The Open Group Architecture Framework (TOGAF) and the US Department of Defense Architecture Framework (DoDAF)

A White Paper by:

Dr. Fatma Dandashi, MITRE Corporation
Rolf Siegers, Raytheon Company
Judith Jones, Architecting-the-Enterprise
Terry Blevins, MITRE Corporation

November, 2006

The Open Group Architecture Framework (TOGAF) and the US Department of Defense Architecture Framework (DoDAF)

Document No.: W061

Published by The Open Group, November, 2006

Any comments relating to the material contained in this document may be submitted to:

The Open Group
44 Montgomery St. #960
San Francisco, CA 94104

or by email to:

ogpubs@opengroup.org

Contents

Boundaryless Information Flow™
achieved through global interoperability
in a secure, reliable, and timely manner

Executive Summary

Numerous architecture framework standards have been developed and matured over the past decade and the focus of these frameworks is diverse. Many engineers believe there is an "either or" decision to be made regarding the frameworks, but this is not always the case. Some of these standards address completely different elements of the architecting process, thus there may be a natural synergy that can be identified and leveraged between architecture frameworks. The Open Group Architecture Framework (TOGAF) has a primary focus on architecting methodology – the "how to" aspect of architecture, without prescribing architecture description constructs. The US Department of Defense Architecture Framework (DoDAF) has a primary focus on architecture description via a set of views, without specifying methodology. An industry working group was formed to analyze and document the relationships between these two frameworks and identify complementary areas between the two. This core group of representatives from MITRE, Raytheon, and Architecting-the-Enterprise was also supported by members of The Open Group Architecture Forum during this effort. The baseline versions of the documents used were TOGAF Version 8.1 and DoDAF Version 1.0.

Introduction

Numerous architecture framework standards have been developed and matured over the past decade and the focus of these frameworks is diverse. Many engineers believe there is an "either or" decision to be made regarding the frameworks, but this is not always the case. Some of these standards address completely different elements of the architecting process, thus there may be a natural synergy that can be identified and leveraged between architecture frameworks. The Open Group Architecture Framework (TOGAF) has a primary focus on architecting methodology – the "how to" aspect of architecture, without prescribing architecture description constructs. The US Department of Defense Architecture Framework (DoDAF) has a primary focus on architecture description via a set of views, without specifying methodology. An industry working group was formed to analyze and document the relationships between these two frameworks and identify complementary areas between the two. This core group of representatives from MITRE, Raytheon, and Architecting-the-Enterprise was also supported by members of The Open Group Architecture Forum during this effort. The baseline versions of the documents used were TOGAF Version 8.1 and DoDAF Version 1.0.

Overview of Analysis Results

The following tables and graphics provide a summary of the results of this comparative analysis between DoDAF and TOGAF. Detailed information between these standards is contained in the sections following.

Notes to the Reader:

- Some textual content from both TOGAF and DoDAF has been intentionally extracted and embedded in this White Paper to provide better insights to the reader on both standards. Some minor edits of this text were made to clarify DoDAF/TOGAF relationships.
- There are numerous detailed method steps in some TOGAF phases. In these instances a subset of the complete TOGAF step listing is presented, focusing on the steps that apply to DoDAF tailoring comments.

Table 1 provides a summary of which DoDAF architecture models relate to which sections within TOGAF's ADM phases.

Table 1: Summary Relating DoDAF Models to ADM Phases

DoDAF 1.0 Model	TOGAF Paragraph Number(s)	Applicable Links into TOGAF 8.1
AV-1	3.6, 4.x, 5.x, 13.x, 25.x, 26.x, 29.x	www.opengroup.org/architecture/togaf8-doc/arch/chap03.html#tag_04_06 www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_prelim.htm www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_a_vision.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/princ/princ.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/gov/gov.htm
AV-2		All phases.
OV-1	3.6, 4.x, 5.x, 13.x, 29.x	www.opengroup.org/architecture/togaf8-doc/arch/chap03.html#tag_04_06 www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_prelim.htm www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_a_vision.htm www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/princ/princ.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/gov/gov.htm
OV-2	6.2.3	www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm
OV-3	6.2.3	www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm

DoDAF 1.0 Model	TOGAF Paragraph Number(s)	Applicable Links into TOGAF 8.1
OV-4	6.4, 6.5	www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm
OV-5	6.2.3, 6.4, 6.5, 34.x	www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm
OV-6a	6.2.3, 6.4, 6.5, 34.x	www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm
OV-6b	6.x	www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm
OV-6c	6.2.3, 6.4, 6.5, 34.x	www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_b_busarch.htm
OV-7	8.x, 31.13	www.opengroup.org/architecture/togaf8-doc/arch/chap08.html www.opengroup.org/architecture/togaf8-doc/arch/p4/princ/princ.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_data.htm
SV-1	10.x, 31.11	www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_intro.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_comp.htm
SV-2	10.x, 31.12	www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_intro.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_comm.htm
SV-3	10.x, 31.11	www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_intro.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_comp.htm
SV-4	10.x, 31.11	www.opengroup.org/architecture/togaf8-doc/arch/chap09.html www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_intro.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_data.htm
SV-5	9.x, 10.x, 33.x	www.opengroup.org/architecture/togaf8-doc/arch/chap09.html www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_comp.htm
SV-6	9.x, 20.1	www.opengroup.org/architecture/togaf8-doc/arch/chap09.html www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_data.htm www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_comp.htm
SV-7	10.x, 31.11	www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_comp.htm
SV-8	12.x	www.opengroup.org/architecture/togaf8-doc/arch/chap12.html www.opengroup.org/architecture/togaf8-doc/arch/p2/p2_f_mig.htm
SV-9	11.x, 14.x	www.opengroup.org/architecture/togaf8-doc/arch/chap11.html www.opengroup.org/architecture/togaf8-doc/arch/chap14.html
SV-10a	9.x, 10.x	www.opengroup.org/architecture/togaf8-doc/arch/chap09.html www.opengroup.org/architecture/togaf8-doc/arch/chap10.html
SV-10b	10.x, 31.11	www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_comp.htm
SV-10c	9.x, 10.x	www.opengroup.org/architecture/togaf8-doc/arch/chap09.html www.opengroup.org/architecture/togaf8-doc/arch/chap10.html

DoDAF 1.0 Model	TOGAF Paragraph Number(s)	Applicable Links into TOGAF 8.1
SV-11	8.x, 31.13	www.opengroup.org/architecture/togaf8-doc/arch/chap08.html www.opengroup.org/architecture/togaf8-doc/arch/p4/views/vus_data.htm
TV-1	10.x, 11.x, 21.x	www.opengroup.org/architecture/togaf8-doc/arch/chap10.html www.opengroup.org/architecture/togaf8-doc/arch/chap11.html
TV-2	11.x, 14.x	www.opengroup.org/architecture/togaf8-doc/arch/chap11.html www.opengroup.org/architecture/togaf8-doc/arch/chap14.html

Table 2 provides an overview of the relationship between these frameworks from a TOGAF-to-DoDAF perspective.

Table 2: Summary Relating ADM Phases to DoDAF Models

TOGAF Phase	Focus	Applicable DoDAF Models
Preliminary	Framework & Principles	AV-1, OV-1
A	Vision	AV-1, OV-1
B	Business Architecture	AV-2, OV-1, OV-2, OV-3, OV-4, OV-5, OV-6
C	Information Systems Architecture: Data Architecture	OV-7, SV-11
	Information Systems Architecture: Applications Architecture	SV-4, SV-5, SV-6, SV-10
D	Technology Architecture	SV-1, SV-2, SV-3, SV-4 (Refined), SV-5, SV-7, SV-10 (Refined), TV-1
E	Opportunities & Solutions	SV-8, SV-9, TV-2
F	Migration Planning	SV-8
G	Implementation Governance	AV-1, OV-1
H	Change Management	SV-9, TV-2

Figure 1 is a visualization of the relationship between these frameworks from a TOGAF-to-DoDAF perspective using the TOGAF circles diagram.

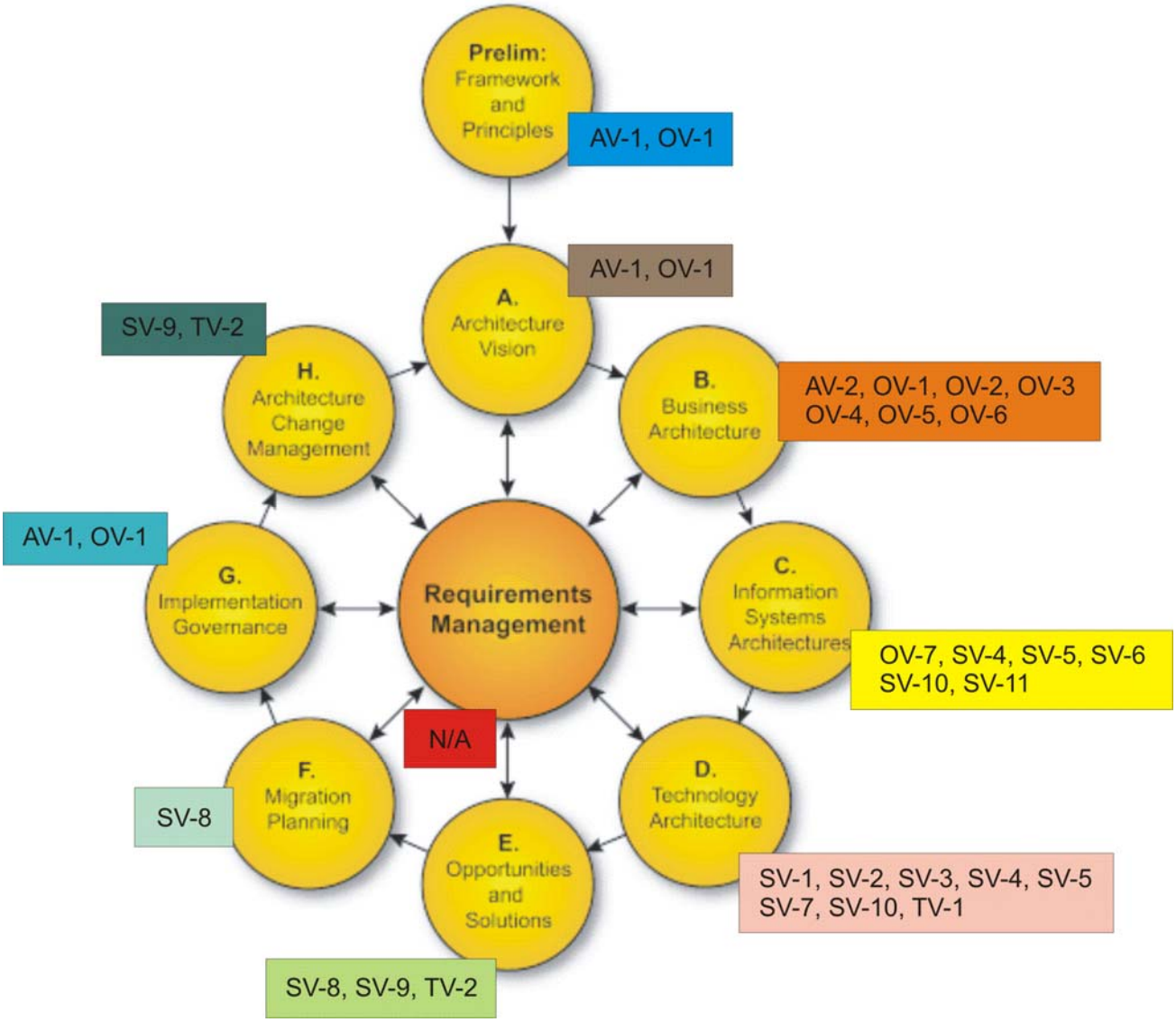

Figure 1: Summary of TOGAF ADM with DoDAF Models as the Architecture Description

The Open Group Architecture Framework (TOGAF)

The US Department of Defense developed a series of architecture guidance documents in the early 1990s known as the Technical Architecture Framework for Information Management (TAFIM). The purpose of these eight volumes was to provide: "*…the services, standards, design concepts, components, and configurations that can be used to guide the development of technical architectures that meet specific mission requirements*" to evolve the US Department of Defense technical infrastructure. [TAFIM-1996] The TAFIM was matured to Version 3.0 and then provided to The Open Group for its ongoing maturation and promulgation across government and industry. TAFIM was the baseline for the development of The Open Group Architecture Framework (TOGAF) in 1995 and was subsequently retired. The US Defense Information Systems Agency (DISA) contributed heavily to the development of TOGAF 1.0, which primarily leveraged TAFIM Volume 2: Technical Reference Model for TOGAF's Technical Reference Model and TAFIM Volume 3: Architecture Concepts and Design Guidance for TOGAF's Architecture Development Method (ADM).

The ADM is a prescriptive, step-by-step instruction guide for "how to" architect. It is presented in a series of phases that guide the architect or architecture team through the architecting lifecycle of system development. (Note that although the TOGAF phases have alphabetic identifiers, there is an understanding that iteration within and between phases is required.) TOGAF is comprised of four parts:

- Part I: Introduction
- Part II: Architecture Development Method (ADM)
- Part III: Enterprise Continuum
- Part IV: Resources

The first seven releases of TOGAF ADM (1995-2001) were focused on providing technical architecture guidance. The 2002 release of TOGAF 8.0 extended this earlier technical focus with elements of business, data, and applications architectures. This "collection" of architectures is commonly known as "enterprise architecture". TOGAF Versions 8.0 (and beyond) are referred to as the "enterprise edition", a superset of the pre-8.0 technical edition releases.

