ARI Research Note 2001-12

Reflections on the Structure of the Future Training System

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August 2001

U.S. Army Research Institute
for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

A Directorate of the U.S. Total Army Personnel Command

EDGAR M. JOHNSON
Director

Research accomplished under contract
for the Department of the Army

Human Resources Research Organization

Technical review by

William R. Sanders

NOTICES

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
August 2001	Final	3 May 2000 – 2 May 2001

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
Reflections on the Structure of the Future Training System	DASW01-99-D-0012 DO #08
	5b. PROGRAM ELEMENT NUMBER: 0602785A
6. AUTHOR(S): Charlotte H. Campbell and William T. Holden, Jr.	5c. PROJECT NUMBER: A790
	5d. TASK NUMBER: 211
	5e. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Human Resources Research Organization (HumRRO) 66 Canal Center Plaza, Suite 400 Alexandria, VA 22314	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences ATTN: TAPC-ARI-IK 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. MONITOR ACRONYM: ARI 11. MONITOR REPORT NUMBER: Research Note 2001-12

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
Contracting Officer's Representative: Bruce S. Sterling

14. ABSTRACT *(Maximum 200 words)*:
In redesigning itself for the future, the Army is grappling with a broad array of issues and challenges. Geopolitical changes, technological capabilities for both operational and training systems, and the demographics of the 21st century force must all be considered. Developments outside the mainstream of military transformation, such as the results of research into group and team behaviors and learning strategies, are also relevant. This paper addresses collective training needs and approaches for future brigade and below staffs. It makes the case for a training transformation, and presents descriptions of the objective training system and the research and policy development needed to construct that system. Three areas are considered: (1) issues and conditions that are driving the need for a training transformation; (2) a description of the objective training system that will enable the vision of the future brigade capabilities to become reality; and (3) recommendations for studies, research, development, and policy formulation needed to achieve the training transformation. This paper will serve as input to a research and development plan for U.S. Army Research Institute for the Behavioral and Social Sciences' Science and Technology Objective 02, Methods and Measures of Commander-Centric Training, by identifying key research issues and approaches for future training.

15. SUBJECT TERMS
Training; Transformation; Digital Training; Embedded Training; Objective Force; Training System; Future Combat Systems

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	42	Dr. Bruce S. Sterling DSN: 464-3450

ACKNOWLEDGEMENTS

This report reflects the thoughts and contributions of a team of researchers, military experts, and future thinkers. During its evolution, the brainpower and creativity of many individuals were applied to preparing a cogent and visionary analysis of the future conditions, and to speculating on the training system that would allow us to meet that future. Notably, we received invaluable assistance from:

Dr. Barbara A. Black (U.S. Army Research Institute for the Behavioral and Social Sciences, Armored Forces Research Unit)

Dr. Bruce Sterling (U.S. Army Research Institute for the Behavioral and Social Sciences, Armored Forces Research Unit)

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Dr. Michael T. Shaler (Colonel, U.S. Army, Retired)

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has a long history of research and development efforts in support of the Army's requirements for training, performance assessment, and feedback. Within the Armored Forces Research Unit (AFRU) at Fort Knox, members of ARI's Future Battlefield Conditions Team are now focusing on training and performance evaluation techniques for future forces in support of Science and Technology Objective (STO) ARI-02, Methods and Measures of Commander-Centric Training.

The AFRU directed preparation of this paper addressing issues associated with collective training needs and approaches for future (e.g., 2013) brigade and below staffs. As an exemplar and marker for that future, the paper focuses specifically on what the Brigade Commander of a unit equipped with Future Combat Systems (FCS), operating as the ground component of a future joint task force, must be able to do to ensure efficient and effective collective training for the unit.

Procedure:

A review of the literature was conducted to examine a number of issues related to future conditions. The general topics for the review included: Army Transformation, the National Military Strategy, the Objective Force and the Future Combat System, embedded training, distributed training, national demographics and projected demographics for recruiting and accessions, and a host of related topics. The original search topics grew from a modest list of seven to an eventual catalog of over 40 topic areas.

The literature was organized and summarized, and a preliminary list of training issues was prepared. These issues were reviewed and expanded by a group of military experts, trainers, and future thinkers. Their contributions were further organized and the resulting issues paper was summarized and finalized by the authors, with the assistance of a small group of reviewers.

Findings:

The issues and challenges tend to fall into three groups: the Army transformation for the full spectrum mission, the Objective Force and Future Combat Systems, and the Army demographic picture.

The description of the future training system is presented in three parts:

- The structure of the training system,
- Emerging training technologies (embedded training, distributed simulations, distance learning technologies, and automatic collection of performance data), and
- Methodology for development of the elements of the future training system.

Finally, the research and development agenda for the future training system calls for four related research and development initiatives:

- Outline the structure of the future training system,
- Exploit and shape technologies,
- Construct the elements of the future training system, and
- Address related issues (the training value of training preparation, distrust of digital data, external realities, and knowing what the future will be).

Utilization of Findings:

This paper will serve as a research and development plan for training needs and training methods for the 21st century, and as such will provide direction for ARI's continuing efforts by identifying key research issues and approaches for future training.

REFLECTIONS ON THE STRUCTURE OF THE FUTURE TRAINING SYSTEM

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REFLECTIONS ON THE STRUCTURE OF THE FUTURE TRAINING SYSTEM

The future for the U.S. Army: a full spectrum of missions, from peacekeeping and stability and humanitarian to direct combat operations.

Soldiers will be on call for operations around the globe, with response times as short as 2 hours from notification to deployment.

Equipment and systems will enable, even require, one soldier to do the tasks of several of today's specialists and experts.

Organizations and operational doctrine will be transformed to leverage the capabilities of military systems across the range of requirements.

And the equipment and systems will be upgraded frequently, as technology continues to develop and offer even more advantages to the warfighter.

INTRODUCTION

That is a view of the future. Will it be our future? We know that we will have technologies on the battlefield that will allow leaders to command, control, and communicate in ways that we can currently represent only in models and simulations. Our concepts of organization, doctrine, decision-making, and logistics will undergo vast transformations. How will the leaders of 2015 know how to take advantage of their capabilities? Will they have the training strategies, programs, and tools that will enable them to take control of the technology? Will the research and development community incorporate research findings on learning, multitasking, skill acquisition, skill retention, versatile leadership, and teamwork? Will engineers build training-friendly capabilities into operational systems? Will simulations experts devise a broad array of adaptable training devices that can be used to train the full spectra of tasks and missions, echelons, skill levels, and group configurations? And will we begin *now*, so that in 2015 we can continue to have an Army that is persuasive in peace and decisive in war?

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has a long history of research and development efforts in support of the Army's requirements for training, performance assessment, and feedback. Within ARI's Armored Forces Research Unit (AFRU) at Fort Knox, members of the Future Battlefield Conditions Team are now focusing on training and performance evaluation techniques for future forces in support of Science and Technology Objective (STO) ARI-02, Methods and Measures of Commander-Centric Training.

The ARI AFRU has directed preparation of this paper addressing issues associated with collective training needs and approaches for future (e.g., 2013) brigade and below staffs. As an exemplar and marker for that future, this paper focuses specifically on what the Brigade Commander of a unit equipped with Future Combat Systems (FCS), operating as the ground component of a future joint task force, must be able to do to ensure efficient and effective collective training for the unit.

This paper makes the case for a training transformation, and presents descriptions of the objective training system and the research and policy development needed to construct that system.

A window on the future would show a world where equipment and organizations will be developed to address new missions and to exploit new technologies. This paper makes the case for the corresponding essential training transformation, and presents descriptions of the objective training system and the research and policy development needed to construct that system. Three areas for consideration will be presented:

- Issues and conditions that are driving the need for a training transformation, in order to achieve the readiness needed to meet the future requirements.
- A description of the objective training system that will enable the vision of the future brigade capabilities to become reality.
- Recommendations for studies, research, development, and policy formulation needed to achieve the training transformation.

This paper will serve as input to a research and development plan for training needs and training methods for the 21st century, and as such will provide direction for ARI's continuing efforts to address key research issues and approaches for future training.

THE ISSUES AND CHALLENGES

In redesigning itself for the future, the Army is grappling with a broad array of issues and challenges. Geopolitical changes, technological capabilities for both operational and training systems, and the demographics of the 21st century force must all be considered. As the Army reacts to these challenges, new ones emerge – how to train and operate with a shifting mix of Active Component (AC) and Reserve Component (RC) units, how to train and operate with joint forces, how to train for and carry out a wide variety of potential missions, how to reduce the effects of skill degradation that result from non-use. Developments outside the mainstream of military transformation, such as the results of research into group and team behaviors and learning strategies, are also posing both challenges and opportunities.

