C³I TRAINING: THE FIGHTING EDGE

Peter Bonanni
BMH Associates
Norfolk Corporate Center
5425 Robin Hood Road, Suite 103
Norfolk, VA 23513

J.C. Williams
BBN Systems and Technologies Corporation
Simulation and Training Systems Division
33 Moulton Street
Cambridge, MA 02238

ABSTRACT

Command, Control, Communications and Intelligence (C³I) elements play the leading role in Airland Battle engagement doctrine. These elements will provide synchronization of forces and are the key to victory. Training to accomplish effective synchronization of diverse force elements is the challenge. This paper will describe how technology in the form of distributed networked simulation can open the door to superior C³I training. With this technology, crucial C³I skills can be practiced and the strengths and limitations of diverse forces and how to employ them on the modern battlefield for mission effectiveness can be learned. Technology applications involving long-haul networks, simulated intelligent forces and interactive simulators have made possible robust training environments which permit daily peacetime practice of C³I procedures.

INTRODUCTION

The theater of war in the 20th century has combined mechanization and maneuver with tremendously destructive weapons. Dimensions of the battlefield in time and space have expanded to accommodate these capabilities. In World War I, the airplane, which embodies mechanization, maneuver and firepower, entered combat from above the French landscape to initiate the era of air-land battle. In the 1920's and 1930's, Russian military theorists such as Tukhachevsky and Triandafillov expounded eloquently on a theory of deep attack and defense in depth. These theories envisioned air armies assisting the ground maneuver of large combined arms formations to achieve theater objectives. Ironically, it was the German Blitzkrieg of 1939-1941, which combined air power in direct support of leading panzer columns, that exemplified and justified Russian doctrine. Using Blitzkreig, the German army crushed superior armed French and British forces to occupy France in 49 days, and then slice through Russian forces to the gates of Moscow. The Americans learned these lessons well. In 1944 the innovative fighting combination of Major General Elwood Quesada's IX Tactical Air Command and Lieutenant General George Patton's Third Army swept out of Normandy and across France, shattering German resistance. The combined arms campaigns of World War II capitalized on the increase in maneuverability, range and lethality of the ground and air forces.

Continuing advances in technology have further expanded the dimensions of this combined arms battlefield. The air and ground forces have added whole new weapon systems and capabilities that are as revolutionary as the addition of the aircraft in World War I. With these new weapons, commanders have the ability to maneuver air and ground forces at unprecedented speeds and strike the enemy with precision far beyond the Forward Line of Troops (FLOT). Use of the electromagnetic spectrum for intelligence and weapons employment has increased the lethality and complexity of the modern battlefield giving an Army with the technological lead a significant potential advantage. Fundamental to the addition of these systems are corresponding changes in doctrine and procedures to exploit this expanded air/land battle area. Training units to employ these superior weapons and effectively execute battlefield tactics and doctrine has become a task of enormous importance for which we are ill-equipped.

AIRLAND BATTLE DOCTRINE

The new Airland Battle doctrine describes how the U.S. forces propose to fight on this modern battlefield. The four basics tenets of the Airland Battle are initiative, agility, depth and synchronization. Success on the battlefield will depend on both the air and ground forces ability to fight cooperatively in accordance with these four tenets. The ultimate goal of the Airland Battle is to use these basic tenets to concentrate firepower at a decisive place and time. In order to achieve this goal, all C³I functions must work effectively to accurately assess enemy force positions and strengths and maneuver friendly forces into engagements with relatively weaker enemy formations. The battlefield is divided into close, deep and rear battle areas and air and ground assets are used in coordinated attacks on enemy forces located in all of these areas. Airland Battle doctrine seeks to capitalize on the recent increases in weapon system capability to prosecute offensive operations against the entire depth of enemy forces.

