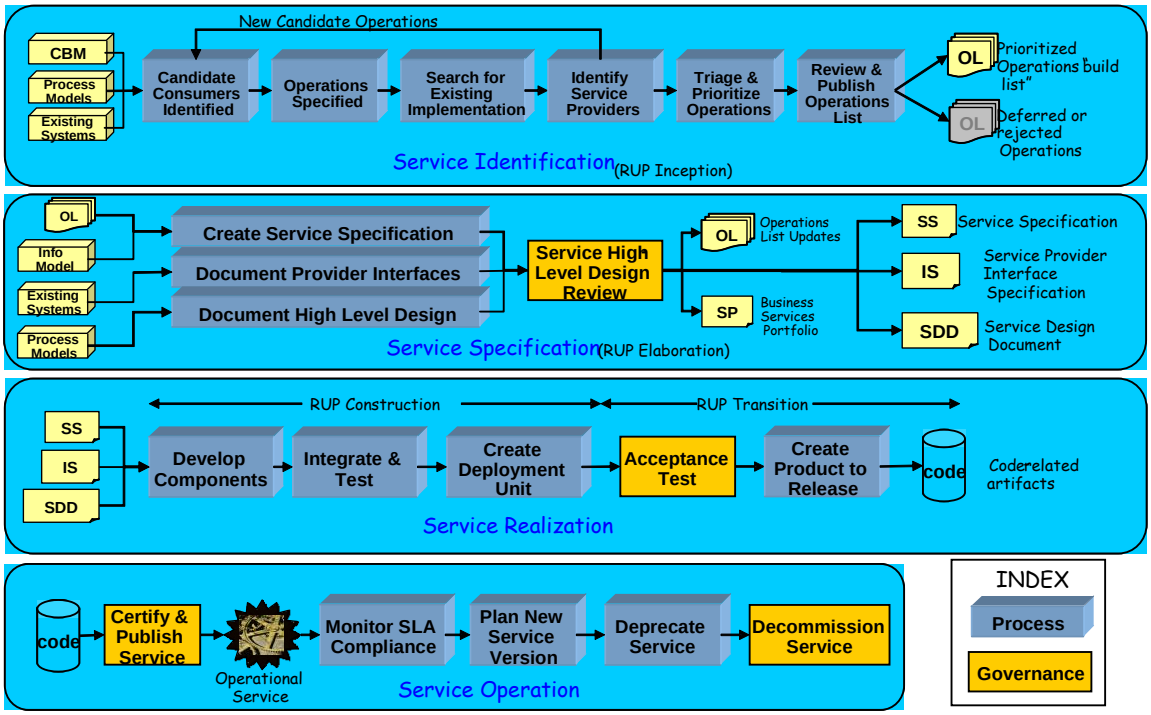

Figure 3.3 -The Complete Service Lifecycle in Detail
(Component Business Model (CBM), Service Level Agreement (SLA))

3.2 Initiating SOA Governance

In order to establish SOA governance, a few fundamental tasks need to be considered.

3.2.1 Task: Define Charter for SOA Center of Excellence (CoE)

Wikipedia (http://www.wikipedia.org/) defines "a **Center of Excellence** (CoE) or Center of Competence as the formally appointed, and informally accepted, body of knowledge and experience on a subject area. It is a place where the highest standards of achievement are aimed for in a particular sphere of activity"

The SOA CoE is comprised of People, Process, Technology and Services and provides the leadership for successful implementation of services in the enterprise.

Essentially, the SOA CoE's primary mission is change management: Everyone involved in the CoE, from the executive leading it to the professionals that design, develop and test services, needs to be an agent of change.

The SOA CoE should aim to establish services as key enterprise assets by:

- Providing leadership in SOA vision and execution through a single, cross-organizational, cross-functional authority for SOA related planning and implementation
- Creating and nourishing expert level SOA skills towards best practices, technology, standards and related SOA methodologies
- Recommending and helping mobilize organizational and governance models for ongoing SOA adoption
- Meeting the agreed target maturity level of service-orientation within the lifetime of the CoE
- Designing infrastructure enhancements for managing the usage of services in areas of security, monitoring, performance, versioning, and shared usage
- Providing enhancements to IT processes to address funding, sharing, and incentives for sharing and reuse of services as well as for the identification, design and specification of services
- Helping plan education and training to broaden SOA delivery skills
- Communicating the strategic intent of the IT department to develop SOA competency into a strategic, core competency for the long term competitive advantage of the organization as a whole

3.2.2 Task: Identify Roles and Responsibilities in Support of SOA

Like any transformation, SOA adoption introduces new challenges. Successful adoption of Service-Orientation requires changes to organizational roles and responsibilities. FAA must invest time and effort in creating an appropriate organization and support structure to enable a smooth adoption of SOA principles. A first step is establishing a Center of Excellence (CoE) focused on SOA.

We will discuss CoE in detail in a separate section. It is suffice to say the SOA introduces new roles and responsibilities such as Service Registrar or Service Architect.

3.2.3 Task: Define Service Ownership and Development Funding Model

A clear understanding and communication of funding and ownership models is necessary to ensure an optimal adoption rate for SOA. The funding model should be established in so as to encourage sharing, reuse, efficient integration and simplicity. In the absence of clear service ownership and funding model, ownership may default to today's silo application and product lines.

Consider the example of unifying the user experience across multiple lines of business:

> In an optimal SOA-based solution, we create a set of shared services across all lines of business in support of a uniform user experience, including services that provide unified access to data.
>
> However, creating such services is not just a technical issue. The lines of business need to be involved to answer the following types of questions:
>
> - Who owns the data and is there agreement to allow the service access to the data?
> - How can permission to access the data be obtained?
> - Who should fund the shared service? Who owns it, or sponsors its development?
> - Who's responsible to fix it if it breaks?
> - How is the business going to motivate the separate lines of business to reuse enterprise assets and shared business services?
> - Who makes a decision on whether a service can be accessible to other applications? What happens if potential users of the service disagree on its content?

Having a well-established service owning and funding model helps resolve such issues consistently and efficiently. In particular, great care must be given to the data access needs of future, unintended users.

3.2.4 Task: Identify Success Factors, Enablers and Reuse Motivators

Before considering the success factors and motivators for SOA and service reuse, it is important to understand the traditional challenges and constraints with shared service models and reuse.

- Lack of agreed upon standards, vendor product/platform interoperability
- Semantics for cross-boundary services, service discovery and visibility into services
- Challenges with licensing models in shared services model: Given the existence of systems using Commercial Off-the-Shelf (COTS) products that have a pre-established licensing model (for example, per CPU, named-users, seat-based), exposing existing capabilities as services (or operations) and then planning 'future' service consumers has significant cost, legal and organizational issues that deter service sharing. Such obstacles discourage interested service providers.
- Lack of certification and support: a shared services model historically adds planning overhead in the areas of availability, reliability and security and do not guarantee a high quality of service through a certification.

3.2.5 Task: Design Policies and Enforcement Mechanisms

For the successful adoption of SOA, the SOA Governance Model requires complete, visible support of sponsors and other stakeholders including, but not limited to, the SOA CoE.

Without adequate checks and balances firmly in place, the foundational processes, standards and best practices created by the SOA CoE are less likely to be applied in practice.

Particularly in the early adoption phases of SOA Governance, it is important that regular vitality checks, walkthroughs, and peer reviews ensure that information and approach flows smoothly. Governance enforcement requires empowered entities at multiple levels of enforcement to effectively govern the standards established by the SOA CoE.

The following are some typical and recommended enforcement entities that could have specific responsibilities attached to them

- SOA Steering Committee – strategic and executive guidance of the SOA journey across the enterprise. This committee ideally should be a subcommittee of an enterprise level governance committee.
- SOA Control Board – tactical guidance on specific tasks performed for the SOA journey. Again, this should be a part of the enterprise level governance control board.
- SOA CoE (Center of Excellence) Advisory Group – day to day guidance of the SOA journey.

3.3 Service Management and Monitoring

One of the major common mistakes enterprises make is embarking on SOA by writing services/Web Services without thinking about service management and monitoring. This has caused a lot of grief in many organizations. Uncontrollable number of services and many copies of the same service (duplicate functionality) with only minor variations are prime examples of lack of service management and monitoring. For this reason, we are addressing this topic in the service lifecycle. Service management and monitoring should be considered at Design-Time, not as an afterthought associated solely with IT operations.

The key to managing services efficiently is to consider them as another resource type. Services need to be secured, deployed, monitored, versioned, and they should have formal SLAs (service level agreements) associated with them.

