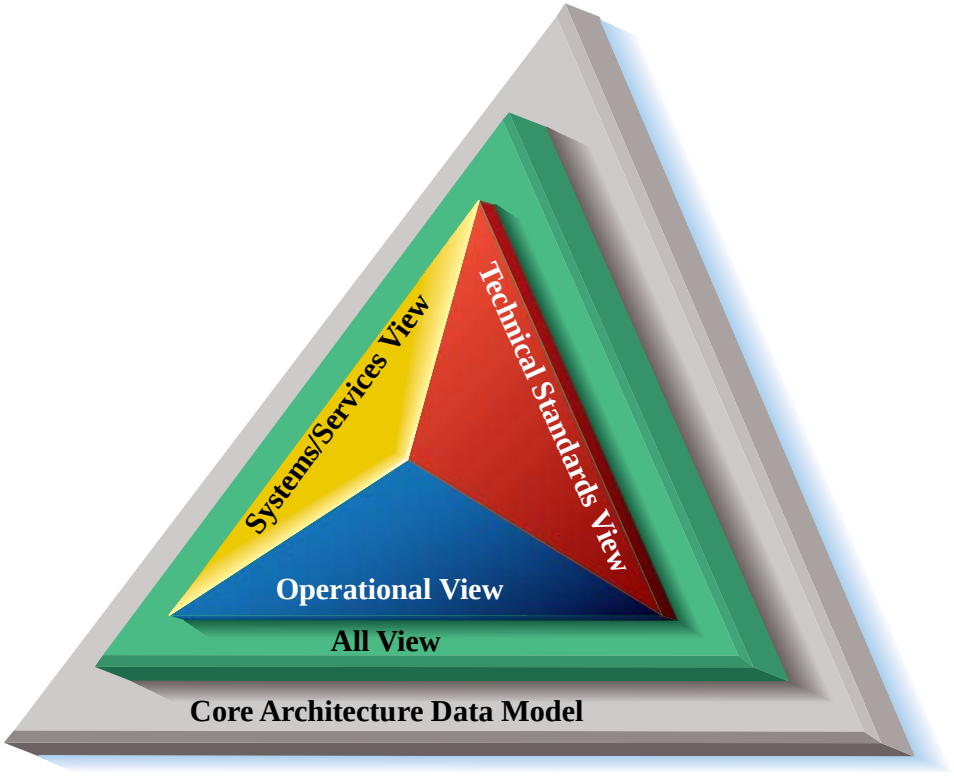
DoD Architecture Framework
Version 1.5



Volume I: Definitions and Guidelines

23 April 2007

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EXECUTIVE SUMMARY

> **Architecture**: the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time.
>
> DoD Integrated Architecture Panel, 1995, based on IEEE STD 610.12

Architectures within the Department of Defense (DoD) are created for a number of reasons. From a compliance perspective, the DoD's development of architectures is compelled by law and policy (i.e., Clinger-Cohen Act, Office of Management and Budget (OMB) Circular A-130). From a practical perspective, experience has demonstrated that the management of large organizations employing sophisticated systems and technologies in pursuit of joint missions demands a structured, repeatable method for evaluating investments and investment alternatives, as well as the ability to effectively implement organizational change, create new systems, and deploy new technologies. Towards this end, the DoD Architecture Framework (DoDAF) was established as a guide for the development of architectures. (For the purposes of this document the terms DoDAF and framework are synonymous.)

The DoDAF provides the guidance and rules for developing, representing, and understanding architectures based on a common denominator across DoD, Joint, and multinational boundaries. It provides insight for external stakeholders into how the DoD develops architectures. The DoDAF is intended to ensure that architecture descriptions can be compared and related across programs, mission areas, and, ultimately, the enterprise, thus, establishing the foundation for analyses that supports decision-making processes throughout the DoD.

As the Department takes appropriate strides to ensure advancement of the Information Technology (IT) environment, it is essential for the DoDAF to transform to sufficiently support new technologies. A significant evolution occurring today is the Department's transformation to a new type of information intensive warfare known as Net-Centric Warfare (NCW). NCW focuses on generating combat power from the effective linking or networking of the warfighting enterprise, and making essential information available to authenticated, authorized users when and where they need it. This ability is at the heart of net-centricity and essential to achieving Net-Centric Operations (NCO).

DoDAF v1.5 is a transitional version that responds to the DoD's migration towards NCW. It applies essential net-centric concepts[1] in transforming the DoDAF and acknowledges that the advances in enabling technologies – such as services within a Service Oriented Architecture (SOA) – are fundamental to realizing the Department's Net-Centric Vision.[2] Version 1.5 addresses the immediate net-centric architecture development needs of the Department while maintaining backward compatibility with DoDAF v1.0.

In addition to net-centric guidance, DoDAF v1.5 places more emphasis on architecture data, rather than the products, introduces the concept of federated architectures, and incorporates the Core Architecture Data Model (CADM) as an integral component of the DoDAF. These aspects

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[1] Reference DoDAF v1.5 Volume II for further information on the following net-centric concepts and their application to DoDAF: 1) Populate the Net-Centric Environment, 2) Utilize the Net-Centric Environment, 3) Accommodate the Unanticipated User, 4) Promote the Use of Communities of Interest (COI), 5) Support Shared Infrastructure

[2] 2005 National Defense Strategy

prepare the way for more efficient and flexible use and reuse of architecture data, enabling broader utility for decision makers and process[3] owners.

The DoDAF is a three-volume set that inclusively covers the concept of the architecture framework, development of architecture descriptions, and management of architecture data.

- Volume I introduces the DoDAF framework and addresses the development, use, governance, and maintenance of architecture data.
- Volume II outlines the essential aspects of architecture development and applies the net-centric concepts to the DoDAF products.
- Volume III introduces the architecture data management strategy and describes the pre-release CADM v1.5, which includes the data elements and business rules for the relationships that enable consistent data representation across architectures.

An Online DoDAF Journal, hosted on the DoD Architecture Registry System (DARS) website (https://dars1.army.mil/IER/index.jsp), replaces the DoDAF v1.0 Desk Book and is designed to capture development best practices, architecture analytical techniques, and showcase exemplar architectures.

The DoDAF will continue to evolve (see **Figure ES-1**, Evolution of the DoDAF) to meet the growing needs of decision makers in a Net-Centric Environment (NCE). Going forward, architectures will need to capture the development of a new generation of net-centric capabilities stemming from operational insights gained in Afghanistan and Iraq. As the maturation of the Global Information Grid (GIG) continues through GIG Capability Increments (an incremental time frame approach to the delivery of GIG-enabling capabilities), architectures will be a factor in evaluating increment investments, development, and performance at the mission portfolio levels. As the DoD increases its use of architecture data for decision-making processes, architects will need to understand how to aggregate the data for presentation purposes at the enterprise level. The DoDAF plays a critical role in the development of architectures and will continue to improve its support for the increasing uses of architecture data.

[3] CJCS Instruction 3170.01E, Joint Capabilities Integration and Development System (JCIDS); DoD Directive 7045.14, Planning, Programming, Budgeting, and Execution (PPBE); DoD Directive 5000.1, The Defense Acquisition System (DAS); DoD Directive 8115.01, Information Technology Portfolio Management (PfM)

EVOLUTION OF THE DOD ARCHITECTURE FRAMEWORK

PAST

- **C4ISR Architecture Framework v1.0, 7 June 1996**

The Command, Control, Communications, Computers, and Intelligence, Surveillance, and Reconnaissance (C4ISR) Architecture Framework v1.0 was created in response to the passage of the Clinger-Cohen Act and addressed in the 1995 Deputy Secretary of Defense directive that a DoD-wide effort be undertaken to define and develop a better means and process for ensuring that C4ISR capabilities were interoperable and met the needs of the warfighter.

- **C4ISR Architecture Framework v2.0, 18 December 1997**

The C4ISR Architecture Framework v2.0 was the result of the continued development effort by the C4ISR Architecture Working Group and was mandated for all C4ISR architecture descriptions in a February 1998 memorandum by the Architecture Coordination Council, co-chaired by the Under Secretary of Defense for Acquisition and Technology (USD[A&T]), the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD[C3I]), and the Command, Control, Communications, and Computer Systems Directorate, Joint Staff (J6).

- **DoD Architecture Framework v1.0, 30 August 2003**

The DoDAF v1.0 restructured the C4ISR Framework v2.0 to offer guidance, product descriptions, and supplementary information in two volumes and a Desk Book. It broadened the applicability of architecture tenets and practices to all Mission Areas rather than just the C4ISR community. This document addressed usage, integrated architectures, DoD and Federal policies, value of architectures, architecture measures, DoD decision support processes, development techniques, analytical techniques, and the CADM v1.01, and moved towards a repository-based approach by placing emphasis on architecture data elements that comprise architecture products.

PRESENT

- **DoD Architecture Framework, v1.5, 23 April 2007**

The DoDAF v1.5 is an evolution of the DoDAF v1.0 and reflects and leverages the experience that the DoD Components have gained in developing and using architecture descriptions. This transitional version provides additional guidance on how to reflect net-centric concepts within architecture descriptions, includes information on architecture data management and federating architectures through the Department, and incorporates the pre-release CADM v1.5, a simplified model of previous CADM versions that includes net-centric elements.

FUTURE

- **DoD Architecture Framework v2.0, TBD**

The DoDAF v2.0 is currently being scoped to include further guidance on planning, developing, managing, maintaining, and governing architectures through a coherent semantic and structural metamodel. This version will place greater emphasis on a “data-centric” approach that facilitates the use of architecture by a wider variety of decision makers and will include additional information on federation for improved enterprise decisions.

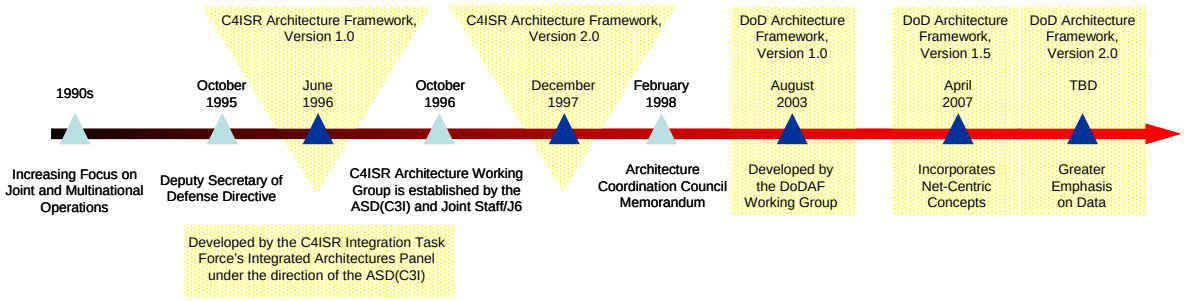

Figure ES-1 Evolution of the DoDAF

1 INTRODUCTION

"The Defense Science Board and other major studies have concluded that one of the key means for ensuring interoperable and cost-effective military systems is to establish comprehensive architectural guidance for all of DoD." [USD(A&T), ASD(C3I), J6, 1997]

1.1 VOLUME I PURPOSE AND INTENDED AUDIENCE

The purpose of the DoDAF v1.5, Volume I is to introduce the DoD architecture concept and provide general guidance with regards to development, usage, and management of DoD architectures. This volume is intended to aid users in understanding the role of architectures in supporting the major decision support processes[4] and NCE regardless of mission area[5] or tier (i.e., program, DoD Component, mission, enterprise).