Synchronization of Combined Forces

Synchronizing diverse forces and directing them in this dynamic battlefield environment is the key to success of the Airland Battle. Fixed wing and rotary wing aircraft, artillery, air defense artillery, and other supporting assets must be woven into the Airland Battle in a way that maximizes their effectiveness against a numerically superior enemy force. Tactical Commanders must understand the strength and weakness of all of these assets in order to make correct battlefield decisions. Knowledge of complex weapon systems across different combat arms and even different services is necessary. Academic knowledge however is not enough. Routine real-time decision making on the use of these combined arms must be practiced in order for commanders at all levels to develop a concept of operations based on battlefield experience. New weapon systems and doctrine have broadened and intensified the battlefield causing a corresponding reduction in reaction time for battlefield decisions.

C3I Functions

Synchronization of the battle flows from commanders at all levels through the C³I functions. These functions include; processing battlefield intelligence and assessing enemy positions, strengths and intentions; tracking movement and status of friendly forces; allocating battlefield resources and controlling and directing the use of friendly forces. Underlying all C³I functions is combat decision making. Unit commanders must usually make time-critical judgments of battlefield conditions with less than perfect intelligence. U.S. Forces find themselves outnumbered in men, tanks, artillery, combat aircraft and most other combat assets. To offset this enemy advantage, friendly forces rely on C3I to tie together superior weapons, tactical doctrine and training. How well our commanders perform in the "fog of war" will directly affect C³I and the outcome of the Airland Battle.

CURRENT C³I TRAINING METHODS

Training the C³I functions is critical to successful execution on the battlefield. Our current C³I training methods consist of wargaming at the senior Command and Staff levels, Command Post exercises (CPX) at the unit commander level, and actual field exercises. These training methods are effective to a degree but fall short of encompassing the entire training problem.

Wargaming and Command Post Exercises

Although beneficial at the strategic level, wargaming fails to mirror the "real world" and generally centers on the logistics and resource management decisions confronting senior commanders. The tactical emphasis is subordinated and attrition levels are based on computer generated decisions trees. CPX exercises are frequently joint service and let commanders and staff make decisions in a computer generated battle scenario. This training method is useful at training procedures but does a poor job of training combat decision making. Battlefield computer simulations that involve human interaction by only a limited number of decision makers cannot accurately present the C³I problems likely to be encountered in combat. Because of the limited numbers of men-in-the-loop, these simulations must use computers to not only model the machines but also human factors. Thus the problems presented to commanders during these exercises are limited and dictated by the assumptions in the computer models. These models channelize decision making into certain discrete paths which will only be valid if the assumptions on which they are based correctly mirror reality in the next war. In addition to channelized decision making or "school solutions", these exercises fail to offer the required complexity and dynamic man-in-the-loop environment to adequately train the C³I functions. At best they provide canned scenarios within which basic C³I procedures can be drilled.

Field Exercises

This is the preferred method of training C³I. In a field exercise actual equipment is used and tactical commanders and C³I elements exercise as they would in combat. Field exercises such as at the National Training Center (NTC) and Red Flag train individual operators and crews as well as C³I functions. This training method is invaluable but limited by cost, number of players, terrain, safety and live fire considerations. While field training exercises offer the best current C³I training, there are significant limitations to this type of training. C³I is by nature distributed geographically and organizationally. All levels of C³I must function effectively in order for C³I to be successful. Training C³I functions at the upper echelons using field exercises is very costly and difficult due to the large numbers and distances involved. As a result, this training occurs infrequently which reduces training effectiveness and unit readiness.

Training C³I functions through all of the combat echelons is the key challenge facing the training community today (Figure 1). Currently, training methods cannot meet this challenge and without effective C³I the Airland Battle doctrine and the high technology weapons to implement it are at risk.