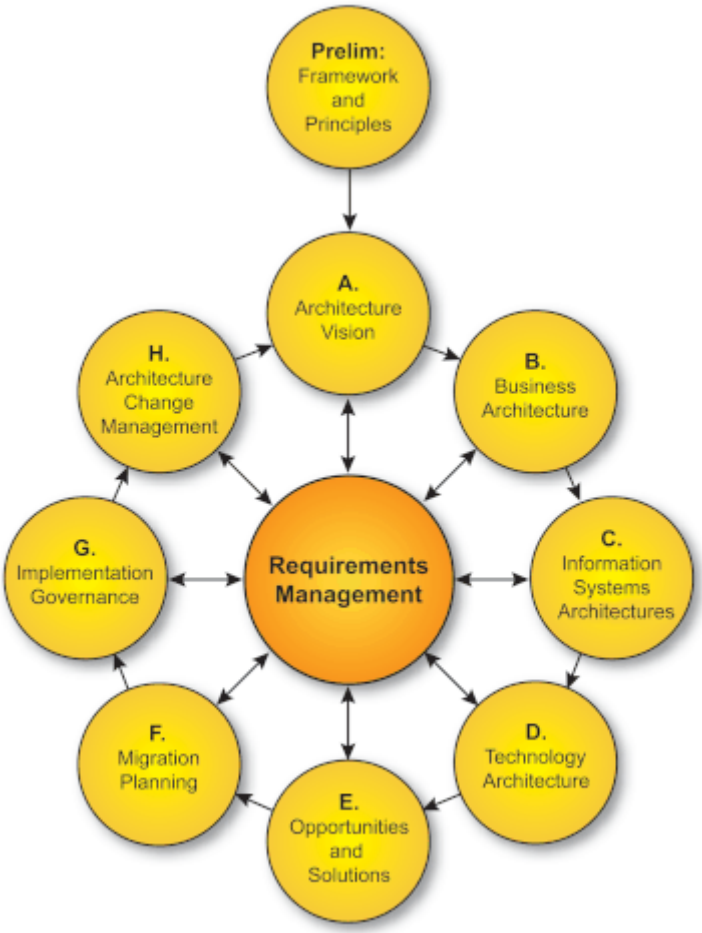

Figure 2: TOGAF's Architecture Development Method (ADM)

Table 3 overviews the nine phases that guide the architect through the ADM.

Table 3: Architecture Development Method (ADM) Phase Descriptions

Phase	Name	Description
Preliminary	Framework & Principles	Identify additional framework(s) to use; define architecture principles to guide the architecture work
A	Architecture Vision	Define scope; create vision; identify relevant stakeholders; define business/mission requirements and constraints; obtain approvals
B	Business Architecture	Develop Baseline and Target Business Architectures, describing product and/or service strategy and organizational, functional, process, information, and geographic aspects of the business/mission environment, based on business/mission principles, business/mission goals, and strategic drivers
C	Information Systems Architecture	Develop target architecture(s) covering either the Data or Application Systems domains (perhaps both depending on project scope)
D	Technology Architecture	Develop Technology Architecture to form the basis of the following implementation work

Phase	Name	Description
E	Opportunities and Solutions	Evaluate and select among the implementation options identified in candidate target architectures; identify strategic parameters for change and top-level work packages or projects required to move from current state to target state
F	Migration Planning	Asses dependencies, costs, and benefits of the various migration projects; prioritize list of projects to form basis of detailed Implementation and Migration Plan
G	Implementation Governance	Make recommendations for each implementation project; construct architecture contract to govern overall implementation and deployment process; perform governance functions while system is implemented and deployed; ensure conformance with defined architecture
H	Architecture Change Management	Provide for the continual monitoring of new developments in technology and changes in the business environment, and for determining whether to formally initiate a new architecture evolution cycle

The TOGAF ADM prescribes no architectural models. This aspect of the architecting process is outside of the defined scope of this architecture framework. The architect must identify which architecture models are required for the specific development activity, along with which elements of the defined models are most appropriate for the receiving stakeholders: "*The TOGAF Architecture Development Method therefore does not prescribe any specific set of enterprise architecture deliverables – although it does describe a set, by way of example. Rather, TOGAF is designed to be used with whatever set of deliverables the TOGAF user feels is most appropriate.*" [TOGAF-2003]

DoDAF prescribes a set of architectural models that together comprise one integrated super-model for describing the architecture of concern. Such a visual architecture model facilitates architectural decisions made following the TOGAF architecture methodology.

US Department of Defense Architecture Framework (DoDAF)

In 1995, the US Deputy Secretary of Defense directed that work begin: "*...to define and develop better means and processes for ensuring that C4I capabilities meet the needs of warfighters*". [CAF-1996] This initiative led to the development of the Command, Control, Communications, Computers, Intelligence, Reconnaissance, and Surveillance (C4ISR) Architecture Framework (CAF). CAF 1.0 was published in 1996 and was matured through deployment analyses and lessons learned. CAF 2.0 was released in December 1997. The US Department of Defense broadened the scope of the CAF by its next release in February 2004, renaming it to the Department of Defense Architecture Framework (DoDAF) to clarify its scope within the US government. Additionally, its version number was reset to 1.0.

DoDAF consists of two volumes:

- Volume I: Definitions & Guidelines
- Volume II: Product Descriptions.

A DoDAF Deskbook was also published to provide supplemental guidance to DoDAF users, consolidating supporting information such as White Papers and Case Studies, along with material on the Core Architecture Data Model (CADM), architecture tools, Universal Reference Resources (URRs), and the Federal Enterprise Architecture (FEA) reference models.

The primary focus of the DoDAF is architecture description – the architecture model consisting of several sub-models (called products in [DoDAF-2004]) and reflecting the architecture from multiple viewpoints. Table 4, extracted from DoDAF Volume II, Section 2.2, lists the set of 26 models organized within the All, Operational, Systems, and Technical Standards views [DoDAF-2004]. DoDAF was developed to facilitate establishing *interoperability* between DoD systems.

Table 4: US Department of Defense Architecture Framework Listing of Architecture Models

Applicable View	Framework Product	Framework Product Name	General Description
All Views	AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings
All Views	AV-2	Integrated Dictionary	Architecture data repository with definitions of all terms used in all products
Operational	OV-1	High-Level Operational Concept Graphic	High-level graphical/textual description of operational concept
Operational	OV-2	Operational Node Connectivity Description	Operational nodes, connectivity & information exchange between nodes
Operational	OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relevant attributes of that exchange
Operational	OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations

Applicable View	Framework Product	Framework Product Name	General Description
Operational	OV-5	Operational Activity Model	Capabilities, operational activities, relationships among activities, inputs and outputs; overlays can show cost, performing nodes, or other pertinent information
Operational	OV-6a	Operational Rules Model	One of the three products used to describe operational activity; identifies the business rules that constrain operation
Operational	OV-6b	Operational State Transition Description	One of the three products used to describe operational activity; identifies business process responses to events
Operational	OV-6c	Operational Event/ Trace Description	One of the three products used to describe operational activity; traces actions in a scenario or sequence of events
Operational	OV-7	Logical Data Model	Documentation of the system data requirements and structural business process rules of the Operational View
Systems	SV-1	Systems Interface Description	Identification of systems nodes, systems, and system items and their interconnections, within and between nodes
Systems	SV-2	Systems Communications Description	Systems nodes, systems, and system items, and their related communications lay-downs
Systems	SV-3	Systems-to-Systems Matrix	Relationships among systems in a given architecture; can be designed to show relationships of interest; e.g., system-type interfaces, planned *versus* existing interfaces, etc.
Systems	SV-4	Systems Functionality Description	Functions performed by systems and the system data flows among system functions
Systems	SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to capabilities or of system functions back to operational activities
Systems	SV-6	Systems Data Exchange Matrix	Provides details of system data elements being exchanged between systems and the attributes of that exchange
Systems	SV-7	Systems Performance Parameters Matrix	Performance characteristics of System View elements, for the appropriate timeframe(s)
Systems	SV-8	System Evolution Description	Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation
Systems	SV-9	System Technology Forecast	Emerging technologies and software/hardware products that are expected to be available in a given set of timeframes, and that will affect future development of the architecture
Systems	SV-10a	Systems Rules Model	One of three products used to describe systems functionality; identifies constraints that are imposed on systems functionality due to some aspect of systems design or implementation
Systems	SV-10b	Systems State Transition Description	One of three products used to describe systems functionality; identifies responses of a system to events

Applicable View	Framework Product	Framework Product Name	General Description
Systems	SV-10c	Systems Event/Trace Description	One of three products used to describe systems functionality; identifies system-specific refinements of critical sequences of events described in the Operational View
Systems	SV-11	Physical Schema	Physical implementation of the Logical Data Model entities; e.g., message formats, file structures, physical schema
Technical	TV-1	Technical Standards Profile	Listing of standards that apply to Systems View elements in a given architecture
Technical	TV-2	Technical Standards Forecast	Description of emerging standards and potential impact on current Systems View elements, within a set of timeframes

A review of column 3 (Framework Product Name) and Column 4 (General Description) in Table 4 reflects that these models are not unique to Defense architectures – most are traditional systems engineering modeling artifacts that have been in use for many years. This architecture framework can be leveraged by many domains outside of the Defense community, providing a baseline for which architecture models the architect (or architecture team) can consider when identifying which viewpoints will be addressed by their overall architecture description.

The DoDAF prescribes no architecture methodology. This aspect of the architecting process is outside of the defined scope of this architecture framework. The architect must identify which methodology is required for the specific development activity.

"*The Department of Defense (DoD) Architecture Framework (DoDAF), Version 1.0, defines a common approach for DoD architecture description development, presentation, and integration for both warfighting operations and business operations and processes. The Framework is intended to ensure that architecture descriptions can be compared and related across organizational boundaries, including joint and multi-national boundaries.*" [DoDAF-2004]

Architecture Development Method (ADM) with DoDAF Artifacts

The following sections consist of excerpts from the ADM specification that have been interjected with a workflow model and specific tailored steps for using DoDAF within the ADM.

ADM Architecture Requirements Management

Objective

The objectives of this phase are to define a process whereby requirements for enterprise architecture are identified, stored, and fed into and out of the relevant ADM phases.

Approach

As indicated by the Requirements Management circle at the centre of the ADM graphic, the ADM is continuously driven by the Requirements Management process.

It is important to note that the Requirements Management circle denotes, not a static set of requirements, but a dynamic process whereby requirements for enterprise architecture *and subsequent changes to those requirements* are identified, stored, and fed into and out of the relevant ADM phases.

DoDAF Models

There are no constructs in DoDAF v1.0 that support the modeling of requirements. However, there are current activities that are looking into augmenting DoDAF with the ability to capture systems requirements, and allocating requirements to the architecture elements that satisfy them. One such activity is an Object Management Group (OMG) effort to define a Unified Modeling Language Profile for DoDAF and MODAF (UPDM) [OMG-2006].

Building Block Specification Process in the ADM

The process of building block definition takes place gradually as the ADM is followed, mainly in Phases A, B, C, and D. It is an iterative process because as definition proceeds, detailed information about the functionality required, the constraints imposed on the architecture, and the availability of products may affect the choice and the content of building blocks. The key parts of the ADM at which building blocks are designed and specified are summarized below.

The major work in these steps consists of identifying the Architecture Building Blocks (ABBs) required to meet the business goals and objectives. The selected set of Architecture Building Blocks is then refined in an iterative process to arrive at a set of Solutions Building Blocks (SBBs) which can either be bought off-the-shelf or custom developed.

The specification of building blocks using the ADM is an evolutionary and iterative process. The key phases and steps of the ADM at which building blocks are evolved and specified are summarized below, and illustrated in Figure 3.

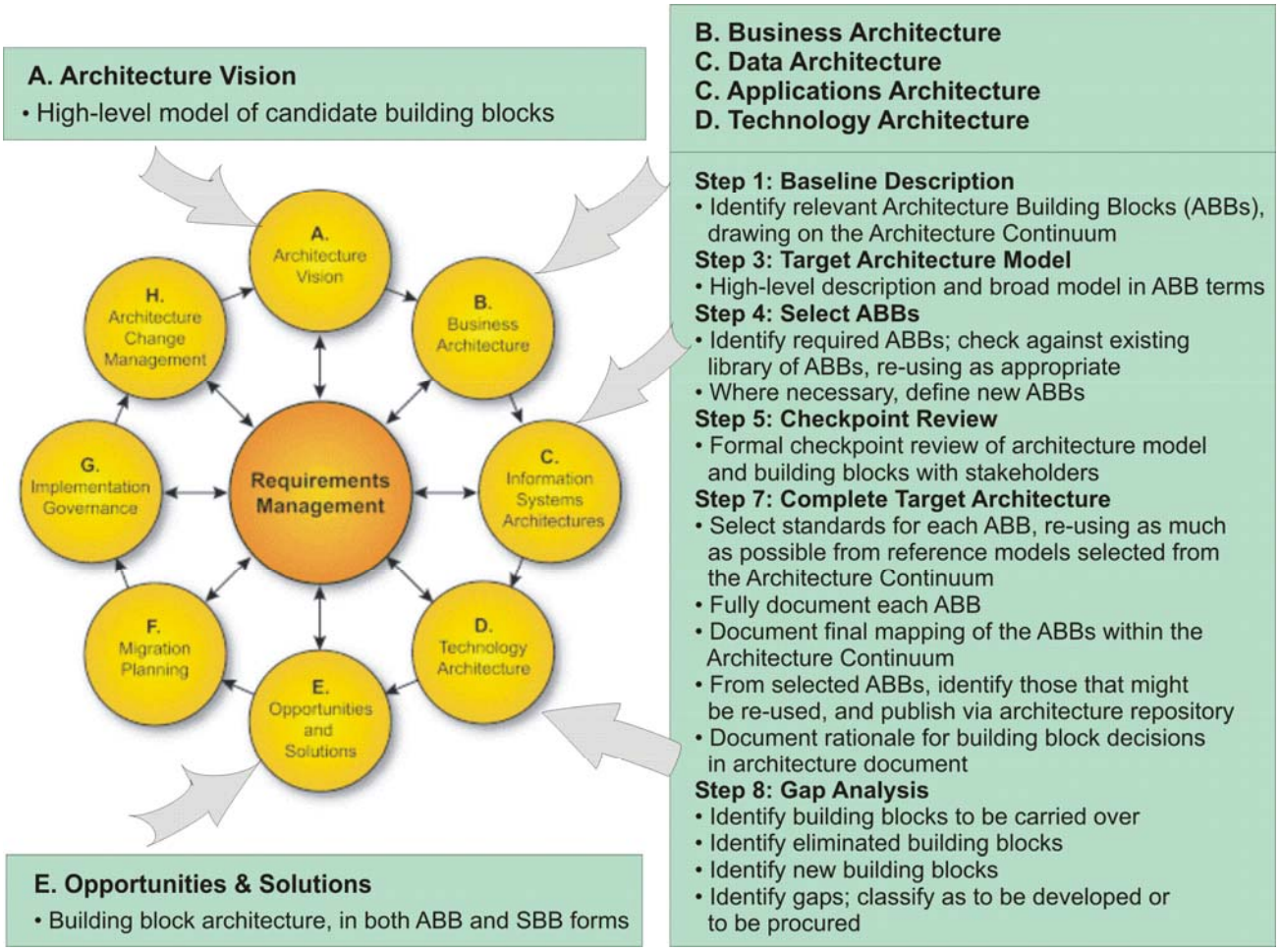

Figure 3: Key Phases/Steps of ADM at which Building Blocks are Evolved/Specified

In Phase A, the earliest building block definitions start as relatively abstract entities within the Architecture Vision. In Phases B, C, and D, building blocks within the Business, Data, Applications, and Technology Architectures are evolved to a common pattern of steps:

