The Live-Synthetic Training, Test and Evaluation Enterprise Architecture

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ABSTRACT

Cross community and interservice Live-Synthetic (Virtual-Constructive-Gaming) initiatives often fail due to the lack of formalized governance, as stated by Frank DiGiovanni, Director, Force Readiness and Training in the Office of the Deputy Assistant Secretary of Defense (Readiness), during the 2014 Interservice/Industry Training, Simulation and Education Conference (I/ITSEC). In March 2014, the US Army initiated a cross community Research and Development (R&D) initiative to investigate the feasibility of establishing a common Live-Synthetic approach for the Training and Test & Evaluation (T&E) communities, called the Live-Synthetic Training and Test & Evaluation Enterprise Architecture (LS TTE EA).

This paper reports on the progress of this initiative in establishing the objective framework for the enterprise architecture (EA) that includes: (1) the initial governance approach, (2) the business architecture, and (3) the reference architecture. The governance approach provides agreed-upon practices and interactions for the formalized collaboration between organizations to build and deploy services that are useful and sustainable for the EA. The framework for the development and evolution of the governance approach for the LS TTE EA is outlined, including how the governance approach is being applied to current prototyping activities. The business architecture provides a common understanding to align Army strategic objectives and tactical Training and T&E demands. Business architecture artifacts and the results of a quick-look cost benefit analysis are discussed. The reference architecture is the authoritative source of information that guides the implementation of EA solutions. The reference architecture layers and initial documentation in Department of Defense Architecture Framework (DoDAF) viewpoints are shown. Finally, the paper discusses the way forward for application of the EA objective framework to the Army's Integrated Training Environment (ITE), Integrated Live-Virtual-Constructive Test Environment (ILTE), and Synthetic Training Environment (STE), and applicability to the Defense Training Environment (DTE).

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BACKGROUND AND MOTIVATION

Live and Synthetic (gaming, virtual and constructive) tools and architectures are essential capabilities in both the Test and Evaluation (T&E) and the Training communities. While there is significant commonality in Live and Synthetic needs in these communities, each community has historically taken its own path in designing, and producing Live and Synthetic capabilities to ensure their community-specific requirements are fully addressed. These uncoordinated, community-focused efforts often result in the development of duplicative capabilities, and/or the development of incompatible architectures and data structures that make it difficult to leverage capabilities developed by the other community (Institute for Defense Analyses, 2008). Today's budget realities, however, demand the development of more affordable and collaborative solutions. Future approaches for Live and Synthetic capabilities must enable the agile leveraging of each community's investments in scale and realism (focus of the Training community) and tactical systems integration and simulation (focus of the T&E community).

Today's Live and Synthetic systems were designed and developed a number of years ago, using information technologies that were state-of-the-art at that time. The evolutionary pace of information technologies has continued unabated and new information technologies such as service-oriented architectures, virtualization, cloud computing, and mobile devices, have sufficiently matured, and are now being transitioned into Army and Department of Defense (DoD) computing environments. These information technologies, coupled with the Army's move towards a common set of information technology standards and architecture, now provide the Training and T&E communities with the opportunity to jointly consider fundamentally different architectural, operational, and business approaches for the development, delivery, maintenance, and evolution of Live and Synthetic capabilities (U.S. Army Combined Arms Center, 2013; Department of Army, 2013; U.S. Army Combined Arms Center, 2014; U.S. Army, 2012; U.S. Army Operational Test Command, 2014; Assistant Secretary of the Army for Acquisition, Logistics and Technology, 2011).

The final motivation for this initiative is the desire to reduce risk. A cross-community approach to Live and Synthetic capabilities will enable each community to leverage the investments and capabilities developed by the other, providing a more capable and resilient environment for both Training and Operational T&E. This will reduce both the risk of accepting warfighting systems that should have failed during testing, and the risk of not having mature Live and Synthetic tools to train the force when those systems are fielded.

RELATIONSHIPS TO OTHER PROJECTS

The Army's current Live-Synthetic training capability is provided by the Live, Virtual, Constructive – Integrating Architecture (LVC-IA) that brings current training systems together to create an Integrated Training Environment (ITE). The Army is planning to evolve this current ITE into a single Synthetic Training Environment (STE) that combines constructive, gaming and virtual capabilities and can interoperate with Live training capabilities to efficiently provide realistic complex training at the point of need (Department of Army, 2012). Further evolution of the STE will provide additional capabilities and a "seamless" interface with Live training capabilities, creating the Army's Future Holistic Training Environment – Live/Synthetic (FHTE-LS).

