TRAINING TRANSFORMATION AND AIR COMBAT COMMAND'S DISTRIBUTED MISSION TRAINING PROGRAM

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In 1997, the US Air Force s Air Combat Command (ACC) embarked on a revolutionary path for operational readiness training of its combat crews, Distributed Mission Training (DMT). In March 2002, the Department of Defense embarked on a training transformation. This paper describes the relationships between the training transformation efforts and DMT. DMT is not the complete solution to training transformation but can offer two important contributions: a synthetic environment composed of live virtual and constructive components with wide area connectivity; and a framework for describing the readiness training skills that link individual and team skills to joint mission tasks. The potential contribution of DMT, however, is not limited to creating the technical infrastructure. Past and current efforts on the soft problems of creating operational training concepts and integrating them into training policies are perhaps even more important to the DoD training transformation.

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INTRODUCTION

We are witnesses to remarkable transformations in America s military power. One transformation has been the technology applied to military weapons. The range and lethality of weapons have extended the dimensions of the battlefield. Another transformation has been the expanded uses of our military power. Late twentieth century military engagements in the Balkans, Southwest Asia, and the Caribbean have demonstrated that the nation is willing to use its military power throughout the globe to pursue policies that are not directly related to the defense of the republic in order to further our humanitarian, economic, and political values.

Our capability and willingness to engage in global enterprises and the dominance of our culture have, however, generated reactionary responses from those who despise us, our freedoms, and our values. As a result, we are confronted with an enemy willing to wage war until either they or we no longer inhabit the planet.

Two years ago, in 2000, President Bush s administration established transformation as the primary thrust of defense policy. Although one could argue that transformation had been occurring for at least a decade, transformation offered a new framework for addressing broken military budgets and restructuring the military Services.

The sudden, unexpected intrusion of an unwanted war has recast the Department of Defenses efforts on transformation. Originally expressed in terms of weapons system technologies, transformation is becoming more associated with our cognitive technologies — that is, how we fight.

The image from Afghanistan of the Air Force special operations air controller on horseback equipped with a satellite receiver directing a B-52 attack is an illustrative example of what is currently included in the definition of transformational. Certainly neither the horse nor the venerable B-52 could be put forward as examples of leading edge technologies. Even the advanced technologies attached to the horse and the B-52 - primarily associated with the satellite navigation and communication - have been around for some time and are available on the commercial market. The operational significant transformation, however, was the ability to employ a joint team with a tightly coupled sensor to-shooter link and a short kill chain.

Training, the Keystone of Transformation

Transformation, then, is not so much a question of what we fight with but how we fight. Viewed in this way, training, especially inter-team training among diverse weapons systems teams, becomes the key enabler for the entire transformation effort. It not only provides the essential proficiency to use weapons systems but also sets the context for how weapons systems should be developed and acquired.

In March 2002, the Office of the Under Secretary for Personnel and Readiness published a short paper, *Strategic Plan for Transforming DOD Training*. The strategy is focused on having the Services train in a joint, networked environment that will mirror the possible spectrum of future conflicts. In July 2002, Mr. Wolfowitz, Deputy Secretary of Defense, directed the Services and combatant commanders to implement the plan. In his directive to he stated:

Since transforming training is critical to building a transformed military, we must ensure that these activities are linked to other transformation efforts, and that we provide the necessary incentives and oversight. (Kaufman and Svitak, 2002)

Purpose and Outline

The purpose of this paper is to describe the relationships between the Department of Defense (DoD) training transformation efforts and Air Combat Command s (ACC) Distributed Mission Training (DMT) program. DMT is not the complete solution to training transformation. There are some critical goals of transformation that DMT does not address such as revision of acquisition processes. In addition, DMT is being used for training needs that are not strictly transformational, those basic individual skills for which simulators and simulators have traditionally proved indispensable. Nevertheless, DMT can offer two important contributions to DoD training transformation:

- A synthetic environment composed of live virtual and constructive components with wide area connectivity.

- A framework for describing the readiness training skills that link individual and team skills to joint mission tasks.

The paper is organized into three main sections and a conclusion. The first section describes the Department of Defense (DoD) training transformation strategy. This section also reviews some of the ideas presented in a Defense Science Board (DSB) study on training. It concludes by providing a hierarchical model of training based on individual, team, and inter-team training. The second section provides an overview of ACC s DMT program, including more discussion of team training. This section also describes the attributes necessary for synthetic environments like DMT. Section three describes mission essential competencies, the new training approach being developed for DMT and its relation to the decision cycle and kill chain. A final concluding section synthesizes the previous sections to provide a summary.