- Step 1, Baseline Description produces:
  - A list of candidate building blocks, from the analysis of the baseline
- Step 3, Target Architecture Model takes the list of candidate building blocks and high-level model as inputs, and evolves them iteratively into a definition of the target architecture, specified in terms of Architecture Building Blocks Specifically, Step 3 produces:
  - A high-level description and broad model of the target system in terms of Architecture Building Blocks
  - A rationale for each building block decision

DoDAF models are mainly developed during this step. By following DoDAF to create the architecture models throughout the ADM, the architect is aided with DoDAF's set of visual models in making architectural decisions and in generating reports to be used in the remaining steps:

- For each Architecture Building Block, Step 4 produces:
  - A service description portfolio, built up as a set of non-conflicting services

- Step 5 produces:
  - A confirmation of the merit and completeness of the model and service description portfolio, and a description of how the emerging target architecture meets the objectives of the architecture development
- Step 7 produces:
  - A target architecture, fully specified in terms of Architecture Building Blocks
  - A fully-defined (by service) list of all the standards that make up the target architecture, and all the Architecture Building Blocks that will be used to implement it
  - A diagrammatic depiction of the building blocks at the levels needed to describe the strategic and implementation aspects of the architecture
- Step 8 produces:
  - A gap analysis of eliminated building blocks, carried over building blocks, and new building blocks

Finally in Phase E: Opportunities and Solutions, the building blocks become more implementation-specific as Solutions Building Blocks, and their interfaces become the detailed architecture specification. The output of Phase E is the building block architecture, both in Architectural (i.e., functionally-defined) and Solution (i.e., product-specific) Building Block forms.

Levels of Modeling

Defining and developing the *context* for a set of building blocks takes place at two levels:

- The **business process** level (colored green in the diagrams in this section). This deals only at the highest level with what has to happen for a business process to be carried out. This level generally maps to producing OV models to describe business needs and requirements, devoid of a technology solution.
- The **technical functionality and constraints** level (colored blue in the diagrams). This level deals with the component activities that form part of the business process and whether they can be supported or not. At this level of modeling, the architect mostly creates SV and TV models to describe a proposed technology solution that meets business requirements described in OV models.

Defining and developing an actual set of building blocks also takes place at two levels:

- The **architectural model** level (colored red in the diagrams). This level identifies the systems and components that will implement the technical functionality and expresses the relationships between them. This level introduces the idea of a notation to describe the architectural elements and relationships. This level generally maps to DoDAF's Operational View.
- The **solution model** level (colored black in the diagrams). This is the level where the individual products and/or product components that will implement the architecture are identified. This level generally maps to DoDAF's Systems and Technical Standards Views.

Working through the four levels is an iterative process. Figure 4 shows how considerations at any level can result in change at any or all of the other levels.

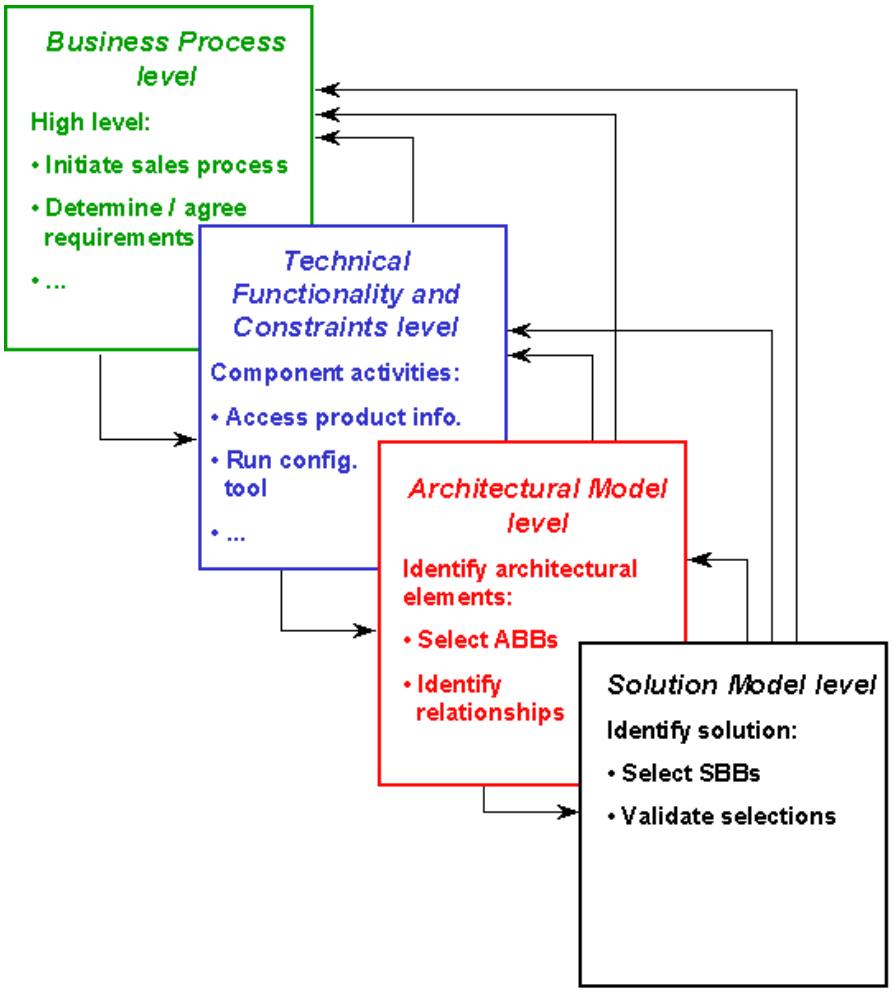

Figure 4: Iteration between the Four Levels of Modeling

Mapping the Modeling Levels to the ADM

The **business process** level of definition takes place in Phases A and B of the ADM.

The **technical functionality and constraints** level work happens early in Phases B, C, and D, once the characteristics of the current system have been established. At that stage it is possible to identify the constraints imposed on new architecture work by the legacy of the old systems (the baseline).

The **architectural model** and **solution model** levels consist of work done later in Phases B, C, and D, the target architecture steps of each phase, and Phase E, Opportunity Identification. Most architectural model work is done when taking different views of the architecture and developing the solution model work in Phase E, where selection of products and projects takes place.

The rest of Chapter 4 of this White Paper consists of detailed excerpts of the ADM phases, augmented with DoDAF steps needed to produce DoDAF models in conjunction with ADM work products.[1,2]

[1] This work is based on using the SPEM Model to define TOGAF phases (refer to www.omg.org/techprocess/meetings/schedule/SPEM_2.0_RFP.html#Revised_Submission).

[2] Activity Models were developed using NoMagic's MagicDraw (refer to www.nomagic.com).

Preliminary Phase: Framework and Principles

Objective

The objectives of this phase are to:

- Ensure that everyone who will be involved in, or benefit from this approach, is committed to the success of the architectural process
- Define the architecture principles that will inform the constraints on any architecture work
- Define the "architecture footprint" for the organization – the people responsible for performing architecture work, where they are located, and their responsibilities
- Define the scope and assumptions (particularly in a federated architecture environment)
- Define the framework and detailed methodologies that are going to be used to develop enterprise architectures in the organization concerned (typically, an adaptation of the generic ADM)
- Set up and monitor a process (normally including a pilot project) to confirm the fitness-for-purpose of the defined framework
- If necessary, define a set of criteria for evaluating architecture tools (an example set of criteria is given in TOGAF Part IV), repositories and repository management processes to be used to capture, publish, and maintain architecture artifacts

Approach

The Preliminary Phase is about defining "how we do architecture" in the enterprise concerned. There are two main aspects:

- Defining the frameworks to be used
- Defining the architecture principles that will inform the architecture work

Framework

The TOGAF ADM is a generic method, intended to be used by enterprises in a wide variety of industry types and geographies. This phase therefore involves doing any necessary work to adapt the ADM to define an organization-specific framework, using either the TOGAF deliverables or the deliverables of another framework. The issues involved in this are discussed under Adapting the ADM in the *Introduction to the ADM*.

DoDAF is an architecture framework that defines a set of elements and relationships, organized into views, that allow an architect to develop a description of the architecture of a current or postulated real-world configuration of resources, rules, and their relationships. DoDAF does not prescribe a method, and using it in conjunction with the ADM allows an architect to produce an architecture description within a well-defined and repeatable process.

Inputs

Inputs to this phase are:

- TOGAF ADM
- DoDAF v1.0
- Business Strategy, Business Principles, Business Goals, and Business Drivers (when pre-existing)
- IT Governance Strategy (when pre-existing)
- Architecture Principles (when pre-existing)
- Principles that are being subscribed to, arising from other, federated architectures

Steps

The TOGAF ADM is a generic method, intended to be used by a wide variety of different enterprises, and in conjunction with a wide variety of other architecture frameworks, if required. It is not practical to define specific steps for adapting the ADM to such a wide variety of potential contexts. The issues involved are discussed in detail under Adapting the ADM in the *Introduction to the ADM*.

Tailored Steps with DoDAF

The ADM may be used as the architecture development methodology when developing architecture artifacts that are compliant with DoDAF. In completing the Preliminary Phase, initial versions of AV-1 and OV-1 may be developed to capture the results of the Preliminary Phase. Figure 5 details the inputs, outputs, and the steps required to complete this phase.

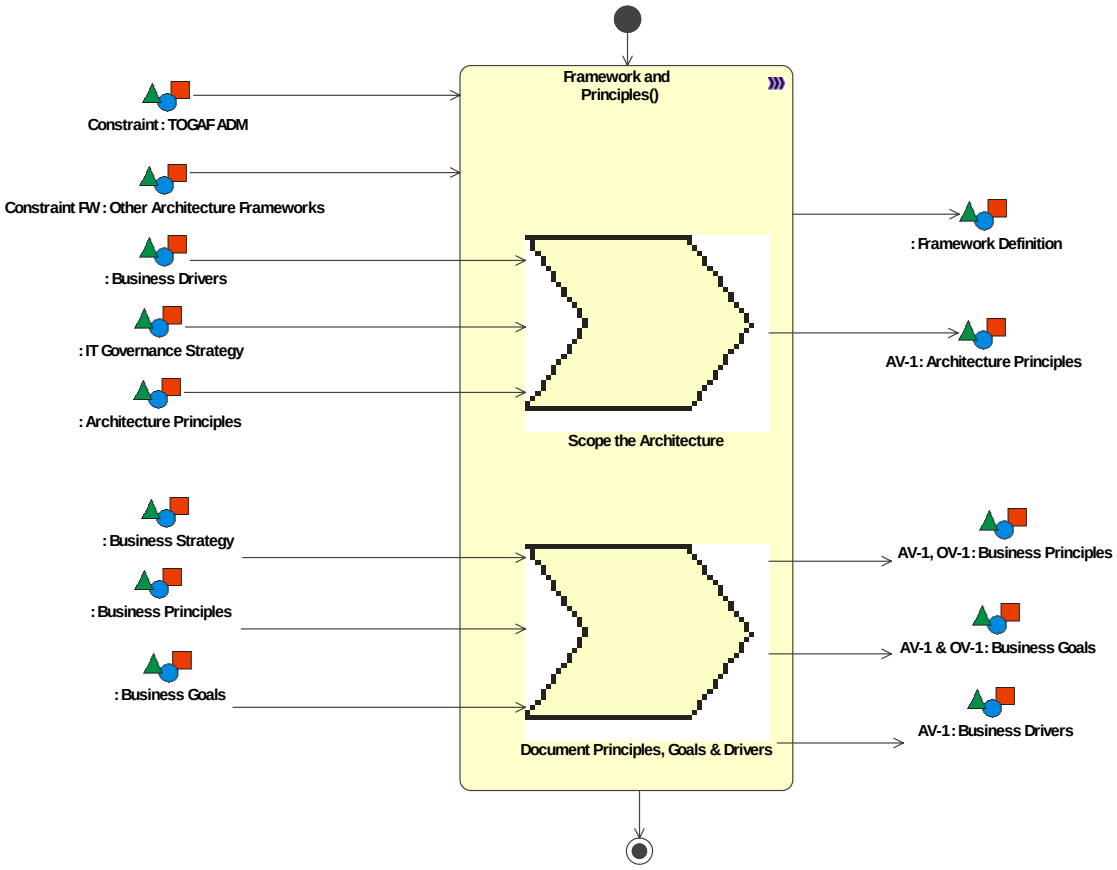

Figure 5: ADM Workflow for Preliminary Phase with DoDAF Views

Outputs

The outputs of this phase are:

- Framework Definition
- Architecture Principles
- Restatement of, or reference to, Business Principles, Business Goals, and Business Drivers
- DoDAF models AV-1, OV-1

Phase A: Architecture Vision

Objective

The objectives of this phase are to:

- Ensure that this evolution of the architecture development cycle has proper recognition and endorsement from the corporate management of the enterprise, and the support and commitment of the necessary line management
- Validate the business principles, business goals, and strategic business drivers of the organization
- Define the scope of, and to identify and prioritize the components of, the Baseline Architecture effort
- Define the relevant stakeholders, and their concerns and objectives
- Define the key business requirements to be addressed in this architecture effort, and the constraints that must be dealt with
- Articulate an Architecture Vision that demonstrates a response to those requirements and constraints
- Secure formal approval to proceed
- Understand the impact on, and of, other enterprise architecture development cycles ongoing in parallel

Inputs

Inputs to this phase are:

- Request for Architecture Work
- Business Strategy, Business Principles, Business Goals, and Business Drivers (when pre-existing)
- Architecture Principles (when pre-existing)
- Enterprise Continuum – existing architectural documentation (framework description, architectural descriptions, existing baseline descriptions, etc.)