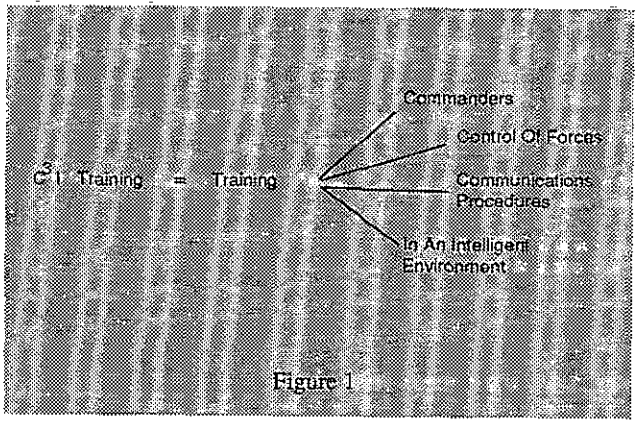

Figure 1

C³I TRAINING POSSIBILITIES

Advances in technology that have expanded the space/time battlefield dimensions also hold promise for solving our critical C³I training needs. At the core of C³I training is decision making. C³I elements consisting of commanders and their staffs must be placed in a dynamic battlefield environment where tactical doctrine can be implemented against a

realistic enemy force. This type of training should allow these individuals to gain a wartime concept of operation that will prepare them for the "next war". Aside from decision making, C³I procedures and systems should be exercised in an environment that will allow realistic enemy disruption. The emerging technologies of expert systems and distributed networked simulation can create this training system.

Distributed Simulation Building Blocks

The concept of distributed simulation mirrors in many respects the operational environment it sets out to simulate. Geographic distribution of fighting units taxes C³I structures and training these units on a regular basis is a major undertaking. The high cost of simulators has not made distributing (networking) simulators attractive. Command and control training generally has been confined to wargaming at professional military education courses or to command post exercises. The occasional field exercise does provide the realistic (albeit non-live fire) C³I training arena. Confined spaces and the forced nature of the battles takes much of the tactical realism from the 2 or 3 day experience. By placing a realistic networked simulation capability in the hands of operational units where it can be exercised every day, the possibilities of C³I training are no longer confined by time, space or dollars.

Distributed simulation capitalizes on available technology. It is not an invention of new technology nor a technological breakthrough in the classic sense, but a clever application of five basic building blocks (Figure 2) - local area networking using robust, simple communications protocols; low cost but superior performing CIG systems; expert systems to add intelligent forces to the network to provide the massed forces necessary to simulate large scale battles; powerful microprocessor (parallel or multi-processor) based simulation hardware; and intelligent network management (local and long-haul) subsystems.

Key Distributed Simulation Building Blocks

- Standard networking protocols
- Low cost CIG systems with standardized terrain data bases
- Intelligent friendly and adversary force modules
- Parallel processing micro computers
- Intelligent network management subsystems

Figure 2

Airland Battle Network

With this technology, battalion level exercises with the required battlefield realism can be conducted in simulation. The Battalion Headquarters or TOC (Tactical Operations Center) can be replicated with all of the key areas represented. From the TOC, the Battalion Commander can be placed in combat with the enemy and must use his available combined arms resources to accomplish his objective. The primary C³I functions from the Battalion down, can be emphasized including combat decision making. The enemy force will consist of manned simulators and intelligent computer created opposing forces directed by a human operator. Orders will be issued to the Battalion and resources such as fuel, ammunition, fixed and rotary wing air support, artillery and other assets must be controlled and directed in order for the Battalion commander to accomplish his mission. This type of simulation offers the advantages of numerically correct human interactions and realism which will allow Battalion commanders to "stay current" in battlefield decision making. The advanced simulation technology to enable this type of training is in hand and shows promise of being relatively low cost compared to the tremendous training benefit it can provide. Figure 3 shows a functional block diagram of such a distributed system.

