Army Training Support System and Implications of Training Transformation (T2)

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ABSTRACT

The Army's Training Support System (TSS) is based on an analysis of the training capabilities required to develop and sustain an expeditionary land force for conducting operations within the Common Operating Environment. The TSS encompasses the capabilities required to enable an operationally relevant training environment which is networked, integrated, and interoperable using analysis of new warfighting capabilities and operational capability trends on training support in the Army. The intent is to ensure a robust, persistent capability that provides the full spectrum of training whenever and wherever needed. This paper will describe the framework of the TSS components and supporting subcomponents and capabilities. This structure provides a rigorous and exhaustive description of 1) the product lines that define the related families of training systems, 2) the architectures and standards that enable interoperability and networking, and 3) the business processes in management, evaluation, and resources that produce these capabilities. The paper will also discuss the implications that DoD Training Transformation (T2) capabilities will have on the Army TSS, such as how the TSS must be extensible and integrated into the emerging T2 training capabilities. This will also enable the "gap and seam" approach that JNTC uses for identifying vertical and horizontal Joint training deficiencies and redundancies to the area of training support. Finally, this paper provides a description of not only how the T2 capabilities will affect TSS design, but also provides suggestions on how T2 could benefit from the fundamental analysis on which the TSS is built.

ABOUT THE AUTHOR

Mr. Randall Chalkley currently works for the Concepts and Plans Office of the US Army Training Support Center, Fort Eustis, VA. His primary area of research and planning is in the area of training support concepts related to Joint and Training Transformation initiatives. His background is in training evaluation and policy, and he has over 30 years of government service. He obtained his BA from the College of William and Mary, and his MBA from the Florida Institute of Technology.

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INTRODUCTION

"In the volatile, uncertain, complex and ambiguous environment we face for the foreseeable future, if we were to choose one advantage over our adversaries it would certainly be this: *to be superior in the art of learning and adaptation." (Fastabend and Simpson, 2004)*

Providing the capabilities for learning and adaptation will be a central theme in Army and Joint training. This revolution is already underway with Army Transformation and DoD Training Transformation (T2). The superiority of our training systems has long been recognized as one of the strengths of our armed forces, and is often credited with the overwhelming success of our armed forces in the last decade (Chatham and Braddock, 2001). The importance of training as a force multiplier will only continue to grow since it is the primary means to prepare the soldier and leader to learn and adapt in today's rapidly changing environment. New equipment and force capabilities will provide the tools that are needed, but training is the means of preparing the soldier and leader to wield these tools effectively.

This paper will describe the concept of "complexity" and apply this to the purpose and structure of the Army Training Support System (TSS). The paper will then briefly describe how Training Transformation is being implemented. The impact of Training Transformation on the TSS will be discussed, followed by implications of the TSS that may assist some elements of Training Transformation.

MANAGING COMPLEXITY

The ability to train as we fight, the need to embed training in operational platforms, the increasing reliance on mission planning and rehearsal are examples of new training strategies that will increase the complexity of training and the design of systems required to deliver this training. Training enablers must share data, increase the fidelity of the training environment, and link Army and joint training. Although this increases the complexity of training support, it should be considered a positive development. VADM (Ret.) Cebrowski, Director of the Office of Force Transformation, has applied the idea of "complexity" to operational capabilities for the Department of Defense. His concept describes complexity as "a diversity of entities and network structure among these entities." Complexity in this sense provides a "swarm" of entities which are aligned on the same goal and controlled from a network. The result is a multitude of enablers that will provide a focused but diverse set of applications. "The more robust the capabilities in our force, the more options we have," says VADM (Ret.) Cebrowski (Mullen, 2004).

This application of complexity is clearly designed to describe how to operationally respond and overwhelm an adversary during combat operations. However, this idea of complexity can also be applied to training. It could be argued that the more agile and adaptive the training required, the more complexity is needed to provide the environment and context for this training. As VADM (RET.) Cebrowski points out, the key to complexity is the "network structure among these entities." Training also must be based on a network structure that identifies the relationships, commonalities, and controls required to recognize interdependencies and integration. Through a networked system of training enablers, we can provide a complexity of potential training solutions to address a broad range of needs. The Army has recognized the need to provide management, evaluation, and integration of the numerous training enablers that current to future force transformation will require.

