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Transformation and The Army School System

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An examination of policies and alternatives for increasing the contribution of The Army School System (TASS) to Army readiness and improving the integration of the Active Component (AC) and Reserve Component (RC) training systems. The study recommends that the Army adopt private-sector models in developing interactive media instruction, develop a more effective local school system to better meet future unit training needs, and improve the integration of AC-RC training institutions to leverage existing resources and expand options.

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Preface

In response to a volatile and uncertain national security environment, the Army is conducting an extensive set of diverse operations and is transforming its organizations and operational concepts to improve responsiveness and lethality. These ongoing and future changes will place increasing demands on Army training. At the request of the Army's Training and Doctrine Command (TRADOC), RAND Arroyo Center undertook a research project to identify policies and options for increasing the contribution of The Army School System (TASS) to Army readiness and to identify ways to improve the integration of the Active Component (AC) and Reserve Component (RC) training systems. The project was sponsored by the office of TRADOC's Deputy Chief of Staff for Operations and Training (DCOPS&T).

This report presents the final project findings. In particular, it develops a set of recommendations for changes needed in order for TASS to meet its training objectives, and it discusses the implications of these changes for improving the integration of AC and RC training institutions. The report will be of interest to those involved in training, training system integration, TASS, and the Army and TRADOC Transformation.

This research was carried out in RAND Arroyo Center's Manpower and Training Program. RAND Arroyo Center, part of the RAND Corporation, is a federally funded research and development center sponsored by the United States Army. Correspondence regarding this report should be addressed to Michael Shanley (Michael_Shanley@rand.org).

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Summary

The Army School System (TASS) Must Respond to the Demands of Army Transformation

The Army is currently conducting an extensive set of diverse and demanding operations, and it is likely that such operational challenges will continue. As part of its response to these challenges, the Army is undertaking a process it calls Transformation, which involves reforming its organizations and operational concepts to improve responsiveness and lethality. Army Transformation will involve, among other things, increased use of joint and combined arms capabilities and the leveraging of networked information systems and other technologies. Changes are also under way in roles and missions for both the Active Component (AC) and the Reserve Component (RC), including modernization and conversions to modular Brigade Combat Team (BCT) organizations. All told, these ongoing and future changes will place increasing demands on Army training.

The Army School System (TASS) will play an important role in meeting the Army's expanded training mission. TASS is responsible for the vast majority of institutional training within the Army; it provides training to soldiers in both the AC and the RC, which includes the Army National Guard (ARNG) and the U.S. Army Reserve (USAR). Each year, TASS provides a total of approximately 75,000 student-years of training to Army personnel at a cost of some $6 billion. TASS is a composite school system comprising the AC, ARNG, and USAR educational training institutions. However, the responsibilities and resources of each of the training systems remain largely divided along component lines.

The RAND Arroyo Center was asked to assist TASS in developing policies and options to respond to the needs of Army Transformation and to increase TASS's contribution to Army readiness. This research also sought to identify ways to improve the integration of the AC and RC training systems within the context of Army Transformation and the corresponding changes required within TASS.

Preparing for the Future Training Environment Requires Solutions to Multiple Challenges

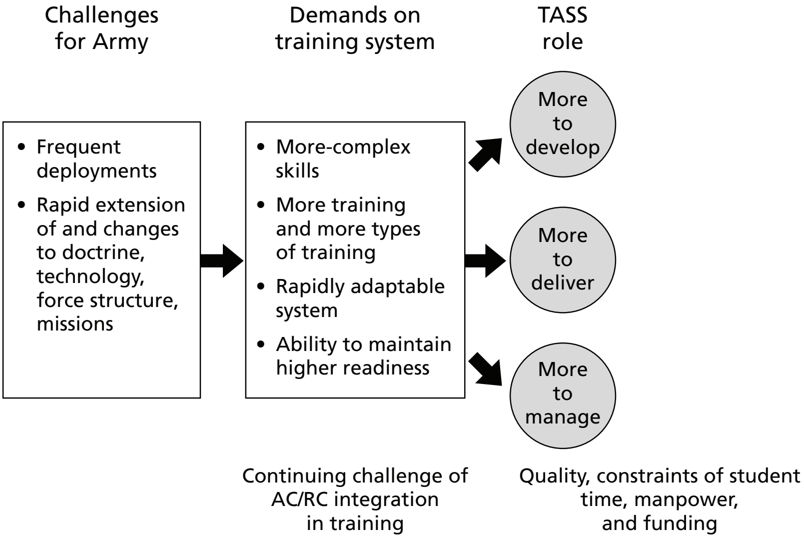
The challenges facing the Army place specific demands on the training system and have implications for TASS's role, as indicated in Figure S.1.