The current baseline of integrated Live-Synthetic solutions used by the Army for Operational T&E (OT&E) includes a number of systems internally developed and managed by the Army Test & Evaluation Command (ATEC), and some training community solutions, such as the family of Multiple Integrated Laser Engagement System (MILES) systems and One Semi-Automated Forces (OneSAF). This baseline suffers shortcomings that affect the realism of the test environment and the data collected during test events. The Army OT&E community is now embarking on the design and development of the Integrated Live-Virtual-Constructive Test Environment (ILTE) to remedy these shortcomings. The ILTE will modernize and equip the operational test community with the tools required to create affordable, sustainable, and cost-effective realistic operational test environments.

The Live-Synthetic Training and Test & Evaluation Enterprise Architecture (LS TTE EA) initiative is focusing the needs and funding of the Army Modeling & Simulation Office (AMSO), the Army Operational Test Command (OTC), and the Program Executive Office for Simulation, Training & Instrumentation (PEO STRI) to develop a comprehensive approach for an Army Live-Synthetic Enterprise Architecture (EA) that is suitable for the Training and the OT&E communities. The primary goals of this initiative are that the LS TTE EA:

- Provides the common architectural structures for the Army's Live-Synthetic enterprise, and
- Enables significant technical risk reduction,

as the Training and OT&E communities transition from the status quo to the STE, FHTE-LS, and to ILTE, respectively.

ENTERPRISE ARCHITECTURE FRAMEWORK

The LS TTE EA initiative that commenced in March 2014, is developing a comprehensive approach for an Army Live-Synthetic EA that is suitable for the Training and the OT&E communities. The Federation of Enterprise Architecture Professional Organizations (FEAPO) states that, "Enterprise Architecture is a well-defined practice for conducting enterprise analysis, design, planning, and implementation, using a holistic approach at all times, for the successful development and execution of strategy" (Federation of EA Professional Organizations, 2013). The FEAPO continues, "Enterprise Architecture uniquely fosters dialog to create shared meaning and to deliver shared goals." With this in mind, the purpose of the LS TTE EA is to:

- Provide stakeholders with a strategic-level architecture and a detailed reference architecture that enables the evolution of the current LS training environment and LS OT&E environment into a single, more effective, and efficient LS TTE environment.
- Provide a common enterprise foundation and business strategy that informs simulation, training, and instrumentation planning, investment, acquisition, and operational decisions through the evolution to the future objective LS TTE environment.

Work performed on this initiative in 2014 established an objective framework for the EA, the initial governance approach, and the business architecture. The specific goals of the EA are:

- <u>Cooperative Command</u> by providing a clear frame of reference allowing stakeholders for the Training and T&E communities to master the linkages between the technical architecture and the business and strategy objectives, facilitating discussions within and between the communities.
- <u>Streamlined Efficiencies</u> by facilitating a comprehensive approach by the Army Training and T&E communities to collaboratively adopt a set of common services to reduce costs.
- <u>Guide the Evolution</u> of the current Live-Synthetic capabilities to the future Live-Synthetic capabilities through common technical and organizational direction.

To aid in the communication of the objective framework for the EA, an illustration of the layers and components of the architecture was created and is depicted in Figure 1.

The top layer, Vision, contains the doctrine-based objectives that drive technical and engineering decisions. The second layer, Business Architecture, contains the engineering trade-offs needed to meet the economic, quality, and schedule requirements of the LS TTE EA. The third layer has both the Governance, which contains the human- and automated-driven policy activities, and the Reference Architecture, which defines an architectural template for managing, developing, and executing ongoing to future programs.

The bottom layer of the illustrated LS TTE EA is the Solution Architecture, which contains the programs and architectures that will fulfill the Vision and Business Architecture goals. The LS TTE EA team's goal is for the Vision layer, the Business Architecture, the Governance, and the Reference Architecture to guide the evolution from the Foundational systems, through the Transitional systems, and finally to the Future systems, while consolidating the common components.