ARMY TRAINING SUPPORT SYSTEM (TSS)

"The Army TSS is a system of systems that provides the networked, integrated, interoperable training In the Army, a distinction is made between "training" and "training support." Training involves the learning and practice of soldiers and leaders on requisite warfighter skills and tasks. Training support consists of all of the enablers required for training to take place. Historically, training support tools and systems were built to solve specific training problems. For example, training support for a new weapon system typically addresses the unique set of requisite training devices, courseware, instructors, and publications, but rarely the impact of that system on associated training systems such as range design, infrastructure, battle staff training, targetry, connectivity, reuse, collective training support packages, etc.

As the Army adopts increasingly complex warfighting systems, Army training systems will also become more complex. Training support implementation approaches need to transition from stand-alone solutions to an integrated system of solutions that consider second and third order effects on the training environment. The same values emerging in the operational environment – networked, integrated, interdependent – are crucial to defining a broad range of training options. Realizing that Army training required a system of systems that is "born integrated" as well as "born joint" resulted in the concept of the support necessary to enable an operationally relevant training environment for warfighters. In short, it is an integrated training support enterprise." (Draft DA Pam 350-XX, unpublished)
TSS. The TSS provides a capability to support a broad spectrum of training strategies across all training domains and environments (DA Pam 350-XX, unpublished).

Design of the TSS
To identify processes for managing, standardizing, and integrating training support, the TSS was divided into three major components (see Figure 1):

- Management, Evaluation, and Resource processes
- Architectures and Standards
- Product Lines

Each of these components deals with a facet of the TSS. The Management, Evaluation, and Resource processes describe the business practices functions that control the TSS enterprise. The Architectures and Standards describe the internal integration of the training enablers, and the external integration with complementary systems. The Product Lines component describes the multitude of training enablers that support the conduct of training and education. Together, the three major TSS components provide the means to enable relevant Army training support.

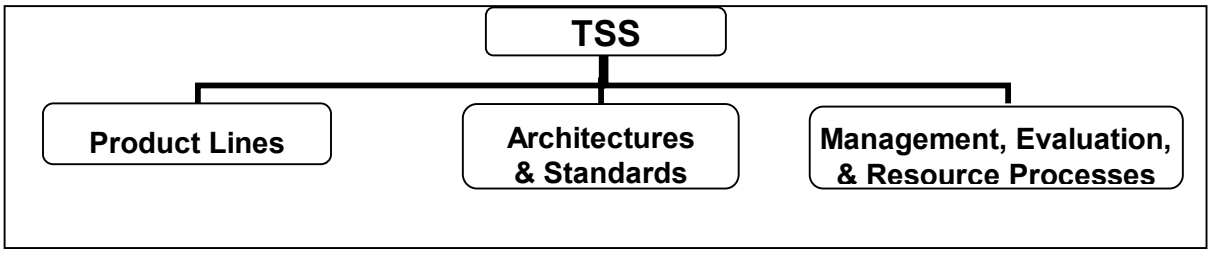

Figure 1. TSS High-Level Composition

Vertical and Horizontal Relationships
Each of these major components is composed of processes and constituents that can be defined, analyzed, and, decomposed into their component programs and products. These subcomponents can be further decomposed until reaching the most basic training support enabler. The result of this top-down decomposition is a complete inventory of all training support enablers organized into a structure that identifies relationships and connections *vertically*, as in "parent-child" relationships. In other words, each enabler shows all of its sub-component elements ("children"), and also shows the higher-level program or process to which it belongs ("parent"). "Vertical" relationships highlight how controls or resources at one level of a TSS component can influence other

levels. This approach can help reveal second and third order effects of decisions on other products or programs up or down the vertical chain.

among siblings. In software engineering, this commonality leads to "reuse" where products with common features only need one development effort that can be shared across related applications. The definition of a Product Line focuses on the identified commonalities and reuse of applications within the Product Line (Carnegie Mellon, 2004). For example, the Microsoft Office Suite uses a product line approach to employ common tools and software applications across products such as Word, PowerPoint, Excel, etc. The sibling relationship can also be used to analyze the redundancy and overlap of products, or "gap and seam" analysis, within a product line.