This section describes some of the key issues and challenges that are shaping the future for Army brigades, their commanders, and the policy-makers who will help to determine how those brigades will be able to meet the challenges.

The Army Transformation for the Full Spectrum Mission

There can be no doubt that the Army's mission is changing: It is more complex, broader in scope, and less predictable. The goal remains to deter war but to win decisively if required. The Army supports the national military strategy by participating in operations to avert collapse of troubled states, mitigate the effects of natural or man-made disasters on countries and their people, provide peacekeeping missions, and support governmental agencies and non-governmental organizations implementing economic and humanitarian assistance programs.

The multiple emphases come at a heavy price, however, not only in terms of the cost of moving soldiers and equipment and supplies, but in the toll it takes on individual and unit readiness. The last decade of the 20th century witnessed over 30 major U.S. Army deployments. These operations included security assistance, domestic civil support, domestic disaster relief, peace-making, peace-building, peace-keeping, nation assistance, show of force, humanitarian assistance, non-combatant evacuation, peace enforcement, counter-drug, and direct combat operations. The effect of frequent and variable deployments on soldier and unit readiness is an important issue for military and civilian leaders. Military deployments must be considered not only in terms of number, but also in terms of factors such as length, intensity, location, and type (e.g., combat, peacekeeping, humanitarian). It is also important to remember that deployments include training, administrative support missions, and service support requirements, all of which can contribute to either higher or lower readiness levels.[1]

> *We will provide to the Nation an array of deployable, agile, versatile, lethal, survivable, and sustainable formations, which are affordable and capable of reversing the conditions of human suffering rapidly and resolving conflicts decisively.*
>
> – GEN Eric Shinseki, Chief of Staff of the Army, and Mr. Louis Caldera, Secretary of the Army.

As a result, Army leaders are rethinking the Army's force structure. It will be critical to maintain the ability to use a complete, or full spectrum, balanced force for potential conflicts. The "full spectrum mission" for the U.S. Army will demand new categories of readiness, more complex than what we have seen in the past. Achieving necessary levels of readiness will be a challenge that will require reengineering of existing training programs and approaches; maintaining it will demand innovative ways of designing and implementing training programs, strategies, and tools.

The Objective Force and Future Combat Systems

The Army's modernization effort, leveraging the latest developments in weapons systems, logistics, and communications, will profoundly impact how the Army operates and trains as

[1] Castro, C. A., & Adler, A. B. (1999, Autumn). OPTEMPO: Effects on soldier and unit readiness. *Parameters* (U.S. War College Quarterly), 86-95. *http://carlisle-www.army.mil/usawc/Parameters/99autumn/castro.htm*

an information-age force in the 21st century. The current explosion in information technology, advanced sensors, and instantaneous communications will allow U.S. forces to arrive at conflicts more quickly from farther away ("just-in-time warfare"), with roll-on-roll-off combat-readiness, able to share with its allies and coalition partners a common view of the battlefield. Technologies that support rapid mobility and improved battlefield awareness will also be used in conflict prevention and crisis management.

Near term, these capabilities requirements are being met by the *Interim Brigade Combat Teams (IBCTs),* currently being formed and activated at Fort Lewis, Washington. The eventual goal is the *Objective Force*, scheduled to be in place by 2012 with vastly changed doctrine, organization, and equipment. The IBCT and the Objective Force will provide an adaptive, near-term, early-entry force capable of rapid strategic deployment, and will possess the agility and decisiveness required to conduct operations in a rapidly changing strategic environment. The IBCT serves as the immediate mechanism for meeting the need, and presages the requirements for the Objective Force of 2012.

> *The enemy quits not because of what has already happened, but because of what he believes might happen if he does not, because of the inevitability of defeat. There is no surer way to demonstrate that inevitability than with overwhelming and imminent threat on the ground.*
>
> – BG (R) Huba Wass De Czega

For both the IBCT and the Objective Force, the Army will acquire systems of lighter combat vehicles and greater strategic lift, providing the ability to deploy a large coherent force with a variety of capabilities to address the broad spectrum of missions in peace, crisis, and war. Because military effectiveness will still depend on control of population and territory, however, the Army must also continue to maximize the capacity of future combat vehicles and soldiers to exploit lethality and control events on the ground.

In addition to the swiftly-moving evolution of technology and vehicles, the transformation to the Objective Force includes doctrine, organization, and training systems. Future forces, beginning with the IBCT and expanding with the Objective Force, will incorporate greatly enhanced capabilities, by means of organizational attributes such as:

- commander- and execution-centric command and control (C^2) environments;
- networked operations;
- multifunctional soldiers, leaders, and staffs;
- effects-based planning;
- execution-focused, distribution-based sustainment; and
- flattened hierarchies and integrated headquarters.

Portions of the force will be optimized primarily for employment in small-scale contingencies in complex and urban terrain, confronting low-end and mid-range threats that may employ both conventional and asymmetric capabilities. Under the C^2 of a corps that is fully integrated

with a joint contingency task force, units will be able to deploy rapidly, execute early entry, and conduct effective combat operations immediately on arrival to prevent, contain, stabilize, or resolve a conflict.

The IBCT is being built to improve strategic mobility and quick response to potential trouble spots. Cutting-edge technologies will play an important role in the IBCT capabilities. As the IBCT paves the way for the Objective Force of 2012 and for the Army After Next (AAN), those capabilities will continue to evolve, new technologies will move from drawing boards to cutting boards and stamping plants, and even newer technologies that we cannot yet conceptualize will emerge. Some of the technologies that will enable the Objective Force to exercise its potential power include the following:

- *Networked systems*, rather than individual platforms, that will cause a shift from platform-centric to network-centric engagements and from plan-centric to operation-centric warfare. It is both essential and highly probable that the U.S. forces will have the dominant battlefield knowledge and the precision weapons to destroy the identified enemy C^2 nodes. To accomplish this, future forces will conduct information operations at the tactical level to disrupt the enemy's information flow and C^2 structure, and will use information from a variety of friendly sources in conjunction with sophisticated weaponry to accomplish disruption and subsequent destruction of the enemy's capabilities.
- *Sensors* that give the commander timely and accurate battlefield intelligence. Battle command success is built on situational awareness, situational assessment, and battlefield visualization; the ability to see the enemy, terrain, and one's self in time, space, and purpose. Commanders will still process and evaluate information, and it will still be true that commanders drive the intelligence process.
- *Unmanned aerial vehicles* (UAVs) which will support targeting to enable the digitized force to destroy or weaken enemy forces long before they are in direct fire contact, thus reducing the number of targets for the close fight and setting the conditions for dominant maneuver at the brigade level. This enhanced situational awareness against fewer targets presents favorable force ratios, reduces exposure time for each weapon system, and lessens the possibility of fratricide dramatically.
- *Unmanned ground vehicles* (robots) operated by humans at a distance in an accompanying control vehicle, that can perform reconnaissance, surveillance and combat missions, as well as other routine tasks.

> *The FCS program is an effort to develop concepts, technologies, and systems for a lightweight, overwhelmingly lethal, strategically deployable, self-sustaining, and survivable combat system of systems.*
>
> COL Marion Van Fosson,
> Program Manager for FCS, Defense
> Advanced Research Projects Agency

The Objective Force will be equipped with many of the tools described above, but the centerpiece will be the FCS. The FCS will be a multifunctional multi-mission reconfigurable system of systems, designed to maximize joint interoperability, strategic transportability, and commonality of mission roles including direct and indirect fire, air defense, reconnaissance, troop transport, countermobility, and C^2 on the move. The goal for FCS is to strike optimum balance between critical performance factors, including strategic, operational, and tactical mobility; lethality; survivability; and sustainability.

The FCS does not yet exist. It is, at present, a program rather than a tangible end-item or even an engineer's drawing. It is slated for initial fielding by 2012, and plans for design, development, and testing are well underway.