TRAINING TRANSFORMATION AND TRAINING SUPERIORITY

DoD Training Transformation Plan

Training transformation as described in the DoD plan envisions a future military training environment substantially different from the one that currently exists. The primary difference is that it is to be more oriented to the mission requirements of the combatant commanders. Today, training is oriented to developing or maintaining proficiency in fundamental skills. Warfighters, for various reasons, don t have sufficient access to training resources oriented to combat performance. As a result, future training environment should be constructed in a manner that allows warfighters to practice military operations in a synthetic replication of the global national security environment. The plan describes the vision for training transformation: (DoD Training Transformation, 2002)

Provide dynamic, capabilities-based training for the Department of Defense in support of national security requirements across the full-spectrum of service, joint, interagency, intergovernmental and multinational operations.

There are three key phrases in the vision that are further described in the strategic plan as basic elements of training transformation:

- ***Dynamic*** —training must be responsive and adaptive to changing environment and technologies.
- ***Capabilities-Based*** — training must be focused on a broad range of potential adversaries and their potential tools.
- ***Joint*** — training must prepare warfighters as an integrated element of national power in concert with other services, reserve components, and multinational coalitions.

The initial DoD training transformation plan has three strategic goals:

- Broaden the Joint focus of training and link this training to readiness assessment.
- Build an integrated live, virtual and constructive environment
- Revise acquisition and other supporting processes.

Defense Science Board Training Superiority Report

An important reference used in the DoD plan was the work done by the Defense Science Board (DSB) Task Force on Training Superiority and Training Surprise. According to the task force report, the US military has already had a training revolution and is on the verge of another. (Defense Science Board, 2001)

The first revolution took place towards the end of the Viet Nam war. It began with the Navy Top Gun program and was quickly picked up and expanded by the Air Force with programs such as aggressor squadrons and Red Flag exercises. The revolution spread to the Army by way of post simulation centers and the National Training Center. We are, according to the task force, on the verge of another training revolution. This revolution will be enabled by the ability to provide distributed, realistic training environments.

Before discussing some of the observations and implications of the DSB report, a short discussion about the impetus for the first training revolution is warranted. The Navy started Top Gun because they were losing far too many air-to-air engagements over North Viet Nam. In spite of superior weapons, the exchange rate was approaching 2:1. After Top Gun was instituted, the exchange rate went to 12:1. Deteriorating combat performance, then, became the driving force for the first revolution.

The impetus for the second revolution is also combat performance but it is expressed as a suspicion that combat performance may be deteriorating rather than a demonstration of poor performance in an actual conflict. (Coincidentally, air-to-air combat was the central driver

in the first revolution and is also found at the center of some of the efforts supporting the second revolution. This concept will be explored further in a later discussion of the kill chain.) From comments made in the DSB report, the DoD training plan, and other sources, these suspicions of impending combat performance shortfalls can be grouped in three related assertions:

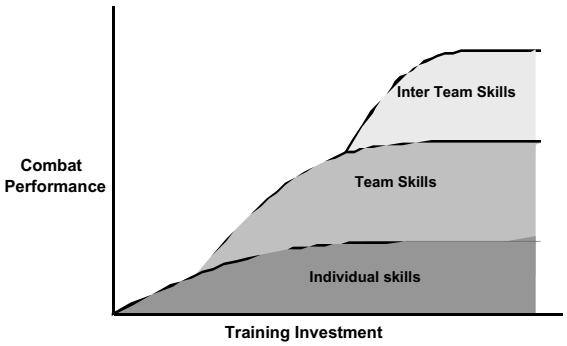

Figure 1

- ***Weapons system complexity*** —more training is needed because modern weapons are becoming much more complicated, expensive, and capable.

- ***Uncertain battlefields*** — more training is needed in order to prepare to meet unforeseen adversaries on unknown battlefields virtually anywhere on the globe.

- ***Nature of warfare*** — morejoint and combined interoperability training is essential because contemporary military operations blur the distinction between the strategic, operational and tactical levels of war.