The Decomposition of the TSS

A summary of the first-level decomposition of each of the three major components of the TSS is described below (DA Pam 350-XX, unpublished):

Management, evaluation, and resource (MER) processes employ best business practices to plan, implement, and sustain the TSS. They are the overarching business practices that enable informed training support decisions in support of training requirements. These processes consider both internal and external drivers that impact TSS and guide the development, maintenance, and sustainment of the TSS.

Management processes are the functions required to ensure best business practices are employed for an operationally relevant TSS.

Evaluation processes provide the feedback mechanisms to measure, audit, and analyze the efficiency and effectiveness of the TSS in meeting its stated requirements.

Resource processes include an integrated training investment strategy and the functions necessary to identify, submit, and sustain training support requirements and capabilities through the Army Program Objective Memorandum (POM) process.

Architectures and standards provide the means to ensure integration and interoperability across product lines.

Architectures are the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time. They are the framework that describes missions, organizations, and systems; specifies interfaces and interrelationships amongst its various parts; and The decomposition of the TSS also shows *horizontal* relationships (known as "siblings") among components with the same "parent." This information can lead to insights about commonalities facilitates coordination and synchronization with internal and external interfaces. There are three types of architectures—organization, functional, and systems—each of which may have operational, technical, and systems views. The TSS focuses on the training domains, which have a direct correlation with the views.

Standards are the technical rules and specifications necessary to build and ensure interoperability in an integrated training environment and are related to the views. They are addressed as part of the technical view.

Product lines are organized into five families of capabilities that enable the conduct of training and education. The product lines provide the capabilities that trainers and soldiers need to train in the institution, operational, and self-development domains.

Training Aids, Devices, Simulators, and Simulations (TADSS) is a general term that includes training instrumentation; Tactical Engagement Simulation (TES); battle simulations; targetry; training-unique ammunition; dummy, drill, and inert munitions; casualty assessment systems; training aids; and other training support devices.

Training Products are courseware, publications, and other products that are the outputs of the training developments process. They include, but are not limited to, multimedia course materials, distributed learning and self-development courses and lessons, mission training plans, videos, and other training material needed to train one or more individual and collective task(s).

Training Facilities and Land are the permanent or semi permanent facilities, such as the ranges, maneuver training areas, classrooms, battle simulation centers, Combat Training Centers, and land that support training.

Training Services are the management, acquisition, and support services that enable the preparation, replication, distribution, and sustainment of training.

Decomposition of the Product Lines

We will now focus on the Product Line component and use this section as an example of the analysis that has been done to decompose the TSS. The intent is to show how training support has been analyzed and classified from a broad capabilities level to the specific programs and products that provide these capabilities.

Figure 2 shows the breakout of each of the Product Lines into its subcomponent parts. This set of subcomponents can be identified as the "categories of enablers" that fit under each TSS product line. The categories provide a structure that begins the traceability from broad concepts of the TSS to specific categories of products and programs.