This introduction of new capabilities will affect how we plan for training on the new systems and equipment, organization, and doctrine. One vision is that the next 12 years will see the introduction of capabilities that move us closer to the Objective Force. As we have seen during the past several years, the rapid development of hardware and software is necessarily accompanied by the requirement for constant training, and is often attended by frustrations associated with operability and interoperability. This will happen whether change takes place continuously over the next 12 years with a graduated progress toward the Objective Force, or if the change is slower but ends with a full-scale revolution of the Army. Either way, preparing soldiers for FCS will be very demanding because of the new and unfamiliar hardware, more complicated C^2 systems, and multiplicity of missions. The difficulty will be compounded by the use of unmanned vehicles and digital networks; at present, little is known about how soldiers will operate on the battlefield with robotics and sensors.

Studies and research on organizational structures must be conducted throughout the period, and doctrine, tactics, techniques, and procedures must be explored, developed, tested, revised, and tested again in a continuous process of learning.

The Army Demographic Picture

The youth population in the U.S. will remain a special concern for the Army.[2] Recruiting and retention will be affected by the supply of young people, their propensity to enlist, their qualifications, and the availability of jobs in both civilian and military sectors. Changes in population should aid in recruiting efforts: The Census Bureau predicts that the U.S. youth population will increase by about 17% from 1999 to 2025,[3] and the fastest growing segment is expected to be Hispanic, who have a high propensity for enlistment. Overall, however, the propensity to enlist has been declining steadily throughout the 1990s, as young people have steered toward personal and vocational goals that do not include the institutional appeal of the military.

Other segments of the population will also increase due to immigration as a result of conflicts in various regions of the world, with attendant language and cultural diversity. This creates additional difficulties, as many high technology positions in the future Army are likely to require special security clearances, for which many foreign-born persons may not qualify.

The technical preparedness of incoming soldiers should, in general, continue to improve as information technologies become more central in homes and schools. Yet there will be significant diversity in terms of proficiency and interests as well as in types of users. Some will be skilled as operators only, while others will be able to modify and create tools. There will be both conventional users and rebellious users (e.g., hackers who have little wish to use the technology as prescribed and designed), and there will be recreational as well as serious users. The average level of experience and expertise will increase, but the experience will not be uniformly useful to the Army, and the interests may in some cases be a threat to Army functions.

Other factors mitigate against recruiting success among the most sought-after youth, as well as against retention of the most highly qualified soldiers. Civilian jobs in high technology sectors are likely to be plentiful and lucrative, and the value of education will remain high, so that many young persons will continue their schooling after high school. Furthermore, with the number of veterans declining and military base closures continuing, young people have fewer family role models with military experience and lower exposure to the military in their neighborhoods. The RC, which allows young people to have both military and civilian careers, will become increasingly important as the visible presence of the Army in the community and as the option for achieving the best of both worlds.

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[2] For a more complete analysis of the future U.S. Army demographic profile, see Ford, L. A., Knapp, D. J., Campbell, J. P., Campbell, R. C., & Walker, C. B. (2000). *21st Century Soldiers and Noncommissioned Officers: Critical Predictors of Performance* (ARI Technical Report 1102). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

[3] Day, J. C. (1996). *Population Projections of the United States by Age, Sex, Race, and Hispanic Origin.* U.S. Bureau of the Census, Current Population Reports, 25-1130. Washington DC: U.S. Government Printing Office.

Summary

These three factors – the changing geopolitical environment and its effect on Army missions; rapid developments in system capabilities; and the changing profile of the military population – are having and will continue to have significant effects on unit missions and how units operate. As military operations become more frequent and unpredictable, recruiting and job placement are likely to become more difficult. Technological advances could be configured to help to cover the shortfalls in manpower and the variability in qualifications, but pursuing and implementing the necessary technologies will put new demands on the training community. The immediate concern is how the changes will affect units equipped with FCS in 2012, and how the Army transforms training in parallel with the transformation in doctrine, organizations, and operations.

DESCRIPTION OF THE FUTURE TRAINING SYSTEM

A vision of what will be required of Army soldiers, leaders, and units in the future was described at the beginning of this paper. If we accept that the vision will be realized, how did it happen? What training was in place to help the commander and unit attain that proficiency? What training technologies were utilized in training implementation? What processes were involved in the design and development of that training?

The Structure of the Training System

Call it a program, or a strategy, or a system – it remains that the training that is conducted must be as well-orchestrated as the most complex military operation. We prefer the term "training system." A system is defined as "a regularly interacting or interdependent group of items forming a unified whole."[4] The training system envisioned for the future will comprise various elements for different purposes and audiences, elements such as simulation-based and live training exercises, self-paced courses in a distributed mode, institutional and unit-based components. And it will be, first and foremost, flexible and adaptive. Exercises and training elements that are prepared and placed on the shelf for any particular configuration or set of assumptions, that do not have a built-in mechanism for accommodating modifications, will not be of great use to an Army that is constantly reacting to changes in geopolitical and technological environments. Rather, by means of reusable and sharable components within flexible instructional programs and training support packages, automated tools to conjoin those components into remixed instructional programs and training support packages, and larger scale automated tools to configure the elements of the training system into a remastered system, training developers and units may have a chance of staying abreast of developments in the rapidly changing world that the Army deals with.

[4] *Webster's Ninth New Collegiate Dictionary* (1989). Springfield, MA: Merriam-Webster.

The current training approach for IBCT is built on six training principles that emerged from the performance and needs analysis – principles that should also guide development of training for the future Objective Force:

- Retain the light infantry ethos of physical and mental toughness.
- Develop digital proficiency early and sustain it.
- Use time wisely by creating a multiechelon (simultaneous), iterative (sequential) training plan.
- Link developmental training to operational training.
- Identify a balance of live, constructive and virtual training.
- Train leaders first, because leaders are the trainers for their units and so must be expert in the training methodology and doctrine specific to the IBCT Operational and Organizational (O&O) concept.[5]

Based on these principles and the lessons learned during training for the IBCT and the first digitized units, it is possible to envision a training system that will address the future needs and missions. The training system that future leaders will rely on to ensure unit readiness will be structured to account for a logical and advantageous mixture of:

- Individual, team, and collective training.
- Single echelon and multiechelon training.
- Conventional and digital skill training.
- Institutional, unit, and professional self-development training.
- New equipment training (NET).
- Integrated training for AC and RC units and for Joint and Multinational Forces.
- Selection and classification.

• *Individual, Team, and Collective Training*

Individual, team, and collective training will be conducted according to an integrated plan that allows for rapid skill building.

The training system of the future will need to encompass a deliberate plan that links individual, team, and collective training in terms of tasks and skills. It will not be enough to identify individual, team, and collective tasks and then simply relegate the tasks to three separate training strategies. Rather, research will guide the development of a skill-building

[5] Dubik, J. M. (2000, September-October). IBCT at Fort Lewis. In *Military Review* [On-line]. Available: *http://www-cgsc.army.mil/milrev/English/SepOct00/dubik.htm*

progression in the training, so that the sequence of training uses an iterative approach to facilitate retention and integration of both individual and collective tasks.

The plan for individual, team, and collective training will prescribe an ongoing and iterative process of training. Because of the personnel turbulence that is expected to continue, the flow of individual replacements within units may be unremitting, and the training system will need to accommodate ongoing individual training, often at an entry level. Likewise, skill decay for digital tasks will be forestalled by means of refresher training, also at an individual level. This individual training will be integrated with ongoing collective training in order to ensure that the individual skills are appropriately built into collective task performance. Training time will continue to be a scarce resource, so new technologies aimed at rapid skill building will be integrated.

- ***Single Echelon and Multiechelon Training***

Single echelon and multiechelon training will be conducted according to an integrated plan that allows for rapid skill building.

In the same fashion, the training system will link single echelon and multiechelon training. Research on learning indicates that collective tasks should be practiced in various configurations, not simply at the highest echelon possible. Dyads and triads, staff groups, commander and full staff, multiechelon leader chains, and full multiecheloned units – all of these groupings will benefit from focused structured training that allows for practice and feedback on key job components. The progression of the training will not always be linear; the training system will specify multidirectional progressions – large to small group as well as smaller to larger and simpler to more complex – so that lessons learned in one grouping may be implemented in others. Small group training allows for more focused attention and practice on specific skills, while large complex group exercises demand a higher degree of integration and teamwork.

- ***Conventional and Digital Training***

Conventional and digital training will be provided according to a plan that allows for optimal skill acquisition.