The challenges of current and future operating environments mean that Army training will need to cover increasingly complex skills for leaders and a wider range of conditions and technical skills, as well as more specialized types of training. In addition, training must be rapidly adaptable to meet the needs of changing missions and operations and must support the achievement and maintenance of high readiness in all AC and RC units.

One result of these increased demands is that TASS will need to achieve more in the following areas in order to support the Army's future training needs:

- **Development.** TASS will need to develop more courses, training support packages (TSPs), and other training products for both the AC and the RC and must be capable of developing and adapting training rapidly.
- **Delivery.** TASS will need the capacity to deliver more types of courses to satisfy the individual training needs of both AC and RC forces and may also need an improved surge capacity to achieve adaptability.

Figure S.1
The Challenges Facing TASS



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- **Management.** The need for more courses means that TASS, in conjunction with the personnel community and units, will have to manage more information to ensure that the right training is delivered at the right time to the individuals who need it.

In addition to achieving more in these areas, TASS must maintain quality standards while facing constraints of student time and available training manpower.

Enablers Can Help TASS Achieve Its Future Training Mission

Our research identified three enablers that will be particularly useful in helping TASS fulfill its role; however, each of the enablers brings its own challenges.

- **Just-in-time/assignment-oriented training (JIT/AOT).** JIT/AOT is training in specialized skills that occurs just before the skills are applied. JIT/AOT provides focused "pieces" of training in the areas that are relevant to the soldier's next assignment. While JIT/AOT will likely require less time and will reduce the total volume of training that would otherwise be required, it could potentially create a significant forcewide management burden due to the need to coordinate appropriate training with personnel assignments. It could also reduce the flexibility that more wide-ranging but less-focused training affords the personnel assignment process.
- **Training technology.** New training technologies can potentially assist TASS training developers in conducting needs analyses, designing training content, and developing training products. Technology can also be used for course management: For example, the Army's investment in a learning-management system (LMS) will enable tracking of training required and completed by individual soldiers. Technology can provide the means to store and deliver training content (i.e., provide the "pipes") and to implement training with a high degree of flexibility (i.e., allowing learners to interact with instructors, other learners, or media). However, the use of technologies to implement training can add to the training-development burden, a burden that would appear inconsistent with the resource constraints facing TASS. Moreover, technology will not be an appropriate delivery vehicle for all kinds of training.
- **A more decentralized capability for TASS.** Decentralized training is individual training that takes place away from a centralized schoolhouse. Such training could be provided by units, distributed learning (DL) supported by technology, or local schools located away from the central schoolhouse (but staffed by TASS personnel and linked to proponent schools). Increased use of decentralized options will allow TASS to expand the number of locations and times at which training can take place, facilitate JIT/AOT, and be more responsive to unit needs in an increasingly diverse force. However, these options must be used selec-

tively if they are to be effective, for several reasons. For example, the training-development burden will increase if more training is conducted by units or through DL. Moreover, technology-supported DL appears suited for only some types of training, and local instruction, if improperly used, could lead to a loss of scale economies. Finally, maintaining training quality and effective resourcing could prove difficult across dispersed training sites.

Our Research Identified Three Key Areas for Change

Our examination of the challenges facing TASS and the potential enablers for meeting those challenges revealed three key areas in which change is required.

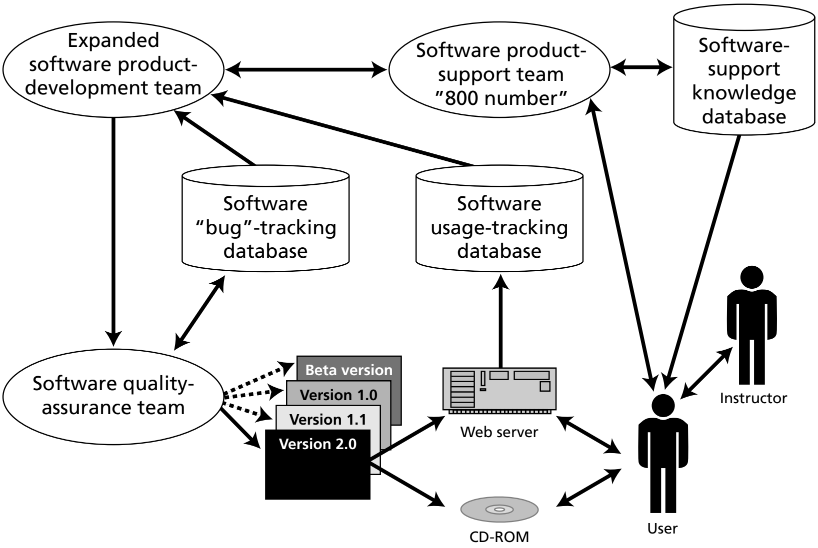
TASS Should Build a More Responsive Training-Development Capacity for Interactive Multimedia Instruction (IMI)