Volume I addresses the following audience (**Table 1-1**):

Table 1-1: Volume I Audience

Decision Maker	Understands the application of architecture in the major decision support processes and how to analyze architecture to support decisions
Architect	Understands how to apply a data-centric approach towards the development of an architecture that supports integration and federation
Manager	Understands the architecture community's approach to governing, maintaining, and managing architecture data

This document is organized in the following manner (**Table 1-2**):

Table 1-2: Organization of Volume I

Section	Content
Section 1	*Introduction* – Provides a high level overview of the DoDAF and introduces the concepts of architecture integration and federation
Section 2	*Architecture Development* – Provides architecture guidance regarding development, integration, federation, and net-centricity
Section 3	*Architecture Usage* – Provides the various uses of architectures and introduces architecture data visualization, a concept that supports the use of architectures in decision analyses
Section 4	*Governing, Maintaining, and Managing Architectures Through Data* – Introduces the architecture community's approach towards architecture governance, maintenance, and management

[4] CJCS Instruction 3170.01E, Joint Capabilities Integration and Development System (JCIDS); DoD Directive 7045.14, Planning, Programming, Budgeting, and Execution (PPBE); DoD Directive 5000.1, The Defense Acquisition System (DAS); DoD Directive 8115.01, Information Technology Portfolio Management (PfM)

[5] Warfighting Mission Area (WMA), Business Mission Area (BMA), DoD portion of the Intelligence Mission Area (DIMA), Enterprise Information Environment Mission Area (EIMA)

1.2 SCOPE OF DODAF v1.5

NCO requires that information and the ability to share information when it is needed, where it is needed, and with those who need it is critical to enabling transformation. The DoDAF V1.5 supports transformation goals by providing net-centric guidance for describing architecture artifacts consistently across all mission operations and processes, and enabling the integration and/or federation of architectures in support of joint capabilities. DoDAF v1.5 begins to transition its focus away from architecture products ("product-centric") as seen in v1.0 and aims toward a greater emphasis on architecture data ("data-centric"). A "data-centric" approach provides a more flexible and adaptable framework for architecting net-centric, integrated, and/or federated architectures.

Version 1.5 is the first phase in transforming the DoDAF and is intended to address concerns and desires from the architecture community in a timely manner, while allowing for more revolutionary improvements in subsequent releases. More complex and substantial topics being scoped for subsequent DoDAF versions include:

- Robust inclusion/enhancements to address SOA
- Increased guidance on describing changes in culture, doctrine, and processes resulting from NCO
- Increased support for data-centric architecture management, including data visualization via extractions to address decision system support and portfolio management (PfM) activities
- Additional guidance and examples to better address the development and use of Enterprise Architecture in aligning with the Federal and DoD Enterprise Architectures[6]
- Streamlining of the architecture development process to enable more rapid fielding and agility
- Other fundamental architecture issues, such as security, systems engineering, tools, and methodology recommendations

1.2.1 Net-Centric Architectures

In the March 2005 National Defense Strategy, the DoD restated its commitment towards net-centricity and NCO. In this paradigm, the NCE, and its associated information and capabilities, are leveraged as a key component for carrying out missions. The GIG, the "globally interconnected, end-to-end set of information, capabilities, associated processes, and personnel for collecting, processing, storing, disseminating, and managing information on demand to warfighters, policy makers, and support personnel" is the foundation for this environment. Because of this shift towards net-centricity and the need to effectively develop and manage the GIG, it becomes necessary for architectures to consistently capture net-centric concepts so as to afford their accountability in transition planning, implementation, and decision making. Consistent representation of net-centric concepts aligns with the goals of integrated and/or federated architectures.

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[6] Department of Defense Enterprise Architecture, http://www.army.mil/escc/cpi/refmod4b.htm

An incremental approach has been established for integrating net-centric concepts into the DoDAF. DoDAF v1.5 reflects the first increment by introducing net-centricity and NCO, and describing the net-centric relationship to the DoDAF. It aims to provide a near-term benefit to architecture developers for capturing an initial set of net-centric concepts within their architecture artifacts. Notable aspects of v1.5 include:

1. **Net-Centric Concepts** – Net-centric concepts were identified in accordance with established Assistant Secretary of Defense for Network and Information Integration (ASD[NII])/DoD Chief Information Officer (CIO) net-centric policy and guidance. These concepts were vetted through subject matter experts and representatives from across the DoD Components through collaborative workshops. DoDAF v1.5 Volume II details the net-centric guidance within existing DoDAF products and views.
2. **Service Oriented Architecture** – "A paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains"[7] has shown promise in commercial IT environments. The DoD recognizes that services and SOA are key enablers for implementing net-centric objectives. Services provide a sensible approach for populating the NCE with dynamic sources of information and capabilities – a tenet of net-centricity that is at the heart of several key DoD strategies such as the DoD Net-Centric Data Strategy. DoDAF v1.5, while not focused on the more robust aspects of SOA, does address various facets of services and SOA while allowing for additional guidance to be provided in subsequent versions as aligned to the ASD(NII)/DoD CIO's vision.
3. **Scope of Net-Centric Guidance –** DoDAF can be used to describe many forms of architecture, including programs/systems or missions. DoDAF v1.5 offers net-centric guidance focused largely on supporting program-level or capability architectures, particularly around information architectures and information technology (IT) infrastructures.
4. **Backward Compatibility** – DoDAF v1.5 introduces guidance for representing net-centric concepts in the DoDAF products while maintaining complete backward compatibility with the architecture views in DoDAF v1.0. Guidance for capturing net-centric aspects of architecture purposefully does not conflict with existing guidance on DoDAF views (Volume II) and is fully compatible with modifications noted to the pre-release CADM v1.5 specifications (Volume III). Pre-release CADM v1.5 is also backward compatible with previous CADM versions. Data sets built in accordance with the vocabulary of CADM v1.02/1.03 can be expressed faithfully and completely using the constructs of CADM v1.5.

To support these notable aspects, it became necessary to extend or change the product list to accommodate the development of architectures for the requirements of the net-centric concepts and SOA. **Table 1-3** identifies the new products and provides reasons for their addition.

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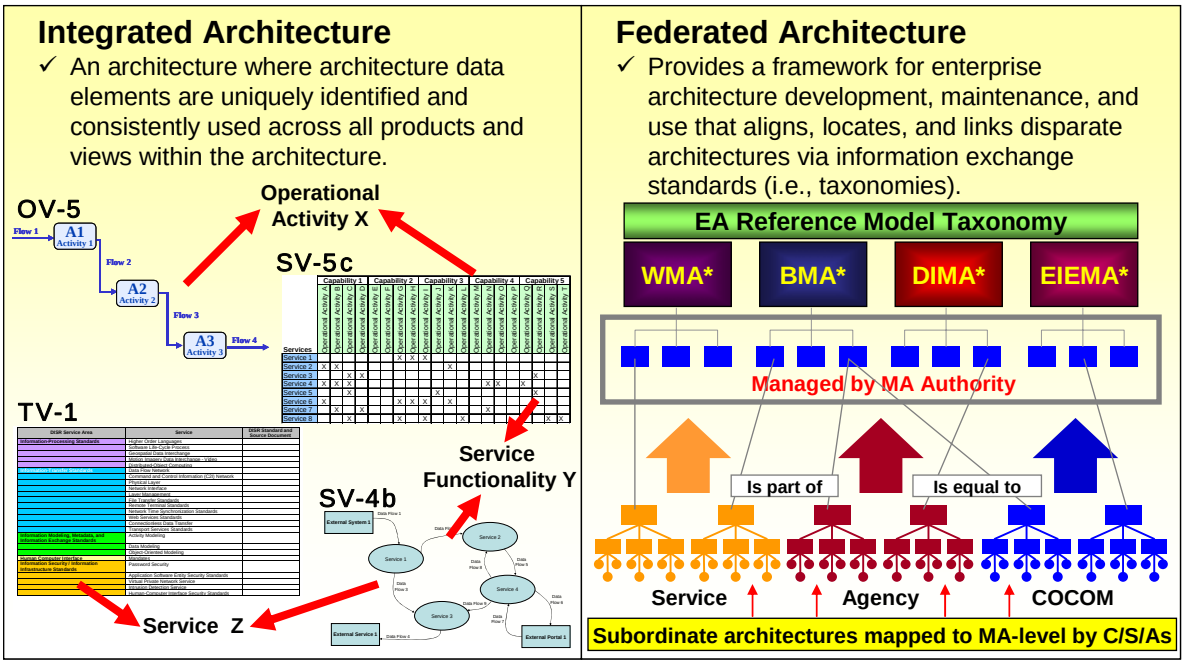
[7] Organization for the Advancement of Structured Information Standards (OASIS), "Reference Model for Service Oriented Architecture 1.0", OASIS Standard, 12 October 2006, http://www.oasis-open.org/specs/index.php#soa-rmv1.0.

Table 1-3: New Products for v1.5

New Product	Description and Reason for Addition
SV-4a Systems Functionality Description	**Description:** The SV-4a documents system functional hierarchies and system functions, and the system data flows between them. **Reason:** This product applies the original v1.0 definition. The net-centric concepts have been applied to a new product to prevent overloading the original description.
SV-4b Services Functionality Description	**Description:** The SV-4b documents service functionality that is exposed to the Net-Centric Environment, their respective grouping into service families, and their service specifications. **Reason:** This product was developed to capture the services functionality of an architecture.
SV-5a Operational Activity to Systems Function Traceability Matrix	**Description:** The SV-5a depicts the mapping of operational activities to system functions and thus identifies the transformation of an operational need into a purposeful action performed by a system. **Reason:** This product applies the original v1.0 definition. The different matrices have been broken out to provide clarity.
SV-5b Operational Activity to Systems Traceability Matrix	**Description:** The SV-5b extends the SV-5a and depicts the mapping of capabilities to operational activities, operational activities to system functions, system functions to systems, and thus relates the capabilities to the systems that support them. **Reason:** This product applies the original v1.0 definition. The different matrices have been broken out to provide clarity.
SV-5c Operational Activity to Service Traceability Matrix	**Description:** The SV-5c depicts the traceability and mapping of services to operational activities to assist in understanding which services support operational activities. **Reason:** This product applies the net-centric concepts. The different matrices have been broken out to provide clarity.

1.2.2 Integrated Architectures and Federated Architectures

As architecture becomes a key means to enabling better decision making throughout the Department's enterprise, the various ways in which architectures are combined, collectively utilized, managed, and governed are pivotal to fulfilling the many needs of architecture stakeholders. See **Figure 1-1**.



*** WMA – warfighting mission area, BMA – business mission area, DIMA – DoD portion of the intelligence mission area, EIEMA – enterprise information environment mission area**

Figure 1-1: Integrated Architecture and Federated Architecture

An ***integrated architecture*** is one in which architecture data elements are uniquely identified and consistently used across all products and views within the architecture. By being "integrated," the architecture is referring to those common points of reference within the architecture description that link the operational view (OV), systems and services view (SV), and technical standards view (TV). Integration of architectures enables aggregation of content to support analyses of a broader scope than what is needed or possible through a single architectural view. In this manner, integrated architectures clarify roles, boundaries, and interfaces between components of large systems of systems and act as a key tool for enterprise-level systems integration. An architecture is integrated through the mapping or standardization of terms, definitions, and relationships across the architecture to support DoD Component decision making and systems development. Accordingly, an architecture is said to be integrated (i.e., an integrated architecture) when:

- The architectural objects common to more than one view are identical or linked via underlying data relationships.
- All objects that have relationships across views are linked via underlying data relationships.

An architecture stemming from the integration or aggregation of content from disparate integrated architectures is known as a ***composite architecture***. A composite architecture broadens the scope of individual integrated architectures to support joint capabilities and operational efforts. It consistently captures data elements across integrated architectures and conforms to an agreed upon "common denominator" across all individual architectures that are part of the integration effort. The development of a composite architecture follows the same guidelines as that of an integrated architecture, only on a larger scale.