Steps

Key steps in this phase include:

1. Project Establishment
2. Business Principles, Business Goals, and Business Drivers
3. Architecture Principles
4. Scope
5. Constraints
6. Stakeholders and Concerns, Business Requirements, and Architecture Vision
7. Statement of Architecture Work and Approval

Business Scenarios

The ADM has its own method (a “method-within-a-method”) for identifying and articulating the business requirements implied in new business functionality to address key business drivers, and the implied technical architecture requirements. This process is known as *Business Scenarios*, and is described in detail in TOGAF Part

IV. The technique may be used iteratively, at different levels of detail in the hierarchical decomposition of the Business Architecture. The generic Business Scenario process is as follows:

1. **Problem**: Identify, document, and rank the objective that is driving the project.
2. **Business and Technical Environments**: Document, as high-level architecture models, the business and technical environment where the problem situation is occurring.
3. **Objectives and Measures of Success**: Identify and document desired objectives, the results of handling the problems successfully.
4. **Human Actors**: Identify human actors and their place in the business model, the human participants and their roles.
5. **Computer Actors**: Identify computer actors and their place in technology model, the computing elements, and their roles.
6. **Roles and Responsibilities**: Identify and document roles, responsibilities, and measures of success per actor, the required scripts per actor, and the desired results of handling the situation properly.
7. **Refine**: Check for fitness-for-purpose of inspiring subsequent architecture work, and refine only if necessary.

Tailored Steps with DoDAF

1. Obtain approval for Statement of Architecture Work to document Project Establishment.
2. Gather Business Principles, Business Goals, and Business Drivers. Develop an OV-1 that models:
   - Their relationships
   - Elements of the architecture that are constrained by them
   - Elements of the architecture that help achieve them
3. Develop an AV-1 to document Architecture Principles and Architecture Drivers.
4. Develop OV-1 to document:
   - Scope
   - Architecture constraints
   - Stakeholders and concerns
   - Business Requirements
   - Architecture Vision
5. Complete Statement of Architecture Work and Approval process within DoDAF AV-1.

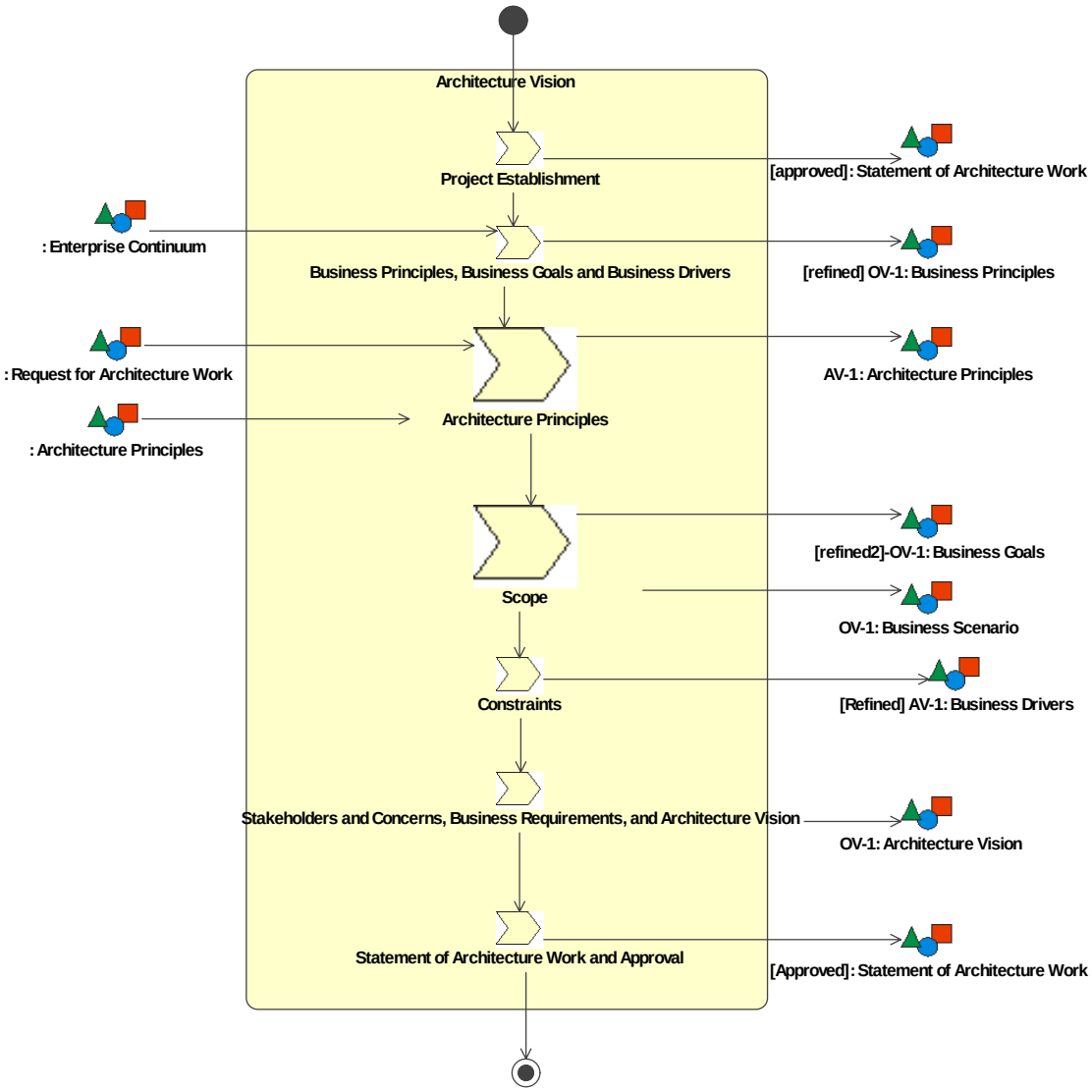

Figure 6: ADM Workflow for Phase A with DoDAF Views

Outputs

The outputs of this phase are:

- Approved Statement of Architecture Work/Project Definition, including in particular:
  - Scope and constraints
  - Plan for the architectural work
- Refined statements of Business Principles, Business Goals, and Strategic Drivers
- Architecture Principles (if not pre-existing)
- Architecture Vision
- Business Scenario, including:
  - Baseline Business Architecture, Version 1

  - Baseline Technology Architecture, Version 1
  - Target Business Architecture, Version 1
  - Target Technology Architecture, Version 1
- Refined DoDAF models AV-1 and OV-1

Note: Multiple Business Scenarios may be used to generate a single Architecture Vision. In TOGAF terms, the Architecture Vision may also be referred to as a “conceptual-level architecture”.

Phase B: Business Architecture

Objective

The objectives of this phase are to:

- Describe the Baseline Business Architecture
- Develop a target Business Architecture, describing the product and/or service strategy, and the organizational, functional, process, information, and geographic aspects of the business environment, based on the business principles, business goals, and strategic drivers
- Analyze the gaps between the baseline and target Business Architectures
- Select the relevant architecture viewpoints that will enable the architect to demonstrate how the stakeholder concerns are addressed in the Business Architecture
- Select the relevant tools and techniques to be used in association with the selected viewpoints

Inputs

Inputs to this phase are:

- Request for Architecture Work
- Approved Statement of Architecture Work/Project Definition
- Refined statements of Business Principles, Business Goals, and Strategic Drivers
- Architecture Principles
- Enterprise Continuum
- Architecture Vision/Business Scenario, including:
  - Baseline Business Architecture, Version 1
  - Baseline Technology Architecture, Version 1
  - Target Business Architecture, Version 1
  - Target Technology Architecture, Version 1

Tailored Steps with DoDAF

A variety of modeling tools and techniques may be employed, if deemed appropriate (bearing in mind the above caution not to go into unnecessary detail). DoDAF specifies development of the following models:

1. Identify relevant taxonomies and create a reference for each architecture element defined within the DoDAF models (in all phases). The AV-2 generated model repository can be used to provide traceability between architecture elements and their referenced taxonomies.
2. Develop OV-2 to define the business groupings (nodes), the “needlines” between them, and the characteristics of the information exchanged.
3. Develop OV-7 to define Information Requirements.
4. Develop OV-1 to establish a Business Baseline.
5. Develop high-level OV-2, OV-5, and OV-6, and generate matrix models to show mapping of business nodes to business functions. Utilize OV-7 to inputs and outputs of business functions.

6. Develop OV-4 to describe business nodes' internal structures.
7. Generate OV-3 report. (Note: Many architecture tools can auto-generate this information exchange requirements matrix model.)
8. Utilize all models to conduct analysis.

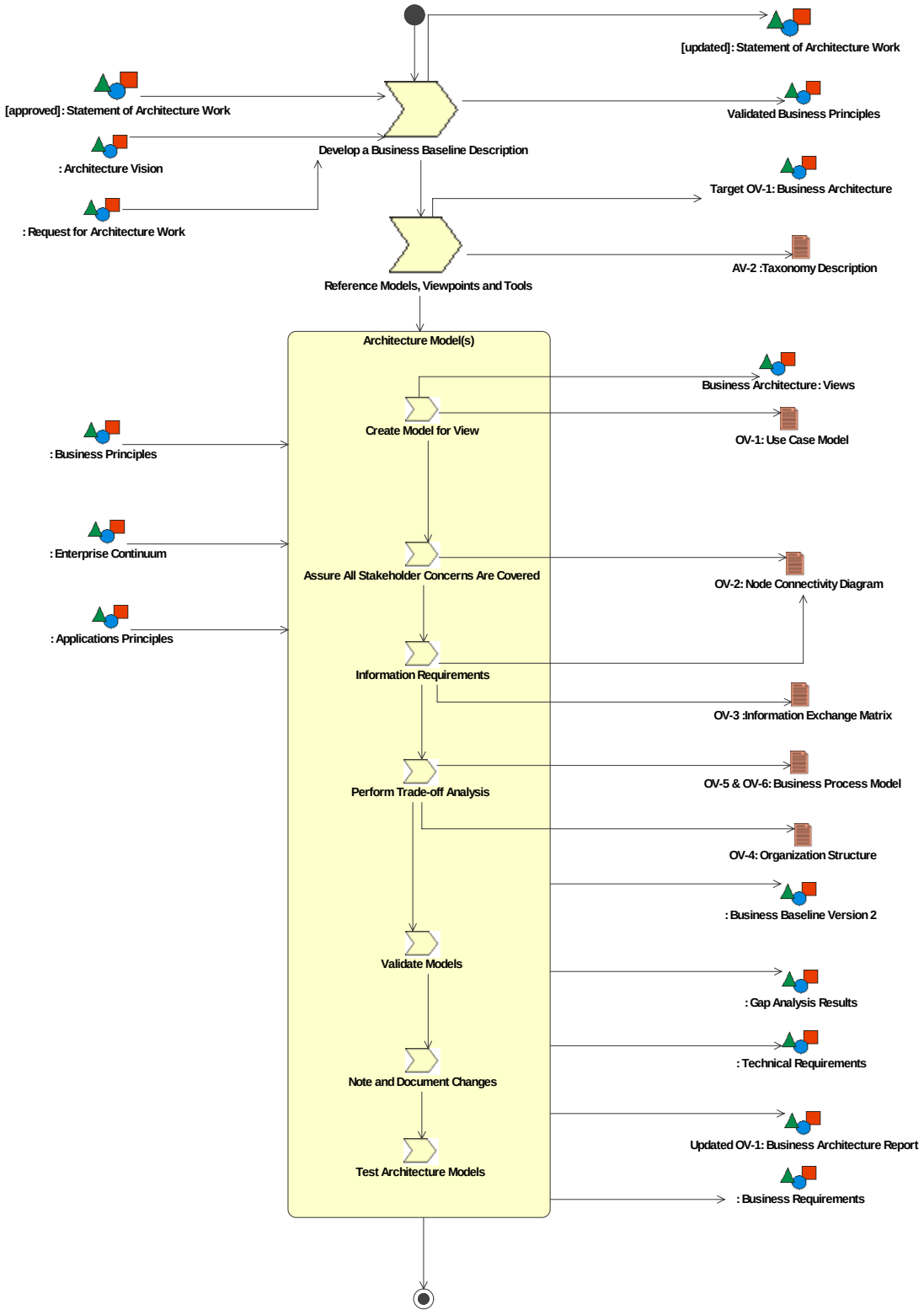

Figure 7: ADM Workflow for Phase B with DoDAF Views

Outputs

The outputs of this phase are:

- Statement of Architecture Work (updated if necessary)
- Validated Business Principles, business goals, and strategic drivers
- Target Business Architecture, Version 2 (detailed), including:
  - **Refined OV-1** for the target architecture.
  - **Referenced taxonomies relevant to the architecture** (defined for architecture elements and documented in AV-2).
  - **OV-4: Organization structure**. Document the organization structure, identifying business locations and relating them to organizational units.
  - **Business goals and objectives**. Document business goals and objectives for each organizational unit.
  - **OV-5: Business functions**. Identify and define business functions. This is a detailed, recursive step involving successive decomposition of major functional areas into sub-functions.
  - **OV-5 & OV-6c: Business services** (the services that each of the enterprise units provides to its customers, both internally and externally).
  - **OV-6c: Business processes** (including measures and deliverables). Not covered explicitly by DoDAF v1.0, but can be described using OV-2 and OV-4: Describe business roles, including development and modification of skills requirements.
  - **Generate** OV-3 as part of Business Data Model, detailing information requirements. Identify for each business function: when, where, how often, and by whom the function is performed; what information is used to perform it, and its source(s); and what opportunities exist for improvements. Show information that needs to be created, retrieved, updated, and deleted. The level of detail to be defined will depend on the scope and focus of the current architecture effort, as described under Approach, above. Focus on what will be worthwhile collecting for the purpose at hand.
  - **OV-2 and OV-5: Correlation of organization and functions**. Relate business functions to organizational units in the form of a matrix report.