To meet future training needs, TASS will require a responsive training-development capacity. We focused on one important part of this requirement: how TASS might improve the training-development process associated with IMI. Increased use of training technology is likely to significantly increase TASS's development burden. Therefore, TASS could benefit from lessons learned by software-development organizations in the private sector. An understanding of these lessons will be useful whether TASS develops training materials in-house or outsources training-development tasks to external contractors. We therefore recommend that the actions outlined below be undertaken.

Embrace best practices of software-development and software-publishing organizations to meet fast-changing customer needs. The commercial sector has established several important requirements for the software-development life cycle, including rigorous quality assurance (QA), high-quality hosting and 24-hour access for Internet training tools, effective customer support, and continuous software maintenance and updates. TASS's training-development process could similarly benefit from a focus on the needs of its customers, both individual soldiers and units.

Adopt an organizational model that ensures quality. Software companies have developed a model of organizations, technologies, and practices to ensure the efficient development, delivery, and management of their software products (see Figure S.2). This model is designed to support rapid revision and adaptation to customer needs. It includes an expanded software-development team, web programmers, subject-matter experts, and database programmers. A separate activity provides QA, while a software product-support team answers users' questions about the software. Three distinct databases and database-access tools—bug-tracking systems, a software-support knowledge base, and usage-tracking databases and analyses—improve the quality of the initial software development and help manage customer support thereafter.

Figure S.2
A Model of Proven Organizations, Technologies, and Practices



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Adopt new methods and team structures to increase speed and efficiency. TASS will also need to improve the speed and efficiency of the training-development cycle. One method used by the private sector for such purposes is Extreme Programming (XP). XP emphasizes the use of rapid, small cycles of "design, implement, test" throughout the development effort and the development of reusable components of code. XP efforts depend on the use of project-based, multiskilled teams, which are often aggressively managed. The flexibility offered by XP could be incorporated in the TASS training-development process, particularly if training-development tasks are outsourced.

Adopt new technologies to increase speed and efficiency. New supporting technologies promise further improvement in the speed and efficiency of IMI development. The available technologies include instructional-design tools, cost-estimation tools, web-development tools, content-management systems, QA tools, and assessment systems. The eventual convergence of many of these technologies will dramatically increase their overall utility.

TASS Would Benefit from a More Effective Local Training System

Decentralized training—including training conducted by units, by technology-enabled DL, and by TASS manpower in local schools—provides an important set of options for increasing the amount and flexibility of training the Army delivers. Current U.S. Army Training and Doctrine Command (TRADOC) plans focus primarily on the DL option; however, we believe that the local school option also has a critical, as yet undeveloped, role to play in expanding the amount of individual training provided by TASS, as well as that conducted by units. In addition, local schools could play a wide range of other roles in support of the larger training system. By increasing direct contact with units, TASS could become more customer-centric. By making local schools multifunctional, TASS could help ensure their cost-effectiveness.

Local TASS manpower can fill in what technology-supported DL and proponent schools cannot provide. While technologies will continue to advance, it is unlikely that artificial intelligence (AI) capabilities will progress in the 2010–2020 time frame to the point at which they can be cost-effectively incorporated into a large number of standalone, or near standalone, training modules. The use of IMI training technologies will be further constrained by limited resources to support the costs of development and will not be economically justified for some courses (e.g., specialized courses with small student loads).

Expert trainers and training support personnel will thus retain an important role in conducting individual training, especially for tasks involving complex cognitive skills, which require demonstration of skills and appropriate feedback. Combining a face-to-face local training capability with self-paced learning technologies and collaborative learning environments will better position the Army to coach, mentor, and advise a greater number of soldiers in DL courses and to attend to the needs of those experiencing difficulty with technology.