A ***federated architecture*** is a distributed strategic information asset base, which defines the mission, the information and technologies necessary to perform the mission, and the transitional processes for implementing new technologies in response to the changing mission needs. It provides a framework for enterprise architecture development, maintenance, and use that aligns, locates, and links disparate architectures and architecture information via information exchange standards to deliver a seamless outward appearance to users. A federated architecture approach recognizes the uniqueness and specific purpose of disparate architectures and allows for their autonomy and local governance while enabling the enterprise to benefit from their content.[8]

Federation is a way to organize an enterprise's body of knowledge (architecture) about its activities (processes), people, and things within a defined context and current/future environment. Federation allows the architecture user a means to examine the enterprise from all aspects of the doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) concept. The Department has chosen this approach as the new GIG architecture paradigm[9] and seeks to facilitate the federation of architectures by:

- Identifying a core set of metadata for all architectures that enables discovery of architecture information
- Establishing an architecture Community of Interest (COI) to develop information sharing agreements that make architectures accessible throughout the enterprise
- Establishing the DoD Architecture Registry System to support linking and discovery of federated architectures
- Semantically aligning disparate architectures to support understanding and interoperability across communities

Both types of architectures are of value to the user. Integrated architectures enable a broader perspective of the mission by representing architecture data elements through multiple views. Federated architectures support decision making at program, DoD Component, mission, and enterprise levels by linking architectures across the enterprise, providing a holistic enterprise view that allows for the assessment of interoperability, identification of duplication and gaps, or determination of reusability. Both integrated architectures and federated architectures support net-centricity by enabling the semantic and structural alignment of data across disparate architectures in a useful manner for the improved reliability and efficiency of decisions, thus, resulting in improved mission outcomes.

1.3 FRAMEWORK OVERVIEW

An *architecture framework* provides guidance and rules for structuring, classifying, and organizing architectures. An *architecture description* is a representation of a defined domain, as of a current or future point in time, in terms of its component parts, how those parts function, the rules and constraints under which those parts function, and how those parts relate to each other and to the environment.

The architecture framework for the DoD consists of two layers: data and presentation. **Figure 1-2** illustrates these layers.

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8 DoD Federated Joint Architectures Working Group (FJAWG) recommendation, Dec 2005.

9 The DoD is currently developing an Enterprise Architecture Federation Strategy that further describes this approach.

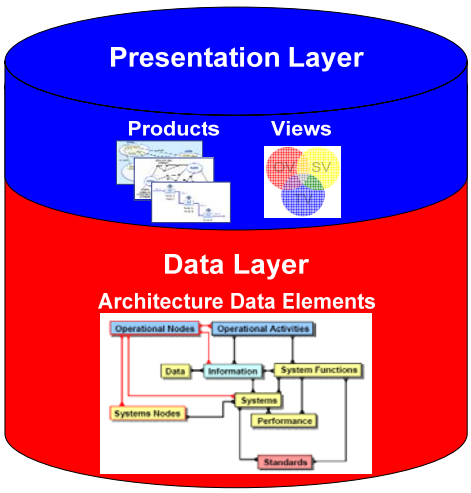

Figure 1-2: Architecture Framework Structure

At the data layer are the architecture data elements and their defining attributes and relationships. At the presentation layer are the products and views that support a visual means to communicate and understand the purpose of the architecture, what it describes, and the various architectural analyses performed. Products provide a way for visualizing architecture data as graphical, tabular, or textual representations. Views provide the ability to visualize architecture data that stem across products, logically organizing the data for a specific or holistic perspective of the architecture.

Architecture tools and applications supporting the DoDAF are available and allow for the development of architectures at the product and/or data level. While these tools maintain the integrity of data element attributes and relationships at the product layer, it is important to note that architectures should be built from requirements specified at the data layer to ensure the ability to integrate and/or federate with architectures from other communities.

1.4 DOD ARCHITECTURE FRAMEWORK

The DoDAF v1.5 provides a foundational framework for developing and representing architecture descriptions that ensure a common denominator for understanding, comparing, and integrating architectures across organizational, Joint, and multinational boundaries. It establishes data element definitions, rules, and relationships and a baseline set of products for consistent development of systems, integrated, or federated architectures. These architecture descriptions may include Families of Systems (FoSs), Systems of Systems (SoSs), and net-centric capabilities for interoperating and interacting in the NCE.

1.4.1 Data-Driven Requirements

The data required for capture in an architecture is defined by its purpose and the requirements of the decision support processes as derived by the process owners. Data requirements are based on the level of detail necessary to facilitate decision making, whether or not it is a capability development, budgetary action, or compliance criteria. Regardless of degree of detail or development methodology employed, these underlying architecture data elements and relationships should remain consistent and be maintained as a thread through the architectural views and products. This data element integrity allows for the flexible and adaptable use of architecture to represent a variety of solutions, net-centric or otherwise. It

enables the incorporation of information in portfolio and enterprise overarching architectures for a more complete view of the organization. **Figure 1-3** represents the information that links the operational view, systems and services view, and technical standards view. The three views and their interrelationships driven – by common architecture data elements – provide the basis for deriving measures such as interoperability or performance, and for measuring the impact of the values of these metrics on operational mission and task effectiveness.

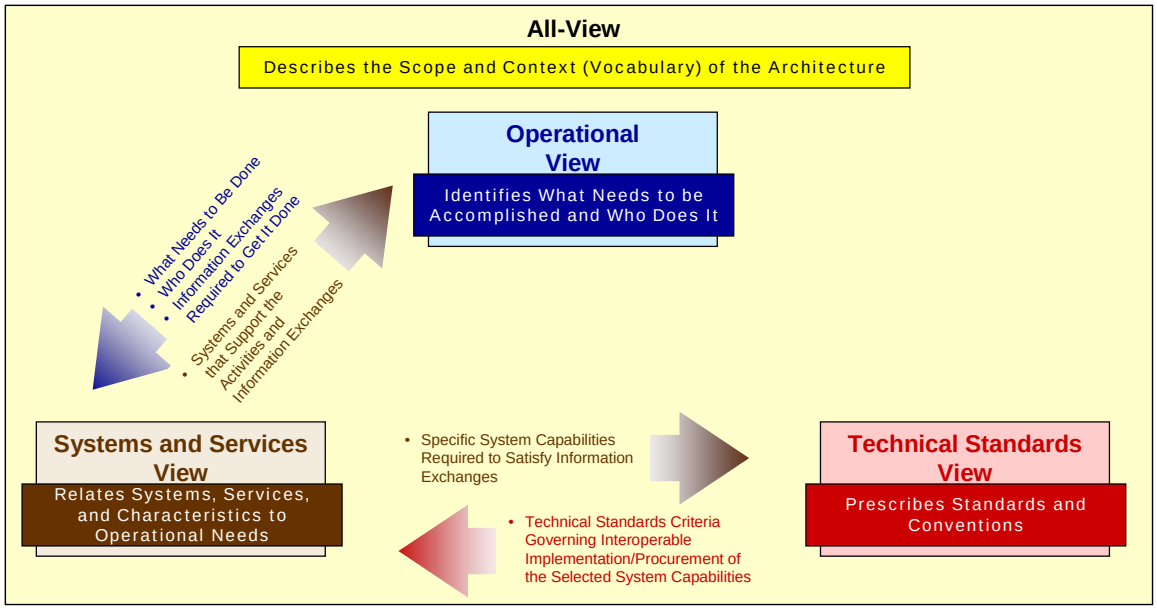

Figure 1-3: Linkages Among Views

DoDAF's data layer is captured in the CADM, which was developed to support the data requirements of the DoDAF. The CADM defines the entities and relationships for DoDAF architecture data elements that enable integration within and across architecture descriptions. In this manner, the CADM supports the exchange of architecture information among Mission Areas, Components, and Federal and Coalition partners, thus facilitating the data interoperability of architectures.

The DoDAF defines a set of products that act as mechanisms for visualizing, understanding, and assimilating the broad scope and complexities of an architecture description through graphic, tabular, or textual means. These products are organized under four views: OV, SV, TV, and All-View (AV). Each view depicts certain perspectives of an architecture as described below.

1.4.2 Definition of the Operational View

The OV captures the operational nodes, the tasks or activities performed, and the information that must be exchanged to accomplish DoD missions. It conveys the types of information exchanged, the frequency of exchange, which tasks and activities are supported by the information exchanges, and the nature of information exchanges.

1.4.3 Definition of the Systems and Services View

The SV captures system, service, and interconnection functionality providing for, or supporting, operational activities. DoD processes include warfighting, business, intelligence, and infrastructure functions. The SV system functions and services resources and components may be linked to the architecture artifacts in the OV. These system functions and service resources

support the operational activities and facilitate the exchange of information among operational nodes.

1.4.4 Definition of the Technical Standards View

The TV is the minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements. Its purpose is to ensure that a system satisfies a specified set of operational requirements. The TV provides the technical systems implementation guidelines upon which engineering specifications are based, common building blocks are established, and product lines are developed. It includes a collection of the technical standards, implementation conventions, standards options, rules, and criteria that can be organized into profile(s) that govern systems and system or service elements for a given architecture.

1.4.5 Definition of the All-View

There are some overarching aspects of an architecture that relate to all three views. These overarching aspects are captured in the AV products. The AV products provide information pertinent to the entire architecture but do not represent a distinct view of the architecture. AV products set the scope and context of the architecture. The scope includes the subject area and time frame for the architecture. The setting in which the architecture exists comprises the interrelated conditions that compose the context for the architecture. These conditions include doctrine; tactics, techniques, and procedures; relevant goals and vision statements; concepts of operations (CONOPS); scenarios; and environmental conditions.

1.5 DEFINITIONS OF BASELINE FRAMEWORK PRODUCTS

The architecture products for each view, as currently defined in DoDAF v1.5, are listed in **Table 1-4**. The first column indicates the view applicable to each product. The second column provides an alphanumeric reference identifier. The third column gives the formal name of the product. The fourth column indicates if the product's definition and purpose were augmented to incorporate net-centric concepts. The fifth column captures the general nature of the product's content. The sequence of products in the table does not imply a sequence for development. A detailed description of each product and their constituent architecture data elements are provided in Volume II.