As digital systems of varying degrees of technological sophistication are continually introduced over the next 10-15 years, training developers will find that there will no longer be a sharp distinction between digital- and conventional- or analog-equipped units. The current digital learning strategy and its three-step approach[6] will no longer apply, although the eventual goal – to develop highly adaptive, hyper-proficient individuals, small teams, leaders, and units that are competent and confident to perform current and anticipated new missions differently – will remain valid. Initial training will address individual skill acquisition and

[6] Goff, L. R. (1988, 22 October). *TRADOC Digital Learning Strategy/Digital Division Learning Program.* Memorandum from the Deputy Chief of Staff for Training.

system familiarity, while more advanced training will address teams, leaders, and small units. The training system of the future will include, at the "graduate" level, highly realistic scenarios with adaptive conditions that challenge the training audience.

There is no question that digital systems, such as Force XXI Battle Command Brigade and Below (FBCB2) and the Army Tactical Command and Control System (ATCCS), provide improved situational awareness. However, future units will only reach full warfighting potential when they are able to convert information to situational understanding and information dominance. Because of the realism and challenge in elements of the future training system, leaders will achieve an objective state of tactical situational understanding and dominance. Training developers will no longer refer to digital and analog warfighting competencies; rather, there will be multi-situational overarching warfighting skills and tactics, and there will be techniques and procedures that will vary according to the specific equipment that the unit uses. The specific equipment configurations will also influence unit organization, which will affect those techniques and procedures but not the generic warfighting skills.

- ***Institutional, Unit, and Professional Self-Development Training***

Institutional, unit, and professional self-development training will be coordinated to allow for continual learning and skill building.

Because of the relative infancy of the FCS concept, there is still the opportunity to consider the likely impact of the system on the institutional and unit training base. Such training impact information can be estimated based on judgments of task complexity and difficulty, using a method developed by ARI.[7] Although training impact estimates may be of marginal value in making system selection decisions, comparisons across requirements may be beneficial in focusing the efforts of the training development community on those systems or features likely to have the most significant training impact when fielded. Information on training impact can give developers a head start in the design of training programs, devices, and materials prior to acquisition and fielding, and can also help to identify deficiencies in system design and training resource budgets.

This training impact information will be collected, analyzed, and integrated for use in constructing the training system, so that the opportunities for training in institutions and units are used to the best advantage and are supplemented appropriately by professional self-development opportunities. Criteria for making the allocation decisions will include consideration of resources, system densities, skill retention, and system upgrade rates. High transfer training strategies, designed to optimize training time and focus for technical tasks, will be applied in all three environments.

[7] Evans, K. L., & Dyer, J. L. (2000). *Direct Observation in the Conduct of Training Impact Analyses* (ARI Research Report 1757). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

All three training pillars – institutional, unit, and professional self-development – will be changed from what they are today.[8] The institution will serve a greater role as a developer and exporter of training, and a reduced role as the training implementer. The success of this approach will depend on a continuous exchange of information between units and institutions. This shift of the training burden to units will be accompanied by a shift in resources, based on research into the most efficient and effective balance between decentralized unit training and more controlled institutional training.

The professional self-development component will be characterized, first and foremost, by a plan – a component that has been lacking in the past. The plan will specify how the content for the training will be determined; who will develop, monitor, and manage the program; where the time for such self-directed training will come from; what incentives will be offered to encourage participation and completion of courses; and how the training objectives will be evaluated and recorded.

The changes in the three separate training pillars will be guided by a plan that establishes policies and procedures for integrating the pillars. The plan will establish authority and responsibility; ensure compatibility; require evaluation of training transfer and training impact among the pillars; and use training effectiveness as the primary criterion for allocation of training.

- ***New Equipment Training***

The NET will remain flexible enough to keep up with rapid changes in hardware and software.

The evolution in technology more closely resembles an explosion. Upgrades to equipment and software are irregular but frequent, and will probably continue on those lines. The future training system will have anticipated this circumstance, and will have addressed it by means of a required training component that physically accompanies every new item or upgraded software. This training component will cover not only operator tasks, but also the tasks of other users whose performance is affected by the change and the collective tasks in which the operators are participants. It will be designed in accordance with known principles of learning (described later in this paper) and will be monitored and maintained so that individuals and teams get the components they need when they need them.

- ***Integrated Training for AC and RC Units and for Joint and Multinational Forces***

Training for AC and RC units and for Joint Service and Multinational Forces will be designed to include both separate and combined exercises.

It is anticipated that each active corps will have a number of RC positions designated as organic, mostly in C^2, staff, signal, aviation, and medical positions. Additionally, RC units will continue to be considered as full-fledged elements of the active corps. Such integration

[8] Campbell, R. C., Ford, L. A., Shaler, M. & Cobb, R. M. (1998). *Training the Force: Issues and Recommendations* (ARI Study Report 98-06). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

has historically been problematic because of differences in requirements, culture, availability, and training opportunities. However, the future training system will contain explicit guidance for integration of training opportunities, in a way that allows both AC and RC units to make the most of their separate and combined training time. Technologies that virtually eliminate long distances will play a significant role in both training and operations, allowing soldiers and commanders to work together and train together despite geographic separations.

On a wider scale, future capabilities will depend on the competencies of a joint force. The transformation to a seamless joint force is already underway, with specifications for doctrine, organizations, and materiel being formulated;[9] the training system of the future will be created in parallel so that the joint training exercises and the requisite preparatory exercises for each service are constructed according to a plan that capitalizes on skill building practice. Command, control, communications, computers, and intelligence (C^4I) capabilities will be pushed to lower echelons in order to increase flexibility and responsiveness of joint forces. But skill training must be supplemented with understanding of the operating characteristics of the partner units, including terminology, organizational and command structure, capabilities, and even language. The response from the training developers must be to construct training that allows for skill acquisition and practice at all echelons and with other services, as well as with coalition forces.

- ***Selection and Classification***

Selection and classification will be instrumental in making training more efficient and effective.

A selection and classification system will be in place that screens applicants for success in training, satisfaction on the job, and advantageous use of knowledge, skills, and abilities. We are prone to think of selection and classification as one of three different approaches to maximizing performance, separate from training and personnel management. The three will not be separate in the future. Rather, they will be coordinated and integrated to a degree not yet realized, in order to achieve savings and greater levels of success in both training and operations.

The issue of the changing demographic picture is not, *per se*, a training issue. However, the future training system will continue to set requirements for entry-level skills in English comprehension, reading, mathematics, and even computer literacy,[10] based on an accurate and comprehensive assessment of the population of trainees. If standards cannot be met, the Army will work with education systems to ensure appropriate instruction for students prior to military service and continue to provide basic skills training, while training developers will continue to develop programs that are suited for the individuals being trained.

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[9] Shelton, H. H. (2001, January). The national military strategy and joint vision 2020. *Army*, 7-9.

[10] Ford, L. A., Gribben, M. A., Campbell, R. C. (2000). *Evaluation and Recommendation of Commercial-Off-the-Shelf Basic Skills and English -as-a-Second-Language Software Programs* (HumRRO IR-00-47). Alexandria, VA: Total Army Personnel Command.

Emerging Training Technologies

How we train in the future will be largely a function of *what we train* – based on analyses and visions such as those described above. The decision on how to train, however, is also affected by new technologies in training and discoveries about how we learn – both of which translate to *how we can train.* The future learning environment will enable the Army to educate, train, and provide performance support anywhere, anytime. Technologies with potential for enhancing the future training system include:

- embedded training,
- distributed simulations,
- distance learning technologies, and
- automatic collection of performance data.

• Embedded Training

Embedded training devices and training programs will be essential to the fielding of every operational system.

One area that will be an integral part of the future training system is that of embedded training. Embedded training is defined by the U.S. Army Training and Doctrine Command (TRADOC) as a capability built into or added onto operational equipment and systems.[11] It enables training delivery to soldiers using their own equipment while in the field or at home station. The goal for unit training and training management is that training aids, devices, simulators, and simulations (TADSS) will be fully embedded and interoperable with an overarching common operating environment. Such systems will leverage technology to link geographically separated units in live, virtual, and constructive simulation training.

Army policy is that embedded training be the first alternative reviewed for providing training for individual operator or maintainer, crew, functional area, and force level.[12] Embedded training uses features incorporated into the end-item equipment to provide training and practice using that end-item equipment. While the goal will be to have the training device completely embedded within the system configuration by software application or a combination of both software and systems configuration, some systems will have some form of strap-on or plug-in equipment or a combination of embedded and appended components in order to satisfy requirements for operational use of the prime system.