Use AV and OV DoDAF models to produce:

- Business Baseline, Version 2 (detailed), if appropriate
- Views corresponding to the selected viewpoints addressing key stakeholder concerns
- Gap analysis results
- Technical requirements (drivers for the Technology Architecture work): identifying, categorizing, and prioritizing the implications for work in the remaining architecture domains; e.g., by a dependency/priority matrix. (For example, guiding trade-off between speed of transaction processing and security.) List the specific models that are expected to be produced (for example, expressed as primitives of the Zachman Framework).
- Business Architecture Report
- Updated business requirements

Phase C: Information Systems Architectures (Introduction)

Objective

The objective of this phase is to develop target architectures covering either or both (depending on project scope) of the Data and Application Systems domains.

The scope of the business processes supported in this phase is limited to those that are supported by information technology, and the interfaces of those IT-related processes to non-IT-related processes.

Approach

Development

This phase involves some combination of Data and Applications Architecture, in either order. Advocates exist for both sequences. For example, Spewak's Enterprise Architecture Planning recommends a data-driven approach.

On the other hand, major applications systems – such as those for Enterprise Resource Planning, Customer Relationship Management, etc. – often provide a combination of technology infrastructure and business application logic, and some organizations take an application-driven approach, whereby they recognize certain key applications as forming the core underpinning of the mission-critical business processes, and take the implementation and integration of those core applications as the primary focus of architecture effort (the integration issues often constituting a major challenge).

Implementation

Implementation of these architectures may not necessarily follow the same order. For example, one common implementation approach is top-down design and bottom-up implementation:

- Design:
  - Business Architecture design
  - Data (or Applications) Architecture design
  - Applications (or Data) Architecture design
  - Technology Architecture design
- Implementation:
  - Technology Architecture implementation
  - Applications (or Data) Architecture implementation
  - Data (or Applications) Architecture implementation
  - Business Architecture implementation

An alternative approach is a data-driven sequence, whereby application systems that create data are implemented first, then applications that process the data, and finally applications that archive data.

Inputs

Inputs to this phase are:

- Applications Principles (if existing)
- Data Principles (if existing)
- Request for Architecture Work

- Statement of Architecture Work
- Architecture Vision
- Enterprise Continuum
- Business Baseline, Version 2 (detailed), if appropriate
- Target Business Architecture, Version 2 (detailed)
- Relevant technical requirements that will apply to this phase
- Gap analysis (from Business Architecture)
- Re-usable building blocks (from organization's Architecture Continuum, if available)

Steps

Detailed steps for this phase are given separately for each architecture domain:

- Data Architecture
- Applications Architecture

Tailored Steps with DoDAF

- Data Architecture Models:

  Develop the target architecture models by developing Data Architecture views to define Information Systems' data elements and relationships:

  - OV-7 Conceptual/Logical Data Model
  - SV-11 Physical Schema (if appropriate)

  Generate SV-6 report.

- Applications and Services architecture Models:

  Develop high-level SV-4 and SV-10 to define software services, applications, their structure and their dependencies, and generate matrix models to show mapping of business nodes to business functions.

  Utilize SV-5 to conduct gap analysis.

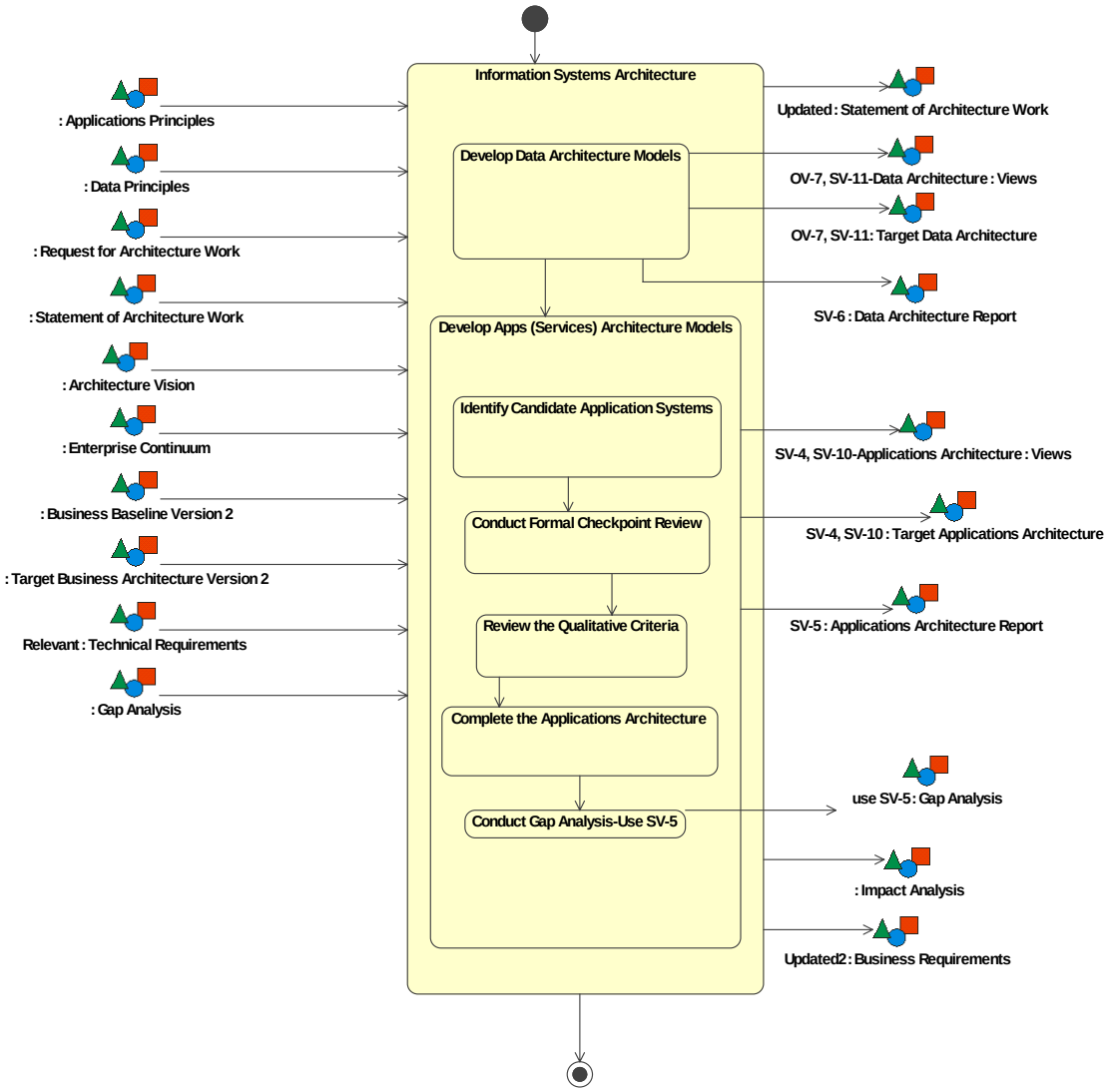

Figure 8: ADM Workflow for Phase C with DoDAF Views

Outputs

The main outputs of this phase are:

- Statement of Architecture Work (updated if necessary)
- OV-7, SV-11: Target Data Architecture
- SV-4, SV-10: Target Applications Architecture
- OV-7, SV-11: Data Architecture Views corresponding to the selected viewpoints addressing key stakeholder concerns
- SV-4, SV-10: Applications Architecture Views corresponding to the selected viewpoints addressing key stakeholder concerns
- SV-6: Data Architecture Report, summarizing what was done and the key findings
- SV-5: Applications Architecture Report, summarizing what was done and the key findings

- SV-5: Gap analysis:
  - Areas where the Business Architecture may need to change to cater for changes in the Data and/or Applications Architecture
  - Constraints on the Technology Architecture about to be designed
- Impact Analysis
- Updated business requirements (if appropriate)

Phase D: Technology Architecture (Introduction)

Objective

The objective of this phase is to develop a Technology Architecture that will form the basis of the following implementation work.

Approach

Detailed guidelines for this phase, including Inputs, Steps, and Outputs, are given under Target Technology Architecture – Detailed Description.

Architecture Continuum

As part of this phase, the architecture team will need to consider what relevant Technology Architecture resources are available in the Architecture Continuum.

In particular:

- The TOGAF Technical Reference Model (TRM)
- Generic technology models relevant to your organization's industry "vertical" sector

  For example, the TeleManagement Forum (TMF) has developed detailed technology models relevant to the Telecommunications Industry.
- Technology models relevant to common systems architectures

  For example, The Open Group has a Reference Model for Integrated Information Infrastructure that focuses on the application-level components and underlying services necessary to provide an integrated information infrastructure.

Some additional resources not identified in TOGAF are:

- US Department of Defense Enterprise Architecture Reference Models
- US Department of Defense NetCentric Operations & Warfare Reference Model
- NATO C3 Technical Architecture Framework

Inputs

Inputs to this phase are:

- Technology Principles (if existing)
- Request for Architecture Work
- Statement of Architecture Work
- Architecture Vision
- Relevant technical requirements from previous phases
- Gap analysis (from Data Architecture)
- Gap analysis (from Applications Architecture)
- Business Baseline, Version 2 (detailed), if appropriate
- Baseline Data Architecture, if appropriate
- Baseline Applications Architecture, if appropriate

- Target Business Architecture, Version 2 (detailed)
- Re-usable building blocks (from organization's Enterprise Continuum, if available)
- Target Data Architecture
- Target Applications Architecture

Steps

Technology Baseline Description

9. Review Business Baseline, Data Baseline, and Application Systems Baseline, to the degree necessary to inform decisions and subsequent work.

1. Develop a baseline description of the existing Technology Architecture, to the extent necessary to support the target Technology Architecture. The scope and level of detail to be defined will depend on the extent to which existing technology components are likely to be carried over into the target Technology Architecture, and on whether existing architectural descriptions exist, as described under Approach, above. Define for each major hardware or software platform type:
   - Name (short and long)
   - Physical location
   - Owner(s)
   - Other users
   - Plain language description of what the hardware/software platform is and what it is used for
   - Business functions supported
   - Organizational units supported
   - Networks accessed
   - Applications and data supported
   - System inter-dependencies (for example, fall-back configurations)
2. To the extent possible, identify and document candidate Technology Architecture building blocks (potential re-usable assets).
3. Draft the Technology Baseline Report: summarize key findings and conclusions, developing suitable graphics and schematics to illustrate baseline configuration(s). If warranted, provide individual Technology Baseline Descriptions as Annexes.
4. Route the Technology Baseline Report for review by relevant stakeholders, and incorporate feedback. Refine the Baseline Description only if necessary.

Target Technology Architecture

See detailed steps. Detailed activities for this step, including Inputs, Activities, and Outputs, are given under Target Technology Architecture – Detailed Description.

Tailored Steps with DoDAF

During Phase D, SV models that model the distribution of application and information systems across the systems environment and the dependencies of legacy systems on the IT infrastructure and services can be modeled using the following:

1. Develop the Baseline Technology Architecture models SV-1, SV-4, and SV-10

2. Document technology constraints in SV-7 and TV-1
3. Generate SV-5 reports to ensure the Technology Architecture meets business objectives
4. Generate SV-3 report
5. Document validated technology principles by refining SV-7 and TV-1 (if appropriate)
6. Develop the Target Technology Architecture models by refining SV-1, SV-4, SV-10, and SV-2 (if appropriate)
7. Generate new SV-5 report

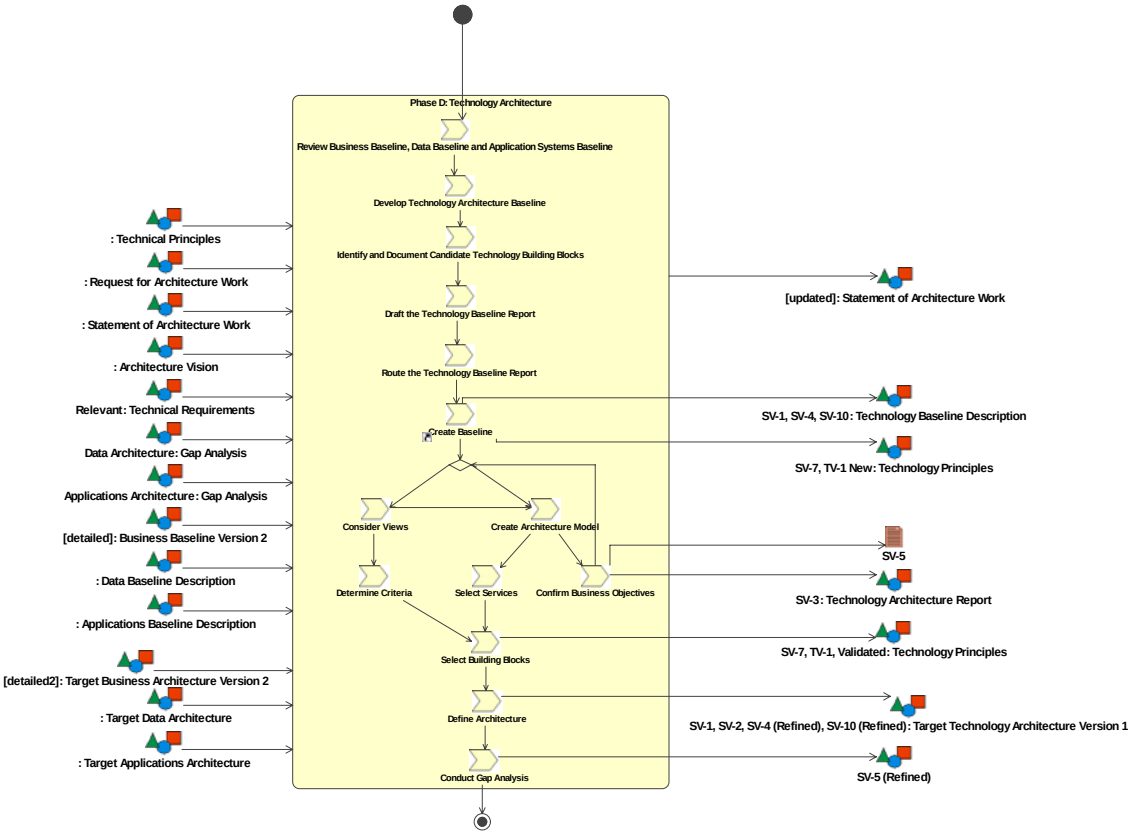

Figure 9: ADM Workflow for Phase D with DoDAF Views

Outputs

The outputs of this phase are:

- Statement of Architecture Work (updated if necessary)
- SV-1, SV-4, SV-10: Baseline Technology Architecture, if appropriate
- SV-7, TV-1: Validated Technology Principles, or new Technology Principles (if generated here)
- SV-3: Technology Architecture Report, summarizing what was done and the key findings
- Target Technology Architecture, Version 1
- SV-1, SV-2, SV-4, SV-10: Technology Architecture – gap report
- Viewpoints addressing key stakeholder concerns
- Views corresponding to the selected viewpoints

Phase E: Opportunities and Solutions

Objective

The objectives of this phase are to:

- Evaluate and select among the implementation options identified in the development of the various target architectures (for example, build-versus-buy-versus-re-use options, and sub-options within those major options)
- Identify the strategic parameters for change, and the top-level work packages or projects to be undertaken in moving from the current environment to the target
- Assess the dependencies, costs, and benefits of the various projects
- Generate an overall implementation and migration strategy and a detailed Implementation Plan

Approach

This phase identifies the parameters of change, the major phases along the way, and the top-level projects to be undertaken in moving from the current environment to the target. The output of this phase will form the basis of the Implementation Plan required to move to the target architecture. This phase also attempts to identify new business opportunities arising from the architecture work in previous phases.