Services introduce additional management challenges emanating from the composite nature of the solutions they participate in. Challenges around having to manage the interdependencies among services and maintaining the expected Quality of Service (QoS) becomes as important as managing the resources that comprise the services themselves. As stated in section 2, policy management provides a mechanism to allocate IT resources according to defined policies established by the enterprise. Therefore, in processes, identification of policy decision points (PDPs), where events are defined and decisions are made and policy enforcement points (PEPs), where policies are executed and monitored are essential.

While the underlying technology and standards in support of SOA provide many options to architect and manage the services, it still takes time and effort to actively design the management strategy and execute the strategy consistently.

3.3.1 Service Management in the Context of IT Management and Operations

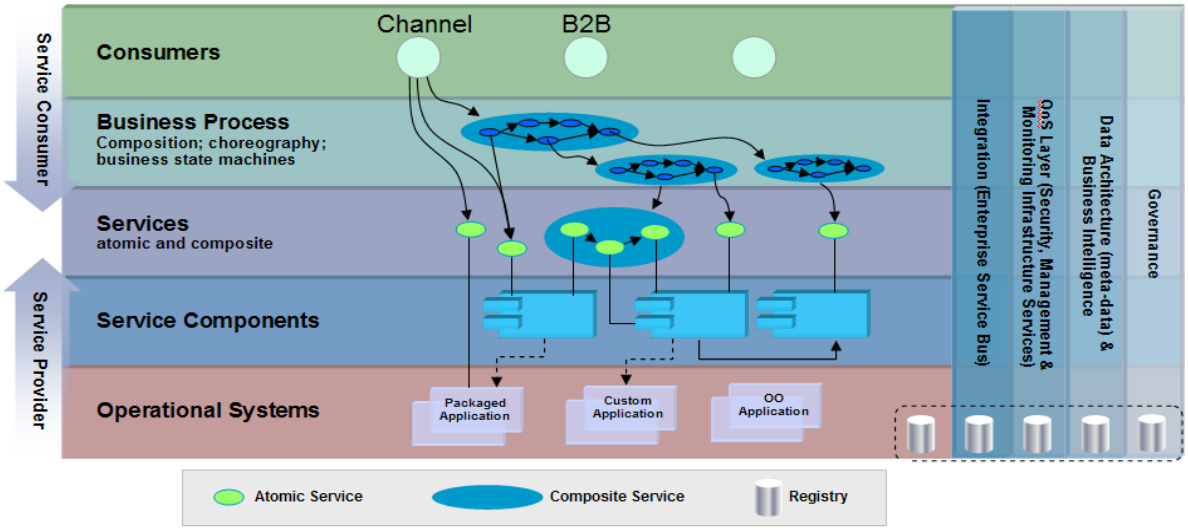

Figure 3.4 - SOA Solution Abstraction Layers

The above graphic depicts a simplified model of atomic and composite services as entities and shows the abstract positioning and relationship amongst systems, components, processes and the consumers.

The intention is to establish the fact that managing services effectively requires management of the service inter-relationships and dependencies, as well as a support model that reflects understanding how services relate to each other and to the IT infrastructure and business process layers.

Flows within the services environment can be controlled through management mediations such as log, filter, route, and transform. Centralized service management policies can define how such mediations are applied.

3.3.2 Service Management and Monitoring Tasks

Complete write-up on Service Management and Monitoring is beyond the scope of this paper. Following is description on two very fundamental tasks that support SOA governance-related goals.

3.3.2.1 Task: Certification and Publishing of Services

Adding a new 'service' entity to the set of enterprise assets requires a way to announce its status and display details to its potential consumers. Service certification and publishing is a vital process for SOA adoption. One of the biggest advantages of this task is that it stops arbitrary introduction and deployment of services.

While this is not an entirely new step within IT operations procedures, there are aspects such as the loosely coupled nature and new interoperability challenges that are distinctly different from client-server systems and which should be addressed. This is a recognized area where technology standards and tools (registry, repository etc.) are quickly evolving.

Service certification is a critical part of SOA governance. The main objective of certifying services is to actively encourage their reuse by warranting overall service quality and assuring potential new users of the service that it will be fully supported and appropriate to their needs.

Such service assurance may be achieved through requiring additional accountability requirements and by publishing the details of such additional certification for the benefit of potential consumers of the service. Service certification should be carried out under the control of the Quality Assurance department and should include operational tests that approximate the actual deployment architecture associated with its initial intended use. Additional information related to alternative uses, including consumption of the service over a wide area network if that was not the initial deployment architecture can be explicitly mentioned, for example.

The certification step builds on the effort already undertaken during the service identification around reuse and due diligence in identification of potential service consumers.

Various details that were developed and documented during the service design and development phase such as SLA and QoS will contribute to the certification process. Certification formalizes the QA process prior to physically publishing the service as being 'enterprise ready', with an assured quality of service and a full and complete set of support materials.

For example, certification ensures that information such as a version number, ownership, who is accountable for the service, and that classification and availability of the service are published as mandatory service metadata.

Certification and publishing services also serve the following purposes:

- It helps the IT operations staff capture and document service related metadata. This benefits visibility and system analysis for later projects that may support unintended users

- During early stages of SOA adoption, it provides a feedback channel from IT operations to design and development teams. This may result in additional design time discipline towards services by prompting reuse questions and considerations associated with the operational aspects of service deployment

- The process of certification ensures the correctness of service contracts created as part of service specification

- It establishes the source for communication related to service lifecycle, usage and subscription information

- It demonstrates that the service has adhered to the required sequence of steps for the service lifecycle status, including intermediate peer reviews. The purpose of defining formal service statuses and allowed status transitions is to clearly provide information related to the stage in which the service is at a given point in time.

- The certification review results in a pass or fail status for the service in consideration. Pass status indicates that the service is ready to be published. Fail status indicates that further work needs to be done before this can be certified as a service.

Note: The certification process also applies to services provided by third parties. Third party arrangements become problematic if the provider changes. Consumer organizations should establish policies that can cope with a chance in the QoS during initial negotiations with the provider.

One way to buffer an enterprise from an uncontrolled or volatile change is to hide the third party service (or services if multiple providers are an option) behind a mediation layer that then manages external / provider volatility without impacting the core business. If a service provider changes, the governance processes might include an introspection of the registry/repository for the mediation "provider" which is under the enterprise's control. Any change in service delivery, interfaces, endpoints, etc. would trigger an announcement to affected consumers.

Some of these requirements might not be established until the service is actually implemented and Service Level Agreements are negotiated with the Service Consumers.

3.3.2.2 Task: Versioning Services

Note: Service versioning is an area that has not yet attained practice maturity. Hence, the context and the guidance below may be considered as leading practices known so far.

Versioning of services requires a mechanism for change tracking and providing visibility into service modifications. Given the nature of SOA drivers (reuse, agility, business alignment, etc) and enablers (technology components, standards), it is natural to expect changes to production services over time. These changes may be a result of a variety of factors such as new requestor, change in compliance/security requirements, and others.

Design decisions need to be made carefully before creating new versions of existing services. Backward compatibility is required in cases where a contract or practical necessity defines the need to support previous versions.

Support for some older service versions may be dropped when the contractual obligation completes or when the need to support the service ends. Some consumers may successfully demand specific versions of services to be created for their sole use.

Unlike the common state in current application scenario, in a services world there are aspects that are native to the programming model that help in versioning. New solutions for running and orchestrating processes (Process Servers), support separation of concerns such as process instance from service implementation.

For example, by specifying a valid "from-date", the Process Server will be able to decide, which of all the deployed versions of a process template to use when creating a given process instance. Importantly, once the instance is created, it will run against that version of the template regardless of what other versions of the process are subsequently deployed.

4 Organizing for SOA & SOA Governance

SOA is the result of rational and logical evolution of the IT industry, in which careful planning and organization play a huge role. According to Gartner, research indicates that through 2010 a lack of a working SOA governance arrangement will be the most common reason for failure of SOA deployments, with an astounding 80% probability of failure. Nowhere in the annals of SOA best practices is there any notion neither advocating, nor supporting a revolutionary or big bang approach in transitioning to SOA.

The concept of Project (or Program) Management has been around for a long time and most companies with a reasonably sized IT department, or IT activities have a formal Program Management Office (PMO). This is a demonstrated commitment by these companies to apply a disciplined project management methodology to project execution.

The need for an official Program Management Office function has evolved as organizations struggled to make traditional project management adequate to handle multiple interdependent projects having touch points throughout the enterprise. Service orientation demands even higher stakeholder involvement and coordination as the organization tries to create business services, used throughout the enterprise with services, to collaborate and participate in multiple interdependent processes.