Table 1-4: DoDAF v1.5 Architecture Products

Applicable View	Framework Product	Framework Product Name	Net-Centric Extension	General Description
All View	**AV-1**	Overview and Summary Information	✓	Scope, purpose, intended users, environment depicted, analytical findings
All View	**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, and information exchange need lines 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
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 three products used to describe operational activity—identifies business rules that constrain operation
Operational	**OV-6b**	Operational State Transition Description	✓	One of three products used to describe operational activity—identifies business process responses to events
Operational	**OV-6c**	Operational Event-Trace Description	✓	One of 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 and Services	**SV-1**	Systems Interface Description Services Interface Description	✓	Identification of systems nodes, systems, system items, services, and service items and their interconnections, within and between nodes
Systems and Services	**SV-2**	Systems Communications Description Services Communications Description	✓	Systems nodes, systems, system items, services, and service items and their related communications lay-downs
Systems and Services	**SV-3**	Systems-Systems Matrix Services-Systems Matrix Services-Services Matrix	✓	Relationships among systems and services in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc.
Systems and Services	**SV-4a**	Systems Functionality Description		Functions performed by systems and the system data flows among system functions
Systems and Services	**SV-4b**	Services Functionality Description	✓	Functions performed by services and the service data flow among service functions
Systems and Services	**SV-5a**	Operational Activity to Systems Function Traceability Matrix		Mapping of system functions back to operational activities
Systems and Services	**SV-5b**	Operational Activity to Systems Traceability Matrix		Mapping of systems back to capabilities or operational activities
Systems and Services	**SV-5c**	Operational Activity to Services Traceability Matrix	✓	Mapping of services back to operational activities
Systems and Services	**SV-6**	Systems Data Exchange Matrix Services Data Exchange Matrix	✓	Provides details of system or service data elements being exchanged between systems or services and the attributes of that exchange

Applicable View	Framework Product	Framework Product Name	Net-Centric Extension	General Description
Systems and Services	**SV-7**	Systems Performance Parameters Matrix Services Performance Parameters Matrix	✓	Performance characteristics of Systems and Services View elements for the appropriate time frame(s)
Systems and Services	**SV-8**	Systems Evolution Description Services Evolution Description	✓	Planned incremental steps toward migrating a suite of systems or services to a more efficient suite, or toward evolving a current system to a future implementation
Systems and Services	**SV-9**	Systems Technology Forecast Services Technology Forecast	✓	Emerging technologies and software/hardware products that are expected to be available in a given set of time frames and that will affect future development of the architecture
Systems and Services	**SV-10a**	Systems Rules Model Services Rules Model	✓	One of three products used to describe system and service functionality—identifies constraints that are imposed on systems/services functionality due to some aspect of systems design or implementation
Systems and Services	**SV-10b**	Systems State Transition Description Services State Transition Description	✓	One of three products used to describe system and service functionality—identifies responses of a system/service to events
Systems and Services	**SV-10c**	Systems Event-Trace Description Services Event-Trace Description	✓	One of three products used to describe system or service functionality—identifies system/service-specific refinements of critical sequences of events described in the Operational View
Systems and Services	**SV-11**	Physical Schema	✓	Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schema
Technical Standards	**TV-1**	Technical Standards Profile	✓	Listing of standards that apply to Systems and Services View elements in a given architecture
Technical Standards	**TV-2**	Technical Standards Forecast		Description of emerging standards and potential impact on current Systems and Services View elements, within a set of time frames

2 ARCHITECTURE DEVELOPMENT

2.1 ARCHITECTURE GUIDELINES

In order to support the requirements of stakeholders, it is effective to start with a common set of principles and a practical set of expectations for architecture. The following set of guiding principles is critical to the development of useful and practical architectures that can be integrated or federated for use by program, DoD Component, mission, and enterprise-level decision makers.

2.1.1 Have a Purpose in Mind

An architecture should have a specific and commonly understood purpose to increase the efficiency of the effort and the utility of the resulting description. The purpose determines the scope, which drives the specification of characteristics, time frames, data requirements, and level of detail or granularity. It should align with the priorities of the community and contribute to the success of mission goals and objectives. This principle applies equally to the description of an architecture as a whole or to any portion or view of an architecture. It also applies to groups of architectures within a federation or enterprise. For example, if architectures built by various organizations are to be compared, it is important that they all be built from the start with the purpose of comparison in mind.

2.1.2 Be Simple and Straightforward

Developing overly complex architectures is costly in both time and money. Focusing the architecting effort is essential to obtain an acceptable return on investment. Care should be given in determining the level of detail appropriate for achieving the desired objectives of the architecture effort. The following are some of the areas that should be considered:

- Scope of the architecture
- Levels of decomposition for the architecture
- Level of specificity in defining architecture data elements

2.1.3 Be Understandable Among Architecture Users

Architectures should be understandable so as to enhance the applicability of the information among architecture users. They should guide the human thinking process in discovering, analyzing, and resolving issues so that architects and analysts understand them quickly. Architectures should provide a clear representation of the information by using common terms and definitions and avoiding extraneous information. Architects should look to their COIs for these common terms and definitions.

2.1.4 Be Interoperable Across the DoD

Architectures should be expressible using a standard vocabulary with unambiguous semantics and a well defined data structure to enable comparability and interoperability across independently developed models throughout the DoD. This principle requires the use of a common set of architectural building blocks or reference documents as the basis for architecture descriptions. It is critical that architecture descriptions clearly describe external interfaces with Joint, multinational, and commercial components in a manner consistent with the method used to describe internal relationships. This common foundation for development ensures the use of similar formats for displaying information enabling the integration, federation, comparison, and reusability of disparate architectures.

As part of being interoperable, architecture descriptions should be readily available across the Enterprise for decision process analyses, reuse in other architecture efforts, and mission support. The DARS provides a trusted environment for the sharing of architectural information. Using and contributing shared architectural information reduces cost, improves efficiency, and ensures reliability.

2.1.5 Be Agile

Architectures should be modular, reusable, and decomposable to achieve agility. Architecture descriptions should consist of related pieces that can be recombined with a minimal amount of tailoring to enable use for multiple purposes. An agile architecture provides the means for functioning in a dynamic environment.

2.2 6-STEP ARCHITECTURE DEVELOPMENT PROCESS

The high-level, six-step architecture development process provides guidance to the architect and emphasizes the guiding principles. The process is data-centric rather than product-centric and emphasizes focus on data and data relationships rather than DoDAF products. This data-centric approach ensures concordance between views and that all essential entity relationships are captured to support a wide variety of analysis tasks. The products created as a result of the architecture development process become visual renderings of the underlying architecture data that convey information from the architecture to specific user communities or decision makers. **Figure 2-1** depicts this six-step process.

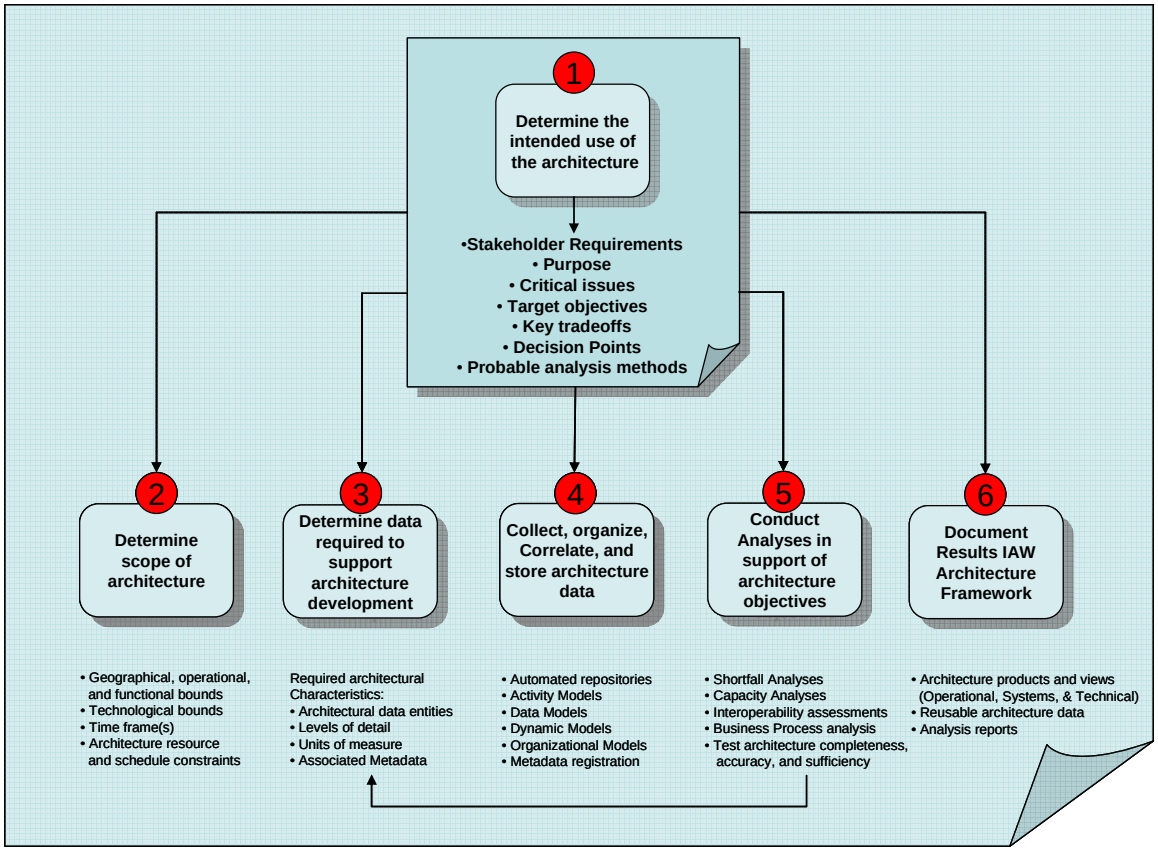

Figure 2-1: The Six-Step Process of Building an Architecture Description

Step 1: Determine Intended Use of Architecture.

Describing the intended use explains how the architecture is meeting data requirements of the Departmental process and why the architecture is being developed. The purpose also explains what the architecture will accomplish and how it may affect organizations or system development. The purpose shall clearly and concisely establish exit criteria to measure the customer's satisfaction with the architecture in meeting overall requirements. All architecture development shall be preceded by an approved purpose and scope portions of the AV-1. (Steps 1 and 2)

Step 2: Determine Scope of Architecture.

The scope defines the boundaries that establish the depth and breadth of the architecture. It bounds the architecture's problem set and helps define its context. Other context considerations that shall be defined are the environment, the organizational mission and vision, the subject area, time frame, and intended users.

Step 3: Determine Data Required to Support Architecture Development.

Based upon the input from the process owner, the operational, systems and services, and technical standards view data entities, attributes, and rules are selected. The required level of detail to be captured for each of the entities and attributes is also determined during this step. These considerations establish the type of data collected in Step 4 that relates to the architecture structure.

Step 4: Collect, Organize, Correlate, and Store Architecture Data.

All new architecture development efforts shall leverage existing architecture artifacts to the greatest extent possible by first accessing the DARS and reviewing registered architecture content. Locating and reusing published and accessible architecture content from other DoD sources can significantly reduce initial development time and redundant development efforts, while capitalizing on taxonomies of standardized reference data.

Once collected, the architecture data shall be cataloged, organized, and correlated into automated repositories to permit subsequent analysis and reuse. Discovery metadata shall be registered in DARS as soon as it is available to support discovery and enable federation (initially using DoD Enterprise Architecture (EA) Business Reference Model (BRM)[10] taxonomy elements).

Step 5: Conduct Analysis in Support of Architecture Objectives.

The architecture data shall be analyzed to determine its effective support of the initial process owner requirements. Completion of this step prepares the architecture for approval by the process owner. An additional result of this step is the identification of additional data collection requirements to complete the architecture and better facilitate its intended use through iteration of the architecture process (repeat steps 3 through 5 as necessary).

Step 6: Document Results in Accordance with Architecture Framework.

The final step in the process involves rendering architecture products based on queries of the underlying data. For presentation purposes, graphic and tabular products are necessary to visualize concepts in a meaningful way to support the use of the architecture by intended

[10] DoD Enterprise Architecture Business Reference Model, http://www.army.mil/escc/cpi/refmod4b.htm

audiences as identified in the AV-1. Standard DoDAF and user-defined custom products are used to illustrate the various aspects of the architecture based on the underlying data. For the standard DoDAF products, their renderings shall be built in accordance with templates established in the DoDAF. Any architecture visualization should be reusable and shareable, and include the underlying data. A number of architecture tools are available to support this step.

2.3 METHODOLOGIES

Several methodologies exist for developing architectures. While DoDAF does not promote a specific approach, the framework provides the rules, standard entities, and relationships for developing architectures in a semantically consistent and interoperable fashion. The methodologies below are currently being used or developed within the DoD. More detailed descriptions of the following methods and other best practices can be found in the Online DoDAF Journal at https://dars1.army.mil/IER/index.jsp.

