Towards a Common Joint Training Architecture Picture: Framing the JNTC Enterprise Architecture and Technical Standards

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ABSTRACT

The paper will describe evolving joint training architecture and technical standards frameworks and the way ahead that enables linking globally distributed capabilities to meet joint warfighter training and mission rehearsal requirements. DoD tasked United States Joint Forces Command, Joint National Training Capability to develop "joint" architecture and technical standards to seamlessly link Live, Virtual and Constructive (LVC) capabilities into an integrated joint training infrastructure. These architectures and standards are developed in accordance with DoD policy and guidelines, commonly referred to as the DoD Architecture Framework (DoDAF). In order to more fully address complexities involved in training integrated architecting, a Business Modeling Framework (BMF) has also been developed. BMF links and extends related DoDAF training architecture views, which can create an enterprise-level common training architecture model. This approach has applicability to joint training support enterprises, such as the Joint National Training Capability (JNTC), with its associated Joint Management Office (JMO) as well as other supporting joint and service directorates. Specific BMF mappings to joint training architecture concepts, including the Joint Training System (JTS) enterprise, JNTC JMO certification processes, as well as JNTC technical standards are described. The joint training enterprise framework contains business practice models, including joint training life cycle processes and business infrastructure requirements. Linkages and interdependencies between these concepts are explained in terms of relationships and higher order effects. Critical to this integrated architecture are JNTC technical standards, which are part of the enterprise technical and business structure essential for joint training realism and interoperability.

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INTRODUCTION

Achievement of Department of Defense (DoD) Training Transformation (T2) objectives requires development of the Joint Training System (JTS) to enable dramatic transformation of DoD training. The Joint Training System is an integrated framework to prioritize, plan, execute, and assess training requirements (DoD T2 Implementation Plan, June 2003). Such a framework is intended to support continuous transformation of DoD military and civilian training in order to accomplish joint tasks supporting operational needs of combatant commands. JTS encompasses three enabling capabilities: Joint National Training Capability (JNTC), Joint Knowledge Development and Distribution Capability (JKDDC), and Joint Assessment and Enabling Capability (JAEC). These capabilities are intended to span across warfighter training echelons, including collective, individual, and staff training. This paper addresses critical enterprise issues in the path towards JTS realization. After highlighting key T2 challenges, a promising integrated architectural approach to address these challenges is described. The key integration roles of certification and technical standards for JTS and JNTC evolution are two critical enablers to the joint training support enterprise architecture.

JOINT TRAINING TRANSFORMATION CHALLENGES

The DoD T2 initiative presents many challenges in the areas of synchronization and alignment of effort. A key integration challenge to achieving DoD-wide training transformation, according to the T2 Implementation Plan, is to integrate joint training into a joint knowledge management architecture. This involves creation and storage of new knowledge for future military operations and imparting it via individual, collective and staff training through the JTS. Potential problem areas within JTS can occur, as with many complex enterprise systems, in the seams across the *lifecycle* dimension related to the evolution and stages of enterprise deliverables to achieve operational capabilities and across the *programmatic/product line dimension* where enterprise programs and organizations are tasked to implement various aspects of deliverable capabilities. Critical enterprise gaps and redundancies can occur in these seams, leading to inefficiencies in a deliverable's capability performance, allocation of lifecycle resources, and timely delivery to the customer.

Joint training synchronization and alignment across the lifecycle dimension is becoming more challenging due to the increasing need for engineering system of systems training capabilities. System of systems engineering deals with planning, analyzing, organizing, and integrating the capabilities of a mix of existing and new systems into a system of systems capability greater than the sum of the capabilities of the constituent parts (Defense Acquisition University, 2004). This requires the development of the JTS as a meta-system, composed of a mix of existing, partially developed, and proposed systems at various points in its lifecycle. Due to this meta-system complexity, program and systems engineering management of JTS are challenged with enterprise level lifecycle issues including developing cross-system technical standards (e.g., interoperability and data) and linking system designs which are at various stages of lifecycle fidelity.