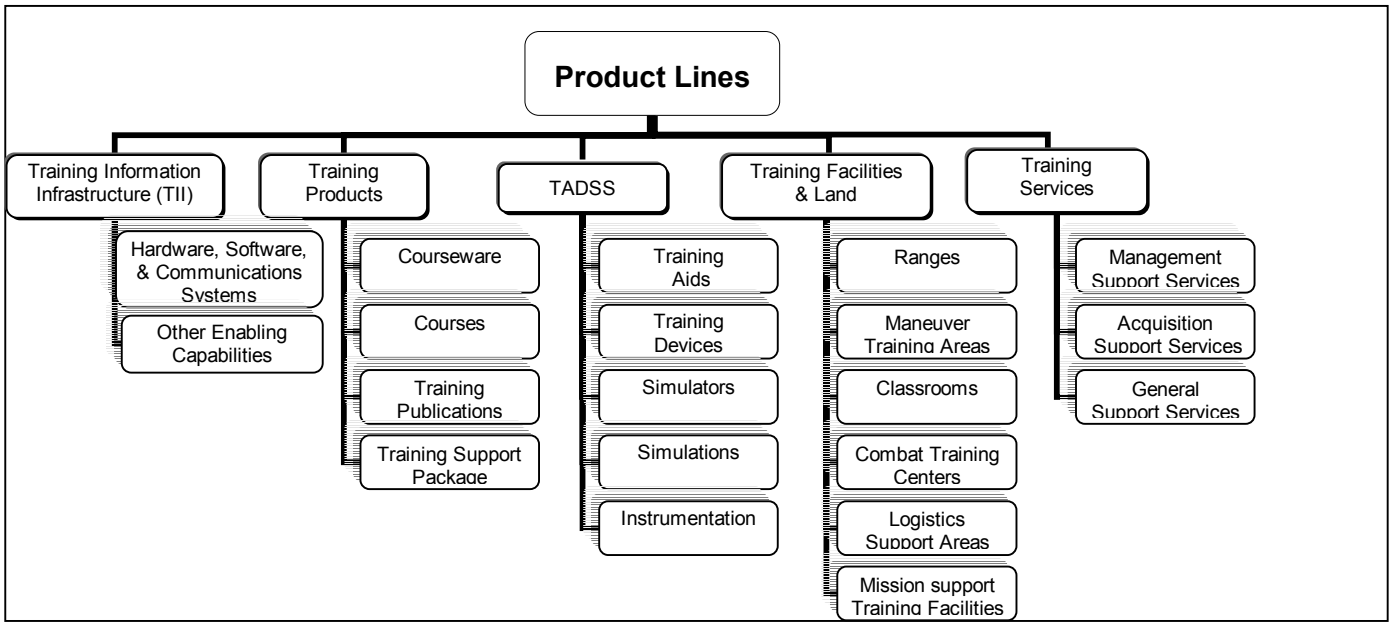

Figure 2. Product Lines

Example of Decomposition

Looking at the descriptions of the categories in Figure 2, it is obvious that there are further elements that fall under each of these categories. Although impractical to show the entire set of exemplars for each, one example is provided for illustration. Under the Training Facilities and Land product line, there is a category of "Ranges."

There are many different types of ranges that the Army requires to provide specialized training experiences. Ranges are areas that are reserved and normally equipped for practice in weapons delivery and/or shooting at targets. The Army currently has a multitude of range types required to meet specific training needs. Below are a few examples:

- Marksmanship ranges
- Hand grenade ranges
- Anti-armor ranges
- Tank gunnery ranges
- Military operations on urbanized terrain (MOUT) assault course
- Multipurpose training ranges (MPTR)
- Future Force ranges

The complete listing of all Army ranges would represent the final step in the breakdown of this TSS subcomponent since it represents the most elemental level in this category. Figure 3 presents an example of the decomposition of a product line "vertically." This shows the resulting ability to trace relationships among programs upwards and downwards once this analysis is completed.