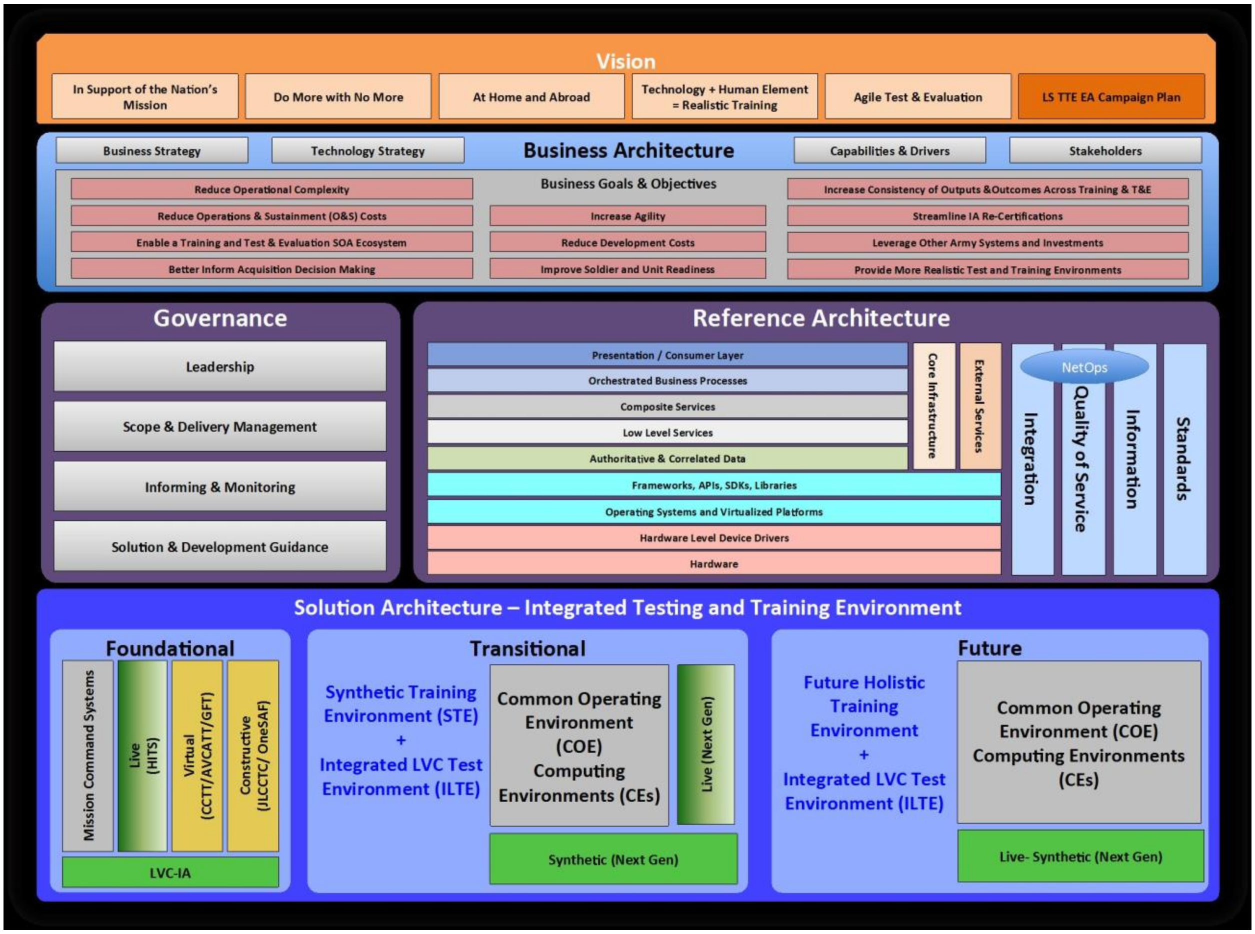

Figure 1 - LS TTE Enterprise Architecture

As a process to strengthen the engineering discipline behind the illustrated LS TTE EA, a series of 25 DoD Architecture Framework Version 2.0 (DoDAF 2.0) viewpoints have been developed. These included *Project Viewpoints* (PV-1 through 3), *System Viewpoints* (SV-1 through 5, and 8), *Capability Viewpoints* (CV-1 through 6), *Standards Viewpoints* (StdV-1 and 2), *Operational Viewpoints* (OV-1, 2, 4, 5a, and 5b), *Services Viewpoints* (SvcV-8), and the overarching *All Viewpoints* (AV-1 and 2).

The DoDAF 2.0 viewpoints have played a key role in rooting the objectives of the LS TTE EA in doctrine, applying systematic definitions to the language used, and linking the architecture to existing standards, which resulted in solidifying the formality of the intent of the designers.

GOVERNANCE APPROACH

The governance approach provides agreed-upon practices and interactions for the formalized collaboration between organizations to build and deploy services that are useful and sustainable for the EA. The governance approach includes how these practices can evolve over time, ensuring that the practices remain relevant to the evolving EA and to the evolving needs of the stakeholders (The Open Group, 2009; Woolf, B., 2007).

For the Army LS TTE EA to have a properly functioning EA and Service-Oriented Architecture (SOA) infrastructure, an organization of people and a set of practices and procedures must be put in place to support the activities associated with the development, deployment, sustainment, and evolution of these components. The organization and its interactions is the EA; the practices and procedures are the governance. Deliberate steps need to be taken to ensure the EA and governance work in tandem as well as evolve concurrently.

The Army operates through a collection of regulations, practices, responsibilities, and procedures that direct how it commands, operates, and disciplines (U.S. Army Command, 2012). This operational system is how the Army provides its governance. At the Army level, the Army Chief Information Officer (CIO)/G-6 is responsible for establishing information technology policies and regulations, as well as defining the EA for future Army computational systems and networks.