As noted in the Gartner statistic above, the risk of failure to SOA projects is high; hence a need for a well organized, strong programmatic approach is required. Organizing for SOA requires an understanding of Program Management, the concept of an SOA Center of Excellence (CoE), and the Roles and Responsibilities that a CoE should consider, and the role of Program Management in the deployment of SOA services.

4.1 Program management

Program Management is usually run out of an enterprise wide Program Management Office (PMO). The Project Management Institute (PMI) defines project/program management as the application of knowledge, skills, tools and techniques to project activities to meet project requirements. PMO ensures that projects within each department or division are managed the same way and are working toward the same goals. This leads to greater efficiency, reduces redundancies and costs and helps the bottom line; very similar to the goals of SOA.

The focus of program management can be summarized in the following 3 categories.

Vision and Strategy
Create or refine a business vision and set of enabling strategies. Identify enabling programs, define them in multiple dimensions, quantify their potential value, and justify related costs.

Mobilization
Establish a governing structure and roles for the program and its projects. This includes developing /implementing a resourcing plan, ramping up staff, and establishing a Program Management Office (PMO). It also includes defining /

implementing the necessary physical and technical infrastructure to support the program staff's work.

Planning
Define a strategy to develop and deliver a project plan, calculate overall and detailed sizing, define a work schedule, and establish milestones for major checkpoints. Then, establish program practices for oversight, risk control, quality, and financial management.

Governance plays an important role in Program Management. Usually, in companies with strong Program Management, governance is part of the culture. To this end, implementing SOA can greatly benefit from a strong Program Management discipline. However, having a PMO is not sufficient for SOA because of its unique needs.

SOA Center of Excellence (CoE) is described next. CoE, in fact, complements PMO by having a complete focus on creating and deploying enterprise level services that will be used in the current as well the planned projects. Although, SOA CoE roles and functions could very well be defined within the PMO structure, but it is recommended for SOA CoE to have its own identity at least at the beginning of the SOA journey. This will have the added benefit for companies without a strong PMO; enabling them to establish their SOA CoE and start their SOA journey.

4.2 Center of Excellence (CoE)

The SOA Center of Excellence (CoE) is a cross-organization team that guides IT investment, design decisions and implementation towards the strategic shared IT solutions targeted by the SOA Vision and Strategy.

Services must be created as key enterprise assets. The CoE assures this by:

- Providing leadership in SOA vision and execution through a single, cross-organizational, cross-functional authority for SOA related planning and implementation
- Creating and nourishing expert level SOA skills towards best practices, technology, SOA standards and related SOA methodologies
- Recommending and helping mobilize organizational and governance models for ongoing SOA adoption
- Achieving the agreed target SOA maturity level of service-orientation within the lifetime of the CoE
- Designing infrastructure enhancements for managing the usage of services in areas of security, monitoring, performance, versioning, and shared usage
- Providing enhancements to IT processes to address funding, sharing, and incentives for sharing and reuse of services as well as for the identification, design and specification of services
- Helping plan education and training to broaden SOA delivery skills
- Communicating the strategic intent of the IT department to develop SOA competency into a strategic, core competency for the long term effectiveness of the organization as a whole

The CoE team will be initially responsible for guiding and augmenting the SOA journey, including selecting which projects adopt a SOA approach, and what services need to be developed. Over time, as SOA becomes 'business as usual', the duties of the SOA CoE may be taken by other bodies such as Architectural Board.

4.3 Roles and Responsibilities

There is no standard organizational model for SOA CoE. Leading SOA practices suggest the following responsibilities for SOA CoE.

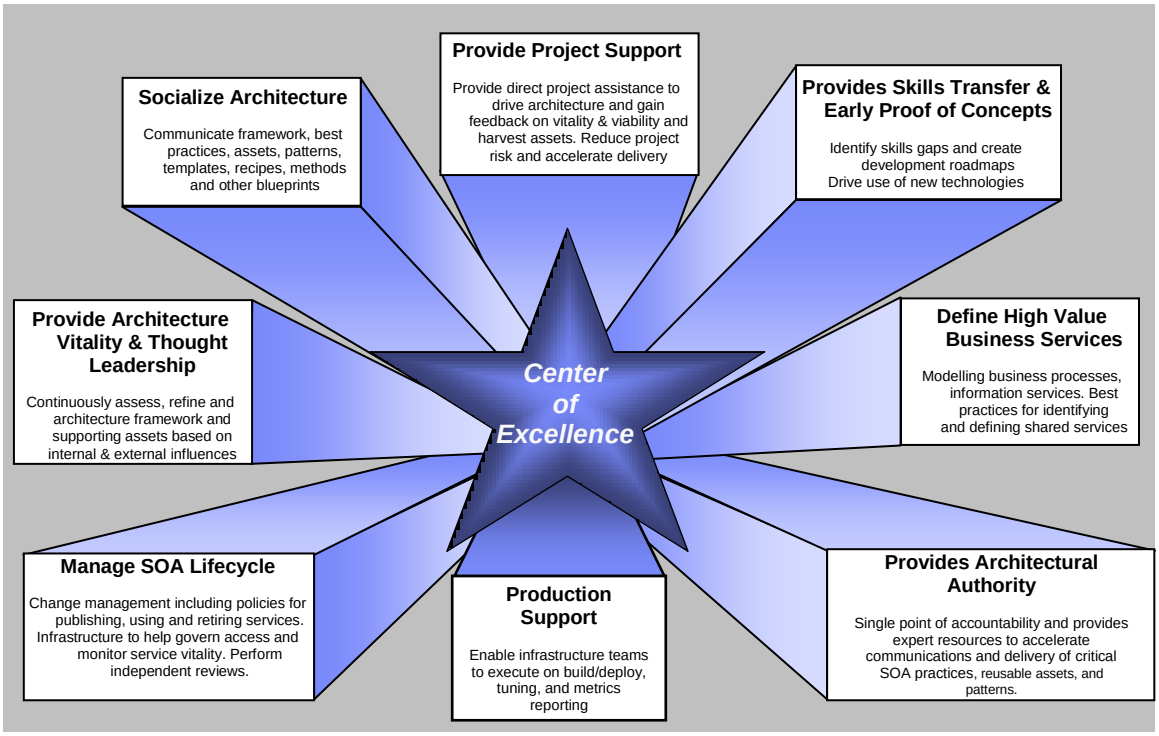

Figure 4.1 – SOA CoE Responsibilities

An appropriate structure to deliver the above responsibilities is shown in figure 4.2. Note that this structure shows roles rather than individuals. Not all of these roles need to be full-time, and it is perfectly possible for individuals to have multiple roles in the CoE. Five to ten individuals could be a typical size for a CoE when SOA is in its early stages at an organization of the FAA's size, and the CoE is fulfilling many or most of the responsibilities noted above.

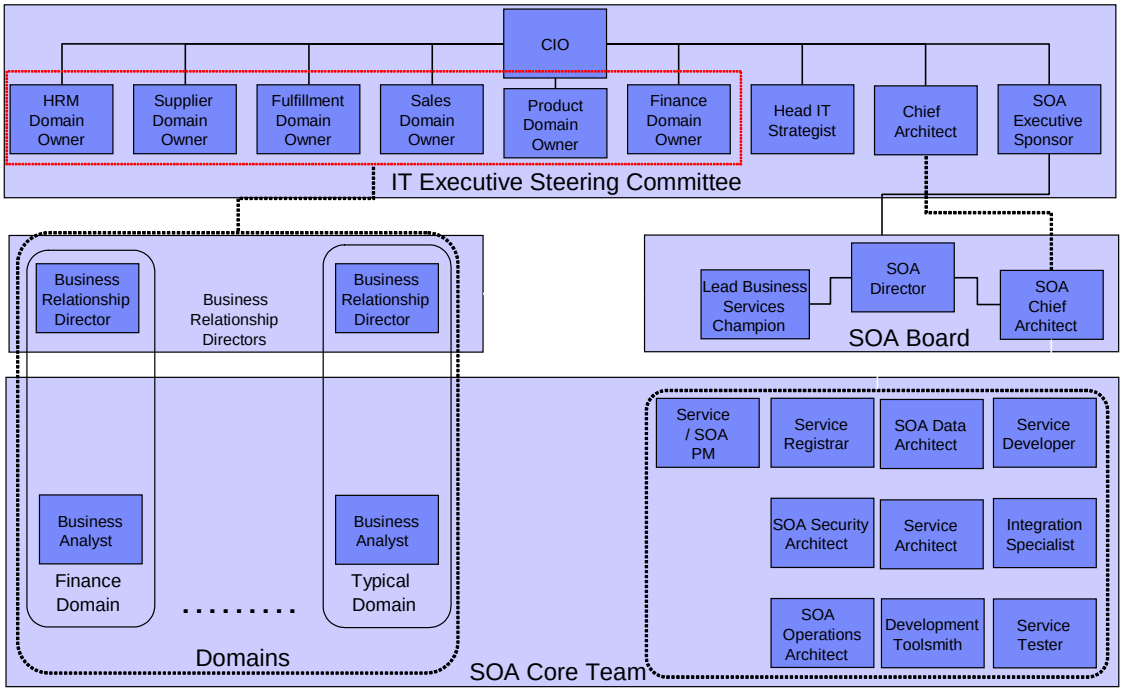

Figure 4.2 – Example of SOA CoE Roles

5 Governance Maturity

If you don't know where you are, a map will not help. If you don't know where you are going, any road will do.