One other important observation can be gleaned from the DSB report, and that is a theory of a hierarchy of learning curves stacked one on top of another. Different types of learning take place on each curve, each spring boarding off the levels below it. (See Figure 1.) The three levels, individual, team and inter-team, are paraphrases of levels displayed in the original DSB report. They are used in order to maintain consistency with concepts presented later in this paper.

If the DSB report presents an accurate model of the relation between combat proficiency and training, then the following possible premises need to be incorporated into a training transformation approach:

- ***Hierarchy of Combat Skills*** - Combat proficiency requires exposure to several different and increasingly complex training environments.

- ***Decreasing Marginal Utility of Training Investment -*** Once proficiency is achieved at a given level, devoting more resources to the training environment that supports it will only produce ever-smaller increases in proficiency.

- ***Dependency of Skills -*** If proficiency at a lower level is lost, the skill levels above collapse.

AIR COMBAT COMMAND S DISTRIBUTED MISSION TRAINING PROGRAM

In the fall of 1997, well before training transformation became a common phrase, the US Air Force s Air Combat Command (ACC) embarked on a revolutionary path for operational readiness training of its combat crews by accepting its first DMT-specific simulator contract. Of course earlier efforts, especially the contribution made by the 4-ship F-16 test bed at the Air Force Research Laboratory in Mesa, AZ had blazed the trail, but the transition from a training research program to an operational training system was a major event for the Air Force.

Distributed Mission Training (DMT), creates a synthetic battlespace by networking high fidelity flight simulators together in both local and wide area networks. As a result, operational squadrons located at geographically separated Air Force bases can practice combat skills and rehearse operational missions together. This capability to train on a daily basis in a realistic combat environment represents a major improvement in providing operational readiness resources to operational units.

The commander of ACC, General Richard Hawley, articulated his vision in several venues and formats. Perhaps the most significant was his keynote address to the Interservice/Industry Simulation Education and Training Conference in 1998. Several thousand uniformed and civilian training professionals in Orlando, Florida heard him commit ACC to creating a synthetic battlespace to help us overcome some of the limitations we face today imposed by a very high operational tempo, by decreasing range space and increasing demands on the airspace and ranges that we do have, and by budget constraints that preclude our ability to bring our forces together to train. He also laid out the major uses and components of DMT, which are listed below and aligned with the hierarchy of training presented earlier.

- ***Individual combat skills*** — High-fidelity simulators that will allow our combat aircrews to train more effectively for the increasingly complex combat environment.

- ***Team combat skills*** — Mission Training Centers at each operational base linked together which would permit training of team tactics.

- ***Inter-team combat skills*** — What better way to prepare [an expeditionary combat] force than with a high-fidelity, synthetic mixed training environment where all those forces can deploy with realistic terrain features, real employment scenarios, real forces, and real adversaries that they can operate against in order to hone their skill.

General Hawley also envisioned DMT as a multi-service and eventually joint capability. I hope that with continued interest from our sister services, eventually they will join the network as well and allow us to conduct that most demanding of all training — joint training. As many of you know, it is almost impossible for our forces to get together to train together in the joint environment before they deploy to conduct a joint operation. We think this is the answer to that shortfall. So that's our vision.

Often one can learn as much by noting what is absent as observing what is present. Significantly, General Hawley made no mention of the training capabilities normally ascribed to simulators. There was no reference to the need for aircrews to have an improved capability to practice emergency procedures or instrument flight. (Weather was only mentioned in the context of the need to have an all-weather combat capability.) There was no mention of the need to improve initial training of new pilots by providing them a better representation of the actual aircraft and its systems. The entire speech was centered on the need to provide a synthetic venue for practicing mission execution of combat operations.

From its inception, then, DMT espoused the same orientation - preparation for combat performance including the need to practice joint employment training - as that presented in the DSB report and the DoD training transformation strategy. Furthermore, as described in the next subsection, DMT can provide the initial backbone for a joint synthetic battlespace.