Sometimes the process of identifying implementation opportunities allows a business to identify new applications, and in this case it may be necessary to iterate between Phase E and previous phases. Iteration must be limited by time or money to avoid wasting effort in the search for a perfect architecture.

Phase E is the first phase which is directly concerned with implementation. The task is to identify the major work packages or projects to be undertaken.

An effective way to do this is to use the gap analysis on the business functions between the old environment and the new, created in Phase D. Any functions appearing as “new” items will have to be implemented (developed or purchased and deployed).

Slightly harder to identify are the projects required to update or replace existing functions which must be done differently in the new environment. One of the options to be considered here is leaving an existing system in place and coexisting with the new environment.

During this final step in the specification of building blocks it must be verified that the organization-specific requirements will be met. Key to this is reason checking against the business scenario driving the scope of this project. It is important to note that the ensuing development process must include recognition of dependencies and boundaries for functions and should take account of what products are available in the marketplace. An example of how this might be expressed can be seen in the Building Blocks Example in TOGAF Part IV.

Coexistence appears on the surface to be easy. After all, the original system is left in place, largely unchanged. Unfortunately, it is not always as easy as it looks. The main problems with coexistence are:

- **User interfaces**: Combining user interfaces to the old and new applications in a single unit on the users' desks can be difficult, if not impossible.
- **Access to data**: Often the new applications need to share some data with the old applications, and some kind of data sharing must be established. This can be difficult unless the old and new systems use the same database technology.
- **Connectivity**: This may involve expenditure on software and gateway equipment. In difficult cases, equipment simply may not be available in a useful timescale. Often this happens because the old system is simply too out of date for connectivity solutions to be still on the market.

The most successful strategy for Phase E is to focus on projects that will deliver short-term pay-offs and so create an impetus for proceeding with longer-term projects.

Inputs

Inputs to this phase are:

- Request for Architecture Work
- Statement of Architecture Work
- Target Business Architecture
- Target Data Architecture
- Target Applications Architecture
- Target Technology Architecture
- Re-usable Architecture Building Blocks (from organization's Enterprise Continuum, if available)
- Product information

Steps

Key steps in this phase include:

1. Identify the key business drivers constraining the sequence of implementation (for example, reduction of costs; consolidation of services; introduction of new customer services; etc.)
2. Review the gap analysis generated in Phase D
3. Brainstorm technical requirements from a functional perspective
4. Brainstorm co-existence and interoperability requirements
5. Perform architecture assessment and gap analysis
6. Identify major work packages or projects, and classify as new development, purchase opportunity, or re-use of existing system

Tailored Steps with DoDAF

During Phase E, SV models that model the long-term Migration Plans and forecasts of technology and technology applications can be modeled using the following:

1. Develop a long-term Migration Plan (SV-8)
2. Document technology forecasts and their possible application in future technology investments (TV-2 and SV-9)
3. Conduct impact analysis

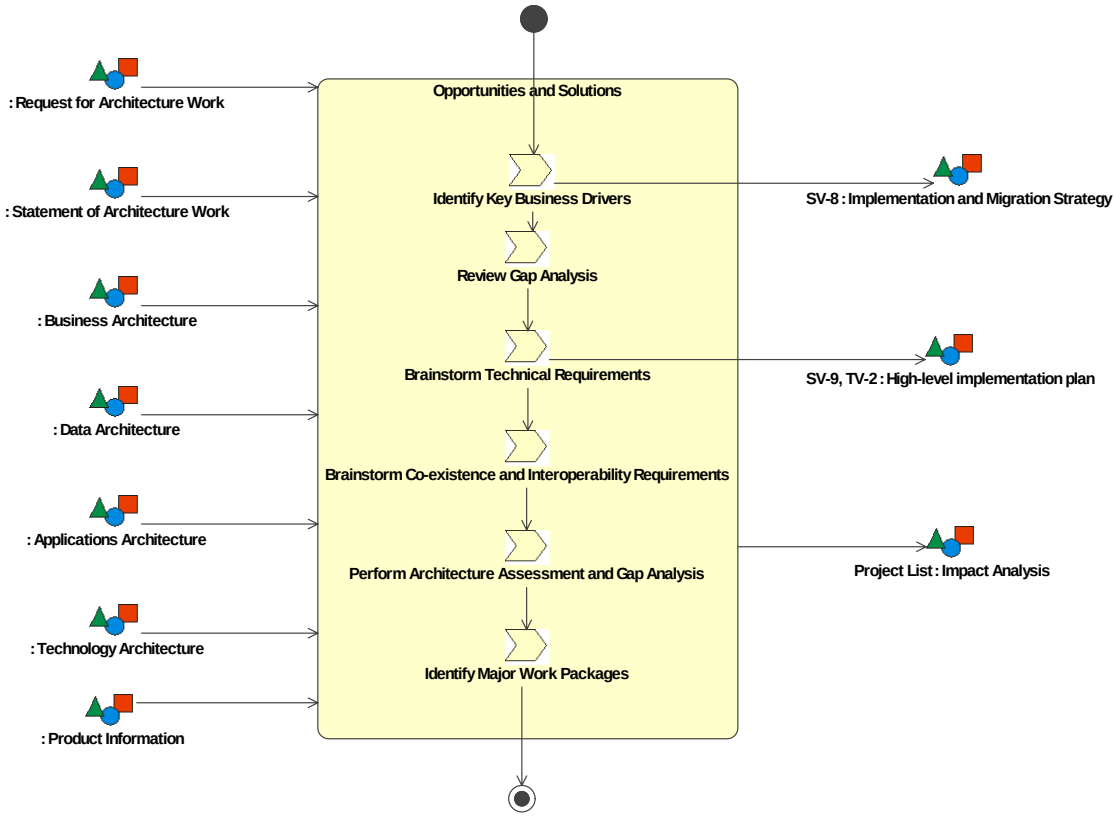

Figure 10: ADM Workflow for Phase E with DoDAF Views

Outputs

The outputs of this phase are:

- SV-8: Implementation and migration strategy
- SV-9, TV-2: High-level Implementation Plan
- Impact Analysis – project list

Phase F: Migration Planning

Objective

The objective of this phase is to sort the various implementation projects into priority order. Activities include assessing the dependencies, costs, and benefits of the various migration projects. The prioritized list of projects will go on to form the basis of the detailed Implementation and Migration Plan.

Approach

There are some important questions to be asked before embarking on a migration exercise:

- What are the implications of this project on other projects and activities?
- What are the dependencies between this project and other projects and activities?
- What products are needed?
- What components must be developed?
- Does the organization have the resources needed to develop such components?
- What standards are the products or components built on?
- When will they be available?
- Will the products stand the test of time, both because of the technology they use and also because of the viability of the supplier?
- What is the cost of retraining the users?
- What is the likely cultural impact on the user community, and how can it be controlled?
- What is the total cost of the migration, and what benefits will it deliver? It is important to look at actual benefits, and not presumed benefits. Is the funding available?
- Is the migration viable?

Many things affect the answers to these questions, including the current and future architectures, the size of the organization and its complexity, and the value of technology to the core functions of the organization. Other things to consider are the asset value of the current systems, and the level of risk associated with changing the solution and/or the supplier.

Most organizations find that a change of architecture has too much impact on the organization to be undertaken in a single phase. Migration often requires consideration of a number of technical issues, not the least of which are those associated with the means of introducing change to operational systems.

Issues requiring special consideration may include:

- Parallel operations
- Choices of proceeding with phased migration by subsystem or by function
- The impact of geographical separation on migration

The decisions resulting from these considerations should be incorporated in the Implementation Plan.

There are a number of strategies for developing the Migration and Implementation Plan.

The most successful basic strategy is to focus on projects that will deliver short-term pay-offs and so create an impetus for proceeding with longer-term projects.

One common approach is to implement business functions in a data-driven chronological sequence; i.e., create the applications and supporting technology that create data before those that process the data, before those that simply store, archive, or delete data.

For example, the following detailed description of this approach is taken from [SPE 68794]:

1. Determine the future disposition of current systems. Each current system is classified as:
   - **Mainstream systems** – part of the future information system.
   - **Contain systems** – expected to be replaced or modified in the planning horizon (next three years).
   - **Replace systems** – to be replaced in the planning horizon.

   The current system disposition decisions should be made by business people, not IT people.
2. Applications should be combined or split into parts to facilitate sequencing and implementation. This rearrangement of applications creates a number of projects, a project being equivalent to an application or to combinations or parts of applications.
3. Develop the data sequence for the projects as described in the Data Architecture. Using the CRUD (Create/Read/Update/Delete) matrix developed as part of the Data Architecture, sequence the projects such that projects that create data precede projects that read or update that data.
4. Develop an estimated value to the business for each project. To do this, first develop a matrix based on a value index dimension and a risk index dimension. The value index includes the following criteria: principles compliance, which includes financial contribution, strategic alignment, and competitive position. The risk index includes the following criteria: size and complexity, technology, organizational capacity, and impact of a failure. Each of the criteria has an individual weight. The index and its criteria and weighting are developed and approved by senior management early in the project. It is important to establish the decision-making criteria before the options are known.

In addition, there will be key business drivers to be addressed that will also tend to dictate the sequence of implementation, such as:

- Reduction of costs
- Consolidation of services
- Ability to handle change
- A goal to have a minimum of “interim” solutions (they often become long-term/strategic!)

Another, possibly complementary approach is for the individual projects or work packages to be group-sorted into a series of plateaux, each of which can be achieved in a realistic timescale.

The following description assumes a Target Architecture with only a single time horizon.

Inputs

Inputs to this phase are:

- Request for Architecture Work
- Statement of Architecture Work
- Target Business Architecture, Version 2
- Target Technology Architecture
- Impact Analysis – project list

Steps

Key steps in this phase include:

1. Prioritize projects
2. Estimate resource requirements and availability
3. Perform cost/benefit assessment of the various migration projects
4. Perform risk assessment
5. Generate implementation roadmap (time-lined)
6. Document the Migration Plan

Tailored Steps with DoDAF

During Phase F, a detailed SV-8 can be refined to model short and long-term Migration Plans and to conduct impact analysis.

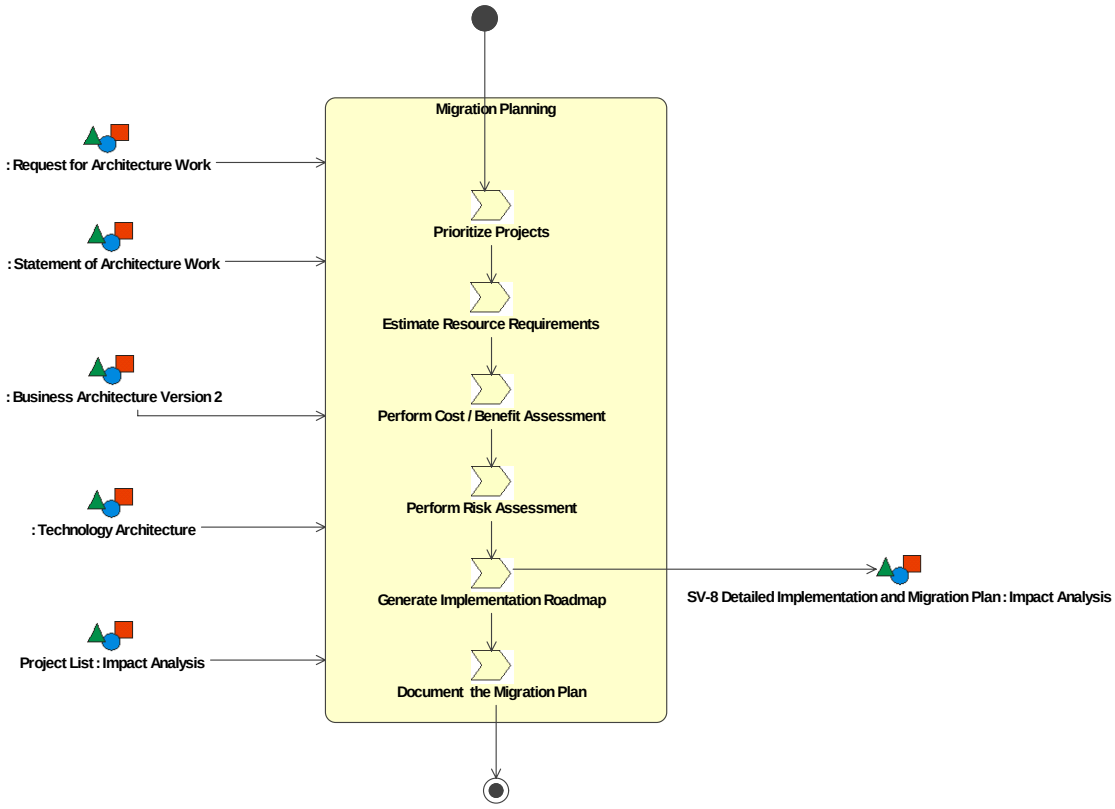

Figure 11: ADM Workflow for Phase F with DoDAF Views

Outputs

The output of this phase is:

- SV-8: Impact Analysis – Detailed Implementation and Migration Plan, including:
  - Architecture Implementation Contract (if appropriate)

Phase G: Implementation Governance

Objective

The objectives of this phase are to:

- Formulate recommendations for each implementation project
- Construct an architecture contract to govern the overall implementation and deployment process
- Perform appropriate governance functions while the system is being implemented and deployed
- Ensure conformance with the defined architecture by implementation projects and other projects

Approach

It is here that all the information for successful management of the various implementation projects is brought together. Note that in parallel with this phase there is the execution of an organizational-specific development process, where the actual development happens.