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[11] Department of the Army (1996). *Embedded Training Concept (Draft).* (TRADOC Pamphlet 350-70-XX). Fort Monroe, VA: Headquarters, U.S. Army Training and Doctrine Command. Available: *http://www-dcst.monroe.army.mil/wfxxi/et-pam1.htm*

[12] Department of the Army. (1987, March). *Policy and Guidance Letter, Subject: Embedded Training.* Washington, DC: Author.

Features will include the capability to provide stimuli necessary to support training as well as both a performance assessment and feedback capability and a training management or record-keeping function. The devices will not adversely impact the operational capabilities of the prime system, and will, in fact, provide additional capabilities that will be considered essential to the system. The embedded training devices will allow dual use of communications and instrumentation for training and operational use, and use of system operating controls with simulation. As a result, embedded training will be an integrated capability of an operational system.

Embedded training consideration will begin early in, and continue throughout, the system development cycle, with active involvement of training developers.

Although an embedded *training* approach will be considered for all equipment training, it must be considered within the context of the overall training system supporting the materiel system. It will never emerge as the only component of the training system. To accomplish this, embedded training and other options will be considered early in the system development cycle, with active involvement of training developers.

There are several obstacles to the conduct of training using embedded devices,[13] but these will have been overcome in the future training system. Those obstacles include the following:

- The user needs to have the prime system to conduct training. This may be difficult if equipment is prepositioned or if the unit moves separate from its equipment during mobilization.
- Training components will likely have to be hardened or ruggedized, making them more expensive than if they are stand-alone.
- Embedded training devices will likely take up space and add weight, and may contribute to excessive wear and tear to operational components on the prime system.
- There are potential safety hazards, particularly when the training involves system movement or weapons firing, real or simulated.

The FCS and other military vehicles and operations centers will be equipped with computer hardware capable of battlefield simulation that can be used to train in the field. The training will be more than tutorials on a computer screen; the Army expects to have actual virtual exercises. This will be particularly important because of the lack of ranges and simulators to support the wide range of specific weapons and systems. The FCS embedded training will be an integral part of the system so that the unit can train even while they are in the process of deploying.

[13] Finley, D. L., Alderman, I. N., Peckham, D. S., & Strasel, H. C. (1988). *Implementing Embedded Training (ET): Volume 1 of 10: Overview* (ARI Research Product 88-12). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

- ***Distributed Simulations***

Distributed simulation capabilities will be exploited by leaders ready to achieve superior training results in the shortest time possible.

Developers are continuing to provide more realistic and versatile simulation environments for training. Earlier research that concentrated on representing and manipulating deep but narrow and specialized knowledge has now shifted to more efficient means of examining and refining the fidelity of the modeled performance compared to live performance. Research on modeling is leading to representations of individual human performance, which should allow small groups to train without a full complement of participants. Wide-area networks and the Internet are being used to overcome the challenges of providing collective training for geographically separated team members, and linked simulations using long-haul networks are maturing to create a realistic training environment.

Given unquestioned training value of simulations, interoperability is critical. The goal is to design the architecture, standards, and protocols to ensure interoperability for the Objective Force so that interactive simulations are available as soon as the FCS is fielded. The FCS should have its own non-system-specific training devices that will allow soldiers to practice operating all vehicles in the FCS family (direct fire, C^2, sensors, etc.) even as the first vehicles are used.

> *All of the TRADOC training and education initiatives support an evolving Army training strategy that seeks to increase operational effectiveness by simultaneously training at several echelons in live, virtual, and constructive environments.*
>
> – GEN John Abrams, Commander, U.S. Army Training and Doctrine Command

Within the future training system, distributed simulations will be used to support training of virtually every facet: individual, team, and collective, small group and large complex group, AC and RC and joint force, generic and system-determined. The training system of the future will include a logical progression of training that first allows units and staffs to work together in less-expensive and more controlled constructive or virtual simulation environments, and then sends those units to high-stress live environments to challenge and hone their skills under more realistic conditions.

- ***Distance Learning Technologies***

Advanced distance learning technologies will allow for self-paced and self-directed training as well as for integrated training for dispersed units.

Training needs analyses for FCS have pointed to the use of training tools within web-based collaborative environments. [14] Collaborative team training environments will be incorporated into the Total Army Distance Learning Program, to enable education and training of forward

[14] Stotts, L. B. (2000, 25 July). MANPRINT in Support of the Army's Transformation Campaign Plan. Briefing presented at MANPRINT Symposium 2000 by the Office of the Assistant Secretary of the Army for Acquisition, Logistics, and Technology.

deployed FCS and Combat Service Support (CSS) units via Internet technologies. This training will address the advantages of increased retention and improved readiness that come with greater amounts of practice, the demand for more accessible training as needed, and the goal of reduced training time away from unit and home station.

As the Department of Defense (DoD) began using the Internet to deliver on-line education under its Advanced Distributed Learning (ADL) initiative, the need for common interfacing software was a significant obstacle. In the future, the Sharable Content Object Reference Model (SCORM) software will be widely used, making it possible for computer systems to communicate with each other. The SCORM will enable ADL to offer accessibility, interoperability, adaptability, reusability, durability, and affordability to developers of on-line education packages, thus increasing the utility for soldiers.

Another innovative use of distributed training will be for the support of live training at the maneuver combat training centers. Observer/controllers (O/Cs) who perform exercise control functions and prepare after action review (AAR) aids at those sites will also provide centralized support for multiple other sites and home station programs. The benefits include the capability to train more units using a given number of analysts, as well as the possibility of enhancing the quality of training feedback and linking it to home station training.[15]

- ***Automatic Collection of Performance Data***

Automatic collection of performance data will support both intrinsic and extrinsic feedback needs.

An integral feature for the whole of the future training system will be the capability for performance measurement, both to allow for feedback and performance improvement, and also to support the design and development of the training programs. The digital C^4I systems have organic capabilities that we will exploit to automatically collect, analyze, and portray data.

Such data collection, accompanied by capabilities for analyzing and displaying the results in terms of processes and outcomes, will support both intrinsic and extrinsic feedback. By "intrinsic feedback," we mean the information that immediately informs the user that something is not right, or that more information is available, or that some critical information need is being answered. This information, provided by means of on-board systems and remote sensors, will be provided as an operational capability as well as during training. "Extrinsic feedback" allows the user to look back on an operation or training exercise and identify ways to sustain or improve performance through optimal use of information systems.

Accessing the collected performance data and making it intelligible to observers or to the unit in training will be a common and routine feature of all training and operational systems. The

[15] Meliza, L. L., Begley II, I. J., & Anderson, L. (2000). Centralized training analysis facility for live training. *Proceedings of the 2000 Interservice/Industry Training, Simulation, and Education Conference* (CD-ROM).

particular data elements that are related to performance, the analytic tools that fuse data to provide useful feedback, and the format for feedback reports will all be optimized from a human factors point of view to allow for clear and immediate impact.

Methodology for Development of the Elements of the Future Training System

In order for the future training system to have the structure described above, certain design and development processes are essential. Currently, we continue to make use of a very powerful, flexible, and comprehensive training development methodology known as *Instructional Systems Development (ISD)*; the Army-specific adaptation of ISD is the *Systems Approach to Training (SAT)*. The methodology describes a cyclical process, where analysis of the training need leads to identification of the training objectives and an overall design. The training is then developed in the form of training materials or guides or texts, and is finally implemented. Evaluation is a continuing process, where all design and development decisions and products are subject to review and revision.

Despite vast changes in missions, equipment, and training technologies, the process for constructing the future training system will differ significantly from the process we follow today in only two respects. First, because of the centrality of the FCS itself to the Army transformation, training developers will be an integral part of the FCS development process. And second, the process will take advantage of technologies that will automate many of the processes, incorporate reusable learning objects and components, and allow for streaming data collection to permit training evaluation. But the basic process of analyze – design – develop – implement – evaluate remains as an effective and comprehensive approach.

• Analysis: The Source of Training Objectives

Analysis of jobs, tasks, and performance conditions and requirements will continue to form the basis of the training system by defining the training objectives.

> *The transformation is not about vehicles; rather, it is a new concept of the fight.*
>
> BG James M. Dubik, Deputy Commanding General for Transformation for TRADOC

Thorough job and task analyses form the basis for training systems. In most training development efforts, analysts have been able to observe performance and examine existing job requirements; for the future training system, there will be no existing organization to analyze. Rather, analysts will be looking at concepts, plans, and simulation-based models of organizations and operations in order to define job and task requirements. One primary source of information will be the Operational and Organizational (O&O) concept for the Objective Force, which describes the initial plans for how the Objective Force will be organized, staffed, equipped, and used.