Joint training program and product line seam challenges are resulting from an increased need to incorporate multi-echelon training capabilities with the goal of more efficient, more timely, higher quality training. A joint multi-echelon training event could include individual, collective, and staff task requirements, requiring integration of joint training capabilities across JTS program boundaries. Another cross-program challenge is the coordination and alignment of various JTS business practice for assessing the development state of relevant training programs, sites, and systems, as well as the assessment of training readiness levels. One promising approach to address such challenges relating to JTS alignment and synchronization is the use of iterative architecting at the enterprise level of JTS.

THE POTENTIAL OF INTEGRATED ARCHITECTURES FOR JTS ALIGNMENT AND SYNCHRONIZATION

In order to help address the challenge of JTS alignment and synchronization, T2 key leadership can make use of emerging enterprise integration modeling approaches. An enterprise can be defined as an organization created to provide products and/or services to customers (Eyefortransport, 2004). A military training support enterprise can be described as a complex system of endeavors within the national security and defense environment, enabling delivery of highly integrated training capabilities to meet warfighter mission training needs (Dryer et. al., 2004). One relevant training support enterprise modeling effort is currently being conducted to evolve the U.S. Army's Training Support System (TSS) enterprise. In order to more fully address complexities involved in the TSS, a Business Modeling Framework (BMF) is being developed. BMF links and extends related DoD Architecture Framework (DoDAF) training architectures to create an enterprise-level common training architecture view. An enterprise architecture framework, such as BMF, is able to model the arrangement and interoperation of business components (e.g., policies, operations, infrastructure, information) that together make up the enterprise's means of operation (Interoperability Clearinghouse, 2003). An Enterprise Architecture (EA) should describe current and target architectures (including rules, standards, and *systems life cycle* information) and a target architecture transition strategy to optimize and maintain the environment (OMB, 2003).

Key concepts of the BMF architecture framework are shown in Figure 1. The horizontal lifecycle dimension depicts deliverable lifecycle aspects of various enterprise deliverables. The left-hand business side of the lifecycle dimension relates to the definition and modeling of interrelated enterprise business practice and systems activities involving processes, information, actors, and systems provided for indirect life cycle support (e.g., planning, development, production, and assessment) of delivered capabilities. Such modeling applies aspects of the Federal Enterprise Architecture (FEA) Business Reference Model (BRM) to BMF, particularly the concepts of enterprise strategic directions, deliverables, delivery modes, and various enterprise actors (e.g., customer and deliverable providers) which are not currently in DoDAF. The business side of the lifecycle dimension also applies business process modeling to improve enterprise business practice. Such modeling can help identify enterprise business functional and system requirements to develop training support capabilities.

The right-hand side of the lifecycle dimension relates to the definition and modeling of interrelated deliverable capability activities, information, actors, systems, products, and services provided to support delivered capabilities directly fulfilling customer needs (Dryer et. al., 2004). This is the portion of the enterprise model that describes training support capabilities for the warfighter's customer needs. Training domain use cases portray critical capability operational views. The range of system-of-system product line capabilities are modeled which achieve these use cases. Capability technical standards are developed and applied to achieve efficiencies and commonality where appropriate.