Methodology	Description
Structured Architectures	Structured architectures are process driven and characterized by a functional process hierarchical decomposition. Historically, structured models originated from the Integrated Definition for Activity Modeling (IDEF0) [IDEF0 1993].
Object-Oriented Architectures	Object-oriented architecture is typically a Unified Modeling Language (UML) architecture and describes the operational need, places warfighter data (objects) in the context of its use, and provides a traceable foundation for system and software design. It is based on the concepts of data abstraction and inheritance from a service-oriented viewpoint. The object-oriented approach provides an orderly arrangement of the parts of the business organization and includes a style and method of design.
Activity-Based Methodology	The Activity-Based Methodology [ABM 2004] was developed specifically to enable development and analysis of integrated DoD architectures. ABM provides a rigorous and disciplined approach to integrated architecture development and analysis.[11]
Architecture Specification Model	The Architecture Specification Model (ASM) is a formal conceptual model that provides a common set of semantics for expressing the "architect's view." The ASM separates architecture elements into six "interrogative" groups and provides a semantically complete shared vocabulary for the DoD architecting Community of Interest.[12]

Table 2-1: Methodologies

As the first generation of DoD architecting comes to an end, a "next generation" DoDAF v2.0 is evolving and maturing that is methodology independent. v2.0 will be visionary in providing a cultural transformation and needed guidance for such DoD key processes and concepts as the Joint Capabilities Integration and Development System (JCIDS) Capability-Based Planning and Analysis, PfM, SOAs, Strategic Enterprise Planning, Systems Acquisition,

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11 Ring, S. J., & Nicholson, D. (2007). Activity-based methodology for development and analysis of integrated DoD architectures. In P. Saha (Ed.), *Handbook of enterprise systems architecture in practice* (pp. 85-133). Hershey, PA: Information Science Reference 978-1-59904-189-6

12 Ang, H. W., Nicholson, N., Mercer, B., *Improving the Practice of DoD Architecting with the Architecture Specification Model*, http://www.mitre.org/work/tech_papers/tech_papers_05/05_0423/05_0423.pdf

architecture federation, net-centricity, executable architectures, and the full range of DOTMLPF alternatives.

One critical component for the development of DoDAF v2.0 is an architecture conceptual data model that provides a semantically complete, tool and methodology independent, holistic, "architect's view" for describing integrated DoD architectures. An "architect's view" is an architect's view in formalizing and expressing an architecture description, and is independent of modeling technology (structured or object-oriented) and source (i.e., commercially available enterprise architecture tools and/or government developed applications). One example of an approach for this architecture conceptual data model consists of a small, yet powerful, set of descriptive concepts and a taxonomy for the DoD architecting community of interest that groups architectural elements according to six interrogatives – WHO, WHERE, WHAT, WHY, WHEN, and HOW. Together, these serve as a foundation for meeting new requirements and demands on future integrated DoD architecture usage.

The goals of this next generation DoDAF are to (1) address current DoDAF limitations, weaknesses, and deficiencies; (2) provide a data-centric approach to building, implementing, and using integrated architectures; (3) enable "federation" of architectures; (4) capture sufficient architectural detail for full DOTMLPF analysis; and (5) provide support for architecture-based analysis and assessments that link directly to mission outcomes and objectives for the DoD core processes.

2.4 DEVELOPMENT OF INTEGRATED ARCHITECTURES AND FEDERATED ARCHITECTURES

2.4.1 Why Develop Architectures that Support Integration and Federation?

The ability to integrate and/or federate architectures is essential for addressing enterprise issues across a broad domain such as the DoD. It enables multiple groups to develop architectures with the focus that best meets their immediate needs, while providing a means for linking and relating those architectures to address issues that cross multiple areas. A single architecture cannot sufficiently address the entire DoD and its diversity of missions to where all of the various types of analyses, enabled by the architecture construct, are supported. The ability to integrate and/or federate multiple architectures leads to a more robust construct for understanding the enterprise. Policies pertaining to the GIG are currently being updated to include specific direction on architecture, a portion of which reinforces this federation concept.

Integrating and/or federating architectures become necessary in a NCE. It plays a significant role in both the development of the environment and the sharing of information. As the DoD becomes increasingly networked, integrated and/or federated architectures become essential in organizing the vast array of information and complex relationships. As an example, the realization of the GIG will be accomplished through GIG Capability Increments. These increments will define IT Capabilities to be achieved in a specific period of time. Federated architecture data can be used to evaluate portfolios of existing systems and programs to make decisions about changes or additions necessary to achieve the IT capabilities in each increment.

2.4.2 Development Considerations for Integrated Architectures

In order to develop integrated architecture descriptions, commonality in the entities or objects represented in multiple views, and the relationships between those entities or objects must be captured in the underlying data model. Examples of important commonalities include:

- Activities – Activities defined in a activity model should be the same as those that are associated with operational nodes in an Operational Information Exchange Matrix (OV-3).
- Operational Nodes – The organizational entities identified in an Operational Node Connectivity Description (OV-2) should be the same as the organizational entities identified in a Command Relationship Hierarchy (OV-4).
- Systems – Systems represented in the Systems Interface Description (SV-1) should be the same as the systems identified in the Systems Communication Description (SV-2) and the Systems Functionality Description (SV-4a).
- Standards – Standards identified in the Technical Standards Profile (TV-1) should be the same as those identified in the Systems Interface Description (SV-1).

A critical aspect of being able to integrate architectures is adherence to the DoDAF, which includes:

- The use of common data element definitions, semantics, and data structure for all architecture description entities or objects.
- Use of an underlying data model (CADM) that faithfully relates common objects across multiple views.

Adherence with the Framework, which includes conformance with the currently approved version of CADM, provides both a common approach for developing architectures and a basic foundation for relating architectures. Conformance with the CADM ensures the use of common architecture data elements (or types). Tables that contain the data elements relative to a product description and the identification of mandatory data elements for an integrated architecture are included in Volume II. CADM entities, relationships, and associated business rules are described further in Volume III. As architecture development and use continue to mature and a common taxonomy becomes adopted, usage of this taxonomy will further facilitate interoperability among architectures. DARS facilitates integration by ensuring that products are Framework-compliant and data elements are CADM-conformant.

2.4.3 Development Considerations for Federated Architectures

In order to federate architectures, there must be elements of semantic agreement so that pertinent information can be related appropriately. Ways of achieving semantic agreement include:

- Adhering to a common framework, such as the DoDAF, which includes the use of common data element definitions, semantics, and data structures for all architecture description entities or objects
- Conforming to common or shared architecture standards
- Using enterprise taxonomies and authoritative reference data.

As noted earlier, adhering to a common framework and conforming to the currently approved version of CADM ensures a standard representation of architecture regardless of mission or capability area. Conforming to common or shared architecture standards increases interoperability. Enterprise taxonomies set the context for aligning mission area activities and

associated reference models, and categorizing and organizing component architectures, thereby facilitating semantic understanding across the various architectures.

The federation of architectures is also facilitated by an environment that enables information sharing. The following support an architecture sharing environment:

- A sound governance structure
- Enterprise architecture services
- The DARS

A sound governance structure applies accountability to the development and maintenance of architecture toward set objectives, facilitating the ability to federate. It places responsibility around processes such as configuration management and quality assurance. Enterprise architecture services allow for the visibility, accessibility, and understandability of architecture information in a consistent and efficient manner. DARS provides for registration and linking of architecture metadata to enable the creation of a navigable and searchable federated enterprise architecture (https://dars1.army.mil/IER/index.jsp). It enforces the policies and governance that surround the usage of architecture, thus reinforcing robust interfaces and data relationships. Sharing architecture and using information and services that exist improve the agility of architecture development, a quality necessary in the NCE.

2.4.4 Development Considerations for Net-Centric Architectures

As the Department migrates towards net-centricity, it becomes essential to represent net-centric constructs within the architecture so as to capture the flow of information for the benefit of those who need it. The following aid in the development of net-centric architectures:

- Usage of the DoDAF net-centric guidance, which includes use of common data element definitions, semantics, and data structure for all architecture description entities or objects
- Compliance with the currently approved version of the Net-Centric Operations and Warfare Reference Model (NCOW RM).[13]

Volume II of DoDAF v1.5 contains net-centric guidance for each product. Usage of this guidance promotes the consistent and clear representation of net-centric concepts within an architecture. The following concepts are captured in Volume II of this version of the DoDAF:

- Populate the NCE.
- Utilize the NCE.
- Support the unanticipated user.
- Leverage COIs to promote jointness.
- Support shared infrastructure.

The NCOW RM brings together the key activities and definitions from various Department-level net-centric strategies and guidance into an integrated document set. The NCOW RM provides a comprehensive depiction of activities required for NCO and assists capability and organizational architects in understanding critical relationships between net-centric activities and

[13] Net-Centric Operations and Warfare Reference Model (NCOW RM), v1.1, 17 November 2005

requirements. Adherence to the NCOW RM is directed in policy through the Net-Ready Key Performance Parameter (NR-KPP).[14]

As depicted in **Figure 2-2**, the NCOW RM, while not itself an architecture, serves as a reference model for use by architects in identifying net-centric activities and linkages within their capability and enterprise architectures. That is, while the NCOW RM (and other DoD policy) describe key net-centric activities desired/required for NCO, the DoDAF v1.5 provides guidance on how to capture adherence to these requirements through a set of structured architecture products. Architectures compliant with the NCOW RM ensure net-centric capabilities are interoperable and in alignment with the goals and attributes of key transforming net-centric strategies (Data, Services, Information Assurance (IA), NetOps, Computing Infrastructure, Spectrum Management, and Networking).

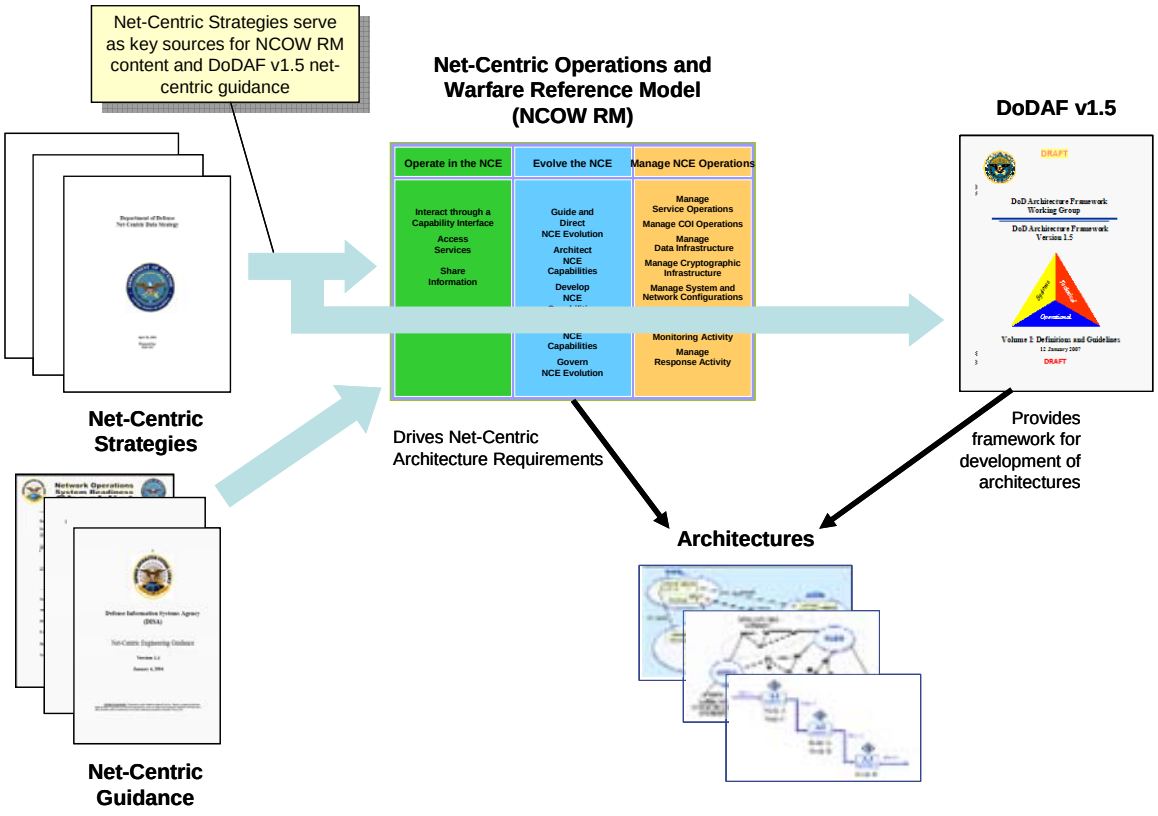

Figure 2-2: NCOW RM, DoDAF v1.5, and Architecture Relationship

[14] DoD Directive 4630.5, Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS), 5 May 2004