Usually, a maturity level provides a way to predict future performance within a given discipline or set of disciplines. But, most importantly, it helps to identify the gaps and helps in prioritizing the areas that are in need of development, improvement or enhancement. Hence, it tells you where you are and helps you to put a roadmap together.

Regardless of the current level of maturity, you need to understand that SOA governance maturity cannot be achieved overnight. It requires total commitment and some if not total culture change that is best achieved incrementally, following a roadmap with well-defined milestones and measurable results. The first step in achieving Governance maturity is assessing and measuring the organization's current status in each governance area. This measurement helps in identifying the focus areas and prioritizing their improvement accordingly.

Specifically, how SOA Governance relates to an organization with well defined ISO 9000 or CMMI processes. CMMI and ISO 9000 give direction on what a good development process must have (repeatability and verifiability of software, integration, and IT processes). The specific development process (such as agile, water-fall, latest-flavor, etc.) can be implemented under CMMI or ISO 9000. Implementing SOA does not mean that existing processes will not suffice, or may be thrown away. In fact, a governance model is required to provide a mechanism for infusing new concepts into existing processes and practices.

As such, SOA Governance is as much art as a science, but there does need to be more science than what SOA Governance practitioners have been using in the past. It is instructive to consider existing IT Governance models for maturity and then apply a services approach to realize an SOA Governance Maturity Model that we can use to understand the organizations governance needs in a more scientific, rigorous manner.

COBIT (Control Objectives for Information and related Technology) was created by the Information Systems Audit and Control Association (ISACA) and the IT Governance Institute (ITGI). COBIT provides a set of generally accepted measures, processes, and best practices for maximizing the benefits of information technology and developing IT Governance. Additional information on COBIT can be found at www.isaca.org/cobit.

COBIT provides an IT Maturity Model, which itself is derived from the Software Engineering Institute's Capability Maturity Model (CMM). In the case of the CMM, for example, the basis for comparison would be the organizations' software development processes. The maturity model uses standard CMM-based maturity levels as modified by COBIT and described in the table below [iv].

0 - Non-existent	Complete lack of any processes. The enterprise has not recognized that this is an area to be addressed.
1 - Initial / Ad-hoc	There is evidence that the enterprise has recognized that this is an area to be addressed. There are, however, no standardized processes; instead, there are ad hoc approaches that tend to be applied on an individual or case-by-case basis.
2 - Repeatable but intuitive	Governance processes have developed to the stage where similar procedures are followed by different people undertaking the same task. There is no formal training or communication of standard procedures, and responsibility is left to the individual. There is a high degree of reliance on the knowledge of individuals and, therefore, errors are likely.
3 - Defined Process	Governance procedures have been standardized and documented, and communicated. It is mandated that these processes should be followed; however, it is unlikely that deviations will be detected and corrected.
4 - Managed and Measurable	Governance authorities monitor and measure compliance with governance procedures and takes action where processes appear not to be working effectively. Processes are under constant improvement and provide good practice. Automation and tools are used in a limited or fragmented way.
5 – Optimized	Governance processes have been refined to a level of good practice, based on the results of continuous improvement. Governance is used in an integrated way across the enterprise to improve quality and effectiveness, making the enterprise quick to adapt.

Table 5.1 – Definition of Maturity levels

5.1 Measurement and Metrics

In order to identify the gaps, we need to understand exactly where we are and where we want to be. Then, we need to identify how the gaps might be filled. Maturity models help in doing that. Maturity levels are measured by the amount of success the organization has in achievement of identified goals for the areas or operational entities of the domain in question. In our case the domain is SOA Governance. So, we need to identify the areas within SOA Governance that need to be measured.

In-house measuring/assessments can be an efficient and cost-effective approach. Staff members can leverage their existing knowledge to do the measurements. However, they might not have the broad-based skill sets required to do this at the enterprise level and with a holistic viewpoint. In addition, this activity can drain vital resources away from other projects. Also, an inherent conflict of interest, political and organizational concerns, pride of authorship, and other factors may influence this measurement. In most cases, a guided measurement by a third party is more appropriate. They can distance themselves from the politics and issues more easily and usually provide unbiased and objective results. In-house staff members not too closely associated with the governance function, combined with expertise from a third party, can be an effective approach.

5.1.1 What should be measured

All the areas and components related to the SOA governance must be measured. There is no standard list of such areas and components. The following diagram shows examples of the areas that could be measured.

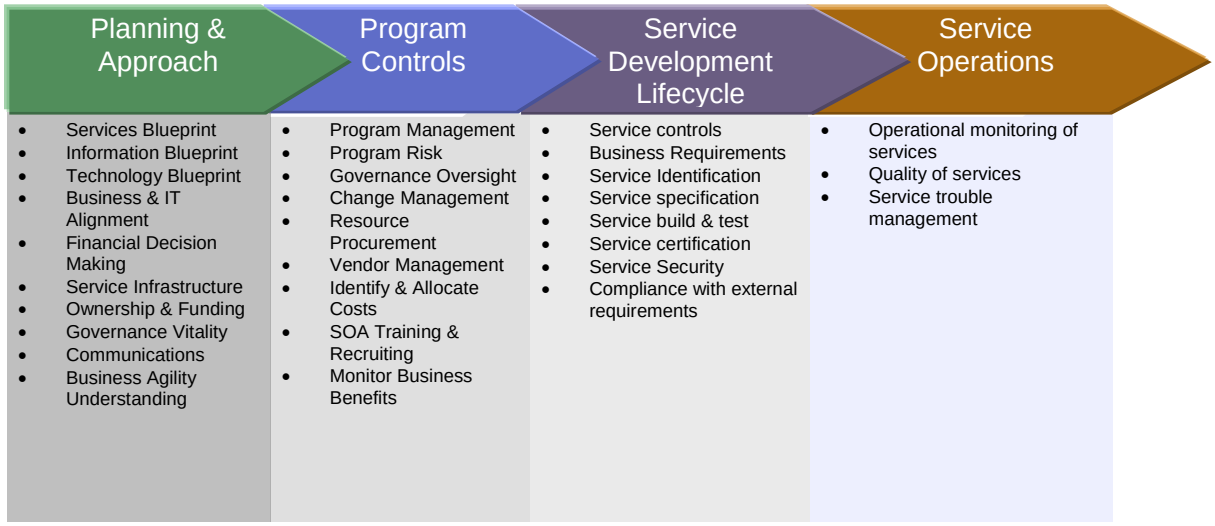

Figure 5.1 – Example of Governance areas for measurement

5.2 Prioritizing Governance Areas

Properly designed and implemented, SOA governance mobilizes SOA which in turn can help an organization reach its business goals more quickly and increase its level of agility and responsiveness to its market and consumers. A Big bang approach is not

recommended in implementation of SOA and neither it is in implementing SOA governance. Assessing governance maturity level and finding gaps is the recommended way to identify the areas of focus that then can be prioritized for a phased implementation. However, lack of such a study should not prevent progress in SOA adoption. Until such time as a maturity assessment is completed, there is an opportunity to identify other priorities. The following is the recommended approach:

- Focus on service lifecycle and its governance needs. Remember that governance is all about transparency. If you look at the service life cycle as a process in which the first step could be proposing the idea of a service and the last step could be service deprecation; then, the governance for the service lifecycle must clearly state what should be done in each step, the policies, standards, and patterns to be used or enforced in the step, and how it is done and what role(s) will be doing it. For example, everybody should know about the required policies and standards for a service and who should be reviewing the results.

- Review the existing project lifecycle and identifying the impact of services on the project lifecycle governance.

- Finally, you could look into the lifecycle of the enterprise transition to SOA.