The analysis will yield both individual and collective performance requirements information in a number of categories:

- *System-specific* requirements will be identified, to include the procedural tasks that are required to operate in a defined environment of organization and equipment. Among the system-specific requirements will be most of the operator and end-user tasks for digital equipment. Both individual and collective performance requirements will be found in this category. Before new equipment and software or upgrades are fielded, specific performance analyses will also be conducted so that NET can be conducted concurrently with the fielding.
- *Non-specific tactical skills*, which are required in all tactical settings, will also be clearly defined and described so that the skills can be trained and practiced without regard to the system definition. This category assumes greater importance as the Army undergoes its transformation. New competencies for commanders and staffs will be operationalized for training, in the form of several specific abilities:
  - Identify and adjust to information technology requirements.
  - Quickly master individual and collective learning requirements.
  - Acquire tacit (how to) knowledge as well as explicit (what) knowledge.
  - Master conceptual as well as mechanical aspects of C^2.
  - Define information requirements and appropriate information filters.
  - Formulate and execute information search strategies.
  - Manage decision contexts as well as make decisions.
  - Delegate as a function of decision context.
  - Sustain all current (analog) commander and staff competencies.
- *Adaptive leadership skills* will be clearly identified and defined. Adaptive leaders are key to addressing shortfalls that cannot be predicted and compensated for by application of doctrine, training, leader development, organization, materiel, or soldiers. An analysis of the human and organizational requirements for the AAN identified several key competencies for soldiers, units, and leaders, including flexibility, adaptability, and extraordinary competence.[16] This last requirement refers to the need for soldiers to be able to understand and make good use of battlefield information, and to be able to deal simultaneously with multiple echelons – the essence of adaptive leadership.
- Analysis will have defined the scope of requirements for *multifunctional soldiering.* Consideration of such force design issues as the impact of decentralized vs. centralized C^2 and the advantages and disadvantages of

[16] Graham, S. E. (1998). *Proposed Army Research Institute Support for Army After Next Experimental Unit* (ARI Research Note 98-08). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

generalized vs. specialized skills for soldiers will result in a common understanding of whether or not, and to what extent, the Army will require (or be forced to accommodate itself to having) fewer soldiers with broader skills and the capability to perform more varied and complex missions.

- ***Design and Development: Constructing the Future Training System***

The design and development process will accommodate the structural requirements for the future training system and will incorporate training and learning principles.

The design and development processes take the analysis outcomes and shape them into the training system, which includes both individual and collective training, in both instructional courseware and practice exercise formats. The future training system will include not only the courseware and exercises, but a training strategy or plan that will steer units and leaders to the appropriate options.[17] During the design and development process, the strategy will be formulated, automated tools will be built for use in navigating among the courseware and exercise options, and many component elements – specific courseware and elements for both specific and non-specific skills – will be constructed. The process will be used iteratively, as designed, so that reassessment of performance requirements because of system redesign can be accommodated in the training.

The design and development will take advantage of what we know about how adults learn, acquire, and maintain skills; how we connect new skills to our schema for performance; how and what we forget; and how to retard the forgetting.[18] For example, the future training system will incorporate many of the recent recommendations for how leaders should acquire and develop proficiency in leadership skills:[19]

- Increase experiential learning.
- Ensure stress in learning.
- Foster commander-dominant digital organizations.
- Use chain-of-command training.
- Develop team cohesion and coherence.
- Fine-tune decision-making processes.
- Establish common tactical scenarios.

[17] Campbell, R. C., Ford, L. A., Shaler, M. & Cobb, R. M. (1998). *Training the Force: Issues and Recommendations* (ARI Study Report 98-06). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

[18] Sanders, W. R. (2001). *Cognitive Psychology Principles for Digital Systems Training* (ARI Research Report 1773). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

[19] Brown, F. J. (2000) *Preparation of Leaders* (IDA Document D-2382). Alexandria, VA: Institute for Defense Analyses.

The future training system will exploit both simulation and embedded training capabilities, using available systems to enhance the training of the identified performance requirements. Determining optimal use of simulation has been a source of concern to the Army, where the question of "the right mix" of simulations is often asked. Unless we mean the mix of live training and electronic (i.e., constructive or virtual) simulation-based training, this is the wrong question. The progression from less-costly and more standardized training in virtual or constructive simulation to live training will be based on research on practice and learning strategies. The use of virtual and constructive simulation will be determined not on the basis of a "right mix" formula, but rather on the basis of performance analysis and how different tasks can best be trained.

Embedded training will also be used as appropriate for allowing instruction and practice on both individual and collective tasks. It is important to note, however, that *embedded training devices* are not the same as *training*, nor do they guarantee learning, skill acquisition, or performance improvement. Along with the devices themselves, which will be built with the assistance of training developers, there will be courseware and exercises that guide the user and provide the scenarios and instructional materials to support learning and practice.

The courseware and exercises will incorporate an appropriate mix of mastery goal orientation, sequenced instructional objectives, and a combination of mastery and performance feedback. Research on the ways to combine different performance objective constructs, performance standards, objective sequencing, and feedback structures and frequency will be considered in designing training that aids initial knowledge, skill acquisition, and eventual superior adaptive performance. Descriptive feedback provided by embedded technologies, simulation systems, O/Cs, or actual digital systems, will be referenced to performance standards or evaluative measures and sequenced to enhance learning and skill acquisition. The future training system will include an underlying emphasis on the learners' mental processes, how they learn. This emphasis will be evident in several characteristics of the instruction and training:

- Active involvement of the learner in the learning process (learner self-planning and self-monitoring).
- Hierarchical analysis to identify prerequisite relationships (cognitive task analysis procedures).
- Structuring, organizing, and sequencing information (outlines, summaries, advance organizers).
- Encourage learners to make connections to previously learned materials (recall prerequisite skills).

These features, designed to take advantage of the cognitive processes, are not necessarily recommended nor appropriate in all situations, but they provide a solid base from which training can be designed. Traditional, lecture-based instruction that focuses on system

operating procedures will be rare; scenario-based problem-solving sessions focusing on cooperative learning will be the norm. Distributed modes of training delivery will be the most common venue for instructional courseware, and will also be used widely to support individual and collective exercises.

The AARs will continue to be a critical element of exercises. The AAR principles, derived from information feedback, performance measurement, cognition and memory, group processes, communication theory, and instructional science, will guide the systems for providing feedback, taking advantage of automated data collection capabilities in simulation systems, embedded devices, and digital equipment.

For the most part, the training system of the future will comprise structured training approaches, which offer a systematic method for ensuring standardized training content and a focus on specified objectives.[20] Such programs are well-received by the training participants and the training directors and others who support implementation. Anecdotal information indicates that the training is effective in strengthening skills for staffs, as shown in their performance during high-intensity live exercises.

Finally, the training system will be built on what we are learning about skill retention and skill decay. Such factors as task complexity, cognitive and perceptual-motor demands, availability of job and memory aids, and time constraints and stress have been shown to be predictive of the amount and rate of forgetting.[21] Because procedural skills are highly perishable[22] and digital skills tend to deteriorate more rapidly than analog skills, it will be increasingly important to incorporate known principles that can improve skill retention:

- Optimize scheduling of refresher training based on prediction of the rate of skill decay.
- Optimize effectiveness of refresher training by using technologies to reestablish context.
- Maximize original learning to require practice beyond meeting of minimal standards.
- Test the skills being trained.
- Provide spaced rather than massed practice.

[20] Campbell, C. H., Quinkert, K. A., & Burnside, B. L (2000). *Training for Performance: The Structured Training Approach.* (ARI Special Report 45). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

[21] Wisher, R. A., Sabol, M. A., & Ellis, J. A. (1998). *Staying Sharp: Retention of Military Knowledge and Skills.* (ARI Special Report 39). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

[22] Sanders, W. R. (1999). *Digital Procedural Skill Retention for Selected M1A2 Tank Inter-Vehicular Information System (IVIS) tasks* (ARI Technical Report 1096). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

- Use task-oriented context-relevant training.
- Use peer tutoring.

- ***Implementation: Bringing Training to the Trainee***

Implementation of instructional programs and exercises will be supported as necessary with guidance and assistance from trained support teams and centralized help desks and analytic personnel.