3 ARCHITECTURE USAGE

3.1 THE VALUE OF ARCHITECTURES – DIFFERENT USES FOR DIFFERENT USERS

The value of an architecture is realized through its usage. Architectures are developed to support strategic planning, transformation, and various types of analyses (i.e., gap, impact, risk) and the decisions made during each of those processes. Additional uses include identifying capability needs, relating needs to systems development and integration, attaining IT interoperability and supportability, and managing IT investments. The following describes architecture usage at different portfolio levels:

- Enterprise – Architectures, particularly federated architectures, are used at the enterprise level to make better decisions that improve (1) human resource utilization, (2) deployment of assets, (3) warfighter investments, and (4) identification of the enterprise boundary (interfaces) and assignment of functional responsibility.
- Mission Area – Architectures are used at the mission area level to better manage capabilities within and across mission areas and improve investment decisions. Architectures at this level are federated to support the development of enterprise architectures. They also provide roadmaps and descriptions of future or desired end states.
- Component and Program – Architectures are used at the component and program level to identify capability requirements and operational resource needs that meet business or warfighting objectives. Component and program architectures may then be integrated to support decision making at the mission level.

Architectures facilitate decision making by conveying the necessary information to the decision maker for the decision at hand as well as enabling the reuse of architecture information for additional needs. Rolling up component and program-level architectures to the enterprise ensures complete, actionable information for more reliable decisions. The following describes architecture data usage for different types of decisions:

- Enterprise and Portfolio Management – Identifies opportunities to satisfy multiple operational requirements with a single, leveraged capability.
- Capability and Interoperability Readiness – Assesses net-readiness to identify gaps in interoperable capabilities.
- Acquisition Program Management and System Development – Represents system concepts, design, and implementation (as they mature over time), which enable and support operational requirements and provide traceability to those requirements. This process simplifies and integrates operational and system analysis, and improves both materiel and non-materiel solution analysis.
- Modeling and Simulation – Models and simulates the implementation of mission threads and scenarios, thus providing an environment for thorough testing of identified use cases.

- Operational Planning – Examines how various mission participants, systems, and information need to work together, to recognize potential problems that may be encountered, and to identify quick fixes that may be available to accomplish a mission.

3.1.1 Federal and DoD Policy

The Federal Government and DoD have established the importance of using architecture through policy and guidance. Federal policies, such as the Clinger-Cohen Act of 1996, OMB's Circular A-130, and the E-Government Act of 2002, along with other guidance, have realized the need for architectures.

Table 3-1: Federal Policy

Policy/Guidance	Description
Clinger-Cohen Act of 1996	Recognizes the need for Federal Agencies to improve the way they select and manage IT resources and states "information technology architecture, with respect to an executive agency, means an integrated framework for evolving or maintaining existing IT and acquiring new IT to achieve the agency's strategic goals and information resources management goals". Chief Information Officers are assigned the responsibility for "developing, maintaining, and facilitating the implementation of a sound and integrated IT architecture for the executive agency."
Office of Management and Budget Circular A-130	"Establishes policy for the management of Federal information resources"[15] and calls for the use of Enterprise Architectures to support capital planning and investment control processes. Includes implementation principles and guidelines for creating and maintaining Enterprise Architectures.
E-Government Act of 2002	Calls for the development of Enterprise Architecture to aid in enhancing the management and promotion of electronic government services and processes.
OMB Federal Enterprise Architecture Reference Models (FEA RM)	Facilitates cross-agency analysis and the identification of duplicative investments, gaps, and opportunities for collaboration within and across Federal Agencies.[16] Alignment with the reference models ensures that important elements of the FEA are described in a common and consistent way.[17] The DoD Enterprise Architecture Reference Models are aligned with the FEA RM.
OMB Enterprise Architecture Assessment Framework (EAAF)	Serves as the basis for enterprise architecture maturity assessments. Compliance with the EAAF ensures that enterprise architectures are advanced and appropriately developed to improve the performance of information resource management and IT investment decision making.
General Accounting Office Enterprise Architecture Management Maturity Framework (EAMMF)	"Outlines the steps toward achieving a stable and mature process for managing the development, maintenance, and implementation of enterprise architecture." Using the EAMMF allows managers to determine what steps are needed for improving architecture management.

15 Office of Management and Budget, http://www.whitehouse.gov/omb/circulars/a130/a130trans4.html#2

16 E-Gov, http://www.whitehouse.gov/omb/egov/a-2-EAModelsNEW2.html

17 Consolidated Reference Model Version 2.0, http://www.whitehouse.gov/omb/egov/documents/FEA_CRM_v20_Final_June_2006.pdf

DoD policies and directives call for the use of architecture data to support analyses for decision making. The DoD decision support processes recognize the need for architecture and, in some cases, provide architecture requirements in support of key decision points within the process (i.e., required data elements, specific product set, etc.). Process owners are responsible for identifying and updating the data set that supports their process (JCIDS, Planning, Programming, Budgeting, and Execution (PPBE), Defense Acquisition System (DAS), PfM), as well as publishing those requirements so that architectures continue to provide correct information. While the DoDAF currently accommodates the data requirements of the processes, it is imperative that as new data requirements are identified by the process owners, they are incorporated into the evolution of the DoDAF so as to ensure that the Framework's support for the processes remains unhindered. **Table 3-2** identifies the use of architecture in the DoD decision support processes.

Table 3-2: DoD Decision Support Process

Process	Description
Joint Capabilities Integration and Development System	"Requires a collaborative process that utilizes joint concepts and integrated architectures to identify prioritized capability gaps and integrated joint DOTMLPF and policy approaches (materiel and non-materiel) to resolve those gaps."[18] Incorporates the requirement for the net-ready key performance parameter (NR-KPP) in accordance with DoD Directive 4630.5[19], DoD Instruction 4630.8,[20] and Chairman Joint Chiefs of Staff (CJCS) Instruction (CJCSI) 6212.01D.[21]
Planning, Programming, Budgeting, and Execution	DoD policy has not formalized the use of architectures in the PPBE process but DoD Services, such as the Navy and Air Force, have noted that architectures provide a context for developing program priorities, formulating programmatic modifications, and making IT investment decisions.
Defense Acquisition System	Includes the requirement for an integrated architecture in developing integrated plans or roadmaps to conduct capability assessments, guide systems development, and define the associated investment plans as the basis for aligning resources.[22]
Portfolio Management	Calls for "the management of selected groupings of IT investments using strategic planning, architectures, and outcome-based performance measures to achieve a mission capability".[23]

3.2 HOW TO USE THE ARCHITECTURE

The ability to use architectures to analyze a variety of situations provides a means to objectively examine many facets of IT investments in order to meet its planning goals, performance measures, and capability requirements. While the DoDAF does not promote any specific analysis techniques, it does articulate the importance of the underlying data to support analysis of architectures at strategic, operational, and tactical levels. (The Online DoDAF

18 CJCS Instruction 3170.01E, Joint Capabilities Integration and Development System (JCIDS), 11 May 2005

19 DoD Directive 4630.5, Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS), 5 May 2004

20 DoD Instruction 4630.8, Procedures for Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS), 30 June 2004

21 CJCS Instruction 6212.01D, Interoperability and Supportability of Information Technology and National Security Systems, 8 March 2006

22 DoD Instruction 5000.2, Operation of the Defense Acquisition System, 12 May 2003

23 DoD Directive 8115.01, Information Technology Portfolio Management, 10 October 2005

Journal, hosted on the DARS website (https://dars1.army.mil/IER/index.jsp), contains additional information regarding specific analysis techniques currently being practiced within the DoD.)

3.2.1 Data Modeling and Visualization

The DoDAF incorporates data modeling (CADM) and visualization aspects (products and views) to support architecture analysis.

The DoDAF's data model, CADM, defines architecture data entities, the relationships between them, and the data entity attributes, essentially specifying the "grammar" for the architecture community. It contains a set of "nouns," "verbs," and "adjectives" that, together with the "grammar," allow one to create "sentences" about architecture artifacts that are consistent with the DoDAF. The CADM is a necessary aspect of the architecture and provides the meaning behind the architectural visual representations (products). It enables the effective comparing and sharing of architecture data across the enterprise, contributing to the overall usefulness of architectures. Volume III describes the CADM, along with the following data model levels in further detail: conceptual, logical, and physical.

Table 3-3: Data Model Levels

Conceptual	Models the user concepts in terms familiar to users
Logical	More formal model that considers unique data representation, emphasis on semantic well-defineness and exclusivity, and domain-level completeness
Physical	Models all the information necessary for database implementation

Data visualization is a way of graphically or textually representing architecture data to support decision-making analysis. The DoDAF provides products as a way of representing the underlying data in a user-friendly manner. In some cases, the existing DoDAF products are sufficient for representing the required information. In other cases, the data required for a decision process may span multiple products or be a composite of data subsets from multiple products. Because of this, flexible visualization of architecture data is necessary to represent the information in the correct context. These visualizations should contribute to the decision maker's understanding of architecture data applicability toward decision support processes. Architects are encouraged to be creative, as visualizations can be as varied or personalized as necessary to accommodate decision maker preferences. Regardless of how one chooses to represent the architecture description, the underlying data (CADM) remains consistent, providing a common foundation to which analysis requirements are mapped.

When visualizing the data, it is important to understand the requirements of the analysis or type of information needed to make the decision. For decision process architecture requirements, architects should refer to the appropriate documentation (i.e., Department of Defense Instruction (DoDI) 5000.2, Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3170.01B, etc.). By knowing these requirements, architecture data that appropriately fulfill the requirements can be identified and graphically depicted to illustrate the architecture data's support towards key decisions. **Figure 3-1** identifies several categories for architecture usage and the product data that provide pertinent input to that use. The listed items are not meant to be exhaustive or all inclusive, but are illustrated to provide a starting point for determining the architecture data needed to address a particular area.