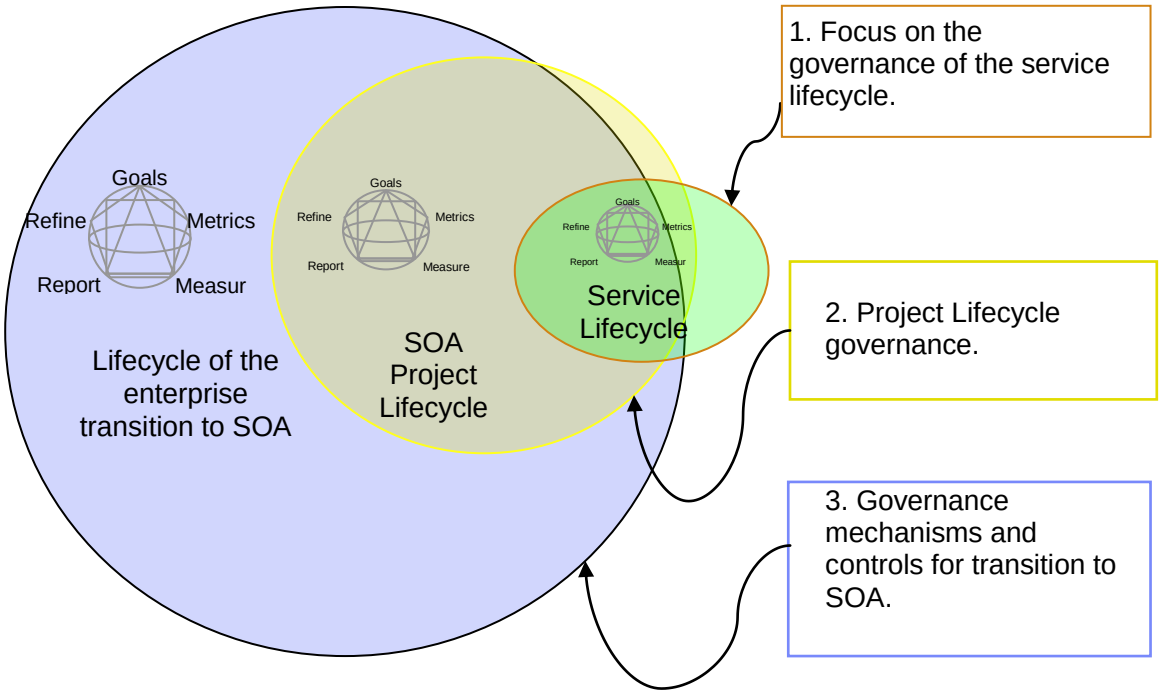

Figure 5.2 – Recommended approach to implementing SOA Governance when no formal Governance Measuring/Assessment is done

6 Governance Tooling

Tooling around SOA governance is evolving as a best practice and standards are being identified and developed. In this section we do not propose tools from specific vendors. Rather, we try to discuss governance needs generically in order to guide development of tool selection criteria.

There are many alternatives in coming up with the criteria that one could use to select the required tooling. In this paper we touch upon two alternatives. Of course, combinations of these alternatives will provide many other possibilities. The focus of the first one is governance areas and components that each area may cover. The second alternative is governance control points. There are no standards or best practices in these areas available at the time of this writing. Identification of such criteria is one of the functions best suited to the SOA Center of Excellence.

6.1 Identifying Tooling Criteria – Alternative One

A very pragmatic way to hone on SOA tooling requirements is to identify the areas and activities in the enterprise that SOA Governance should cover, break the areas into components and find out how tooling could help. The following is an example of such a breakdown. For each area/activity, two components, as examples, are identified and briefly described. The CoE or any surrogate team functioning as the CoE in any organization should complete this breakdown and identify their exact tooling needs. By doing this, one may realize that some of the existing tools could satisfy some of the SOA governance tooling needs. Obvious examples are requirement management software packages and Asset Management Software packages that handle assets such as "Services" and "Policies" as enterprise assets.

Here is a list of possible breakdown and two example components:

- **Strategy**
  - **Business Vision** – Creation and maintenance of the business vision for an agile enterprise. Creation and maintenance of a business architecture that identifies service domains, business functions, business processes and the mapping of those to SOA services and IT applications.
  - **Standards and design patterns** – Relevant standards and patterns that must be followed during development life cycle service deployment and beyond.
- **Enablement**
  - **Ownership & Funding** – Who funds what and how rights and obligations are distributed.
  - **Vendor Management** – Managing policies and standards for products and vendors.
- **Development**
  - **Regulatory Compliance** – Ensure compliance with legal, state, county and international regulations.
  - **Service Certification** – Create, maintain and utilization of standards for a service certification process.

- **Program/Project management**
  - **Risk management** – Identify sources for risk.
  - **Change management** – Processing change requests and providing input for version management.
- **Operations**
  - **Service Support** – Problem reporting and support. Release management.
  - **Service Monitoring** – Setting performance measures and monitoring them.

6.2 Identifying tooling criteria – Alternative Two

As an alternative, a team could concentrate on the control points that are relevant to the SOA Governance. Again, there are different ways to go about this. We could use alternative one described above and identify the control points. A better way would be to go through Service Life Cycle and the operational aspect of a service and identify the control points.

Before introducing a suggested list of control points, let's defines what control points are. Control points provide an opportunity to measure a process and decide whether the execution of the process needs adjusting. Certain critical activities within a process may be associated with a control point. At the end of each identified control point activity, the governance function decides if the process is ready to move to the next activity.

Knowing what decisions within the process are critical and understanding what measurements are needed as input to those decisions helps decide where control points are best placed. This is an important part of governance.

The following is a suggested list of control points with some examples of the requirements for tooling support:

- **Business Requirements Control Point** – Business goals and the requirements driven by these goals. Identification and measurement of Key Performance Indicators.

- **Solution Architecture Control Point** – Standards and policies to be followed. Architectural decisions are being recorded and maintained.

- **Service Identification and Specification Control Point** – Identified services are in line with goals and objectives. Service specification is complete.

- **Service Design Control Point** – Design policies and standards are being followed. Data messaging model and data access patterns are being used.

- **Service Build Control Point** – Rules are policy based. Existing services are being considered.

- **Service Test Control Point** – Load and stress testing. Security testing.

- **Service Certification & Deployment Control Point** - Verify compliance.

- **Service Vitality Control Point** – Governance processes and procedures are up-to-date.

7 Governance Vitality

As SOA evolves, governance processes will also need to evolve in order to stay relevant. This evolution of governance processes is the essence of Governance Vitality. In addition, changes in many aspect of an organization warrant changes in governance processes as well. In an environment where SOA is chosen to enable fast reaction to market and customer needs and agility is a concern, governance needs to always be the pillar to support and embrace the required changes. Governance is not a one off job. It is not possible to establish governance processes and expect them to run forever. In a real world everything changes and so should the associated governance processes.

In this section we present the manner in which organizations could maintain their governance vitality. We also review events that may trigger changes in governance processes.

7.1 How is it done and who should be doing it?

There is no defined way to assure governance vitality; indeed there should be vitality in the vitality process itself! As part of the governance planning process, there should be thought given to what aspects of the SOA journey should be measured. There should also be thought given as to whom, and how often, should review the metrics. Suggestions, based on observations, should be summarized into a plan that suggests changes to aspects of the governance process. There should be an explicit mechanism in place to log ideas and set up review meetings and ensure that a well-defined decision-making process is followed for every log entry. Governance vitality is an important task that usually is initially associated with a member of the CoE team. Once SOA governance is established, and its relationships with IT and Enterprise governance are defined, then it will be easier to identify who should be responsible for governance vitality and how the SOA Governance Vitality processes are triggered.

Best practices suggest that involvement in standard bodies also helps keep the organization abreast of industry changes. Staying abreast of technology standards is often associated with organizational efficiency. Involvement in standard bodies also provides enterprises with the opportunity of influencing standards bodies to ensure that industry standards are relevant to their enterprise.

The key to successful governance and ensuring governance vitality is education on how governance and the associated tooling helps improve daily tasks, as opposed to getting in the way. In this fashion, everyone becomes a stakeholder in improving governance. The responsibility for governance vitality will be embedded in the entire organization.

7.2 Events triggering review of the SOA Governance Processes

Certain events trigger governance vitality activities. As noted before, SOA governance is an augmentation of, and an extension to, existing IT and Enterprise governance; therefore, these triggers are useful frameworks to identify the where, what, and for whom governance in general should be considered appropriate.

- **Business Strategy changes**. Any change in business strategy may cause removal or update of existing governance processes, procedures and policies. A business strategy change could be as simple as adding or removing one of the communication channels with the clients/consumers/partners … such as removing direct mail and adding email; or as complex as outsourcing a division of the business.

- **Business Process changes**. For many reasons, business processes may change. This could be as simple as a change in sequence of activities to addition of new activities or removal of existing activities within processes. We need to always determine the impact of the change on the governance processes. Some organizations are adopting the notion of Processes Governance for their Business Process Management (BPM) initiatives – SOA Governance vitality would benefit from governance mechanisms should they exist.