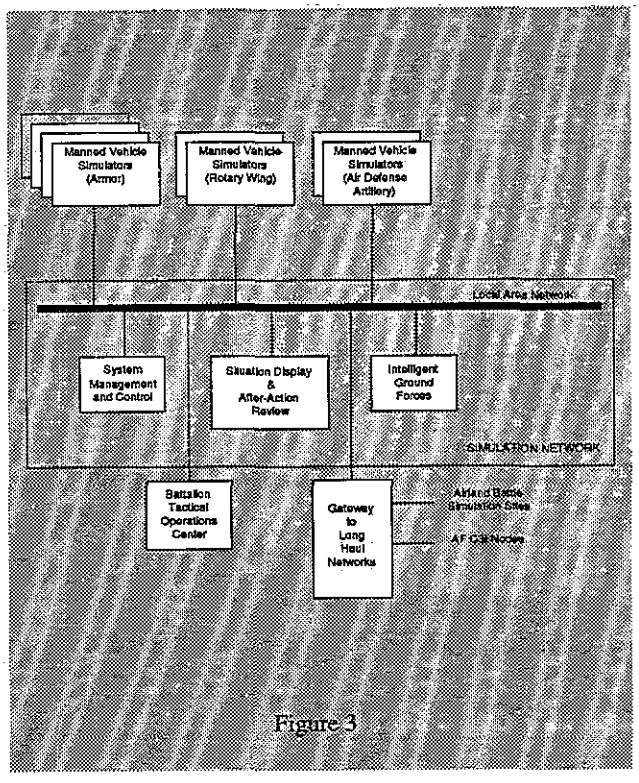

Figure 3

To completely address the Airland Battle C³I training problem however, Army levels above Battalion, such as Brigade, Division, and Corps must be included. Decision making at these upper levels also requires critical and perishable skills which must be honed periodically. Distributed simulation technology makes it possible to add these command echelons incrementally with a mix of manned simulators, semi-automated opposing forces and part task and desktop trainers. Expanding this type of training system to include C³I training of these upper Army command levels and including the parallel Air Force structure is vital to providing the needed joint interactive C³I training environment which mirrors the battlefield. Current and future training systems can be made compatible with today's networked simulations to allow C³I training for upper command echelons. Man-in-the-loop training will ensure a robust and dynamic battlefield environment.