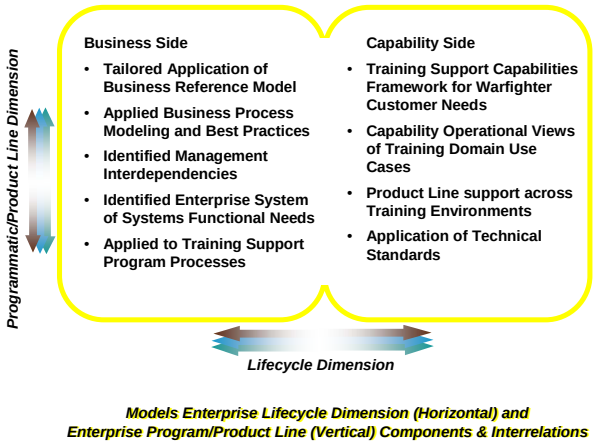

Figure 1. Business Modeling Framework (BMF) Architecture Dimensions

A critical component to the BMF is the enterprise and technical structure "frame", as shown in Figure 2. This aspect of the enterprise model incorporates enterprise guidance, technical standards, as well as business and capability best practices. This frame can be viewed as the structure of linkage points which tether and align various enterprise components across lifecycle and programmatic/product line dimensions. Enterprise business structural points include common business practice, such as deliverable capability development and assessment processes. Such business practices can benefit from common business infrastructure tools including: requirements management, systems engineering, configuration management, verification and validation, information technology, and security.

Towards the capability side, the enterprise structural points include collective, staff, and individual training

practices, which can make use of joint training use cases. Training readiness performance during such training operations needs to be assessed through common tools and procedures. Finally, technical standards structural points are shown, which align the design and implementation of JNTC and JKDDC system of systems capabilities. These technical standards include data and interface specifications across and within the JTS product line capabilities.

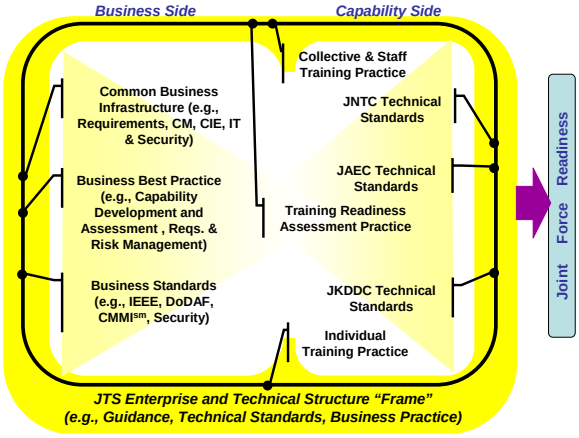

Figure 2. JTS Enterprise and Technical Structure Frame using BMF

Now that the key concepts of BMF have been described and mapped to the JTS enterprise, a representation of JTS components and interrelation mappings is shown using a composite enterprise model in Figure 3. The three enabling JTS capabilities: Joint National Training Capability (JNTC), Joint Knowledge Development and Distribution Capability (JKDDC), and Joint Assessment and Enabling Capability (JAEC) are represented using BMF. The various joint management offices of these capabilities are represented on the left hand business side, along with enterprise business focus areas. The reason for these business organizations is the creation of the JTS suite of joint training capabilities as shown on the right hand side of the model. JNTC focuses on collective training and satisfying joint staff training requirements. JKDDC focuses on individual training and its incorporation into multi-echelon training practices. JAEC is involved in the development and deployment of training readiness assessment operations and supporting systems spanning all joint training domains. The tethering of these complementary aspects of JTS is accomplished through the JTS frame with structural interrelations depicted via arcs which align and synchronize components within and between programs and across various stages of lifecycle development.

Correlations to DoDAF views are shown in Figure 4. The operational, systems, and technical standards views of DoDAF are mapped to the JTS enterprise representation by expanding and decomposing the JTS composite view from Figure 3 into operational, systems, and structural layers. Critical linkage supports between the enterprise structure foundation to the other operational and systems layers are shown with arc lines. As an example of structure linkage within a JTS program, JNTC technical standards support the alignment and synchronization of various JNTC system of systems, which are in various stages of lifecycle development. Examples of across program linkage structure are common JTS business practices and business standards guiding the development of JNTC, JAEC, and JKDDC assessment procedures.