The Army G-8 oversees the work of the AMSO, which seeks to rationalize the development and utilization of Army models and simulation across all communities enabled by modeling and simulation (M&S). Included among these are the Training and Testing communities. Army Regulation 5-11, "Management of Army Modeling and Simulation," is the capstone policy document governing M&S for all Army communities enabled by M&S. This document describes the Army M&S Management Framework, including the roles and responsibilities of the M&S General Officer Steering Committee and the M&S Council of Colonels (U.S. Army Headquarters, 2014).

Training/Testing Governance describes collaborative decision-making, associated M&S services, and the mechanisms and practices used to measure and control the way M&S Services are built and deployed by programs in support of Army training and test missions. In the M&S area, the Army's primary training [Training and Doctrine Command (TRADOC), PEO STRI, and Land Component Commands] and testing (ATEC) governing organizations collaborate with AMSO to encourage cost savings through reuse. Army regulations and policy documents that govern test activities include AR 73-1, "Test and Evaluation Policy," (U.S. Army Regulations, 2006) and Department of the Army (DA) Pamphlet 73-1, "Test and Evaluation in Support of Systems Acquisition (U.S. Army Headquarters, 2003). ATEC supplements these governance documents for developmental and operational tests, issuing its internal regulations and test operations procedures. Test operations procedures help standardize the conduct of tests, prescribing the required facilities and instrumentation, standard test conditions, and detailed test procedures, including data inputs and collection methods (U.S. Army Developmental Test Command, 2008).

The driving organization for successful governance is the Stakeholder Integrated Product Team (IPT). The Stakeholder IPT, initially assembled by PEO STRI, will be the controlling body for determining the best approach to guide the progress of the EA and the SOA. Because the Stakeholder IPT will be representing the interests of multiple stakeholders – AMSO, Army OTC, Department of the Army Management Office – Training Simulations (DAMO-TRS/G8), the Assistant Secretary of the Army (Acquisition, Logistics and Technology) (ASA(ALT)), the National Simulation Center (NSC), and PEO STRI – the accumulative knowledge of the stakeholders should cover the organizational, managerial, and technical components of the EA from the Vision layer to the Solution Architecture.

There are six steps to conducting successful SOA governance (Afshar, M., 2007). JHU/APL has adapted and extended these six steps to be applicable to the entire EA, as illustrated in Figure 2. This adaptation and extension were achieved by overlaying the driving

Figure 2 – The Six Steps to Successful EA Governance

goals and objectives of a SOA governance with those of the goals and objectives that are derived from the LS TTE EA Vision and Business Architecture.

The LS TTE EA governance approach will evolve and mature through the iterative application of the six-step process across a series of related projects and programs. In the first iteration (i.e., the FY2014 JHU/APL LS TTE EA project), the governance approach development (Steps 1–3) is initiated from a blank sheet of paper. In the case of LS TTE EA, the developed governance approach is specific to the initial target project (the FY2015 Prototype Project), while maintaining consistency with the vision of the envisioned business architecture. The governance approach is applied to the project (Step 4), and data and lessons learned are gathered. Following project completion, the data and lessons learned are analyzed, and process improvements and SOA/EA refinements are developed (Steps 5–6). The resulting improved governance approach then becomes the starting point for the governance approach development (Steps 1–3) of the second iteration of the six-step process.

Successful evolution and maturation of the LS TTE EA governance approach can occur through iterative applications of the six-step process in support of specific projects and programs that are predecessors of the LS TTE EA. The specific projects and programs that we recommend the six-step process be iteratively applied to are:

- The establishment of PM ITE
- The ILTE Increment 1
- The ILTE Increment 2
- The Synthetic Training Environment (STE)

This successive iteration of the six-step process is shown in Figure 3. Please note that time duration is not depicted. We expect that Step 4 will generally be much longer in duration than the other five steps of the process combined.