Local TASS instruction is the best individual training option in certain situations. While it is clear that traditionally delivered proponent school and DL training will be key components of the future individual training system, some types of future training can be made more cost-effective through the use of local face-to-face delivery methods within TASS. For example, new digital skills have been found to require frequent sustainment training, which could be offered cost-effectively by local instructors. Local schools would also be a cost-effective option for some short courses, especially those for which travel to a central site is inefficient and the student load in a particular occupation is sufficiently large. Local instruction would also likely be preferable for units with emerging organizational and operational concepts, such as would be expected for the initial set of Future Combat Systems (FCS) Units of Action (UAs), because the content of training for such units is likely to change often.

Local TASS schools could cost-effectively support expansion of individual training conducted in operational units. TASS local schools could provide resources to support unit training. For example, local TASS personnel could provide train-the-trainer instruction and research and could adapt proponent-developed training products to specific unit needs. They could also provide direct training support by conducting classes or other training that is needed by a unit but beyond the unit's capabilities.

A local TASS capability could assist the Army in accomplishing other training system goals:

- **Collective and leader-training exercises.** Local TASS personnel could help units set up and conduct simulation-supported training exercises, adapt training-support products, develop exercise plans, assess results, and develop remedial training options. TASS instructors could also train and augment observer controllers and support exercise execution and After Action Reviews (AARs).
- **Training development.** Local TASS instructors could serve as links between units and proponent schools by identifying and communicating to proponents the most pressing needs for training-support products and updating units on the latest thinking in both proponent and other schools. Local schools could also share a portion of the development workload.
- **JIT/AOT implementation.** The presence of local instructors would facilitate the process of delivering JIT/AOT to soldiers and leaders after they are assigned to new positions and at the locations of their new assignments.
- **AC/RC integration.** Local AC and RC schools could deliver some required training to AC and RC soldiers simultaneously.
- **"Reachback" support.** Local schools could also be task-organized to provide deployed units with information to help plan and execute ongoing operations (i.e., reachback). Units would benefit from having a local school organization immediately available for specific support rather than having to depend on a "from scratch" effort from the Center for Army Lessons Learned (CALL).
- **Synchronization of unit training cycles.** Local schools could help units improve efficiency by synchronizing individual training with unit training cycles. To the extent that individual training could be conducted locally, unit training programs would expe-

rience fewer disruptions, since there would be less need to send soldiers and leaders to courses at proponent schools.

Improved Integration of AC and RC Training Institutions Would Increase Available Training Options

The evolution of training technologies and organizations to satisfy future training requirements suggests greater benefits to training system integration in the future and a wider role for the RC portion of TASS.

A move toward AC/RC institutions would allow the Army to leverage the existing RC school system to inform and support the development of more options for AC training. Since the RC already has an extensive local school system, it makes sense to create one for future Army training that uses those resources and incorporates the lessons learned from the RC operation. For example, RC-sponsored reclassification and transition training for a wide range of occupational specialties could be made available to AC soldiers, providing added flexibility in training choices.

The RC might also be called upon to provide support in meeting specific future training needs. For example, the advent of JIT/AOT training will likely result in the need for more short-duration training events, the type of events that RC school staff could effectively support. RC school subject-matter experts could also effectively support students in technology-based DL courses, by serving either as web-based instructors or facilitators or as on-the-ground trainers.

The RC might also become more involved in QA, training support, and training development, including the conversion of DL courses. For example, RC instructors might serve on training-development teams or might use web-based technologies to contribute to the development or maintenance of DL courses. They could also play a useful role in QA testing. RC instructors could also be made available to provide support to DL-based courses, by either e-mail, Internet chat/Instant Messaging, or phone.

To the extent that the AC joins the RC in providing training at local schools, communication between the components can be improved. In addition, the proximity of AC and RC training staffs would make it easier to coordinate and receive feedback for the cross-component production and maintenance of better training products, such as appropriate RC courseware.

Spiral Development Can Be Used to Begin the Process of Change

Because our recommendations call for significant changes and are complicated by many other ongoing Army initiatives, TASS would do well to use a spiral development process to implement change. Under spiral development, an initial version of a product or program is developed as a work in progress. The working prototype is then fielded early, followed by a cycle of evaluation and adjustment in a series of compressed stages (or spirals). This "build a little, test a little" approach is consistent with the DoD Training Transformation Plan and is especially suited to the resource-constrained and rapidly changing environment that TASS faces. Moreover, the spiral development approach provides ongoing opportunities for feedback and revision, a sound argument for resource shifts, and more assurance of ultimate success.