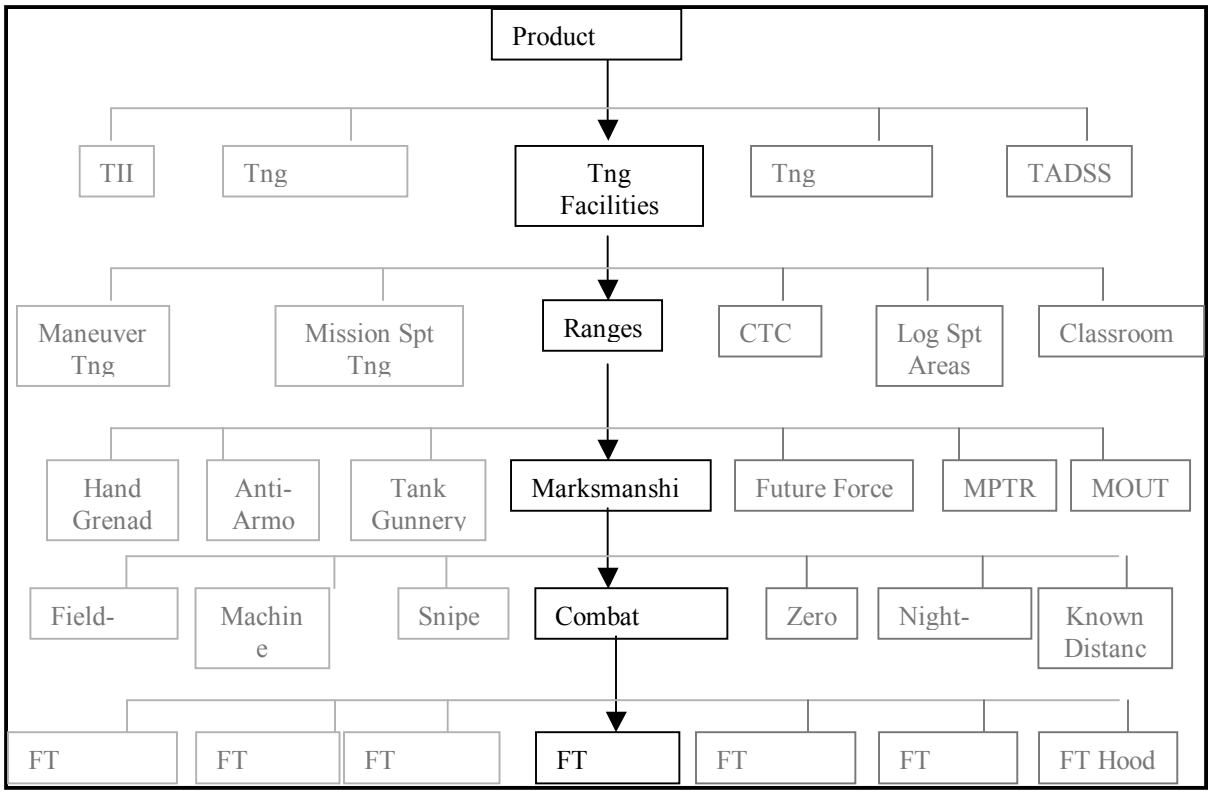

Figure 3. Example of Product Line Decomposition

TSS Value Added

The Army is far from completing the inventory of all enablers within the TSS since this consists of thousands of entities across the five product lines. However, when complete, all Army training support products will be defined and relationships and interdependencies understood. This will allow for Army training support to be managed and integrated as a complete system of connected products and programs.

In addition, the TSS program structure will enable the Army to link operating information about each product. For example, vital information about each training range would be organized and maintained (e.g., location, type of units supported, geographic and environmental constraints, targetry systems, supporting facilities, usage, and resources). Also, this allows the Army to document linkages to other product line subcomponents. This information would be invaluable to managing the TSS as an enterprise. Decisions on future actions could look across the complete array of available training support enablers with data that would inform second and third order effects of these decisions. We can then address relationships within the range program. This same process would be used to identify relationships across all of the Product Lines and supporting enablers across the TSS.

Modeling the TSS

The breakdown of the TSS into the lowest level of training enabler can be thought of as identifying the "discrete entities" described by VADM (Ret.) Cebrowski. These entities provide a "swarm" of complementary capabilities that allow the commander and trainer to select from a wide range of training tools. Although the Management, Evaluation, and Resource processes and the Architectures and Standards of the enterprise would help provide the network control for this "swarm" of enablers, there is another tool that would assist with controlling the TSS. An interactive model of all of the entities their relationships within the TSS would provide an automated process using visualization technologies that would assist Army leaders in identifying ramifications of their decisions. Without a TSS model, the tracing and linking of relationships among TSS components will be a more difficult and time consuming task. The process of applying the information and relationships among the components of the TSS without a model would be analogous to

finding square roots of numbers without a calculator. The TSS model will provide a useful management tool that expands on the analysis done to define the TSS.

An interactive model also provides the potential capability of managing the TSS in real time to ensure that the needed training enablers are available when and where they are needed. Mr. Terry Faber of the Army Training Support Center has described the analogy of the TSS Model with the Air Traffic Control system. The Air Traffic Control system is a real-time model of a physically dispersed set of entities. It is used to help monitor and manage the planes and other components of the system. Similarly, the TSS Model would monitor the state of components and entities within the TSS, and corrections to the operation of the TSS could be identified and implemented in real time. With a model describing real-time events, responses to training support needs would be more adaptive and responsive. By identifying and correcting training support deficiencies before they became a problem, the TSS model would assist the trainer and commander. This application of the TSS model will enable the learning and adaptation of our soldiers and leaders by providing the "complexity" as described by VADM (RET.) Cebrowski.