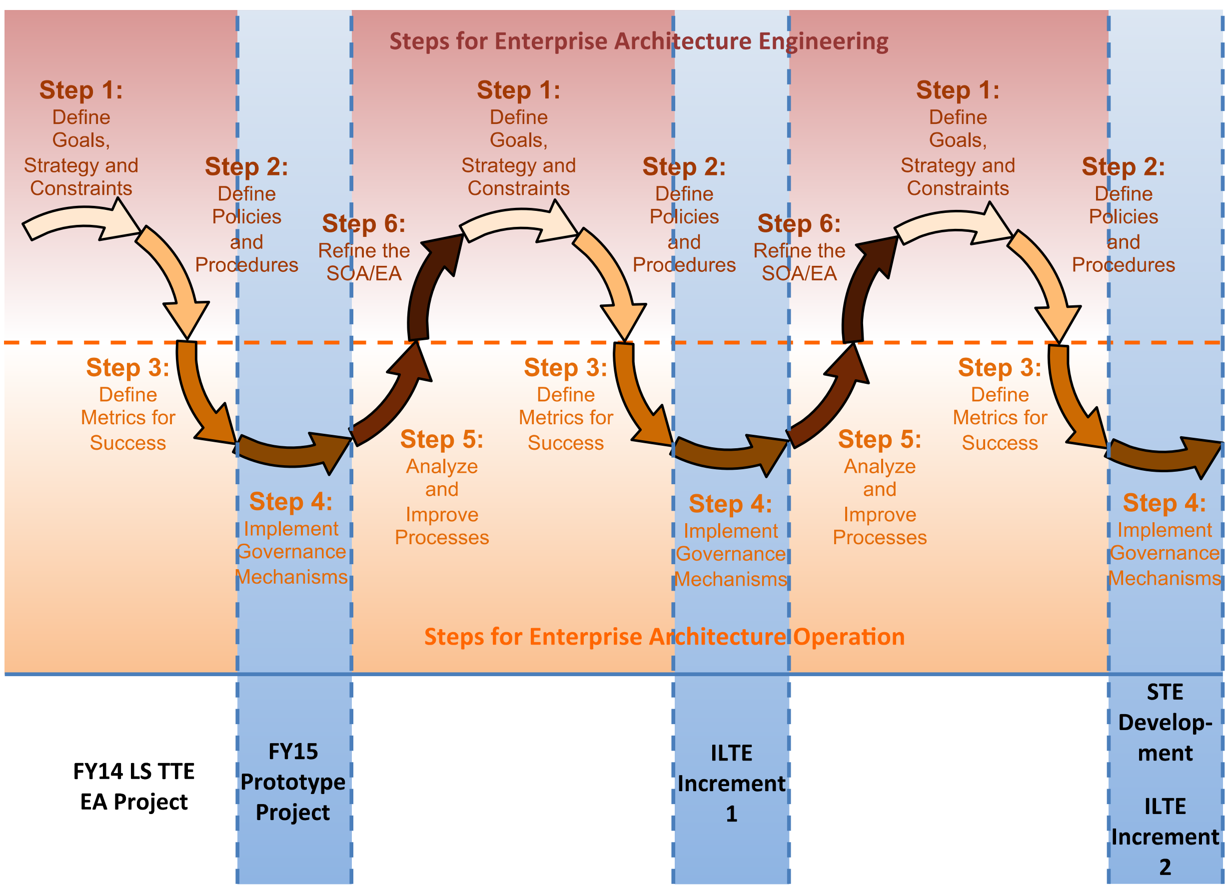

Figure 3 - Application of the Six Steps Across the LS TTE EA Timeline

BUSINESS ARCHITECTURE

The Business Architecture Working Group (BAWG) of the Object Management Group (OMG®) defines a Business Architecture as, "A blueprint of the enterprise that provides a common understanding of the organization and is used to align strategic objectives and tactical demands" (Object Management Group, 2014). The BAWG provides additional detail on a Business Architecture by stating, "Business Architecture defines the structure of the enterprise in terms of its governance structure, business processes, and business information. In defining the structure of the enterprise, business architecture considers customers, finances, and the ever-changing market to align strategic goals and objectives with decisions regarding products and services; partners and suppliers; organization; capabilities; and key initiatives" (Business Architecture Working Group, 2014).

The transformation of an enterprise, especially a multi-organizational and cross-domain enterprise like Training and OT&E, begins with a vision. The vision is a description of what the enterprise aspires to in the future and encompasses a high-level plan for achieving it. The Vision layer of the LS TTE EA provides the description of the future aspirations of the Training and OT&E enterprise through a set of high-level vision statements. Each high-level vision statement has been decomposed to provide the detail necessary to drive lower levels of the EA. Each vision statement, and its decomposition, are traceable to formal Army strategy and plans. The Vision layer also provides the high-level plan for achieving the vision, called the LS TTE EA Campaign Plan.

Using the Vision layer as input and guidance, the Business Architecture layer establishes the goals and objectives that the EA is to achieve and provides the business and technology strategies to be executed to achieve the goals and objectives. Metrics were developed for each of the business goals and objectives to, in the short term, support a quick look Cost Benefit Analysis (CBA) and, in the long term, support the quantification of the benefit provided by the LS TTE EA. The metrics fall into two categories:

- Financial Metrics – A goal or objective that can be measured in terms of dollars ($), for example, a reduction in R&D, Procurement, Operations & Sustainment, or Information Assurance (IA) Re-certification costs.
- Non-Financial Metrics – A goal or objective that cannot easily be measured in terms of dollars but can be measured in terms of metrics that are specific to that goal or objective. Nine (9) benefits were derived from the business goals and objectives, and twenty-nine (29) non-financial metrics were developed to quantify the benefits. Examples of the metrics are:
  - Time to prepare for a training exercise or test event
  - Percentage of event planning and control activities executable by workflow and services
  - Number of tactical systems/platforms on which training applications can run
  - Time to introduce a new capability, service, and/or threat data/model
  - Number of mobile and remote training applications
  - Operational availability of training applications at home station, when deployed, at Army training institutions, and for self-development
  - Percentage of system-level operational requirements that are fully testable within the Live-Synthetic T&E configuration
  - Number of unique data formats for terrain representations, units, and platforms
  - Mean time for the development and fielding of a new capability / service
  - Time to obtain IA re-certification

The final elements of the Business Architecture layer are the strategies that provide the detailed approaches for the realization of the LS TTE EA. The two strategies in this layer are the Business Strategy and the Technology Strategy. The Business and Technology Strategies flow from the Vision layer's LS TTE EA Campaign Plan, ensuring that both strategies remain aligned with the future aspirations of the Training and OT&E enterprise.

The purpose of the quick look CBA is to provide decision support to the LS TTE enterprise for determining the optimal solution for achieving the overarching goal or opportunity. In doing so, the quick look CBA measures the benefits and costs of the LS TTE EA in comparison to the status quo Training and Operational Test and Evaluation (OT&E) systems as well as other alternatives that may realistically achieve the desired end state. The quick look CBA adhered to the process detailed in the U.S. Army Cost Benefit Analysis Guide V3.10, dated 24 April 2013. The CBA charter consisted of the estimation of both benefits and costs associated with three specific alternatives, shown in Figure 4, over the study timeframe of 2015 through 2054.

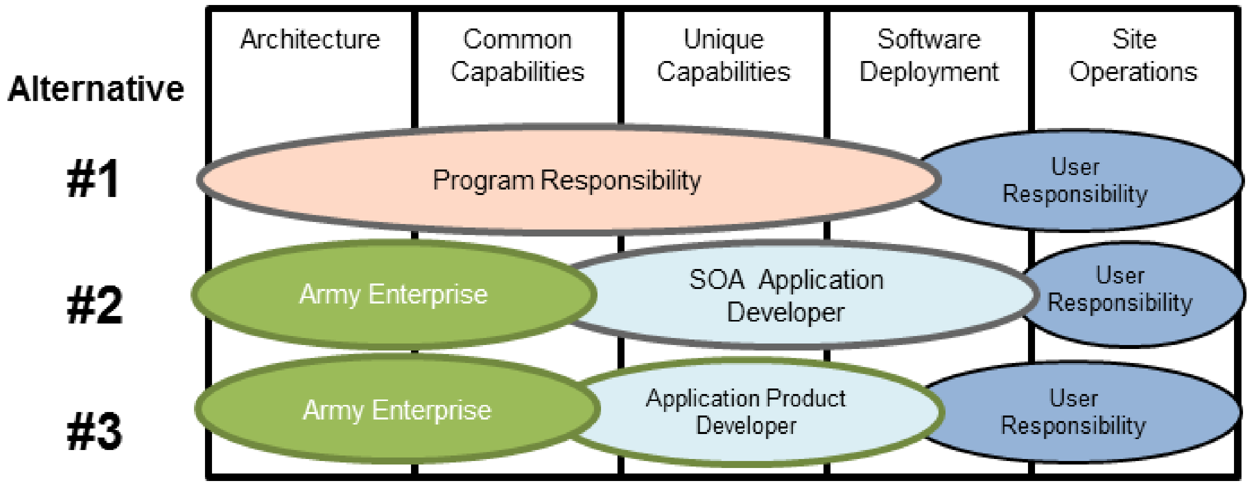

Figure 4 - Alternatives Considered in the Quick Look CBA

As illustrated, Alternative 1 represents the execution of the development, deployment, and site operations as it is currently done, which was referred to as the "status quo." The status quo is to have the program itself address the development and the majority of the deployment of a system, while the user addresses the operations of the system in-house. In contrast, Alternative 2 employed a Service-Oriented Architecture (SOA) to deliver the unique capabilities of a system and to address delivery using various over-the-network services such as downloading or

cloud services. Alternative 3 offered a compromise between Alternatives 1 and 2, which relies on the user to address more of the software deployment, but retained the use of an application's product development architecture to aid in the development of common and unique system capabilities.

The cost estimating effort consisted of Rough Order of Magnitude (ROM) life-cycle cost estimates for each alternative calculated in Base Year (BY) 2015 and Then-Year dollars and reported as a point estimate with an uncertainty range reflecting confidence levels. Benefits estimates were calculated for each alternative through the stakeholder weighting of decision criteria derived from the LS TTE EA business goals and objectives, as well as the SME scoring of those criteria. The weighting and scoring was then merged for each benefit, and aggregated to calculate one unit-less benefit value for each alternative.