One initial objective of JTS business architecting can be the cross-program alignment of *assessment* practice using the evolution of the JNTC certification process as a model for enterprise certification activities. Linkages between the enterprise business structures (standards and best practices) and JNTC certification are shown using thick arc lines on the left side of Figures 3 and 4. Such certification practice is a critical component to determine JNTC investment strategy and is further described below. JNTC certification relies on technical standards to assess whether candidate sites meet the minimum standards, architectures, protocols, configurations, and capabilities to support joint training. The linkage between the JNTC technical structure and the JNTC system of systems evolving capability are shown using a thick arc on the right side of Figures 3 and 4. The JNTC technical standards discussion below can serve as an initial JTS model approach for enterprise system and data interoperability.

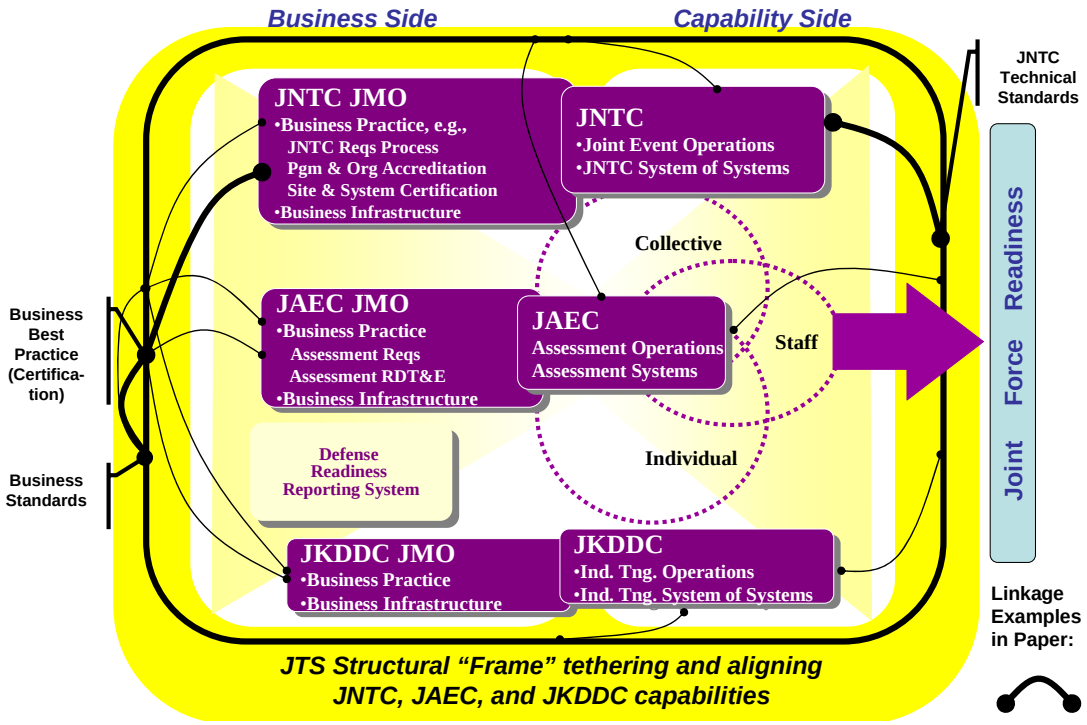

Figure 3. JTS Composite Model using BMF

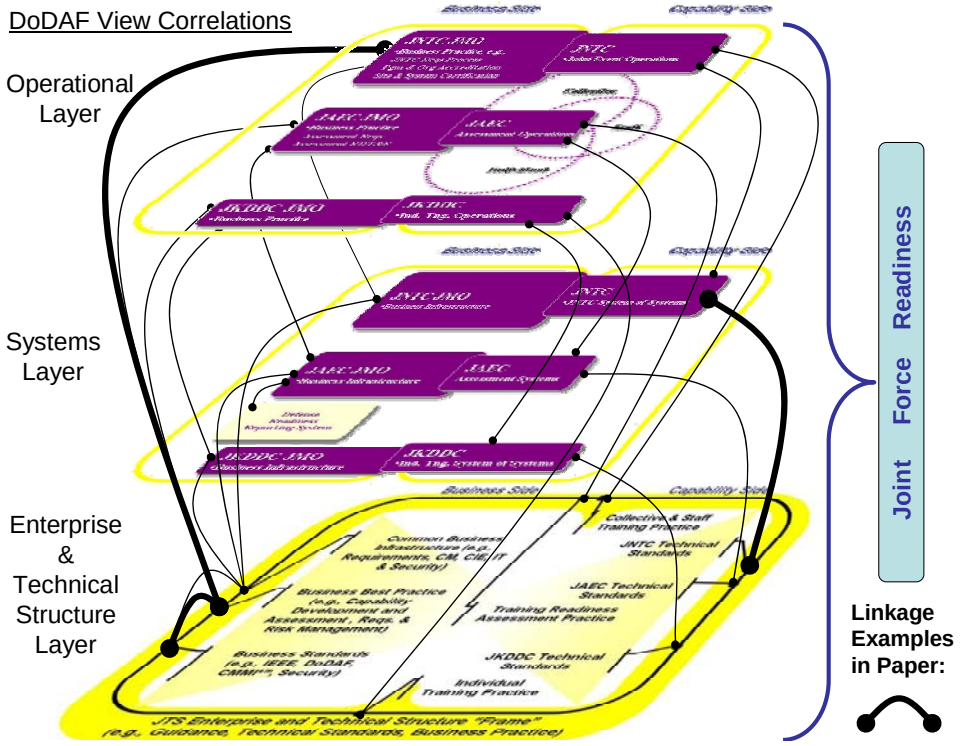

Figure 4. DoDAF View Correlations to Expanded JTS Enterprise Mapping using BMF

THE KEY ROLE OF CERTIFICATION FOR T2 EVOLUTION

The Training Transformation (T2) Implementation Plan specifies that the Joint National Training Capability (JNTC) global joint training infrastructure provide a network of "certified" training sites that enable the execution of JNTC accredited joint training events. Certification is a determination that training sites and systems are compliant with specified Department of Defense (DoD) and JNTC architectures, configurations, and standards. JNTC certification establishes that the capability exists at a particular site to support a joint training role through the creation of a realistic joint environment for training/mission rehearsal of joint tasks.