	Applicable Architecture Product Data																					
	All View		Operational View (OV)							Systems and Services View (SV)											Tech Stds View	
Uses of Architecture Data	1	2	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	1	2
Analysis & Assessment																						
Capabilities																						
- Gaps/Shortfalls					◉		●						●	●								
- Mission Effects & Outcomes, Operational Task Performance	●	●	●	●	●	◉		●		●	●				●	●			●	◉		
- Trade-Offs	●	●	●	●	●	●	●	●		●	●		●	●	●	●			●	◉	●	◉
- Functional Solutions	●	●	●	●	●	●	●	●		●	●		●	●	●	●			●	◉	●	◉
Operations																						
- Process Re-engineering	●	●		●	●		●	●														
- Personnel &Organizational Design	●	●	●	●	●	●	●	●	◉	◉	◉	◉			◉							
- Doctrine Development/Validation	●	●	●	●	●		●	●														
- Operational Planning (CONOPS and TTPs)	●	●	●	●	●	●	●	●		●	◉	◉	◉	◉							◉	
Systems/Services																						
- Communications	●	●								●	●	●							◉		●	◉
- Interoperability and Supportability	●	●	●	●	●	◉	●	●	◉	●	◉		●		●	◉	●			◉	●	◉
- Evolution/Dependencies	●	●									●	●	●		●		●			●	●	●
- Materiel Solutions Design & Development	●	●		●	●		●	●	◉	●	●	●	●	●	●	●	●	◉	◉	◉	●	◉
- Facilities Packaging	●	●		●			●	●		●	●		●	●							●	◉
- Performance							●	●						●		●			●			
Socialization/Awareness/Discovery																						
- Training	●	●	●	●	●	●	●	●		●	●	◉	◉	◉	◉							
- Leadership Development	●	●	●	●		●	◉	●		●			●	◉								
- Metadata (for federation)	●	◉																			◉	◉

● = Data Highly Applicable
◉ = Data is Often or Partially Applicable
= Data is Usually Not Applicable

Figure 3-1: Architecture Products by Use

Data visualization, the representation of architecture data that relates directly to decision making architecture requirements, provides value through all tiers of the organization. It allows one to represent data in a meaningful way for decision makers, while remaining consistent with the CADM.

3.3 FACILITATING THE USE OF ARCHITECTURE

ASD(NII)/DoD CIO wishes to facilitate the use of integrated and federated architectures that support decision makers in the warfighting, business, intelligence, and enterprise information environment mission areas. The following sections provide a consistent manner in which to facilitate the use of architecture at any tier in the organization.

3.3.1 Use the DoDAF

Architecture descriptions should use common and/or standardized terms and definitions. The criticality of common language during architecture product creation, analysis, comparison, and integration cannot be overemphasized. The control of vocabulary, to include the use of a common language for product names, architecture data elements, and common system data values, helps to minimize potential misrepresentations and misunderstanding of shared information, and assists with architecture consistency and validation. The DoDAF defines a standard for architecture data elements, their attributes, and their relationships. The Framework requires that every architecture description contain an Integrated Dictionary (AV-2) that defines terms used in the architecture to ensure semantic understanding across the enterprise.

3.3.2 Use the CADM

To support data interoperability of architectures, they should be developed with a foundation that aids in the standardization and performance of information in decision-making processes across the enterprise. The pre-release CADM v1.5 provides a canonical data model that identifies data attributes and relationships. It provides the semantic agreement by which data can be understood.

3.3.3 Use the DARS

To facilitate architecture reuse, architecture information should be visible, accessible, and understandable across the enterprise. DARS provides a trusted environment for registering, posting, discovering, and retrieving architectural information. Registering architecture metadata in DARS enables enterprise-wide discovery and content linking, making the enterprise architecture visible and navigable. Posting architectures to DARS enhances accessibility and trust through community controlled access and version management. DARS facilitates collaboration, reuse, and architecture interoperability across the community. At a minimum all architecture metadata should be registered in DARS to ensure effective architecture information sharing. DARS can be accessed at https://dars1.army.mil/IER/index.jsp (Secret Internet Protocol Router Network (SIPRNET) at http://dars1.monmouth.army.smil.mil).

4 GOVERNING, DEVELOPING, MAINTAINING, AND USING ARCHITECTURES THROUGH A DATABASED APPROACH

4.1 ARCHITECTURE GOVERNANCE

As the DoD community adopts the usage of architecture in support of decisions, it becomes increasingly necessary to federate architectures for decision makers at the enterprise and mission level. Due to the need for federated architectures, a governance structure becomes essential in order to provide direction and oversight. An organization as large as the DoD requires a governance framework of tiered accountability (TA), where the authority and responsibility of elements of the enterprise architecture are distributed throughout the organization.

Through TA, architecture owners become responsible for the governance of their own architecture holdings. A process will be established not only to ensure that architectures are being developed and used under the appropriate authority and direction with the correct guidance, but that a method of monitoring is in place to assert affirmative or remedial actions when necessary. Architecture owners will ensure that the architectures meet their specific purpose, are in accordance with policies and directives from the tiers above, and allow for federation with disparate architectures. In order to do this, roles and responsibilities should be in place to account for the development of architectures, ensure alignment between tiers, and maintain architecture data integrity. Having a governance structure ensures the consistent and efficient development and usage of architectures that align with the priorities of the mission.

4.2 ARCHITECTURE DEVELOPMENT, MAINTENANCE AND USE

The development, maintenance and use of architecture data become critical in a net-centric environment where information is shared and used for the benefit of making reliable and efficient key decisions. The maintenance and use of architecture data follow the goals of the DoD Net-Centric Data Strategy[24] and like governance, are implemented through TA. Volume III of the DoDAF includes detailed information on the Architecture Data Management Strategy.

Architecture owners are responsible for maintaining and managing the visibility, accessibility, understandability, interoperability, and trustworthiness of their architecture data. Processes will be in place to ensure that regardless of architecture format, data model, or tool, the data can still be discovered, linked, exchanged, and/or integrated. Architecture owners should look toward using services for configuration management, assigning metadata values compliant with the DoD Discovery Metadata Specification (DDMS),[25] and cataloging and linking architectures for federation. Architectures should be stored in repositories that enforce data management goals and support federated search services. Going forward, the DARS will house these services to enable the more reliable and efficient sharing of architecture data.

The DoDAF plays a critical role in successfully using architecture to support capability, investment, and mission decisions. It is key in the development of consistent architectures that can be analyzed, assessed, and related across the enterprise, thus contributing to the visibility, understandability, and trust of a federated enterprise architecture. It is the goal of the DoDAF to

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[24] DoD CIO, DoD Net-Centric Data Strategy, 9 May 2003

[25] Department of Defense Discovery Metadata Specification (DDMS), v1.3, 29 July 2005

support the warfighter by enabling greater utilization of architectures to more effectively manage and develop an agile and responsive IT environment geared towards improving mission results.

ANNEX A
GLOSSARY

A

A&T	Acquisition and Technology
ABM	Activity-Based Methodology
ASD(C3I)	Assistant Secretary of Defense for Command, Control, Communications, and Intelligence
ASD(NII)	Assistant Secretary of Defense for Networks and Information Integration
ASM	Architecture Specification Model
AV	All-Views

B

BMA	Business Mission Area
BRM	Business Reference Model

C

C2	Command and Control
C3	Command, Control, and Communications
C3	Command, Control, and Consultation (NATO usage)
C3I	Command, Control, Communications, and Intelligence
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CADM	Core Architecture Data Model
CIO	Chief Information Officer
CJCS	Chairman Joint Chiefs of Staff
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
CJCSM	Chairman of the Joint Chiefs of Staff Manual
COI	Communities of Interest
CONOPS	Concept of Operations

D

DARS	DoD Architecture Registry System
DAS	Defense Acquisition System
DDMS	Department of Defense Discovery Metadata Specification
DIMA	Defense Portion of Intelligence Mission Area
DoD	Department of Defense
DoDAF	DoD Architecture Framework
DoDD	DoD Directive
DoDI	DoD Instruction
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership & Education, Personnel, and Facilities

E

EA	Enterprise Architecture
EAAF	Enterprise Architecture Assessment Framework
EAMMF	Enterprise Architecture Management Maturity Framework
EIEMA	Enterprise Information Environment Mission Area

F

FEA	Federal Enterprise Architecture
FEA RM	Federal Enterprise Architecture Reference Model
FJAWG	Federated Joint Architectures Working Group
FoS	Family of Systems

G

GIG	Global Information Grid

I

ICD	Initial Capabilities Document
IDEF0	Integrated Definition for Activity Modeling
IEEE	Institute of Electrical and Electronics Engineers
IA	Information Assurance
IT	Information Technology

J

J6	Command, Control, Communications, and Computer Systems Directorate, Joint Staff
JCIDS	Joint Capabilities Integration and Development System
JROC	Joint Requirements Oversight Council

M

MA	Mission Area

N

NCE	Net-Centric Environment
NCO	Net-Centric Operations
NCOW RM	Net-Centric Operations and Warfare Reference Model
NCW	Net-Centric Warfare
NetOps	Network Operations
NR-KPP	Net Ready Key Performance Parameter
NSS	National Security Systems

O

OASD	Office of the Assistant Secretary of Defense
OMB	Office of Management and Budget
OMG	Object Management Group
OV	Operational View

P

PfM	Portfolio Management
PPBE	Planning, Programming, Budgeting, and Execution
	S
SIPRNET	Secret Internet Protocol Router Network
SOA	Service Oriented Architecture
SoS	System of Systems
SV	Systems and Services View
	T
TA	Tiered Accountability
TV	Technical Standards View
	U
UML	Unified Modeling Language
USD(A&T)	Under Secretary of Defense for Acquisition and Technology
	W
WMA	Warfighting Mission Area

ANNEX B
DICTIONARY OF TERMS

The terms included in this Annex are used in some restrictive or special sense. Certain terms are not defined (e.g., event, function) because they have been left as primitives, and the ordinary dictionary usage should be assumed. Where the source for a definition is known, the reference has been provided in parentheses following the definition. Terms that are being used by both the DoDAF and the C4ISR CADM are marked with an asterisk.

All definitions shared between the DoDAF and CADM documents are denoted with an asterisk (*).

Analysis of Alternatives	The evaluation of the performance, operational effectiveness, operational suitability and estimated costs of alternative systems to meet a mission capability. The Analysis of Alternatives (AoA) assesses the advantages and disadvantages of alternatives being considered to satisfy capabilities, including the sensitivity of each alternative to possible changes in key assumptions or variables. The AoA is one of the key inputs to defining the system capabilities in the capability development document. (CJCSI 3170.01E)
Architecture Artifacts	Architecture artifacts are those items produced through the development of architecture including: architecture data and relationships, DoDAF graphical, matrix, or textual products derived from architecture data, and existing architecture products developed that are not based on architecture data but can still provide insightful and meaningful exposure of past architecture development efforts.
Architecture Data Element	One of the data elements that make up the Framework products. Also referred to as architecture data type. (DoDAF)
Attribute	A quantitative or qualitative characteristic of an element or its actions. (CJCSI 3170.01E)
Business Mission Area	The BMA ensures that the right capabilities, resources, and materiel are reliably delivered to our warfighters: what they need, where they need it, when they need it, anywhere in the world. In order to cost-effectively meet these requirements, the DoD current business and financial management infrastructure - processes, systems, and data standards - are being transformed to ensure better support to the warfighter and improve accountability to the taxpayer. Integration of business transformation for the DoD business enterprise is led by the Deputy Secretary of Defense in his role as the Chief Operating Officer of the Department. (DoDI 8115.02)
Capability	The ability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. It is defined by an operational user and expressed in broad operational terms in the format of a joint or initial capabilities document or a joint doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) change recommendation. In the case of materiel proposals, the definition will progressively evolve to DOTMLPF performance attributes identified in the capability development document and the capability production document. (CJCSI 3170.01E)
Capability Development Document	A document that captures the information necessary to develop a proposed program(s), normally using an evolutionary acquisition strategy. The CDD outlines an affordable increment of militarily useful, logistically supportable and technically mature capability. (CJCSI 3170.01E)
Capability Gaps	The inability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. The gap may be the result of no existing capability or lack of proficiency or sufficiency in existing capability. (CJCSI 3170.01E)
Capability Production Document	A document that addresses the production elements specific to a single increment of an acquisition program. (CJCSI 3170.01E)
Communities of Interest	*Communities of Interest (COIs)* is the inclusive term used to describe collaborative groups of users who must exchange information in pursuit of their shared goals,