As a general rule, the preferred alternative is the alternative that provides the greatest amount of benefits in relation to its cost. Alternative 2 is the most preferred alternative in terms of non-monetary benefits, scoring higher in eight of the nine benefits than Alternatives 1 and 3. Likewise, Alternative 2 is the lowest cost alternative, both in terms of recurring research and development savings due to projected software, hardware, systems engineering, and program management savings from SOA implementation (13% of Alternative 1 on average), and recurring operations and maintenance annual savings (~50% of Alternative 1).

REFERENCE ARCHITECTURE

One of the primary challenges in evolving multiple systems of the ITE, a single STE, or ILTE to a services-based design approach is to provide a consistent and "seamless" interface between the different architectural components and/or external systems that might have been previously independent systems. To address this, a Reference Architecture (RA) was defined that provides an architectural template for managing, developing, and executing the programs as they evolve (as inset in Figure 1 and shown in detail in Figure 5). As these systems migrate towards a consistent architectural foundation via the RA, future integration is simplified, providing PEO STRI with a practical approach to instituting various commercial practices and technology through the use of common services and standards.

The Reference Architecture, which focuses on the information technology aspects of the Enterprise Architecture, is based on the Open Group Technical Standard for SOA Reference Architecture (The Open Group, 2011), which defines a common vocabulary and best practices to implement a SOA. The standard has nine layers to group important considerations and responsibilities that are typically considered when designing a SOA-based solution. Each of these layers, and their associated capabilities and architectural building blocks, are used to communicate and derive a domain specific SOA implementation. The RA layers define a hierarchy of services that support composibility of systems.

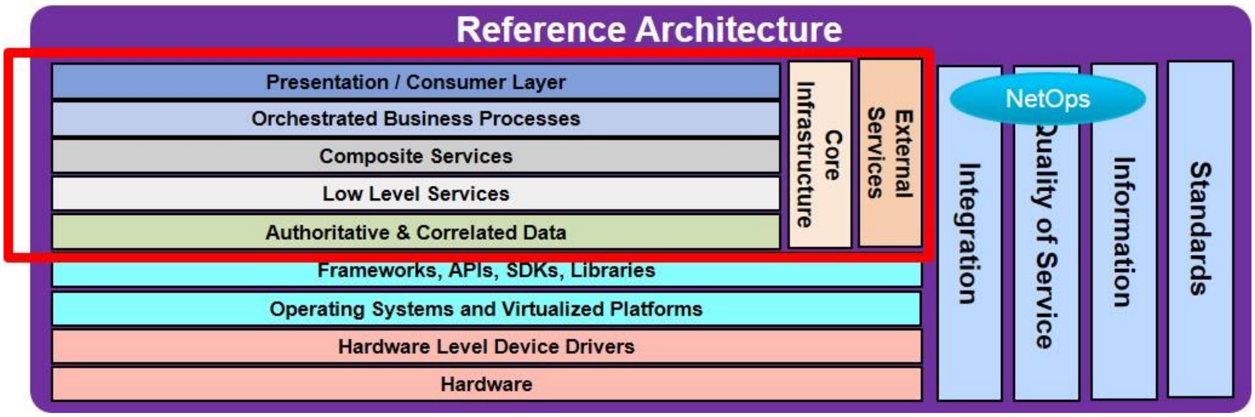

Figure 5 - LS TTE Reference Architecture

However, there is a set of software features that are needed at all levels, which can be thought of as vertical capabilities of the layers. These include integration points, Quality of Service (QoS), information consistency, and uniform use of standards. The horizontal RA Host layers are composed of the following layers: Presentation/Consumer, Orchestrated Business Processes, Composite Services, Low Level Services, and Authoritative and Correlated Data. The Presentation layer is primarily used to allow interaction with the SOA. It is the point of entry of interactive consumers to include humans and other applications and external services. The Orchestrated Business Processes layer contains business process flows. The process flow is described using the Business Process Model and Notation (BPMN) and decoupled from the underlying services used. These process flows are characterized by services being orchestrated by controller. The Composite Service layer provides multiple services from either the Low Level Service and/or the Composite Service layer. The Low Level Services layer contains services components. Each service component realizes one or more services and provides a functional and technical specification of the service. The Authoritative and Correlated Data layer provides trusted, accurate, and related data to be used by the system and its users. It provides data storage retrieval for repositories such as parametric data, authoritative source data, event archives, runtime databases, and event loggers. These set of horizontal Host layers have their own set of vertical layers, which include Core infrastructure and External services layers. The Core Infrastructure Layer provides many of the architectural building blocks required to realize a SOA. The external services layer leverages existing enterprise services accessed by the domain specific infrastructure architecture.