The overarching purposes of certification are to: 1) establish the baseline technical infrastructure at JNTC training sites; 2) verify that each site meets the minimum standards, architectures, protocols, configurations, and capabilities needed to host JNTC training events; 3) ensure, through a configuration management plan, that each site retains the ability to fully participate in JNTC events; and 4) as the JNTC evolves and future standards and architectures are developed, sites are upgraded to maintain their certification. Certification supports the accreditation process by ensuring that the architecture, systems, equipment, software, support infrastructure, etc., that are required to complete training of joint tasks (or portions of joint tasks) and provide the inherent joint context, are available (to standard) at a site or facility.

The certification process is described in the Certification Concept of Operations (CONOPS). Since its inception the JNTC Joint Management Office (JMO), in collaboration with the Combatant Commands (COCOMs), Services and other JNTC stakeholders, has been developing the CONOPS and has chartered a Certification Management Team to stand up the certification program. The team follows the guidelines below.

- Site certification is applicable to all commands or facilities expected to participate in training on specified joint tasks, including linked sites that provide support to the site being certified. It verifies that existing systems and equipment meet JNTC criteria and that those systems and equipment utilize the Joint Training Experimentation Network (JTEN).
- System certification verifies that newly acquired systems (or system of systems) intended to support training on specified joint tasks meet JNTC criteria.
- The sites are certified as capable of supporting the training on joint tasks specified by the JWFC accreditation process. This process is based on the operational and training requirements of the COCOMs and Services. These training requirements drive the capabilities required at the training sites and reflect schedule, training throughput, and accreditation of the training organizations and/or programs.
- Certification requirements for sites are tailored to the specific capabilities required at that site.
- Certification focuses on training command and control (C2) nodes vice operational C2 nodes.
- Certification generally does not apply to training systems installed on operational platforms such as ships, vehicles, and aircraft.