Mission Training Centers

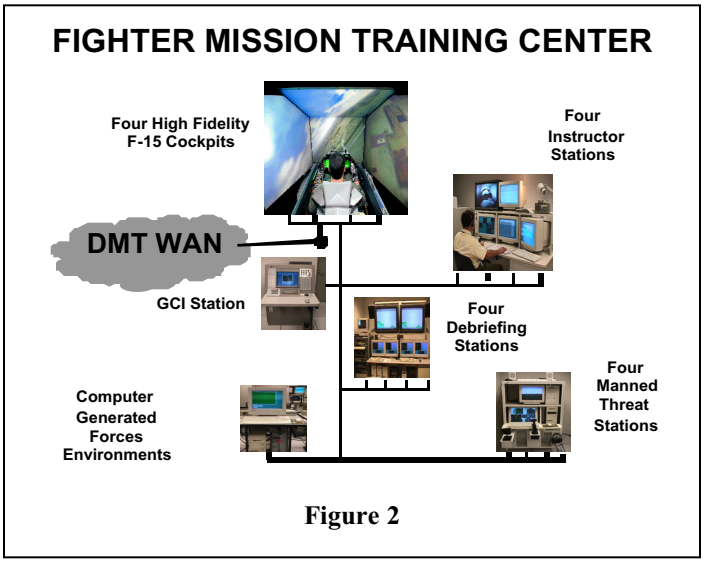

Figure 2

The principal elements of the DMT network are Mission Training Centers (MTCs) located at operational bases. The F-15C MTC, provided by Boeing, represents the prototypical fighter MTC. The F-16C MTC, currently being fielded by Lockheed Martin, is very similar. Figure 2 depicts the F-15C MTC as currently operational at Langley Air Force Base, Virginia, and Eglin Air Force Base, Florida. The central feature of the MTC is four high-fidelity cockpits with full 360° visual systems. Other major components include 4 instructor operator stations, 4 desktop computer threat stations, 4 briefing/debriefing stations, a separate mission observation center, and a weapons director station.

Figure 3 depicts the AWACS MTC, provided by Plexsys, currently operational at Tinker AFB, Oklahoma. The AWACS MTC serves the mission crew of 11-15 personnel. (The AWACS flight deck is not part of the MTC.) In early 2002, the locally networked F-15C and AWACS MTCs were joined into a common wide area network federation. In addition, the AWACS MTC can be networked into operational

surveillance radars and thereby control live air-to-air training missions within the contiguous United States. (MS Lite). DMT, therefore, is truly an integrated live, virtual and constructive training environment.

DMT Network

Connectivity among the MTCs is provided by TRW through the DMT Operations and Integration (O&I) contract. Each MTC will be capable of conducting stand-alone events or participating in distributed events with other MTCs. Team training will include both stand-alone and distributed events. The DMT Wide Area Network (WAN) will accommodate multiple, simultaneous stand-alone and distributed events.

As the DMT network expands, many MTCs can be linked together to large-scale, distributed events such as theater preaparation for expeditionary force training and eventually mission rehearsal. Figure 4 depicts the magnitude of this network. In addition the DMT network services by the O&I contract will allow other legacy simulators to participate. Some, however, will require major improvements for in order to establish connectivity. (Note, the sites in figure 4 depict only operatianal units. Other sites such as the Nellis Air Opeations Center or TACCSF are not depicted.)

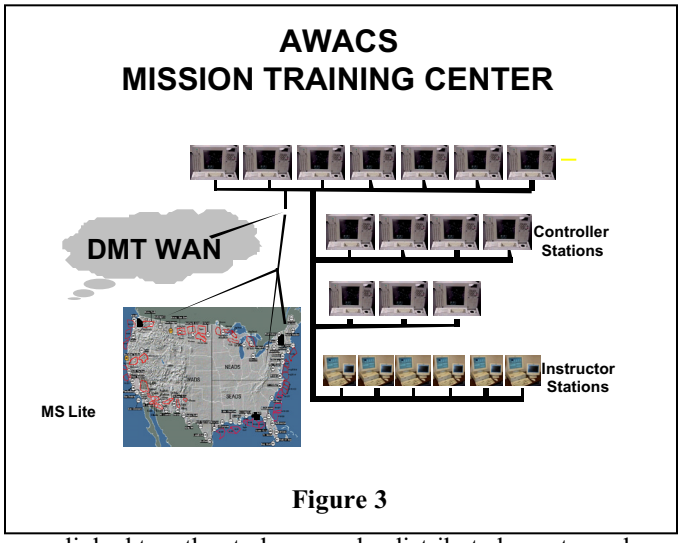

Figure 3

Attibutes of the DMT Synthetic Environment

As the DMT grew to include existing simulators or those already planned, the questions of what makes a training device DMT capable came up. The technical standards for inclusion in the network will be those established under the O&I contract. However, other questions such as visual system resolution and debriefing capability were raised. To answer these questions and provide guidance for simulator modernizations, the following attributes were derived to describe the attributes necessary for a training device to be considered DMT-capable:

- ***Cognitively Immersive*** — A DMT-capable simulator should provide a high fidelity representation of the mission space, including theater-specific terrain and accurate physics-based simulation of mission essential objects (weather, targets, weapons, sensors, threats, civil activity, etc.). Cockpits or mission workstations should replicate the actual look and feel of the combat system. A DMT system should so be realistic that it evokes combat behaviors and responses from mission-ready crews.