This phase establishes the connection between architecture and implementation organization, through the Architecture Contract.

Project details are developed, including:

- Name, description, and objectives
- Scope, deliverables, and constraints
- Measures of effectiveness
- Acceptance criteria
- Risks and issues

Implementation governance is closely allied to overall Architecture Governance, which is discussed in TOGAF Part IV, Architecture Governance.

A key aspect of this phase is ensuring compliance with the defined architecture(s), not only by the implementation projects but also by other ongoing projects within the enterprise. The considerations involved with this are explained detail in TOGAF Part IV, Architecture Compliance.

Inputs

Inputs to this phase are:

- Request for Architecture Work
- Statement of Architecture Work
- Re-usable Solutions Building Blocks (from organization's Solutions Continuum, if available)
- Impact Analysis – Detailed Implementation and Migration Plan (including Architecture Implementation Contract, if appropriate)

Steps

Key steps in this phase include:

7. Project recommendation formulation; for each separate implementation project do the following:

- Document scope of individual project in Impact Analysis
- Document strategic requirements (from the architectural perspective) in Impact Analysis
- Document change requests (such as support for a standard interface) in Impact Analysis
- Document rules for conformance in Impact Analysis
- Document timeline requirements from roadmap in Impact Analysis

1. Document Architecture Contract
   - Obtain signature from all developing organizations and sponsoring organization
2. Ongoing implementation governance and architecture compliance review

Tailored Steps with DoDAF

During Phase G, the architecture description created as a set of integrated models during the previous phases may be utilized to produce implementation recommendations. The SV and TV models can be utilized by system integrators as a high-level system of systems architecture model that describes information systems interoperability needs and a possible technology solution. AV-1 and OV-1 are additional resources to ensure that the architecture's implementation complies with key information captured in this model (assumptions, constraints, principles, drivers, etc.).

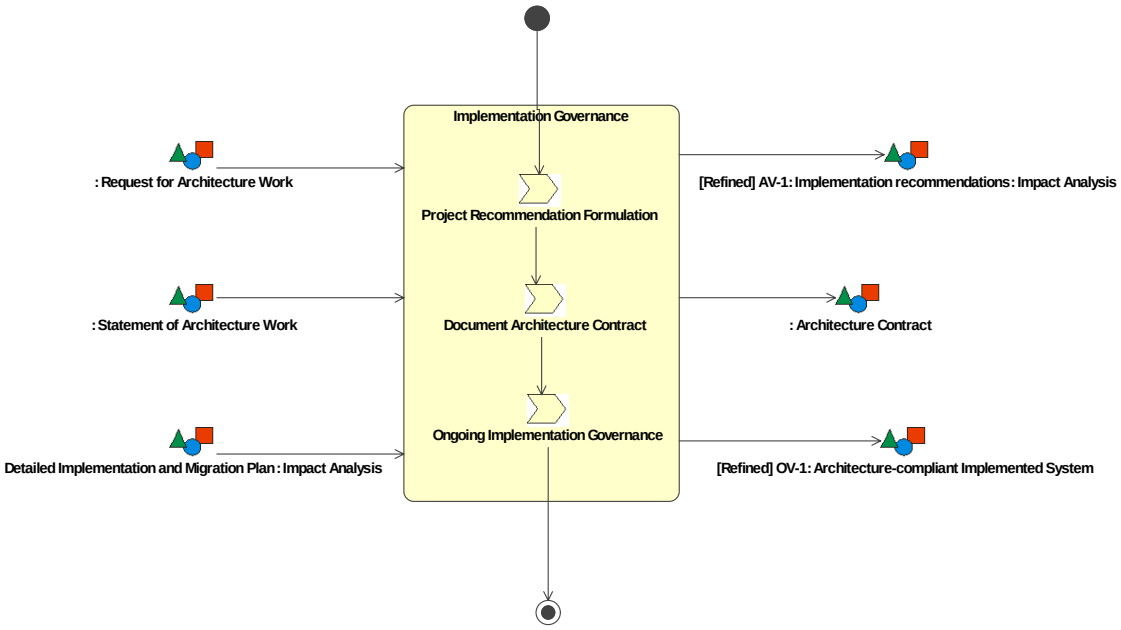

Figure 12: ADM Workflow for Phase G with DoDAF Views

Outputs

The outputs of this phase are:

- AV-1: Impact Analysis – Implementation recommendations
- Architecture Contract, as recommended in TOGAF Part IV, Architecture Contracts
- OV-1: The architecture-compliant implemented system

  Note: The implemented system is actually an output of the development process. However, given the importance of this output, it is stated here as an output of the architecture development method. The direct involvement of architecture staff in implementation will vary according to organizational policy, as described in TOGAF Part IV, Architecture Governance.

Phase H: Architecture Change Management

Objective

The objective of this phase is to establish an Architecture Change Management process for the new enterprise architecture baseline that is achieved with completion of Phase G. This process will typically provide for the continual monitoring of such things as new developments in technology and changes in the business environment, and for determining whether to formally initiate a new architecture evolution cycle.

This phase also provides for changes to the Framework and Principles set up in the Preliminary Phase.

Approach

The goal of an Architecture Change Management process is to ensure that changes to the architecture are managed in a cohesive and architected way, and to establish and support the implemented enterprise architecture as a *dynamic* architecture; that is, one having the flexibility to evolve rapidly in response to changes in the technology and business environment.

The Architecture Change Management process once established will determine:

- The circumstances under which the enterprise architecture, or parts of it, will be permitted to change after implementation; and the process by which that will happen
- The circumstances under which the enterprise architecture development cycle will be initiated again to develop a new architecture

The Architecture Change Management process is very closely related to the architecture governance processes of the enterprise, and to the management of the Architecture Contract between the architecture function and the business users of the enterprise.

In this phase it is critical that the governance body establish criteria to judge whether a change request warrants just an architecture update or whether it warrants starting a new cycle of the architecture development method. It is especially important to avoid “creeping elegance”, and the governance body must continue to look for changes that relate directly to business value.

Guidelines for establishing these criteria are difficult to prescribe, as many companies accept risk differently, but as the architecture development method is exercised, the maturity level of the governance body will improve, and criteria will become clear for specific needs.

Inputs

Inputs to this phase are:

- Request for Architecture Change – technology changes:
  - New technology reports
  - Asset management cost reduction initiatives
  - Technology withdrawal reports
  - Standards initiatives
- Request for Architecture Change – business changes:
  - Business developments
  - Business exceptions

- Business innovations
- Business technology innovations
- Strategic change developments

Steps

Key steps in this phase include:

1. Ongoing monitoring of technology changes
2. Ongoing monitoring of business changes
3. Assessment of changes and development of position to act
4. Meeting of Architecture Board (or other governing council) to decide on handling changes (technology and business)

Tailored Steps with DoDAF

During Phase H, the DoDAF architecture models that were created as a set of integrated models during the previous phases may be utilized to conduct change management, where all modification changes are made in the model and communicated to the various stakeholders. Further, SV-9 and TV-2 may be specifically used to model future plans for the systems modeled in the various DoDAF models.

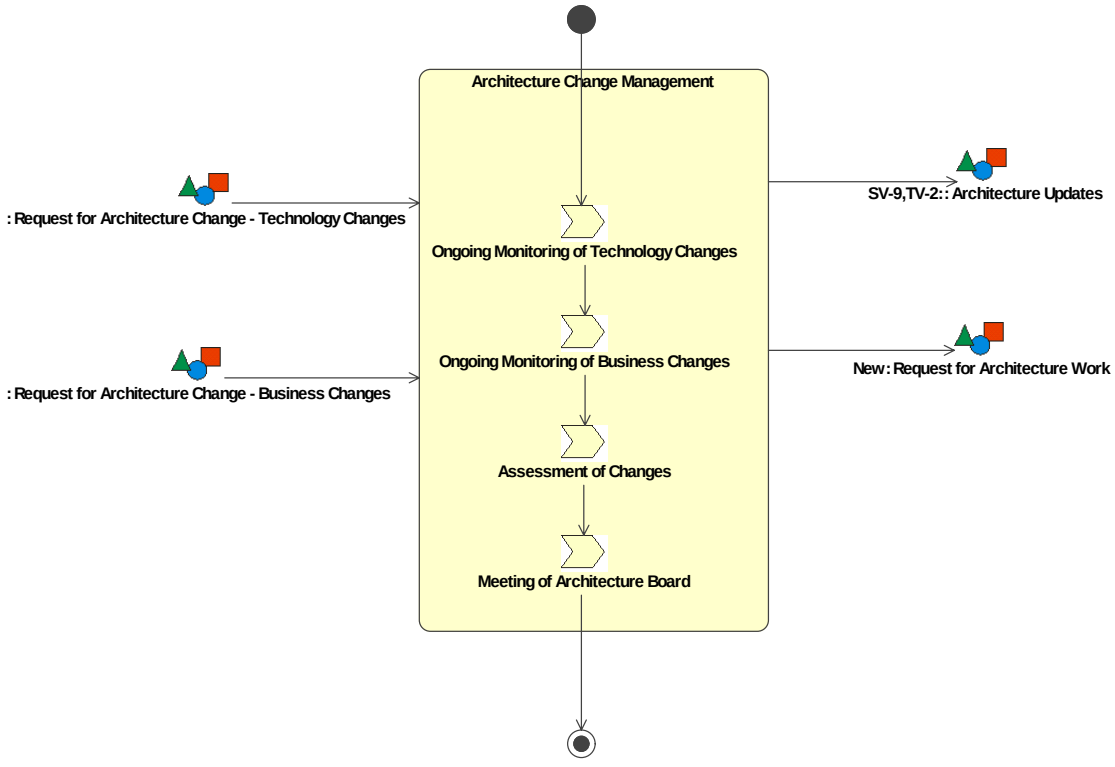

Figure 13: ADM Workflow for Phase H with DoDAF Views

Outputs

The outputs of this phase are:

- SV-9, TV-2: Architecture updates
- Changes to Architecture Framework and Principles
- New Request for Architecture Work (to move to another cycle)

DoDAF within the ADM

The following subsections document our TOGAF relationship observations associated with each DoDAF architecture model. It is important to note that there are cases where no DoDAF descriptive model was identified for a certain TOGAF construct. This should not be considered a problem. The goal of this White Paper is to outline which parts of TOGAF ADM relate to the intended content of each DoDAF architectural model. DoDAF can thus be leveraged to develop a visual model of the architecture and to use this model in facilitating and documenting decisions made during the ADM steps. Table 1 provides a quick overview of the correlation level (high, low, or none) between each DoDAF model and TOGAF ADM, along with a set of web links into specific parts of the ADM for each architectural model.

AV-1: Overview and Summary Information

The Overview and Summary Information provides executive-level summary information in a consistent form that allows quick reference and comparison among architectures. AV-1 includes assumptions, constraints, principles, and limitations that may affect high-level decision processes involving the architecture. It also documents aspects such as the approving authority, level of effort and costs, organizations involved, constraints/limitations, assumptions, and other planning elements of the architecting activities. AV-1 serves two purposes. In the initial phases of architecture development, it serves as a planning guide. Upon completion of an architecture description, AV-1 provides summary textual information concerning the architecture, acting as an Architecture Contract. This DoDAF model's focus is on the *architecting process*, rather than the *architecture description*.

TOGAF ADM elements supporting the development of AV-1 include Architecture Vision, IT Governance Strategy, Architecture Principles, and Impact Analysis. AV-1 is initially populated during TOGAF's Preliminary Phase and Phase A: Architecture Vision. It is updated to reflect results during TOGAF Phase G: Implementation Governance.

AV-2: Integrated Dictionary

The Integrated Dictionary contains definitions of terms used in the given architecture. It consists of textual definitions in the form of a glossary, a repository of architecture data, their taxonomies, and their metadata (i.e., data about architecture data), including metadata for tailored models, associated with the architecture models developed. AV-2 enables the set of architecture models to stand alone, allowing them to be read and understood with minimal reference to outside resources. AV-2 is an accompanying reference to other models, and its value lies in unambiguous definitions. The key to long-term interoperability can reside in the accuracy and clarity of these definitions.

AV-2 development begins during TOGAF Phase B: Business Architecture and evolves across all remaining phases of TOGAF ADM.

OV-1: High-Level Operational Concept Graphic

The High-Level Operational Concept Graphic sets the context for the architecture being described in the remaining models. It does this by describing a mission and highlighting the main operational nodes (see OV-2 definition) and any interesting or unique aspects of operations. It provides a description of the interactions between the subject architecture and its environment, and between the architecture and external assets. OV-1 should also reflect the principles, constraints, and environment defined in AV-1.

OV-1 is the graphical summary of the text that documents the Architecture Vision, IT Governance Strategy, Architecture Principles, and Impact Analysis. OV-1 is initially developed during TOGAF's Preliminary Phase and

Phase A: Architecture Vision (Scoping the Architecture) and early in Phase B: Business Architecture. It is updated to reflect results during TOGAF Phase G: Implementation Governance.

OV-2: Operational Node Connectivity Description

The Operational Node Connectivity Description graphically depicts the operational nodes (or organizations) with needlines between those nodes that indicate a need to exchange information. The graphic includes internal operational nodes (internal to the architecture) as well as external nodes. OV-2 is developed during TOGAF Phase B: Business Architecture elements: Business Architecture, Business Baseline, Business View, and Business Data.

OV-3: Operational Information Exchange Matrix

The Operational Information Exchange Matrix provides further detail about the exchange of information between operational activities. The OV-3 includes a description of required information exchanges (e.g., the providers and consumers that produce and consume information), a description of the information exchanged, and why the exchange is necessary. There is not a 1:1 mapping of the OV-3 information exchanges to the OV-2 needlines; rather, many individual information exchanges may be associated with one needline.

There is a coarse correlation to TOGAF Phase B: Business Architecture (Business Modeling), where information exchanges are discussed within the context of activity models.