In summary, certification assists the Joint Warfighting Center (JWFC), JNTC and Service investments in training systems infrastructure by identifying for the JNTC and Services those *program* training systems and capabilities that are not compatible with JNTC systems and capabilities. A business case analysis, based on data collected during certification, provides the JWFC and other decision makers with the information required to support the most cost-effective investment strategy that yields the highest return on investment in support of joint training requirements. Towards this end, the JMO, in accordance with established priorities and available funding, allocates funding to assist COCOMs and Services in the procurement of necessary equipment and/or network changes to become compliant with JNTC technical certification requirements.

THE JNTC TECHNICAL STANDARDS APPROACH

The JNTC Joint Management Office (JMO) is developing joint training infrastructure integrated architecture and standards in order to clearly articulate constructs for integrating Live, Virtual and Constructive (LVC) capabilities in support of training transformation. Architectures provide a formal description of the management improvement process adopted by DoD while providing a mechanism for understanding and managing complexity. There are three components or views to architecture: operational, systems, and technical. Technical architecture provides the technical systems-implementation guidelines, i.e., standards and protocols, upon which engineering specifications are

based, common building blocks are established, and product lines are developed. Figure 5 depicts a summary of the three architecture views.

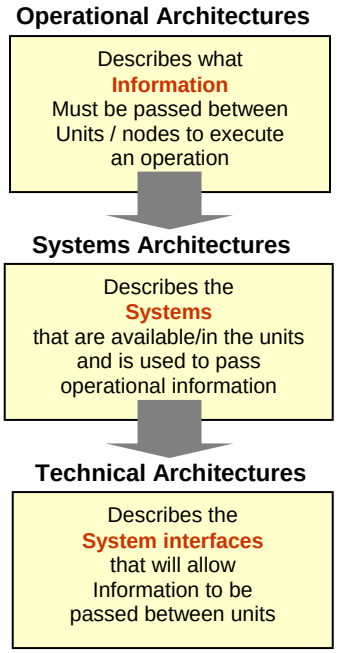

Figure 5. Three Architecture Views

The JNTC JMO is leading the development of standards documentation required to seamlessly link the LVC capabilities across the services into an integrated joint training infrastructure. The Technical View identifies relevant guidance, *standards*, rules, and conventions. A standards list has been incorporated into a document called Technical Standards Profile View (TV-1), which is a requirement of DoD Architecture Framework (DoDAF). This document is developed collaboratively with the Combatant Commands (COCOMs), Services and other JNTC stakeholders and is key to defining how the LVC capabilities are linked into a distributed joint training environment. A baseline has been published that captures the current "as is" standards that are currently being utilized within JNTC. Final comments have been received and adjudicated. The final authoritative step is the General's signature. The TV-1 and Baseline documents will be updated and refined annually to reflect the spiral development process, technology advancements and evolving requirements.

The TV-1 encompasses the technical standards/rules that govern the implementation and operation of a system's or sets of systems' architecture. As standards generally govern what hardware and software may be implemented and what system data formats may be used, TV-1 delineates which standards may be used to implement the systems, system hardware/software items, communications protocols, and system data formats for JNTC interoperability. Knowledge of the technical standards for the systems in use is relevant for most architecture uses, including C4I Support Plans (C4ISPs); where the absence of such knowledge may lead to failed plans and the inability to receive or transmit information due to incompatibility of systems.

The TV-1 matrix is organized in columns labeled: Focus Area, Service Area, Service Category, Service Standard, Service Specification, and L-V-C (Live, Virtual, and Constructive). Each of these column headings is explained in more detail below.