A proof-of-concept (POC) infrastructure architecture, which is the initial domain-specific implementation of the LS TTE Reference Architecture, was developed starting in 2014 and is being used to prototype software services that address numerous LS capabilities. The application layers within the red box in Figure 5 are implemented by the LS TTE IA prototype. Since one of the goals of the STE is to implement an architecture that delivers training capability via Software as a Service, it's envisioned that the Army's Common Operating Environment (COE) Data Center computing environment will provide the surrounding layers of the Reference Architecture. The POC implementation and alignment with COE software standards ensures a seamless interoperability and integration with the Army's COE computing infrastructure. These remaining horizontal layers of the RA include the top-most Media layer, which consist of frameworks, Application Programming Interfaces (APIs), Software Development Kits (SDKs), and libraries. The second highest Media layer consists of operating system and virtualized platform services. Below that is a layer that supports hardware-level device drivers. At the lowest level is the hardware itself.

LONG-TERM PLANS

As previously mentioned, one of the primary goals of the LS TTE EA is to provide common architectural structures for the Army's Live-Synthetic enterprise. This Live-Synthetic enterprise is beginning its major transformation as the Training community moves from LVC-ITE to the STE, and eventually FHTE-LS; and as the OT&E community moves from its current Live-Synthetic baseline to ILTE and beyond. The LS TTE EA will guide this Live-Synthetic enterprise transformation in many ways.

The first way the LS TTE EA is guiding the Live-Synthetic transformation is by providing technical architectural capabilities that will support both the continuing evolution of the ITE towards STE, and the development of the initial ILTE capabilities. During FY15, new infrastructure architecture capabilities are being developed in three layers of the Reference Architecture – the Orchestrated Business Processes layer, the Low Level Services layer, and the Authoritative & Correlated Data layer – specifically to support both LVC-IA and ILTE. Future proof of concept development efforts related to the Reference Architecture layers will continue to be supportive of both the ILTE and evolution of LVC-IA and STE into FHTE-LS.

The second way the LS TTE EA is guiding the Live-Synthetic transformation is through the application of Governance. The initial technical governance structures prescribed in the Governance Approach – the SOA Monitoring IPT, the Service Development Team, and the Solution Development Teams – have been formed to:

- Ensure compliance with LS TTE EA standards and guidelines through coordination with solution developers using the architectural services.
- Manage the design, development, test, deployment, execution, and delivery of the services.
- Design, develop, test, deploy, execute, and deliver the service-oriented architecture solution within Programs utilizing the architectural services

Four Programs, including ILTE and LVC-IA, have formed Solution Development Teams and are currently utilizing the architectural services. Additionally, the Stakeholder IPT and Business Sub-IPT are being formed within PM ITE to establish and monitor the strategic roadmap for the EA and to define and approve the technical and business govern principles for the EA.

The final way the LS TTE EA is guiding the Live-Synthetic transformation is through the initial implementation of the Business and Technology Strategies of the Business Architecture layer of the EA. Aspects of the Business Strategy are being developed through the 2015 Long-Range Investment Analysis (LIRA) process. Likewise, a formal Technology Readiness Assessment is being performed and Technology Roadmaps are being developed for EA capabilities required for the initial increment of STE.

SUMMARY

This paper has described the initial R&D efforts to develop a comprehensive approach for an Army Live-Synthetic Enterprise Architecture that is suitable for the Training and the OT&E communities. The objective framework for the Enterprise Architecture was established, and a number of initial artifacts were developed including the initial Governance Approach, the Business Architecture, and the Reference Architecture. The artifacts have been applied in a number of efforts including:

- A quick-look Cost Benefit Analysis that concluded that a Service-Oriented Architecture implementation of the Enterprise Architecture will provide the greatest benefits and be the lowest cost approach.
- The development and evaluation of proof-of-concept, domain-specific implementation of the Reference Architecture.
- The application of the Governance Approach within the newly formed PM ITE in PEO STRI to produce enterprise thinking, decision-making and action within the PM.

Continued evolution of the Enterprise Architecture will guide the Army in the transformation of the Live-Synthetic enterprise. Specific ways in which the Enterprise Architecture is guiding the transformation include:

- Providing the technical architectural capabilities that will support both the continuing evolution of the ITE towards STE, and the development of the initial ILTE capabilities.

- The application of Governance structures and practices to the design, development, test, deployment, execution, and delivery of new capabilities.
- The initial implementation of the Business and Technology Strategies of the Business Architecture layer.

The continued evolution and application of the Enterprise Architecture will provide the common architectural structures for the Army's Live-Synthetic enterprise, and will enable significant technical risk reduction as the Training community transitions from LVC-IA to the STE and to FHTE-LS, and as the OT&E community moves from status quo to ILTE and beyond.

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