OV-4: Organizational Relationships Chart

The Organizational Relationships Chart illustrates the relationships among organizations or resources in an architecture description. These relationships can be command and control relationships, coordination relationships (which influence what connectivity is needed), and many other types of relationships depending on the purpose of the architecture. This model is developed during Phase B: Business Architecture. OV-4 maps directly to the TOGAF Business Architecture activities. TOGAF ADM requires the identification of the organization structure and the business locations' relationships to organizational units.

OV-5: Operational Activity Model

The Operational Activity Model describes the operations that are normally conducted in the course of achieving a mission. It describes capabilities, operational activities (or tasks), information flows between activities, and information flows to/from activities that are outside the scope of the architecture. Additionally, overlays may be used to show cost, performing nodes, or other pertinent information. Activity models are explicitly addressed within TOGAF Phase B: Business Architecture.

OV-6a: Operational Rules Model

OV-6a identifies business rules that impact operations. This architecture model documents the law, policy, and guidance that constrain the business processes. TOGAF ADM discusses *rules* as an element within the Activity model in Phase B: Business Architecture, as an annotation of that activity information.

OV-6b: Operational State Transition Diagram

OV-6b identifies business process responses to events. It is one of the OV models that model behavior (along with OV-5 and OV-6c). TOGAF does not specify a modeling notation or technique, but operational states can be described during TOGAF Phase B: Business Architecture.

OV-6c: Operational Event Trace Diagram

The dynamic behavior referred to in DoDAF concerns the timing and sequencing of events that capture the operational behavior of operational activities, thus describing a process or a mission thread. OV-6c is a Process (Control) Flow diagram for those operational processes where the sequence is known. TOGAF ADM requires the description of the business processes and scenarios during Phase B: Business Architecture.

OV-7: Logical Data Model

The Logical Data Model describes the structure of an architecture domain's information and data types and the structural business rules (defined in the architecture's Operational View) that govern the data. It provides the architecture domain vocabulary, taxonomy, and upper-level ontology (product, material, data enumeration lists, and decomposition) related to communities of interest (CoI). OV-7 is developed during TOGAF Phase C: Information Systems Architecture [Data Architecture].

SV-1: Systems Interface Description

The Systems Interface Description depicts systems nodes and the systems resident at these nodes to support organizations/human roles represented by operational nodes of the Operational Node Connectivity Description (OV-2). SV-1 also identifies the interfaces between systems and systems nodes, both from inter-nodal and intra-nodal perspectives. These models are used during TOGAF Phase D: Technology Architecture [Developing Architecture Views: Systems Engineering View].

SV-2: Systems Communications Description

The Systems Communications Description depicts pertinent information about communications systems, communications links, and communications networks. SV-2 documents the kinds of communications media that support the systems and implement their interfaces as described in SV-1. SV-2 is developed during TOGAF Phase D: Technology Architecture [Developing Architecture Views: Communications Engineering View].

SV-3: Systems-Systems Matrix

The Systems-Systems Matrix provides detail on the interface characteristics described in SV-1 for the architecture, arranged in an N-squared matrix form. SV-3 can be extended with system-centric information of interest such as planned interfaces, retired interfaces, types of interfaces, etc. SV-3 can be utilized as a supporting model within TOGAF Phase D: Technology Architecture [Developing Architecture Views: Systems Engineering View].

SV-4: Systems Functionality Description

The Systems Functionality Description documents system functional hierarchies and system functions and services, and the system data flows between them. SV-4 supports TOGAF Phase C: Information Systems Architectures [Applications Architecture] and Phase D: Technology Architecture [Developing Architecture Views: Data Flow View]. SV-4 is used to model supported system inter-dependencies, software services, applications, their structure, and their dependencies.

SV-5: Operational Activity to Systems Function Traceability Matrix

SV-5 maps the operational activities documented in OV-5 to the set of system functions/services identified that will support those activities. Although there is a correlation between Operational Activity Model (OV-5) or business-process hierarchies and the system functional hierarchy of SV-4, it need not be a one-to-one mapping, hence, the

need for the Operational Activity to Systems Function Traceability Matrix (SV-5), which provides that mapping. This is a report that is auto-generated through many architecture tools. It can be used to support alignment of TOGAF Phase B with Phases C and D.

SV-6: Systems Data Exchange Matrix

The Systems Data Exchange Matrix specifies the characteristics of the system data exchanged between systems. This model focuses on automated information exchanges (from OV-3 requirements) that are implemented in systems. The SV-6 contents relate to each data element's description, consumer, producer, performance attributes, information assurance/security attributes. SV-6 supports TOGAF Phase C: Information Systems Architecture [Applications Architecture].

SV-7: Systems Performance Parameters Matrix

The Systems Performance Parameters Matrix model specifies the quantitative characteristics of systems and system hardware/software items, their interfaces (system data carried by the interface as well as communications link details that implement the interface), and their functions. It specifies the current performance parameters of each system, interface, or system function, and the expected or required performance parameters at specified times in the future. SV-7 supports TOGAF Phase D: Technology Architecture [Developing Architecture Views: Systems Engineering View].

SV-8: Systems Evolution Description

SV-8 documents the sequencing plan to be used to evolve the current legacy system(s) to the desired future system(s). TOGAF Phase E Opportunities and Solutions and Phase F: Migration Planning are centered on this aspect of architecting and align with this DoDAF model.

SV-9: Systems Technology Forecast

SV-9 summarizes future software and hardware technologies that impact the architecture and the deployed system(s). Time periods are documented to reflect when these technologies are anticipated for real-world use. Although there is no explicit relationship within TOGAF ADM, SV-9 could be utilized during TOGAF Phase E: Opportunities and Solutions as an extension to the implementation details, and during Phase H: Architecture Change Management.

SV-10a: Systems Rules Model

SV-10a is the systems perspective of OV-6a. At the systems or system hardware/software items level, SV-10a describes the rules under which the architecture or its systems behave under specified conditions. The ADM mentions *rules* as an element within the activity model in Phase B: Business Architecture, but SV-10a can be utilized as a supporting model within TOGAF Phase C: Information Systems Architectures [Applications Architecture] and Phase D: Technology Architecture [Developing Architecture Views: Systems Engineering View].

SV-10b: Systems State Transition Diagram

The Systems State Transition Description is a graphical method of describing a system (or system function) response to various events by changing its state. SV-10b is the systems perspective of OV-6b. It identifies system state transitions in response to certain events. System states can be described during TOGAF Phase C: Information Systems Architectures [Applications Architecture] and Phase D: Technology Architecture [Developing Architecture Views: Systems Engineering View].

SV-10c: Systems Event Trace Diagram

SV-10c is the systems perspective of OV-6c. It identifies system-specific refinements of critical sequences of events described in OV-6c. SV-10c can be used to support TOGAF Phase C: Information Systems Architectures [Applications Architecture] and Phase D: Technology Architecture [Developing Architecture Views: Systems Engineering View].

SV-11: Physical Schema

SV-11 defines the structure of the various kinds of system data that are utilized by the systems in the architecture. TOGAF discusses the development of higher-level database models (conceptual, logical) during Phase C: Information Systems Architecture [Data Architecture].

TV-1: Technical Standards Profile

The Technical Standards Profile collects the various systems standards rules that implement and sometimes constrain the choices that can be made in the design and implementation of an architecture description. TV-1 can be utilized as a supporting model within TOGAF Phase D: Technology Architecture [Developing Architecture Views: Systems Engineering View].

TV-2: Technical Standards Forecast

The Technical Standards Forecast contains expected changes in technology-related standards and conventions, which are documented in the TV-1 model. The forecast for evolutionary changes in the standards should be correlated against the time periods as mentioned in the SV-8 and SV-9 models. TV-2 can be utilized as a supporting model within TOGAF Phase E: Opportunities & Solutions, and during Phase H: Architecture Change Management.

Summary

ADM and DoDAF each address different aspects of the needs of the architect: methodology and architecture description, respectively. There is synergy across a number of areas between these two frameworks, where DoDAF views can be used throughout the ADM steps to develop a model of the architecture of concern. Such a visual model facilitates architectural decisions made following the TOGAF architecture methodology.

Iteration and evolution should occur for all architecture models across the lifecycle of system development, but there are general relationships between the DoDAF views and TOGAF phases:

- DoDAF's All Views primarily aligns with TOGAF Preliminary Phase and Phase A: Architecture Vision.
- DoDAF's Operational View primarily aligns with TOGAF Phase B: Business Architecture and Phase C: Information Systems Architecture activities.
- DoDAF's Systems View primarily aligns with TOGAF Phase C: Information Systems Architecture, Phase D: Technology Architecture, Phase F: Migration Planning, and Phase E: Opportunities and Solutions.
- DoDAF's Technical Standards View primarily aligns with TOGAF Phase D: Technology Architecture, Technical Reference Model, and Phase E: Opportunities and Solutions.

Each complex architecting endeavor requires several key elements in order to reach a successful conclusion: repeatable methodology, standardized output models, formal validation, governance, collaboration guidelines, configuration management, tools, and patterns. The architect is able to address many of these needs through the application of the TOGAF ADM as a disciplined process in developing the DoDAF set of views to model the architecture.

References

[CAF-1996] C4ISR Architecture Working Group, Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance Architecture Framework, Versions 1.0-2.0, 1996-1997

[DoDAF-2004] US Department of Defense Architecture Framework Working Group, Department of Defense Architecture Framework (DoDAF), Version 1.0, February 2004; refer to: www.dod.mil/cio-nii/cio/earch.shtml (scroll down to bottom of page)

[OMG-2006] UML Profile for DoDAF/MODAF (UPDM); refer to: syseng.omg.org/UPDM.htm www.omg.org/cgi-bin/doc?c4i/2006-11-04

[REAP-2005] Raytheon Company, Raytheon Enterprise Architecture Process (REAP), Revision F, 2005

[TAFIM-1996] US Department of Defense Architecture Methodology Working Group, Technical Architecture Framework for Information Management (TAFIM), Versions 1.0-3.0, 1993-1996

[TOGAF-2003] The Open Group, The Open Group Architecture Framework (TOGAF), Versions 1.0-8.1, 1995-2003

Acronyms

ADM	Architecture Development Method [from TOGAF]
AV	All Views [from DoDAF]
C4ISR	Command, Control, Communications, Computers, Intelligence, Reconnaissance, Surveillance
CADM	Core Architecture Data Model
CAF	C4ISR Architecture Framework
DoD	Department of Defense
DoDAF	Department of Defense Architecture Framework
MODAF	Ministry of Defence Architecture Framework
OV	Operational View [from DoDAF]
SV	Systems View [from DoDAF]
TAFIM	Technical Architecture Framework for Information Management
TOGAF	The Open Group Architecture Framework
TV	Technical Standards View [from DoDAF]
URR	Universal Reference Resource
US	United States

About the Authors

Dr. **Fatma Dandashi** is currently leading an Object Management Group (OMG) effort to define a UML profile for the DoD Architecture Framework (DoDAF). Prior to this activity, she supported the development of Air Force Enterprise Architecture for SAF/XC. Fatma was task lead on the MITRE development team responsible for DoDAF v1.0 (Volumes I and II), and currently serves on the working group developing DoDAF v2.0.

Fatma holds a PhD in Information Technology from George Mason University, a Master of Science Degree in Computer Science from the University of Louisiana (Lafayette), and a Bachelor of Arts degree in Computers/Business Administration from the Lebanese American University.

Rolf Siegers is Raytheon's Corporate Director of Architecture & Systems Integration and an Engineering Fellow. He joined Raytheon in 1984 and leads the Raytheon Enterprise Architecture Process (REAP) Initiative [REAP-2005], a standards-based unification of several architecture frameworks and is Raytheon's company-wide architecting process. Rolf also sits on Raytheon's corporate Architecture Review Board (ARB), leading and supporting a variety of architecture-related initiatives.

Rolf's program experience includes leading several multi-discipline software architecture teams for largescale, software-intensive national and international systems since 1997. He is a certified TOGAF 8 architect, ATAM® Evaluator (SEI), and Software Architecture Professional (SEI). Rolf holds bachelor degrees in Computer Science and Mathematics from Huntingdon College and is a member of IEEE and INCOSE.

Judith Jones has served as an advisor to Brussels, CCTA, and Industry Organizations on Enterprise Architecture and IS/IT Architecture and Frameworks, eGovernment, Practitioner of TOGAF, and PRINCE-2. Her background experience includes 10 years as an independent consultant and 20+ years as a business manager with ICL, now Fujitsu Services.

Judith is an experienced program manager and principal consultant with significant skills in customer-centric programs, including Customer Relationship Management, Enterprise Architecture, Operational Business, and IT Infrastructures. Her consulting experience includes business change, strategy development and communications, business architecture, business development and marketing, sales, strategy and partnership alignment, business re-engineering to change, specify, and deliver customer value, process, and commercial initiatives.

Judith is an extremely active member of The Open Group and has worked with their Architecture Forum to establish Enterprise Architecture development processes and strategies suitable for global government and private sector usage. She currently leads the TOGAF 9 development effort.

Terry Blevins is Branch Chief & Lead Architect, US Air Force Operational Support Enterprise Architecture, at the MITRE Corporation.

Terry has been involved with the architecture discipline since the 1980s when he was at the NCR Corporation as Director of Strategic Architecture. He has been involved with evolving this discipline since 1996 when he first was introduced to The Open Group Architecture Forum. He was co-chair of the Architecture Forum and frequent contributor of content to TOGAF, including the Business Scenario Method.

Terry was previously VP & CIO of The Open Group, where he contributed to The Open Group vision of Boundaryless Information Flow™. He holds undergraduate and Masters degrees in Mathematics from Youngstown State University. He is TOGAF 8 certified.

About The Open Group

The Open Group is a vendor-neutral and technology-neutral consortium, whose vision of Boundaryless Information Flow™ will enable access to integrated information within and between enterprises based on open standards and global interoperability. The Open Group works with customers, suppliers, consortia, and other standards bodies. Its role is to capture, understand, and address current and emerging requirements, establish policies, and share best practices; to facilitate interoperability, develop consensus, and evolve and integrate specifications and Open Source technologies; to offer a comprehensive set of services to enhance the operational efficiency of consortia; and to operate the industry's premier certification service, including UNIX® system certification. Further information on The Open Group can be found at www.opengroup.org.