Focus Area

The four focus areas are: Joint Command, Control, Communications, and Computers (JC4) Systems and Communications Action Team, Joint Training Data and Instrumentation Action Team (INSTR), Opposing Forces Technologies Action Team (OPFOR), and Live, Virtual, and Constructive (LVC) Testbed Action Team. The JC4 Action Team develops, installs, operates, and maintains a dedicated, persistent, bandwidth-on-demand, JNTC C4 infrastructure that is supported 24/7 for key combatant commands, Services, agencies, or interagency locations throughout the world. The INSTR Action Team defines the technical goals for data systems that enable joint, distributed training across DoD sites, simulation centers, Service, and combatant command training locations. The OPFOR Action Team identifies the technological products/concepts that support establishment of a credible, full capability, adversary representation. The LVC Action Team identifies and selects Advanced Training Technologies (ATT) to ensure integration of LVC components into a seamless joint training environment. More information on these four focus areas can be found in the JNTC Implementation Plan.

Service Area

This area is a technical tier that supports the secure construction, exchange, and delivery of business or service components. Each Service Area groups the requirements of component-based architectures within the Federal Government into functional areas. Per the Joint Technical Architecture (JTA) (available online at the DoD Information Technology Standards and Profile Registry (DISR)), the Service Area is a set of capabilities grouped into categories by function. The DISR defines a set of services common to DoD information systems.

Service Category

This category is a sub-tier of the Service Area to classify lower levels of technologies, standards, and specifications in respect to the business or technology function they serve.

Service Standard

A standard is a document that establishes uniform engineering or technical criteria, methods, processes, and practices (DoD 4120.3-M). It can be hardware, software, or specifications that are widely used and accepted (De facto – exercising power or serving a function without being legally or officially established), or are sanctioned by a standards organization (De jure – according to law; by right). De facto standards are generally created by a single vendor with market dominance or a highly specialized niche product. They may be widely used and implemented, but controlled by a single vendor or group. De jure standards are generally known as public or industry standards, established by public bodies. These standards are endorsed and disseminated by official standards organizations. Standards are typically categorized as follows: Programming Language Standards, Character Code Standards, Hardware Interface Standards, Storage Media Standards, Operating System Standards, Communication and Networking Standards, Machine Language Standards, File System Management Standards, Database Management System Standards, Text Systems Standards, Graphic Systems Standards, and Internet Standards.

Service Specification

A document prepared to support acquisition that describes the essential technical requirements for purchased materiel and the criteria for determining whether those requirements are met (DoD 4120-24-M). A service specification is a formal layout/blueprint/design of an application development model for developing distributed component-based architectures. Developing components based on a specification simplifies enterprise applications by basing them on standardized modular components, and by providing a complete set of services to those components.

L-V-C (Live, Virtual, and Constructive)

Live simulation involves real people operating real systems. Virtual simulation involves real people operating simulated systems. Constructive models or simulations involve simulated people operating simulated systems. (DoD 5000.59-P, "Modeling and Simulation Master Plan," October 1995).

CONCLUSION

Iterative architecting using an enterprise framework, such as BMF, is essential for alignment within and across JTS capability initiatives. The BMF, which links and extends related DoDAF training architecture views, can create an enterprise-level joint training architecture model, including the critical technical structure "frame" incorporating enterprise guidance, technical standards, as well as business and capability best practices. An example of linked enterprise components has been described involving the JNTC certification process and supporting technical standards development. The JNTC certification process is being developed using an enterprise structure of underlying business standards and industry best practices. This certification of the JNTC system of systems can only be realized by the continuing development and application of a JNTC technical architecture, which provides data and interface standards for JNTC systems in various stages of lifecycle development. The synergy between JNTC's certification and standards development can serve as a model for cross program alignment of JTS structure, systems, and operational practice.

ACKNOWLEDGEMENTS

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