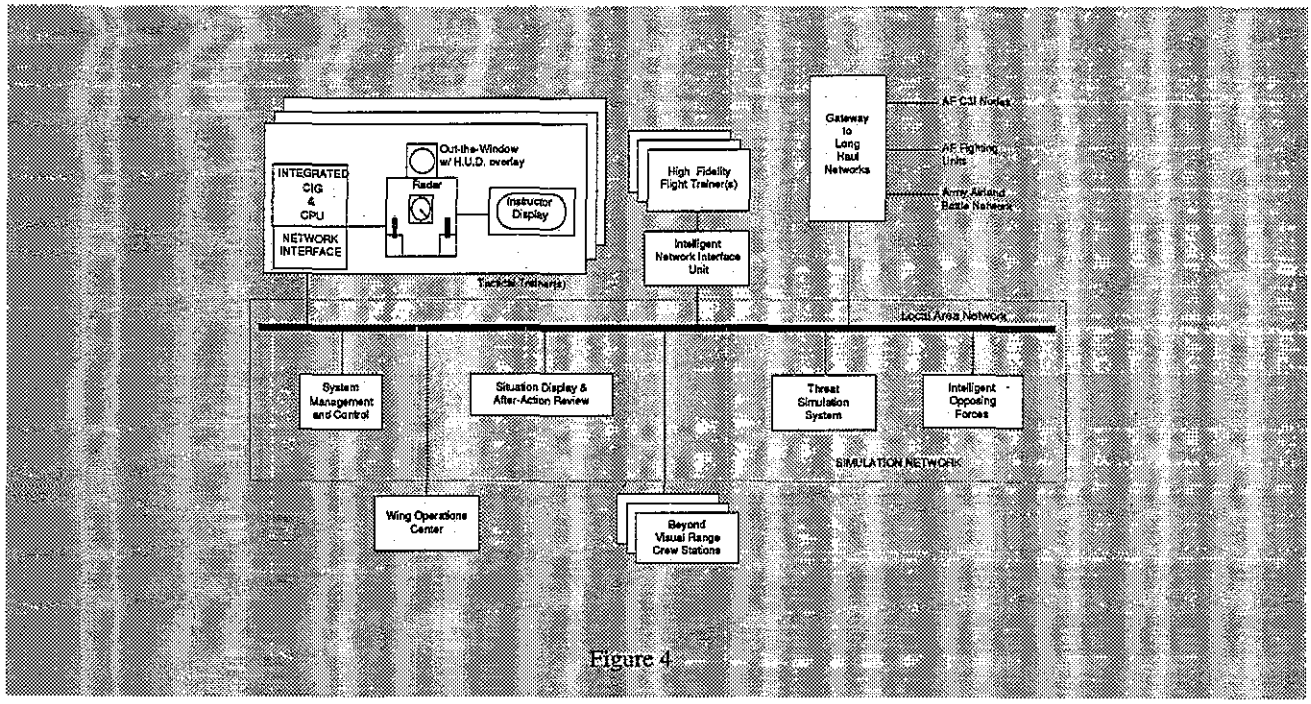

Figure 4

Air Force Interface

The distinction between the land battle and the air battle has blurred with the advent of new weapon systems and capabilities. The air battle is not fought in support of the ground battle in the classic sense, rather air assets including fixed and rotary wing aircraft are used in parallel with ground forces to extend the battlefield. The close, deep, and rear battles are conducted with synchronized air and ground forces. These combined forces also gain and maintain air-superiority over our own ground based assets and installations. In order for Airland Battle C3I training to have the desired scope, the Air Force must be fully integrated on the battlefield to include all of the critical Air Force tasks: not just ground attack. A simulated battlefield with the Air Force represented only in the ground attack role risks badly skewing the C³I training. The U.S. Army has not been under intense and disruptive air attack since the North African campaigns in WW II and has evolved a corresponding tactical perspective based on this experience. Air-superiority cannot be assumed by either service. The battlefield of the future will feature an intense fight for control of the air with a corresponding profound effect on the ground battle. Army surface-to-air missiles and rotary wing aircraft will play a large role along with Air Force fixed wing aircraft in winning air-superiority. The resources allocated to accomplishing this mission may change with the dynamics of the battle and C³I will have to be responsive to these changing conditions. For example, an Army commander may request a close air support mission in support of an upcoming offensive operation only to divert these aircraft to air-superiority if his force comes under enemy air attack. This commander will have a choice of options in combat which may include using his own Air Defense Artillery (ADA) or rotary wing aircraft to do the job or diverting fixed wing assets. The corresponding C³I training system must present Air Force and Army commanders with these realistic battlefield problems.

Future Air Force Involvement

There is a critical need for Air Force involvement in this future distributed training system to complete the Airland Battle picture. The Air Force currently uses trainers of varying fidelity to train individual and crew skills. Team fighting skills are developed in the actual aircraft. Distributed simulation technology advances have made it possible to expand the use of simulator training in the Air Force which will in turn enhance C3I training. Currently each operational fighter wing has at least one high fidelity Operational Flight Trainer (OFT) or Weapon System Trainer (WST) at its disposal for training purposes. This trainer can be augmented by low cost simulators (tactical engagement trainers) that are designed with an emphasis on tactical team training vice individual or crew training. A fighter wing including the command post could then contain a local area network of simulators that would be linked via a long-haul network into a larger scale Airland Battle scenario (Figure 4).

Above the wing level, additional C³I elements would be included. An Air Support Operations Center (ASOC) is collocated with an Army Corps Tactical Operations Center (TOC). This command and control element works with the Army to plan the Airland Battle. Resource allocation is the primary end product of these plans. The Tactical Air Control Center (TACC) puts these ASOC plans into action by issuing Air Tasking Orders (frags) which direct specific fighter wings into action. Fighter wings then plan and fly the missions outlined in the frag. Mission execution usually requires diverse air assets working in harmony. AWACS and ABCCC aircraft are the airborne C³I elements that are used to orchestrate this air battle. As automation continues to enhance the operational environment, C³I elements become more closely connected to the weapon systems they support. Training both becomes a problem in real-time interaction of weapon systems and C³I elements and in man-in-the-loop decision making.