- ***Operationally Integrated*** — DMT-capable simulators should provide warfighting teams with the ability to debrief team and inter-team missions based upon data captured during the DMT event. For this reason, a robust briefing/debriefing system should be an integral part of the DMT simulator and provide the mission commander with the ability to capture mission essential data tailored to mission objectives.

- ***Technically Interoperable*** — DMT-capable simulators should have scalable and extensible system architectures to provide the connectivity needed for team and inter-team training. Team training is often conducted within a single unit, requiring local networking. Inter-team mission training usually requires wide area networking. Because DMT is a mission readiness tool, the need to preserve operational and program security must be supported by the local and wide-area networks. DMT components must

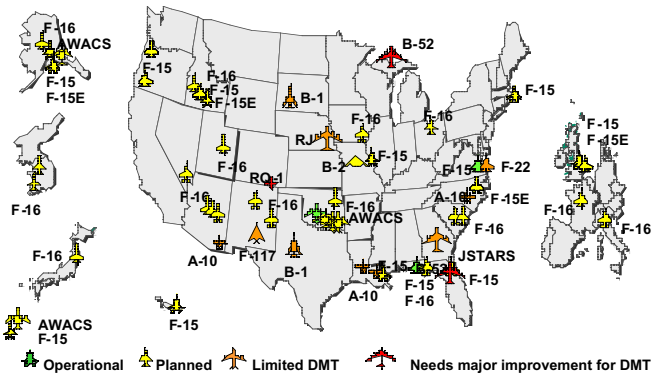

Figure 4

be able to be rapidly configured to support multiple simultaneous small and large training and rehearsal events in both synchronous and asynchronous formats.

MISSION ESSENTIAL COMPETENCIES

As ACC began to field DMT, they discovered that the existing training paradigms did not fit the implementing visions of the ACC commanders. Most of the training methodologies focused on weapons system skills rather than combat proficiency. (Bennett and Crane, 2002). A detailed examination of how warfighters engage in air combat was consequently pursued. (Chapman MTDS 2, 2002)

A new approach was developed by focusing on the combat mission environment. The result was a team-oriented approach that took the F-15C and AWACS mission relationship and applied it to a generalized sensor — shooter concept. From that came the observation that there are few stand-alone systems. Most missions require some type of inter-team sensor-to-shooter relationship and many also incorporate closely coupled weapon delivery processes. Furthermore this trend is increasing with long range, multi-spectral, integrated weapons systems. From a training standpoint, then, what was needed was a readiness training approach that emphasized team and inter-team training within the combat mission environment. Unfortunately an appropriate training methodology did not exist. (Colegrove and Aldinger, 2002)

Training Task Lists (TTLs), for example, tend to focus on weapons system operations —how to operate radars, perform an intercept, etc. The TTL used for the F-16C, for example, has several hundred separate entries. TTLs can be very useful for initial training of pilots at formal training squadrons where basic actions such as successfully completing checklists are important. Generally speaking, they focus on discrete actions and downplay the importance of representing the combat operational environment. However, they quickly lose their utility in an operational environment where squadrons must consider specific theaters, their unique warplans, geography and rules of engagement.

At the other end of the spectrum are the Mission Essential Task Lists (METLs) delineated in joint and Service publications such as AFI 3-1.1. Where the TTLs are too detailed, the METLs are defined at such a high level that they are unsuitable for defining the team combat skills required of operational aircrews. For example, there are only 2 primary METLs for an F-15C wing, both one-sentence statements. And like TTLs, METLs are static in the sense that it is very difficult to demonstrate how tasks are accomplished over time and integrated into larger events such as a campaign or joint force mission statement.

A new readiness training concept, Mission Essential Competencies (MECs) was developed. MECS bridge the detail of TTLs with the mission orientation of METLs. But more importantly they capture the dynamic aspects of combat proficiency, something that neither TTLs nor METLs can. Several important concepts emerged from the early MEC development effort the most significant, however, was the use of the kill chain to structure the MECs.