- **Organizational changes**. Decision rights may change as the result of organizational changes. This triggers review of the governance processes and procedures

- **Legislative and Policy changes**. Legislative and policy changes can require significant changes to company operations (e.g. SOX, BASEL II etc) and as the result require changes in the governance processes and procedures.

- **Changes in Standards**. Standards usually replace proprietary parts of the governance processes. Lack of standards force enterprise to devise their own way of doing things. Once standards are developed and available they warrant review of the existing governance processes to identify required changes.

- **Technology improvements.** Organizations should always be on the lookout to automate processes as a way to improve productivity and save money. New technology can make existing tasks or processes easier, more accurate, or provide more control. In many organizations, there is a formal body charged to run a technology scan, this trigger is normally tied to their output

- **Assessment of current governance effectiveness.** As part of the SOA 'measure' phase, metrics should be maintained that indicate the effectiveness of SOA adoption. SOA Governance is responsible for periodically reviewing these metrics and making the needed changes to governance policies, standards, and processes. Metrics for governance vitality tend to vary for each organization, but tend to include measures such as: Number of Control Gate Meetings (a low number probably means the process is not working or being bypassed), Number of Services Certified (is the certification process too stringent, is it being used?) and so on.

8 SOA Governance and FAA

Establishing SOA governance within the FAA requires cultural, organizational, and technical changes at both the enterprise and local levels. Creation of a NAS SOA Center of Excellence (COE) will greatly facilitate this process.

NAS SOA governance requires involvement from a number of FAA organizations. Figure 8.1 illustrates the major FAA organizations likely to be involved. This section discusses a number of SOA governance subjects that are mostly relevant to FAA and they should be addressed by these organizations. These subjects address how the various FAA groups shown in Figure 1 identify, define, and approve potential new services and modifications to existing services, measure the effectiveness of the SOA architecture, and tailor their collective culture to facilitate a SOA oriented NAS architecture. Technical SOA issues address how the NAS architecture is defined and implemented.

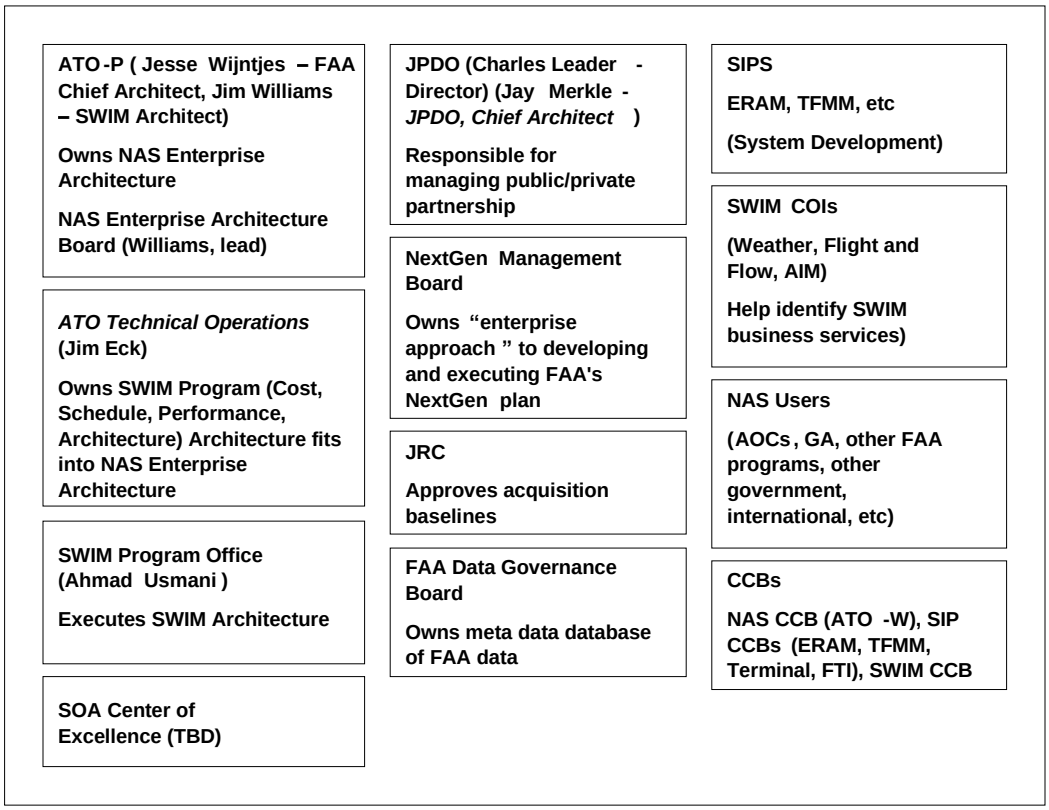

Figure 8.1 NAS SOA Governance Organizations

A major step towards the introduction of SOA governance into the NAS is the establishment of a NAS SOA Center of Excellence. The NAS SOA COE promotes the use of SOA throughout the NAS, provides SOA related training, provides SOA expertise, facilitates the use of best SOA practices, leverages reusable assets, provides knowledge transfer, helps assure conformance with NAS and SWIM architectural/SOA standards and policies, supports Program Office planning activities, and works closely with NAS

programs to ensure that SOA solutions are supportable and are developed in conformance with NAS SOA standards and policies.

The NAS SOA COE is strictly a resource organization and does not replace existing groups. For example, the COE does not replace the SIP or SWIM Program Offices or duplicate their functions. Cost and schedule ownership of SWIM program activities remains within the SWIM Program Office and SIP cost and schedule ownership for individual programs remain within each SIP Program Office.

A major decision point will be determining where the COE fits within the FAA organization. Two obvious options include the FAA Chief Architect's office and the SWIM Program Office.

8.1 Establish Decision Rights

The major impact of SOA is that all service-related decisions have to be made in an **Enterprise** context rather than a project context.

SOA roles and responsibilities within the FAA organization should be defined. Major issues to be addressed include which FAA organizational components:

- Identify the need for new services, or improvements to existing services;
- Own specific portions of the service portfolio;
- Implement and maintain portions of the service portfolio;
- Determine when a service is retired;
- Grant access to services within the service portfolio;
- Define the metadata to be generated and stored regarding each service.

How services are identified and approved for implementation and operation is a major issue. Within the NAS, new services and improvements to existing services may come from a number of individuals and organizations from within the NAS, such as individual programs and research organizations, and from NAS users (e.g. airlines). Clear NAS-wide policies and procedures should be established to address this need.

A related issue is how the FAA will determine how services are exposed. NAS services may be provided to three (3) basic categories of users:

- NAS internal users. For example, use of ERAM services by TFMS
- Program (i.e. SIP) internal users. For example, services provided by TFMS for use within TFMS subsystems.
- External users. For example, use of TFMS services by AOCs

Some services may be used exclusively by one of the above categories of users; others may be used by multiple categories of users. Additional considerations may also be applied, for example, due to security constraints some data may be provided to only a subset of external users (e.g. DOD users) while not provided to other external users (e.g. AOCs).

Determining which users gets access to which services must be addressed at multiple levels of the FAA SOA organization:

1. NAS Business Services may be identified by a number of organizations including the FAA Architect's office, each individual program, each NAS Community of Interest, and any number of NAS user's such as CDM participants. New NAS Business Services will then be approved at various levels of the organization to address such issues as cost/benefits, security, reuse, allocation to NAS subsystem, etc. This will involve participation of a number of organizations. For example, the FAA Architect's office can address NAS wide cost/benefits and NAS subsystem allocation. The SWIM Program Office can address compliance with SWIM policies and standards. Individual programs/SIPs can address local reuse and implementation issues. Services that will be exposed to external users may also be vetted for benefits and usability with COIs, and if necessary additional external users. NAS SOA COE will support this process by providing both technical and prototyping assistance.

2. Program/SIP specific services may be identified by each SIP. Program level services will be addressed by the program's engineering and implementation teams, program CCB and the Program Office. The SWIM Program Office will provide inputs regarding compliance with SWIM policies and standards, and de-confliction between programs. The NAS SOA COE will support this process by providing technical and prototyping assistance.

8.2 Defining High Value Business Services

FAA Services portfolio must contain High Value Business Services.

It is important to define potential services at the highest level of the FAA's business and then determine, and perhaps even quantify, which set of services provide the most value to the FAA's mission. Broad participation will be required to define criteria to be used to identify and select business services. NAS and SWIM architects, members of the JPDO and the NextGen Management Board, along with those NAS users identified as potential users of the new services, should all participate in portions of this effort.

8.3 Managing Service Life-Cycle

Clear definition of roles and responsibilities play an important role is managing the service Life-Cycle.