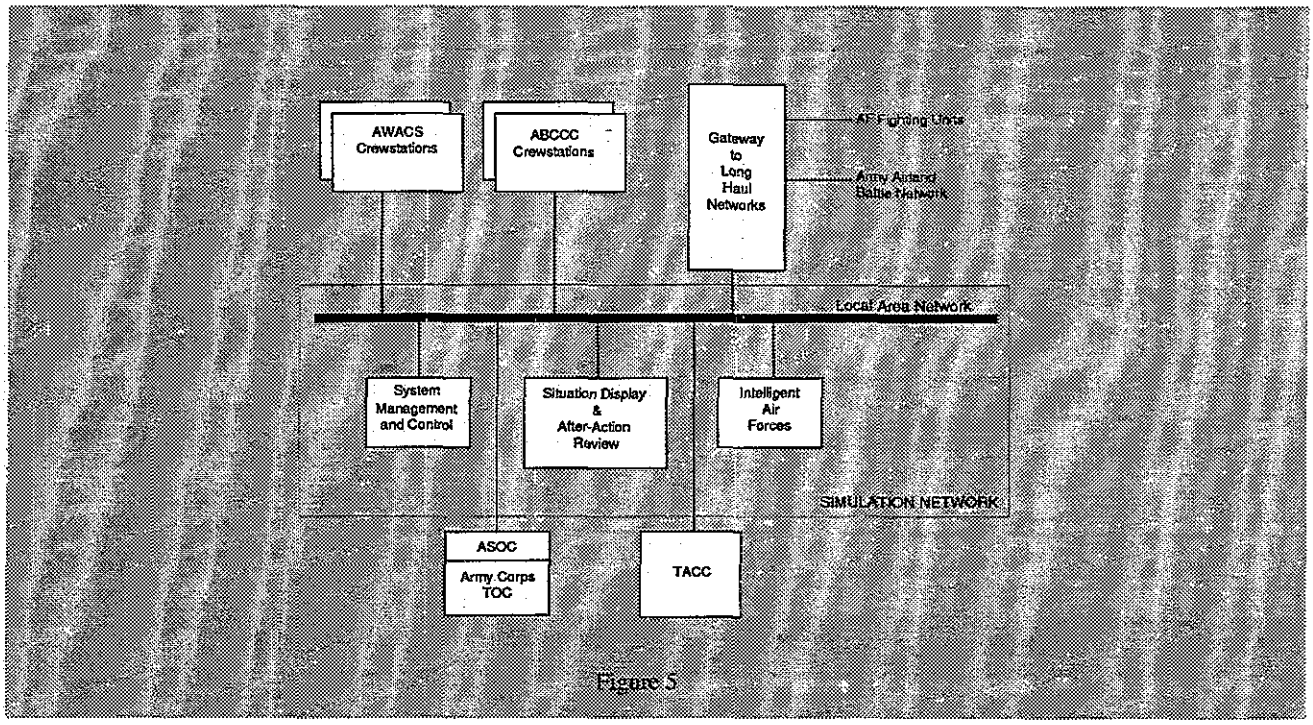

Figure 5

Select support assets would be included on the simulated battlefield using desk top trainers or their own existing simulators adapted to be compatible with the network. The maximum use of existing simulators and part-task trainers is essential to keep the cost down to allow a large battle simulation (Figure 5).