	interests, missions, or business processes and who therefore must have shared vocabulary for the information they exchange. (DoD Net-Centric Data Strategy, 9 May 2003)
Data	A representation of individual facts, concepts, or instructions in a manner suitable for communication, interpretation, or processing by humans or by automatic means. (Institute of Electrical and Electronics Engineers (IEEE) 610.12)
Data Model	A representation of the data elements pertinent to an architecture, often including the relationships among the elements and their attributes or characteristics. (DoDAF)
Data-Entity*	The representation of a set of people, objects, places, events or ideas that share the same characteristic relationships. (DDDS 4362 (A))
Defense Acquisition System	The management process by which the Department of Defense provides effective, affordable, and timely systems to the users. (DoDD 5000.1)
Department of Defense Discovery Metadata Specification	To facilitate data asset discovery, the Department of Defense has developed the *DoD Discovery Metadata Specification* (DDMS) as the common set of descriptive metadata elements that are to be associated with each data asset that is made visible to the Enterprise Discovery capability. The DDMS defines a core set of elements that must be used to describe data assets made visible to the Enterprise. (DDMS, v1.3)
DoD Component	The DoD Components consist of the Office of the Secretary of Defense, the Military Departments, the Chairman of the Joint Chiefs of Staff, the combatant commands, the Office of the Inspector General of the Department of Defense, the Defense agencies, the DoD field activities, and all other organizational entities within the Department of Defense. (DoDD 8100.01)
DoD Portion of Intelligence Mission Area	The DIMA includes IT investments within the Military Intelligence Program and Defense component programs of the National Intelligence Program. The USD(I) has delegated responsibility for managing the DIMA portfolio to the Director, Defense Intelligence Agency, but USD(I) retains final signature authority. DIMA management will require coordination of issues among portfolios that extend beyond the Department of Defense to the overall Intelligence Community. (DoDI 8115.02)
Enterprise Information Environment Mission Area	The EIEMA represents the common, integrated information computing and communications environment of the GIG. The EIE is composed of GIG assets that operate as, provide transport for, and/or assure local area networks, campus area networks, tactical operational and strategic networks, metropolitan area networks, and wide area networks. The EIE includes computing infrastructure for the automatic acquisition, storage, manipulation, management, control, and display of data or information, with a primary emphasis on DoD enterprise hardware, software operating systems, and hardware/software support that enable the GIG enterprise. The EIE also includes a common set of enterprise services, called Core Enterprise Services, which provide awareness of, access to, and delivery of information on the GIG. (DoDI 8115.02)
Family of Systems	A set or arrangement of independent systems that can be arranged or interconnected in various ways to provide different capabilities. (DoDD 4630.5)
Global Information Grid	The globally interconnected, end-to-end set of information capabilities, associated processes, and personnel for collecting, processing, storing, disseminating and managing information on demand to warfighters, policy makers, and support personnel. The GIG includes all owned and leased communications and computing systems and services, software (including applications), data, security services, and other associated services necessary to achieve Information Superiority. It also includes National Security Systems as defined in section 5142 of the Clinger-Cohen Act of 1996 (reference (b)). The GIG supports all Department of Defense, National Security, and related Intelligence Community missions and functions (strategic, operational, tactical, and business), in war and in peace. The GIG provides capabilities from all operating locations (bases, posts, camps, stations, facilities, mobile platforms, and deployed sites). The GIG provides interfaces to coalition, allied, and non-DoD users and systems. (DoDD 8100.1, 19 September 2002)
Information	The refinement of data through known conventions and context for purposes of

	imparting knowledge.
Information Technology	Any equipment, or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency. This includes equipment used by a DoD Component directly, or used by a contractor under a contract with the Component, which (i) requires the use of such equipment, or (ii) requires the use, to a significant extent, of such equipment in the performance of a service or the furnishing of a product. The term "IT" also includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources. Notwithstanding the above, the term "IT" does not include any equipment that is acquired by a Federal contractor incidental to a Federal contract. The term "IT" includes National Security Systems (NSS). (DoDD 4630.5)
Initial Capabilities Document	Documents the need for a materiel approach, or an approach that is a combination of materiel and non-materiel, to satisfy specific capability gap(s). It defines the capability gap(s) in terms of the functional area, the relevant range of military operations, desired effects, time and doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) and policy implications and constraints. The Initial Capabilities Document (ICD) summarizes the results of the DOTMLPF and policy analysis and the DOTMLPF approaches (materiel and non-materiel) that may deliver the required capability. The outcome of an ICD could be one or more joint DOTMLPF Change Recommendation (DCR**)** or capability development documents. (CJCSI 3170.01E)
Integrated Architecture	An architecture consisting of multiple views or perspectives (Operational View, Systems View, and Technical Standards View) that facilitates integration and promotes interoperability across family of systems and system of systems and compatibility among related architectures (DoDD 4630.5) An architecture description that has integrated Operational, Systems, and Technical Standards Views with common points of reference linking the Operational View and the Systems View and also linking the Systems View and the Technical Standards View. An architecture description is defined to be an *integrated architecture* when products and their constituent architecture data elements are developed such that architecture data elements defined in one view are the same (i.e., same names, definitions, and values) as architecture data elements referenced in another view. (DoDAF)
Interoperability	The ability of systems, units, or forces to provide data, information, materiel, and services to and accept the same from other systems, units, or forces and to use the data, information, materiel, and services so exchanged to enable them to operate effectively together. IT and NSS interoperability includes both the technical exchange of information and the end-to-end operational effectiveness of that exchange of information, as required, for mission accomplishment. (DoDD 4630.5)
Joint Capabilities Integrated Development System	Policy and procedures that support the Chairman of the Joint Chiefs of Staff and the Joint Requirements Oversight Council in identifying, assessing, and prioritizing joint military capability needs. (CJCSI 3170.01E)
Key Performance Parameters	Those attributes or characteristics of a system that are considered critical or essential to the development of an effective military capability and those attributes that make a significant contribution to the key characteristics as defined in the Joint Operations Concepts. KPPs are validated by the Joint Requirements Oversight Council (JROC) for JROC Interest documents, and by the DoD component for Joint Integration or Independent documents. Capability development and capability production document KPPs are included verbatim in the acquisition program baseline. (CJCSI 3170.01E)
Link	A representation of the physical realization of connectivity between systems nodes.
Mission Area*	The general class to which an operational mission belongs. (DDDS 2305(A)) Note: Within a class, the missions have common objectives.
Mission*	An objective together with the purpose of the intended action. (Extension of DDDS

	1(A)) Note: Multiple tasks accomplish a mission. (Space and Naval Warfare Systems Command)
Needline*	A requirement that is the logical expression of the need to transfer information among nodes.
Net-Centric Environment	A framework for full human and technical connectivity and interoperability that allows all DOD users and mission partners to share the information they need, when they need it, in a form they can understand and act on with confidence, and protects information from those who should not have it. ("Net-Centric Environment - Joint Functional Concept" document (v1.0) from April 2005.)
Net-Centricity	An information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. In essence, (net-centricity) translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace (Alberts, David S., Garstka, John J., and Stein, Frederick P., Network Centric Warfare: Developing and Leveraging Information Superiority, 2nd Edition (Revised), 1999, CCRP Publication Series)
Net-Centric Operations	The exploitation of the human and technical networking of all elements of an appropriately trained joint force by fully integrating collective capabilities, awareness, knowledge, experience, and superior decision making to achieve a high level of agility and effectiveness in dispersed, decentralized, dynamic and uncertain operational environments. ("Net-Centric Environment - Joint Functional Concept" document (v1.0) from April 2005.)
Net-Centric Warfare	An information superiority oriented concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. (*Network Centric Warfare*) A sub-set of Net-Centric Operations, see above. ("Net-Centric Environment – Joint Functional Concept", v1.0, 7 April 2005.)
Network*	The joining of two or more nodes for a specific purpose.
Node*	A representation of an element of architecture that produces, consumes, or processes data.
National Security Systems	Telecommunications and information systems operated by the Department of Defense – the functions, operation, or use of which (1) involves intelligence activities, (2) involves cryptologic activities related to national security, (3) involves the command and control of military forces, (4) involves equipment that is an integral part of a weapon or weapons systems, or (5) is critical to the direct fulfillment of military or intelligence missions. Subsection (5) in the preceding sentence does not include procurement of automatic data processing equipment or services to be used for routine administrative and business applications (including payroll, finance, logistics, and personnel management applications). (DoDD 4630.5)
Operational Activity Model	A representation of the actions performed in conducting the business of an enterprise. The model is usually hierarchically decomposed into its actions, and usually portrays the flow of information (and sometimes physical objects) between the actions. The activity model portrays operational actions not hardware/software system functions. (DoDAF)
Operational Activity	An activity is an action performed in conducting the business of an enterprise. It is a general term that does not imply a placement in a hierarchy (e.g., it could be a process or a task as defined in other documents and it could be at any level of the hierarchy of the Operational Activity Model). It is used to portray operational actions not hardware/software system functions. (DoDAF)
Operational Node	A node that performs a role or mission. (DoDAF)
Organization*	An administrative structure with a mission. (DDDS 345 (A))
Planning, Programming,	The primary resource allocation process of the DoD. One of three major decision

Budgeting, and Execution Process	support systems for defense acquisition, PPBE is a systematic process that guides DoD's strategy development, identification of needs for military capabilities, program planning, resource estimation and allocation, acquisition, and other decision processes.
Platform*	A physical structure that hosts systems or system hardware or software items.
Process	A group of logically related activities required to execute a specific task or group of tasks. (Army Systems Architecture Framework) Note: Multiple activities make up a process. (Space and Naval Warfare Systems Command)
Service	A distinct part of the functionality that is provided by a system on one side of an interface to a system on the other side of an interface to include those capabilities to execute a business or mission process or exchange information among both machine and human users via standard interfaces and specifications. (Derived from IEEE 1003.0)
Service Oriented Architecture	Service Oriented Architecture is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations. (OASIS RM for SOA)
System	Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions. (DoDAF)
System Data Element	A basic unit of data having a meaning and distinct units and values. (Derived from 8320.1) The architecture data element or type that stores data from the architecture domain (i.e., it has a value) that is produced or consumed by a system function and that has System Exchange attributes as specified in the Systems Data Exchange Matrix. (DoDAF)
System Exchange	The collection of System Data Elements and their performance attributes such as timeliness, quality, and quantity values. (DoDAF)
System Function*	A data transform that supports the automation of activities or information elements exchange. (DoDAF)
Systems Node	A node with the identification and allocation of resources (e.g., platforms, units, facilities, and locations) required to implement specific roles and missions. (DoDAF)
System of Systems	A set or arrangement of independent systems that are related or connected to provide a given capability. The loss of any part of the system will degrade the performance or capabilities of the whole. (DoDD 4630.5)
Task	An action or activity (derived from an analysis of the mission and concept of operations) assigned to an individual or organization to provide a capability. (UJTL, CJCSM 3500.04D, 2005)
Warfighting Mission Area	The WMA provides life cycle oversight to applicable DoD Component and Combatant Commander IT investments (programs, systems, and initiatives). WMA IT investments support and enhance the Chairman of the Joint Chiefs of Staff's joint warfighting priorities while supporting actions to create a net-centric distributed force, capable of full spectrum dominance through decision and information superiority. WMA IT investments ensure Combatant Commands can meet the Chairman of the Joint Chiefs of Staff's strategic challenges to win the war on terrorism, accelerate transformation, and strengthen joint warfighting through organizational agility, action and decision speed, collaboration, outreach, and professional development. (DoDI 8115.02)

ANNEX C
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