The kill chain is an adaptation of the decision cycle. The decision cycle is a theory that holds that in modern warfare, the opponent with the most cognitive agility has an overwhelming advantage. The decision cycle has four stages — Observe, Orient, Decide and Act. It is also iterative in that, after action is taken, observation begins again. The OODA loop, as it was often called, was developed by an Air Force fighter pilot, John Boyd, to model the agility needed for success in a visual air-to-air engagement. In his era, the pilot who won was the pilot who could maneuver inside his opponents flight path loop and employ a missile or gun. The maneuvering, he observed, was based an iterative series of constructing and implementing decisions.

Boyd made a lasting contribution to military theory when he applied the air-to-air OODA loop model to military operations in general. (Boyd 1987). Today the OODA loop is called the decision cycle and is used in joint doctrine. (Joint Pub 3-13.1, 1996)

The kill chain is a specific application of the OODA loop tailored to C2ISR sensor-shooter operations within contemporary military operations. It expands the OODA loop to Find Fix Track Target Engage and Assess (F2T2EA).

General John Jumper established the emphasis on the kill chain first as the commander of ACC and later as the Air Force Chief of Staff. As ACC commander he directed that DMT be accelerated to in order to bring in the C2ISR platforms earlier and focus on mission integration. At this point, MECs were just being developed and the kill chain served as the most appropriate way to meaningfully describe combat proficiency and mission execution. The heart of MECs is defining, from a warfighter view, what skills one performs perform during each phase of the kill chain; how and when one moves between phases; and what are the critical interactions within and among combat teams at each phase.

The use of MECs based upon the kill chain has proven to have several advantages:

- Dynamic — MECs emphasizes the time sensitive and iterative nature of combat.

- Decomposable — MECs provides a detailed structure for training programs.

- Linkable — MECs relate individual, team and inter-team training to joint interoperability needs and mission.

The Way Ahead

ACC s current commander, General Hal Hornburg, has supported DMT with the same enthusiasm as his predecessors. In public forums, such as I/TSEC where he delivered the keynote address in 2001, he stated the absolute necessity for having DMT as a primary component of readiness training. Furthermore, he personally directed increased funding to the program so that a robust DMT synthetic environment will be in place within 6 years. His most recent direction for DMT is that it will be a centerpiece of ACC transformation. To that end he outlined the following focus issues to other Air Force senior leaders at a June 2002 Corona Top conference.

- Continue to assess DMT capabilities and its training value

- Expand credit for DMT simulator events in ACC readiness training policies

- Continue R&D efforts for DMT enhancement especially with respect to C2ISR and bomber integration

- Pursue a rapid database generation capability in order to support DMT-based mission rehearsal

- Establish full spectrum integration with other combat forces.

Currently, ACC is making a concerted effort to participate in the Navy DMT program. DMT requirements will also be the foundation for the Air Force portion of the Joint Synthetic Battlespace.

CONCLUDING COMMENTS

From both an operational and technological perspective, the ACC DMT program has been extremely successful. In many respects the program has exceeded its founding vision. (Chapman MTDS 1, 2002). This simulation-based capability to train on a daily basis in a realistic combat environment represents a major improvement in providing operational readiness resources to operational units. With respect to DoD training transformation, DMT is aligned with its primary elements:

- ***Dynamic*** — DMT will provide a training environment that is responsive and adaptive to changing warfighting environment and weapons system technologies.

- ***Capabilities-Based*** — DMT will provide training that can be tailored to broad range of potential adversaries and their potential tools.

- ***Joint*** — DMT training can support joint interoperability by integrated training at the appropriate level from the team to battlestaff.

The success of DMT however, is not due solely to solving the technical challenges. Past and current efforts on the soft problems of creating operational training concepts and integrating them into the physical system as well as the training policies are perhaps even more important to the DoD training transformation:

- The attributes of cognitive immersiveness, operational integration and technical interoperability can help define synthetic environment requirements.

- Using the structure provided by mission essential competencies and the kill chain one can develop appropriate training strategies oriented to the combatant commander missions that link individual and team skills to joint mission tasks.

In conclusion, this paper has shown that DMT is critical enabler of transformation. Without it, it will be nearly impossible to provide weapons system and combat proficiency training for warfighters. Furthermore, DMT is demonstrating a potential to be viewed a transformational technology in itself.

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