SIMULATOR FIDELITY AND C³I TRAINING

The matter of simulator fidelity is a matter of taste - and cost. Distributed simulation technology works in the high end, high fidelity trainer as well as the low end, moderate fidelity tactical engagement trainer. Depending on the training requirement, any number of high fidelity and lower fidelity simulators can be successfully networked to create force-on-force environments where C³I elements can be replicated (on the network) and interactive training takes place. Using the building block approach, C³I training begins with a single simulator. Ignoring for a moment that initial vehicle training might be for emergency procedures training or cockpit or crew compartment familiarization, the premise here is that communication between vehicles (and within them) is necessary to actually mirror the C³I environment. From the single simulator to an interconnected suite of multiple cockpit (or crew compartment or crewstation) configurations, basic crew coordination, communication and procedural skills can be learned and practiced. At this level, at best, basic fighting unit skills (vice force-on-force) can be trained with limited threats (targets) and most of the attention is focussed on gunnery, airmanship or situational awareness. A good example of this in practice is the 1V1 or 1V2 or 2V2 domed simulators. Adding the instructor interaction, additional threats and some debriefing aids (large screen displays, etc.) creates an acceptable, but limited environment for C³I training.

There will always be a need for higher fidelity individual skill trainers. Perhaps technology can contribute to getting their cost down. It is more likely that as weapon systems become more complex, the training devices that simulate these weapon systems will also grow more complex and their costs will in fact go up. This will force their numbers down but initial weapon system qualification demands a highly realistic replica of the actual equipment to be operated. Part task trainers provide a convenient lower cost means to reinforce basic system knowledge. There are not presently too many extensions possible for these types of configurations to evolve into the necessary C³I training environment. The advent of tactical engagement trainers, lower fidelity replicas of specific weapon systems networked in a distributed manner rounds out the next generation "family" of individual, crew and unit trainers. Without a representation of the C³I environment, collective team trainers cannot provide the necessary training to meet the needs of our fighting forces. Distributed simulation technology provides all of the necessary characteristics to create the representative environment within which to conduct this type of training. Team skills, unlike individual skills, cannot be "qualified" nor "quantified" because they rely on practicing in a dynamic C³I environment on C3I training. A robust training system, based on distributed simulation technology, which allows continuous, sufficient interaction to practice daily will increase survival on the battlefield and in the cockpit.

CONCLUSION

Airland Battle doctrine has evolved in response to new weapon system capabilities. Key to this doctrine are the C³I functions which are implemented by combat decision making. Current C³I training methods are inadequate to

prepare U.S. Forces to employ Airland Battle doctrine in the "next war". The new technologies of distributed simulation and expert systems can solve this training deficiency by creating a robust training environment for commanders and staffs at all levels. This training system should be constructed across service lines to create a true air and land battle simulation. This system should consist of existing trainers and new tactical engagement trainers built exclusively for distributed combined arms training. Future and current trainers should be adapted for use in this simulated battlefield environment.

On the modern battlefield, where firepower, protection, and mobility are the true combat multipliers, command and control of high intensity combat operations in depth is critical to victory. It will not be achieved on the ground alone or in the air alone. The successful practitioners will be individuals with the vision and innovative spirit to develop training systems with the capability to meet Airland Battle training requirements. Such individuals are the legitimate heirs of two cooperative fighting leaders, Quesada and Patton.

ABOUT THE AUTHORS

Pete Bonanni is Vice President, Operations for BMH Associates. He is responsible for aerospace consulting and technology marketing activities and frequently serves as a subject matter expert for training systems development. He is currently an A-7 pilot with the Virgina Air National Guard in Richmond, VA and Group Weapons Officer. A former active duty F-16 pilot and Fighter Weapons School Graduate, Mr. Bonanni is a graduate of the USAF Academy.

J.C. Williams is Director, Business Development for BBN Systems and Technologies Corporation. He is responsible for all marketing and advanced program development activities for the Simulation and Training Systems Division. A former USAF F-4 Weapon Systems Officer, Mr. Williams is a graduate of the program manager's course at the Defense System Management College and holds a masters degree from Boston University in business administration.