This work has already begun. The Army Training Support Center is working with the Virginia Modeling and Simulation Center to define the capabilities of a TSS model. "The Virtual training support system of systems is an integrated, executable enterprise architecture model whose purpose is to enhance TSS business practice, information flows and relationships, and technology infrastructure" (Dryer and Berbesi, 2004).

Example of TSS Model

To visualize the dependencies among TSS components and subcomponents, Figure 3 depicts the many interactions of the Army Ranges and Training Land Program (RTLP) management process. This program crosses multiple TSS components and elements of multiple product lines. Figure 4 illustrates the varying strength of the interdependencies of the other TSS components/subcomponents to the RTLP management process. It shows the "shot pattern" of component and subcomponent strengths, with greater dependencies closer to the center of the graphic. The graphic shows a top-level view of the complexity of interrelationships and interdependencies within just one aspect of the TSS. (Berbesi and Dryer, 2003).

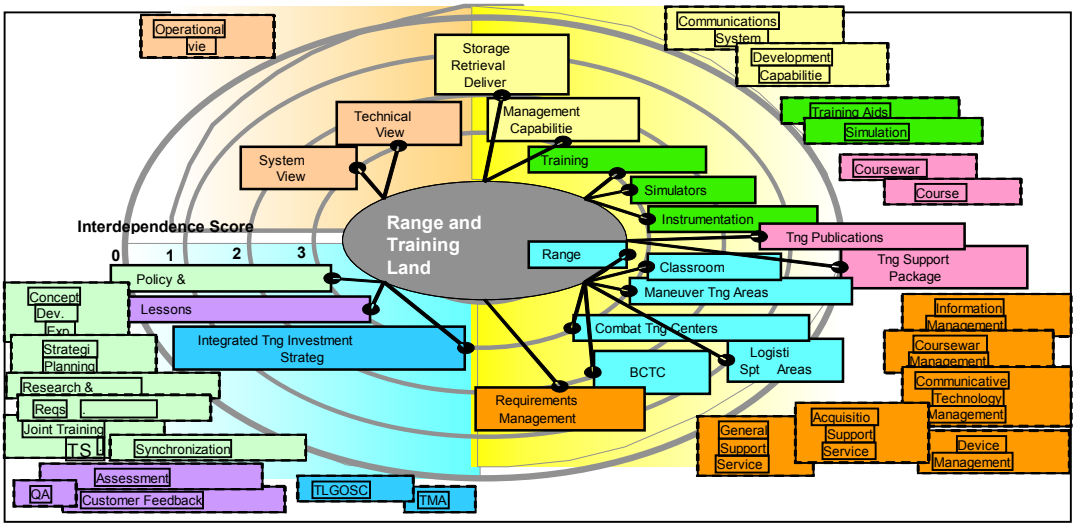

Figure 4. TSS interrelationships for the RTLP

TRAINING TRANSFORMATION (T2) AND THE TSS

"Department of Defense Force Transformation is about becoming more adaptable, agile, and lethal through application of rapidly evolving capabilities and technologies, and the Training Transformation program is a key enabler for the overall success of DoD Transformation. As a key enabler, Training Transformation will result in the ability to train truly as we fight and fight truly as we train… It requires identifying capabilities that U.S. military forces will

need to deter and defeat potential adversaries. This fundamental shift in defense strategy demands a parallel shift in training focus – one that provides exceptional speed and agility in preparing individuals and joint forces to respond decisively anywhere and anytime to any type of challenge." (Strategic Plan for Transforming DoD Training, 2002)

This objective for T2 also reinforces VADM (RET.) Cebrowski's emphasis on complexity. The need to provide "exceptional speed and agility in preparing individual and joint forces" requires a broad array of networked training entities. One of the additional challenges faced by T2 is networking Service training capabilities with joint capabilities. It would be simpler perhaps to build a joint system from the ground up than trying to kluge at least four very different training systems to create a joint training capability.

An expected benefit of integrating joint training with Service training is the ability to expand the "diversity and entities and network structure among these entities." This will further the goal of providing "exceptional speed and agility in preparing individuals and joint forces." The primary challenge lies in providing the management processes and controls to network these numerous training "entities." The complexity described for the Army TSS pales when all of the service and joint systems are considered. However, without a structure and identified relationships of training support enablers, it will be difficult to provide the "network control" for the individual services to provide agile and adaptive training that the current environment demands.