Roles and responsibilities should be defined regarding:

- Configuration and Change Control
- Service versioning
- Service transition
- Well defined process definition
- Life-Cycle control points
- Policy Decision Points (PDP) and Policy Enforcement Points (PEP)

8.4 Prepare the Culture

Preparing the FAA culture for effective implementation of SOA is critical for success

SOA is not a revolution, however, it brings about a new paradigm in which:

- Culture of sharing,
- Breaking down the departmental barriers and stove pipe thinking,
- Having holistic view of the enterprise,
- Breaking down barriers between IT and Business,
- Well communication,
- Collaboration,
- Valuing standards and governance

are of extreme importance. Shifting from being technology driven to business driven in application development by itself is a huge shock to most organizations.

Preparing the FAA culture for effective implementation of SOA is critical for success. Defining clear roles and responsibilities and a comprehensive communication plan could substantially help the SOA journey at FAA.

8.5 Measure Effectiveness

Identifying control points, Key Performance Indicators (KPI) and Policy Enforcement Points (PEP) are some of the ways that could help measuring the effectiveness.

Monitoring and measuring effectiveness should be an integral part of adopting SOA at FAA. Defining appropriate policies and enforcing them are of paramount importance. Identifying control points, Key Performance Indicators (KPI) and Policy Enforcement Points (PEP) are some of the ways that could help measuring the effectiveness. A method must be established to measure the effectiveness of the use of SOA in the NAS. Measures of effectiveness may include:

- Quality of service
- SOA service usage
- Service Level Agreements
- SOA adoption
- Reuse
- Life-cycle costs

8.6 Establish Policies and Procedures

Policies need to address the very distributed, asynchronous, and heterogeneous nature of the SOA environment.

Policies need to create a strong connection between the business and technology.

SOA policies and procedures will be required at a number of levels. For example, policies and procedures may be established at the NAS, SWIM, and SIPs levels. The NAS SOA COE may be used as a resource towards the establishment of policies and procedures and coordinating between groups to ensure consistency.

8.7 Establish Standards

SOA standards facilitate **sharing** and **reuse**. These are the two fundamental promises of SOA.

Establishment of rigorous technical standards to be used to develop SOA services, such as SOAP, WSDL, XML, and JMS is critical to support service reuse and inter program compatibility. Since reuse and inter program compatibility are NAS wide architectural goals, the FAA may consider allocating ownership of the standards to the owner of the NAS architecture (ATO-P). Identifying and defining the standards will be a team effort involving a number of interested parties (such as the SWIM program and the SIPS). The SOA Center of Excellence may be used to coordinate this process as well as a source of expertise. Ensuring compliance with the standards may be allocated to the individual SWIM and SIP programs. For example, each SIP program will have to include the SOA technical standards in each programs system requirements.

8.8 Define SOA Architecture

Defining a common SOA architecture across FAA is essential for successful adoption of SOA.

Defining and agreeing upon a common SOA architecture is a collaborative effort that should be facilitated by the FAA SOA CoE. This architecture should be under the control of an architectural board. However, different organizations within FAA will have the responsibility of making the architecture operational.

8.9 Establish SOA Development Environment

While maximum flexibility must be afforded to each program and SIP to define and establish the SOA development environment that best meets their individual and specific needs, the FAA, through the NAS SOA CoE may establish development environment standards.

8.10 Provide SOA Training

Comprehensive and consistent adoption of SOA within an organization with as many programs as the NAS depends heavily on the provision of training to all parts of the organization. Training will help ensure that programs are defined, managed, and implemented in a consistent manner. For this purpose, a gap analysis between the current skill set and the required skill set is recommended. The result of this analysis could be used to identify the required training.

9 Governance Success Patterns

Successful patterns are derived from many years of successful practice in given areas and are a sign of maturity for that area. SOA, by no means, has reached the level of maturity associated with proven patterns in some other disciplines. We are still in the relatively early stages of SOA adoption. However, SOA Patterns are now emerging and we are at a point where we can talk about patterns that have been leading indicators of SOA success so far. In this section we will discuss the top 10 leading practices that have proven to make SOA adoption successful and the role of SOA governance in successful SOA adoption. The following patterns are presented in no particular order. No priority or ranking should be inferred from the presentation.

9.1 Assure Executive Sponsorship/Champion

The SOA journey requires executive level attention. One or more executive sponsors who are enthusiastic about SOA and realize its benefits could have a great impact on getting the SOA journey on its way. Such executive(s), on the one hand would help evangelize SOA and on the other hand will have the power to make the required resources available. Ideally the sponsorship should be a joint effort between Business and IT. SOA governance should emphasize and encourage executive sponsorship/champion especially at the early stages.

9.2 Create Real or Virtual/Interim CoE

Governance requires a supporting organization of some sort, no matter what you might choose to call it. The creation of an SOA Center of Excellence, as an example, has proven to be extremely helpful in many organizations. In cases where it is early in the SOA adoption process and the enterprise needs some more time to create a physical organization, then creating a "virtual" CoE could be helpful. A virtual CoE does most of the work that a real CoE does without a formal structure. This should be a very short-lived phase for the CoE. The benefit of having a virtual CoE instead of no CoE at all is that it can provide a short-term focal point for necessary initial SOA activities, albeit in an informal fashion. On the negative side, because the CoE is not formal, it may not have the required support and may not produce the needed results. Virtual, or interim CoEs, are often created by SOA pioneers in the enterprise. Candidate individuals include those in the enterprise who believe in the benefits of SOA and have a passion to establish SOA in the right way, and who understand the chaos that will results from the creation of services in an ad-hoc manner in an unstructured environment.

9.3 Communicate Business Values

The best sales people are those who first buy, and wind up believing in, the product they are supposed to sell. It simply means that they really understand the product and truly believe that it delivers on all of its promises. SOA has a huge promise of business value. SOA governance must assure that this becomes a reality and there must be a clear means of communicating that to all stakeholders. That way, everyone who is impacted has an understanding of the goals and objectives and can act as an evangelist for promoting the business value of SOA.

9.4 Grow into SOA, Don't Jump Into It.

The concept of Service Orientation and the agility enabled by the creation of reusable and consumable services has created an excitement in the technical and business community. In some organizations, services are being produced faster than traditional applications. The rigidity and lack of flexibility of the legacy applications forced us to consider a services approach. If we do not pay attention to the way we create new services, if we do not think about their granularity and if they are not created with a holistic view of the enterprise, these services become the smaller versions of the old stove piped applications. Instead of a dozen large rigid applications you may end up with hundreds of smaller rigid services. Due to lack of governance, there can be many variations of the same service that will result in additional development and support costs.

9.5 Adopt Policies

Policies make decision making faster and better. By having policies for situations that are likely to happen, management of those situations could be automated and less will be left to chance for those situations where explicit instructions are not available. Exceptions will always require human involvement and a decision making process. Policies play an important role in the service development life cycle, as well as management and monitoring. Therefore, policies become extremely important in SOA governance. As an example, a policy such as "an enterprise service needs to have a minimum of three consumers" helps in deciding what qualifies as a centrally hosted, enterprise-level service. Any service candidate that does not warrant three or more consumers could automatically be rejected, or simply classified as a departmental service and associated with specific resource constraints.

Policy based management is used in Network Resource management and makes it easier. Security measures, including access to portions of the network, or control over quality of the service, are best addressed through policies. In Policy Based Management, Policy Enforcement Points (PEP) and Policy Decision Points (PDP) are two components worthy of mentioning. They make tremendous sense in SOA environments. A PEP component sends a message to the PDP component asking if a condition in the policy is met, or not, in order to allow the process to continue, or stop the process. Governance plays a crucial role in defining PDPs and PEPs as well as their behavior.

The Control points discussed in Section 6 are analogous to PEPs.

9.6 Measure every step of the way

Measurement is key to effective governance. Without measuring effectiveness, vision, mission and goals are soon forgotten. Good governance enforces defining and solidifying Vision and Mission statements; clearly defining goals and a set of metrics identifying when goals are achieved. This ensures there is a viable measurement capability to see how business objectives are being attained.

9.7 Employ Tooling and Establish a SOA Lab

Enforcing governance at times become repetitive and mundane. Tooling and automation has proven to be instrumental. Of course, many factors play in selecting the type of the tools and their functionality. Please use the guideline in section 6 for choosing the right tools as they play important part in successful SOA journey.

Put in place a SOA Lab, to conduct early prototyping, validation of technical concerns (hardware and software) and testing of processes and procedures such as Service Development Life Cycle. This way, technical obstacles are identified early on. Usually, the CoE runs the lab. In fact, one of the early activities of a CoE should be establishment of a SOA lab. The CoE needs to identify what should be in the lab, how and for what purpose the lab will be utilized, when the lab should become operational and for how long.