Future forces will not rely only on exported materials for training support. Instructors, surge teams (personnel who assist units with first time implementation of more complex exercises), O/Cs, and other experts will continue to be an integral part of the implementation plan. Given a continuing structured program of support, from education and information through exercise preparation to conduct of the exercise and feedback facilitation, units are able to participate in a wide range of training elements. Similarly, instructors will be available for students in distributed individual instruction situations.

- ***Evaluation: Ensuring High Quality Training Elements***

Every training element (instructional program and exercise) will show evidence of doctrinal correctness and completeness, acceptability, effectiveness, and implementability.

The training system of the future will be no stronger than its component elements. It will be an accepted practice in the future that every newly-developed instructional program and exercise will be thoroughly evaluated prior to fielding. Training elements will continue to receive doctrinal reviews, where they will also be reviewed for completeness. Asking a sample of users whether the training is acceptable will continue to be a common practice, but there will also be thorough investigations of whether participants have greater skill on the training objectives after the training, and whether those skills transfer to job settings. Information on difficulties with implementation will be collected routinely and continuously and appropriate corrections will be made so that training is implemented with a minimum of distractions.

Summary

The wide array of digital systems, both those being used now and those that will be in use in 2012, provides a potentially ideal environment for combining force training and mission rehearsal. Interactive environments in which all systems are interoperable will significantly enhance training, allowing combat teams at different locations to train together in a common battle-zone using the battlefield-wide digital picture. Digital systems, with their infrastructure of powerful computers, databases, and data collection and analysis capabilities, will also be used to provide feedback, both during actual operations and during training, to operators and staffs.

As new weapon systems are in their earliest stages of conceptualization (a stage that FCS is moving through very quickly), concurrent efforts will be made to design the training itself, as well as the training strategy. The training development process will identify the tasks, training technologies (including simulation, embedded training, or distance learning modes) required, and circumstances for use of each element of the training (individual and collective, small group and complex group, specific and non-specific, instructional courseware and practice exercise, etc.). An overall model for early training estimation shows how various training development tools can be integrated to support strategy development. By using the model, developers can ensure training integration at several levels, including individual skills training across duty positions; individual skills training with collective training; collective task training across unit missions; and collective task training across echelons.[23] The resulting training strategy will specify device options (operational equipment, embedded, full mission simulator, networked simulations, and part task trainer); indicate where each task should be trained initially (institution or unit or professional self-development); indicate which individual and collective tasks are addressed by each device; and require minimal developmental risks.

THE RESEARCH AND DEVELOPMENT AGENDA FOR THE FUTURE TRAINING SYSTEM

Outline the Structure of the Future Training System

The broadest requirement for the future training system is that *it needs to be a system*. It needs to have a structure that integrates all of the venues for training, including individual and collective training, institutional and unit and professional self-development training, and so on. The research agenda concerning the structure of the future training system must address the following topics.

- ***Sequence and Organization of Training Elements***

  What do we know about building effective learning hierarchies? What do we know about the best methods for sequencing training? What do we know about sustainment training and refresher training, when and how to conduct it for different skills? We must collect and analyze what is known about how to train in order to determine how the future training system should be organized and managed. Policies for training management must reflect the best practices for training gleaned from prior experience and research.

[23] Meliza, L. L., & Knerr, B. W. (1991). *Early Training Strategy Development for Individual and Collective Training* (ARI Technical Report 936). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

- ***Elements of the Training System***

  What is available to become a part of the training system? What elements (courseware for instructional programs and training support packages for exercises) are already developed, and what elements are still needed? The elements should be analyzed and organized (conceptually or in a repository or database) with respect to audience, training objectives, training environment, and skill level. If it has not already been done, there should be an evaluation of each existing training element in terms of completeness, doctrinal correctness, acceptability, effectiveness, and implementability, and similar evaluations should be required for all new training elements.

- ***Tools for Exploiting the Training System***

  What tools are needed in order to navigate the training system? What applications will commanders need in order to access and tailor existing elements or to request or build new elements? Each unit will be faced with training challenges, depending on its own organization, equipment, mission, and immediate tasking. For example, a unit planning for a deployment will need to construct a specific set of training elements in order to prepare for the deployment, maintain readiness during deployment, and prepare to hand over the mission and return to its normal mission.

- ***Maintaining Currency of the Training System and Elements***

  What policies and tools are needed to ensure that the training elements and the training system overall will be as current as is optimal? Who will coordinate and manage updates to doctrine, organizations, and tactics and ensure that the training system is also updated? How will updates to the system and the elements be disseminated and implemented? The future training system will need to keep up with a constantly changing world of hardware and software, doctrine and organizations, missions and tactics. This will require both guidance and policy about how the updates will be made public and fielded, and applications that will allow the fielding to be done completely, reliably, and quickly.

- ***Synchronization with Selection, Classification, and Job Restructuring***

  How can the Army's selection and classification system support training? What is known about future performance requirements and the future personnel pool, and how will the selection and classification system be able to help place the appropriate people into training? As organizations and job requirements change, how will jobs be restructured? How will the training system and elements of the system keep pace with the restructuring? Researchers continue to learn more about how to predict future job requirements in terms of knowledges, skills, and abilities, and these requirements are being correlated with information on job tasks and processes. At the same time, there are suggestions that jobs and skill levels (noncommissioned officers) or ranks (commissioned officers) could be better aligned to make

personnel management simpler and more useful for job assignments and career progression. How this will affect the training system needs investigation and monitoring.

- ***Standards for Readiness***

  How will readiness or proficiency be determined? How will units and commanders know when to move on to the next phase of training and when to go back and repeat elements of the training? It is possible that we will adopt a "completion" criterion as the badge of certification, where to have completed a course or participated in an exercise will be sufficient evidence of a certain level of readiness. It is more likely that we will first insist on evidence of training effectiveness (part of the development process described below), and then also demand evidence of success in training, not mere survival. The training system of the future should resemble the training matrix that we see for the Conduct of Fire Trainer (COFT), where participation in a prescribed set and sequence of exercises with evidence of proficiency at each stage constitutes the training.

Exploit and Shape Technologies

The rapid pace of change in technologies, both in operational systems and in training systems, offers another set of challenges. Complicating this is the move toward embedded training devices, by means of which the distinction between operational and training devices is blurring. In order for the future training system to take full advantage of the developments in technology, the following topics must be addressed.

- ***Correspondence Between Training Technologies and Training Needs***

  What is known about how best to match training needs to training device capabilities? Do we have a rubric for when to use particular technologies, based on the audience or training objectives? Some of this work has been done, but much of it is still ongoing. Developers need guidance on when to use particular technologies and when not to, aside from a determination of which technology is most accessible to a particular unit.

- ***Flexible Use of Technologies***

  Are the distributed simulation systems, embedded training devices, and distributed learning technologies sufficiently accessible? If not, what are the alternatives? What other capabilities are needed? Flexibility will be one of the key determinants of how (or whether) the training system is used. If units are faced with only one way of training any particular skill or collective task, then their alternatives when that venue is unavailable are nil. The training system will not be used if it is more difficult than the training itself.

- ***Reliability of Technologies***

  Are the technologies reliable and interoperable? If the training technologies are not operable, or not interoperable, they cannot be used. This is not rocket science, but it is proving to be

one of the greatest sources of frustration for individuals and units who are willing to try technology-based training. Internet sites that are not accessible, links that do not work, simulations that crash under intense scenario loads, connected simulations that fail to translate information correctly, and embedded devices that are no more than electronic manuals – these will not encourage increased use for future units. By the same token, operational systems that crash frequently will not inspire confidence in users. This is not a problem that training developers should have to overcome – it is a matter for Program Managers, Systems Managers, and acquisition agencies.

- ***Embedded Training Development and System Development***

  Is embedded training in fact being incorporated into operational systems while they are still on the drawing board? Are training developers part of the system development team? How are training elements being matched to embedded training capabilities? Are the capabilities that are being built the ones that units need in order to execute the appropriate parts of the training system? Every writing on embedded training stresses the importance of involving training developers and the results of performance analyses early in the system development process, and all point out the hopelessness of developing embedded training without this process.

- ***Learning Technologies and Principles***

  Is training development using the principles for effective training that have been identified in previous research? Is the reusable object model (SCORM) being used by developers, and is it working as planned? What tools do developers need to help them build distributed training that is appropriate and uses the best practices for delivery of different subject matter to different audiences? With the amount of research that has been done on learning styles and optimal modes of presentation, it ought to be possible to design and construct automated tools to help developers access information on how to use training technologies most effectively.