T2 as a Roadmap

The emerging primacy of joint concepts and initiatives will require changes in Services' applications and enablers. The T2 Strategic Plan and T2 Implementation Plan have provided an excellent description of the goals and methods of Training Transformation. T2 is organized around three primary capabilities:

Joint Knowledge Development and Distribution Capability focused on individual joint combat proficiency and effectiveness.

Joint National Training Capability preparing units through an integrated live, virtual, and constructive training environment.

Joint Assessment and Enabling Capability providing essential support tools and processes to guide T2 development.

Once completed, these initiatives describe a complete roadmap for development and implementation of Joint training. This roadmap is essential as well to the Army's planning and implementation of training. It will guide Army planning to ensure that Army training will be seamless with Joint training. It will be a major factor in decisions on modernizing, discarding, or replacing Army training enablers. New training systems, such as embedded training in the Future Combat System, must be built to T2 standards and architectures to ensure they are "born Joint." Table 1 shows the profound impact of the three T2 capabilities on the TSS components and product lines.

Table 1. Impacts of T2 on TSS Components

TSS COMPONENTS	JKDDC	JNTC	JAEC
Management, Evaluation Resources	X	X	X
Architectures and Standards	X	X	X
Product Lines			
Training Information Infrastructure	X	X	X
Training Products	X	X	X
Training Services	X	X	X
Training Aids, Devices, Simulators, and Simulations	X	X	X
Training Facilities and Land		X	

TSS Value to the Joint Community

While T2 will be a major influence in the future design and implementation of Army training and training support, the TSS may also help influence the design and implementation of T2 systems. The TSS structure can assist the Joint community as well as the

other Services in defining the total set of training enablers. If undertaken, collaboration among the services and DoD would establish a common TSS frame of reference and expand DoD-wide the benefits of a TSS enterprise.

The TSS Architectures and Standards component describe the interdependencies, technical standards, and data flows that will have a parallel requirement in Joint training support. The analysis of Architectures and Standards in the TSS can assist T2 analysis of what is required to ensure the internal components of Joint training are integrated, and that Army components are interdependent with Joint systems. Similarly, the TSS Standards provide a template that can help define Joint training support standards. These standards are important to enable reuse of products and services within the Joint community, as well as between the Joint community and the Services. The TSS Product Lines provide a list of enablers that serve as the initial baseline for T2 capabilities and as a template for the Services and Joint community. The Product Line analysis can also assist the Joint community in a rough "gaps and seams" analysis of what enablers are available and what enablers would need to be developed to provide full T2 capability.
The idea of a TSS model could also be applied to the T2 arena to help design and manage all aspects of Joint training. The success of building a TSS model may have some future applicability to the development of a T2 training support model. Analysis on the Army's TSS model has already identified some applications for use in the DoD Architectural Framework by applying an enterprise approach and incorporating business practices into architectural design (Dryer and Berbesi, 2004).

SUMMARY

Complexity as described by VADM (RET.) Cebrowski should be a goal of our training systems – to provide a swarming network of discrete entities that allow a robust and manifold set of options for our soldiers and leaders. Combined with rapid infusion of lessons learned and a high-fidelity training environment, we can prepare our forces to be superior to our adversaries in the art of learning and adaptation.

Although the journey to a complete Army TSS is not complete, the goal is for a TSS that will manage business processes, architectures, and individual training enablers within product lines. By identifying interdependencies among these enablers, the Army can locate training enabler gaps and seams, consider risks associated with different alternatives, and manage integration with future and Joint systems.

Training Transformation will affect how the Army trains, and consequently, it will affect all of the major components and product lines in the Training Support System. To reach the jointness Training Transformation seeks will require the Army to build new and upgrade old training systems. Experience in designing the Training Support System has identified opportunities for analyzing and improving Training Transformation. Keeping the goal of developing an agile and adaptive force in focus will guide the solutions that we build.

As VADM (Ret.) Cebrowski counsels, there needs to be a shift in focus from being just responsive to being responsive and preventative (Koch, 2004). As Training Transformation matures, we will move from being "agile in response" to being "adaptive in prevention." The transformation of Army and joint training is the means of achieving this goal.

ACKNOWLEDGEMENTS

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