9.8 Understand your Maturity Level

Many organizations start Service Oriented Architecture by introducing services into their IT environment and after a while they believe that they have implemented SOA. But, SOA is not only a bunch of services that are created because a few IT individuals decided to write Web Services instead of applications. Services need to be created with a holistic view of the organization in mind. In order to understand how to proceed, we need to realize where we are. Therefore, understanding the current maturity level is very important. This maturity assessment should be done on Enterprise and IT governance as well as assessing the state of service orientation.

9.9 Create and Govern a SOA Roadmap

Creation of a SOA roadmap is an integral part of a successful SOA journey. This is not by any means an easy process as it requires understanding of the current organization, clear understanding of the vision, the mission and the goals of the organization and how they can be met through Service Orientation. Creation of a roadmap and subsequently governing its implementation is one of the most time consuming and difficult aspect of a successful SOA journey.

9.10 Govern the Return of Investment

In the business world, any investment should be associated with a return on that investment. No return on investment is unacceptable. Moving to SOA is no exception. Defining the right metrics in capturing and measuring return on investment has helped enterprises of all kinds in controlling their costs and achieving their goals faster. This is one of the most important functions of governance and a huge success factor for SOA overall.

Appendices

Appendix 1 – FAA SWIM Acronyms

Below is a list of key acronyms the FAA uses to discuss operations and the environment SWIM will support. Not all of these terms arise in the current whitepaper, but they appear here for completeness and to support future discussions.

ADDS ..... Aviation Digital Data Service
ADOC ..... Airline Direct Operating Cost
AIM ..... Aeronautical Information Management
AOC ..... Airline Operating Center
ARMT ..... Airport Resource Management Tool
ARTCC ..... Air Route Traffic Control Center
AS ..... Application Server
ASDE-X ..... Airport Surface Detection Equipment – Model X
ASDI ..... Aircraft Situational Display for Industry
ATC ..... Air Traffic Control
ATCT ..... Air Traffic Control Tower
ATM ..... Air Traffic Management
ATO ..... Air Traffic Operations
AWC ..... Aviation Weather Center
BPEL ..... Business Process Execution Language
BPEL4WS ..... Business Process Execution Language for Web Services
BPM ..... Business Process Management
CA ..... Certificate Authority
CBR ..... Content Based Routing
CDM ..... Collaborative Decision Making
CERAP ..... Center Radar Approach Control
CIWS ..... Corridor Integrated Weather System
CMP ..... Configuration Management Plan
CoE ..... [SOA] Center of Excellence
COI ..... Community of Interest
CORBA ..... Common Object Request Broker Architecture
COTS ..... Commercial off-the-Shelf
CP ..... Central Processor
CPMP ..... Commercial Product Management Plan
CSIRC ..... Computer Security Incident Response Center
DAFIF ..... Digital Aeronautical Flight Information File
DNS ..... Domain Name Service
DOTS ..... Dynamic Ocean Track System
EA ..... Enterprise Architecture
EAP ..... Extensible Authentication Protocol
EFSTS ..... Electronic Flight Strip Terminal System
ERAM ..... En Route Automation Modernization
ESM ..... Enterprise Service Management

ESP ..... Encapsulating Security Payload
ETE ..... End-to-end
EVM ..... Earned Value Management
FAA ..... Federal Aviation Administration
FBWTG ..... FAA Bulk Weather Telecommunication Gateway
FDIO ..... Flight Data Input Output
FID ..... Final Investment Decision
FSS ..... Flight Service Stations
FTI ..... FAA Telecommunications Infrastructure
FTP..... File Transfer Protocol
FY ..... Fiscal Year
GCNSS ..... Global Communications, Navigation, and Surveillance ..... System
HADDS..... Host Automation Data Distribution System
HIDS ..... Host-based Intrusion Detection Sensor
HT ..... Hypertext and Transfer Protocol
IETF ..... Internet Engineering Task Force
IKE ..... Internet Key Exchange
ILS..... Integrated Logistics Support
ILSP ..... Integrated Logistics Support Plan
IOC ..... Initial Operating Capability
IOT&E ..... Independent Operational Test and Evaluation
IOTRD ..... Independent Operation Test Readiness Decision
IP ..... Internet Protocol
IPCP ..... Internet Protocol Control Protocol
IPS ..... Internet Protocol Service
IPSec ..... IP Security
ISD ..... In-Service Decision
ISR ..... In-Service Review
ISS ..... Information Systems Security
IT ..... Information Technology
ITWS ..... Integrated Terminal Weather System
J2EE ..... Java 2 Platform, Enterprise Edition
JMS ..... Java Messaging Service
JPDO ..... Joint Planning and Development Organization
LAN ..... Local Area Network
LDAP ..... Lightweight Directory Access Protocol
MADE ..... Military Airspace Data Entry System
MOU ..... Memorandum of Understanding
MQ ..... Message Queuing
NACO ..... National Aeronautical Cartographic Organization
NAIMES ..... NAS Aeronautical Information Management Enterprise ..... System
NAS ..... National Airspace System
NASE ..... NAS Adaptation Services Environment
NASR ..... National Airspace System Resources
NextGen ..... Next Generation Air Transportation System
NGATS ..... Next Generation Air Transportation System
NIDS ..... Network Intrusion Detection Sensor

NIST ..... National Institute of Standards and Technology
O&M ..... Operations and Maintenance
OT&E ..... Operational Test and Evaluation
PEP ..... Policy Enforcement Point
PDC ..... Pre-Departure Clearance
PDP ..... Policy Decision Point
PDR ..... Preliminary Design Review
PHA ..... Preliminary Hazard Analysis
PIREP ..... Pilot Report
PKI ..... Public Key Infrastructure
POC ..... Point of Contact
PP ..... Protection Profile
PTR ..... Program Trouble Report
PVT ..... Passenger Value of Time
QAP ..... Quality Assurance Plan
QA ..... Quality Assurance
QoS ..... Quality of Service
RFC ..... Request for Comment
RMI ..... Remote Method Invocation
RVR ..... Runway Visual Range
SA ..... SWIM Adapter
SAML ..... Security Authorization Markup Language
SAMS ..... Special Use Airspace Management System
SC ..... Service Container
SD ..... Situation Display
SDP ..... Service Delivery Point
SEC ..... Systems Engineering Council
SIG ..... Security Incident Group
SIP..... SWIM Implementing Program
SLA ..... Service Level Agreement
SMTP ..... Simple Mail Transfer Protocol
SOA ..... Service-Oriented Architecture
SOAP ..... Simple Object Access Protocol
SOW ..... Statement of Work
SNMP ..... Simple Network Management Protocol
SRVT ..... Safety Requirements Verification Table
SMS ..... Safety Management System
SRMGA ..... Safety Risk Management Guidance for Acquisitions
SSAR ..... System Safety Assessment Report
SSD ..... System Specification Document
SSH ..... System Safety Handbook
SUA ..... Special Use Airspace
SWIM ..... System Wide Information Management
TBD ..... To Be Determined
TCP ..... Transmission Control Protocol
TDDS..... Terminal Data Distribution System
TDLS ..... Terminal Data Link System
TFM-M ..... Traffic Flow Management – Modernization Program
TFMS..... Traffic Flow Management System
TRACON ..... Terminal Radar Approach Control

TSG ..... Telecommunications Service Group
UDDI ..... Universal Description, Discovery, and Integration
UDP ..... User Datagram Protocol
URI ..... Uniform Resource Indicator
URL ..... Uniform Resource Locator
USNS ..... United States Notice to Airmen (NOTAM) System
VNTSC ..... Volpe National Transportation Systems Center
VPN ..... Virtual Private Network
VRTM ..... Verification Requirements Traceability Matrix
WAN ..... Wide Area Network
WARP ..... Weather and Radar Processor
WINS ..... Weather Information Network Server
WJHTC ..... William J Hughes Technical Center
WMSCR ..... Weather Message Switching Center Replacement

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[i] FAA SOA Best Practices Whitepaper, GEIA, 2008

[ii] "The Next Revolution in Productivity", Harvard Business Review Article, 1 June 2008, Ric Merrifield, Jack Calhoun, Dennis Stevens, http://harvardbusinessonline.hbsp.harvard.edu/relay.jhtml?name=itemdetail&id=R0806D

[iii] IBM EA Academy Study Team, Orlando Workshop, 12th-13th March 2004

[iv] See COBIT Framework, Page 19: http://www.isaca.org/AMTemplate.cfm?Section=Downloads&Template=/ContentManagement/ContentDisplay.cfm&ContentID=34172