- ***Linking Performance to Measured Outcomes***

  What is known about measures of performance and measures of effectiveness for collective tasks and for C^2 tasks? Is it possible to link collective and C^2 performance to available data from digital systems and simulators? The digital advances in Army units, the need for measurement in training, and the data-capture capabilities of digital systems and simulations together provide what amounts to a set of imperatives for research and development. The advent of digital C^4I systems increases the need for training in information management and situational awareness skills, training which should take advantage of the principles of cognitive processing and learning. The technologies that enable enhanced C^4I also offer the opportunity for more effective and efficient methods of performance assessment and feedback. The integration of instrumented C^4I systems and virtual simulation provides a unique opportunity for research and development efforts directed at automating collection

and analysis of performance data to increase the scope and precision of assessment and feedback.

Construct the Elements of the Future Training System

Construction of the elements of the future training system – the instructional program courseware and the exercise training support packages – will continue to build on the ISD/SAT model. Several important research and development topics in these areas are identified below.

- ***Status of Performance Requirements Analyses***

  How much of the analysis has already been done, and what remains to be done? The components listed for the structure of the future training system must all be analyzed in order to determine performance requirements. This includes requirements for individual and collective performance; small group, single echelon, and multiechelon performance; generic and system-specific skill requirements; and requirements for operations by AC and RC units and by joint and multinational forces.

- ***Research on Overarching Skills and Training***

  How much of the analysis has been done on leadership skills, adaptive skills, and other overarching performance requirements and how to train them? What do we know about team skills and how to train them? Research on these performance requirements has been in progress in the Army, Navy, and Air Force, as well as in the civilian sector. Once the findings are aggregated and organized, they should be used in constructing generic skills training, and should also be useful for designing training for collective system-specific training.

- ***System-Specific Performance Requirements***

  How can we stay informed on performance requirements for system-specific tasks? How can training developers be involved in the early stages of system development so that training needs are attended to? For the future training system, including initial training with every system and software upgrade, such training must be developed and verified in parallel with the system or software itself. Policy will be needed (and will need to be enforced) to ensure that this becomes an accepted part of the system development process.

- ***Skill Retention and Refresher Training***

  Are training developers using what is known about skill retention and skill decay in order to construct strong training elements? The research addresses types of skills and types of training that can help in initial skill acquisition, skill retention, skill transfer to related situations and settings, and retraining or refresher training. But unless the research findings are translated to guidance for construction and implementation of training elements, we will be continuously guessing at the best way to present instruction and exercises.

- ***Tools for Training Developers***

  How will ISD/SAT be reinvented to take advantage of technologies? What tools are needed for training developers so that they can use existing content objects (e.g., pieces of courseware, training support package components) in developing new elements? Automated tools, similar to the wizards found in many word-processing and spreadsheet applications, would be a boon to developers who know that content is out there and available but have not yet ascertained how to access the objects.

- ***Validation and Verification of Training Effectiveness***

  How should existing training and new training be evaluated? To take the position that training developers will be able to rigorously evaluate their own products will be a triumph of hope over experience. Automated data collection capabilities should be exploited to amass and aggregate performance information that will serve as the analytic basis for modifying or updating existing training.

Address Related Issues

Finally, there are four additional topics that do not pertain directly to the three areas presented above. These topics demand attention, however, as they may have significant impact on decisions made in the other three areas.

- ***Training Value of Training Preparation***

  Today's Army commanders and leaders, faced with an increased operational tempo and reduced personnel and budgetary resources, are finding it difficult to plan and prepare effective training and still have adequate time to focus on training execution. If the cost of getting ready to train exceeds the perceived benefit of the training, there may be a tendency to not to want to conduct the training. Recognizing this condition, significant efforts are being made to provide leaders with ready access to training tools that simplify planning and preparation requirements. Many senior leaders envision a training support system where unit commanders and leaders, having decided to conduct training, have immediate access to everything that is required to execute the training, such as tactical operations orders, O/C guidelines, opposing force (OPFOR) instructions, AAR worksheets, completed ammunition request forms, and so forth. For such training events, the only actions required of commanders and leaders would be to marshal their unit and initiate the activity.

  If such a training support system is adopted, it will relegate the role of commanders and leaders into beneficiaries of the training development experience of others. It will not require them to develop insights into the myriad of details required to plan, prepare, and execute challenging, effective, realistic training. In that case, where and when will they gain such professional experience? A determination needs to be made of what is the most effective

combination of providing training support packages to commanders and leaders and providing them an opportunity to plan and prepare their own training.

- ***Distrust of Digital Data***

  How can training help to encourage users to have more complete confidence in their digitally displayed information? There is a human factor to overcome, one that says that gut reactions and feelings are as valid as digital data. Until commanders and operators can learn to rely on their digital systems, the systems will not help them to achieve the desired performance edge. Part of this is a matter of training them to sift through the glut of information quickly and intelligently – can this skill be trained? How can the lessons learned in the Air Force and Navy, where operators rely on digital displays, be adapted and leveraged for the Army?

- ***External Realities***

  How can a unit realistically expect to train to cover the full spectrum of missions given stability/turnover, time, and human limitations? How can research and development advance an approach for "rapid learning?" Developers are taking steps to provide units with a variety of tools for planning and preparing individual and collective training, for implementing programs whenever and wherever needed, for including different groupings of staffs and units in order to focus on specific needs, and for collecting information that helps sustain performance and direct the next needed elements of training. The research on the efficacy of such approaches is still sparse, and information on the circumstances that warrant different approaches is still needed.

- ***Knowing What the Future Will Be***

  We don't *really* know what the future will be – not of threats and missions, technologies and organizations, or demographics of the force. The training program that we design rigidly today for a confidently expected set of circumstances is doomed to obsolescence before it gets much beyond the drawing boards. How can we continue to design for an unknown quantity? The ARI's future, in support of future training, must include a master plan for tracking developments, reevaluating how training is affected, and recommending adaptive approaches for being responsive.

IN CONCLUSION...

The Army's transformation will be an ambitious and formidable undertaking, but the training transformation will be no less challenging. The transformation will allow us to arrive at a future where leaders can confidently embark on their mission, knowing that the training system has prepared them well. Even as they deal with personnel turbulence, frequent system upgrades and changes, and a wide variety of possible situations and missions, the training tools will allow them the power to access a range of training elements and to tailor the training elements as necessary for their situation.

This paper offers a view of ARI's vision of training for the future. It includes a discussion of three of the driving forces that necessitate redesign of training; a description of the critical characteristics of the future training system in terms of its structure, uses of training technologies, and methodologies for training development; and a presentation of the needed analysis, research, and development initiatives. The future has a way of changing, however. What we anticipate for 2015 now is unlikely to occur just as we picture it. The ARI's "big picture" of meeting the future includes a healthy skepticism of all prognostications, and a realistic plan for reevaluating any and all predictions and the courses of action predicated on those predictions.

However the future unfolds, training will not be the only answer to meeting the challenges for readiness in the future. Yet it will be an important component in the solution set. The advances in operational equipment and the concomitant changes to organizations and doctrine will provide the capabilities to protect future forces and intensify their value. A well-planned and constantly adaptive training system, built on principles of training and learning and integrating all of the potential training audiences and settings, will then be the means to ensure that the new equipment, organization, and doctrine are effective in the hands of the users.

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ACRONYMS

AAN	Army After Next
AAR	after action review
AC	Active Component
ADL	Advanced Distributed Learning
AFRU	Armored Forces Research Unit
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ATCCS	Army Tactical Command and Control System
C^4I	Command, control, communications, computers, and intelligence
COFT	Conduct of Fire Trainer
CSS	Combat Service Support
C^2	Command and Control
DoD	Department of Defense
FBCB2	Force XXI Battle Command Brigade and Below
FCS	Future Combat Systems
IBCT	Interim Brigade Combat Team
ISD	Instructional Systems Development
NET	New Equipment Training
O&O	Operational and Organizational
O/C	Observer/controller
OPFOR	opposing force
RC	Reserve Component
SAT	Systems Approach to Training
SCORM	Sharable Content Object Reference Model
STO	Science and Technology Objective
TADSS	Training aids, devices, simulators, and simulations
TRADOC	U.S. Army Training and Doctrine Command
UAV	Unmanned Aerial Vehicle