The spiral development process can be supported through implementation research and exploratory pilot studies. We recommend several, focusing on ongoing programs and efforts to minimize costs. For example, one potential pilot could identify opportunities to develop a TASS local school concept by building on existing programs such as the Army's transition to modular BCTs. Another pilot could examine evolving DL and IMI products to strengthen future products and training-development processes. Another option would be to build and disseminate expertise in rapid training development.

In sum, Army Transformation and wider operational demands will increase the Army's and TASS's training requirements and will require a more highly adaptable training system. After a review of the available enablers, we conclude that TASS will need to become more customer-focused, that is, more responsive to unit needs for the training of individuals and the production of training-support materials. Further, the study findings highlight how TASS could accomplish this objective in two key areas: the development of IMI and the implementation of decentralized training and training development. We also conclude that making the required changes offers the Army an opportunity to further its goal of increasing integration of AC and RC TASS institutions within the larger training system.

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- staff from TRADOC, TASS, and the Army Training Support Center (ATSC)
- commandants of TRADOC's Armor and Military Intelligence schools and the staff of five schools (Armor, Infantry, Military Intelligence, Signal, and Ordnance)
- the Director and training staff, Army National Guard
- the Chief and training staff, U.S. Army Reserve, as well as staff from the U.S. Army Reserve Command and several commanders of U.S. Army Reserve Training Divisions
- other Army organizations, including the training staff of Forces Command (FORSCOM) and representatives from the Objective Force Task Force
- various personnel from the Office of the Secretary of Defense (OSD), including the Under Secretary of Defense for Personnel and Readiness.

We are also grateful for assistance received from our RAND colleagues, including Chip Leonard, John Bondanella, and Rodger

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We have benefited greatly from assistance provided by all these individuals. Errors of fact or interpretation, of course, remain the authors' responsibility.

Glossary

AAR	After Action Review
AC	Active Component
ADT	Active duty for training
AI	Artificial intelligence
AIT	Advanced individual training
AO	Area of operations
AOT	Assignment-oriented training
ARNG	Army National Guard
ATRRS	Army Training Requirements and Resources System
ATSC	Army Training Support Center
BBS	Brigade/Battalion Battle Simulation
BCC	Brigade Coordination Cell
BCT	Brigade Combat Team
BCTC	Battle Command Training Center
C4ISR	Command, control, computers, communications, intelligence, surveillance, and reconnaissance
C4SI	Command, control, computers, communications, surveillance, and intelligence
CALL	Center for Army Lessons Learned
CASCOM	Combined Arms Support Command
CATS	Combined arms training strategies

CBT	Computer-based training
CCTT	Close Combat Tactical Trainer
COE	Contemporary operating environment
CONUS	Continental United States
CS/CSS	Combat Support/Combat Service Support
DIMHRS	Defense Integrated Military Human Resource System
DL	Distributed learning
DMOSQ	Duty Military Occupational Specialty Qualified
DoD	Department of Defense
FBCB2	Force XXI Battle Command–Brigade and Below
FCS	Future Combat Systems
FM	Field manual
FORSCOM	Forces Command
FSC	Full Spectrum Command
GAO	General Accounting Office
IDT	Inactive duty for training
IET	Initial entry training
IMI	Interactive multimedia instruction
IMT	Initial military training
ITRRS-GIS	Individual Training Requirements and Resources–Geographic Information System
ITS	Intelligent tutoring system
JC4ISR	Joint command, control, computers, communications, intelligence, surveillance, and reconnaissance
JIT	Just-in-time
JRTC	Joint Readiness Training Center
LMS	Learning Management System
MACOM	Major Army Command
MDMP	Military Decision Making Process
MOS	Military occupational specialty

MSTF	Mission Support Training Facility
MTT	Mobile Training Team
NCO	Non-Commissioned Officer
NCOES	Non-Commissioned Officer Education System
NET	New Equipment Training
NETT	New Equipment Training Team
NGO	Non-governmental organization
NTC	National Training Center
O&O	Operational and organizational
OES	Officer Education System
OOTW	Operations other than war
OPFOR	Opposing force
OPTEMPO	Operational tempo
OSD	Office of the Secretary of Defense
PME	Professional Military Education
POM	Program Objective Memorandum
PS	Prior service
QA	Quality assurance
RC	Reserve Component
RTSM	Regional Training Site—Maintenance
SBCT	Stryker brigade combat team
SCORM	Sharable Content Object Reference Model
SIDPERS	Standard Installation/Division Personnel System
SME	Subject-matter expert
SOF	Special Operating Forces
SOP	Standard operating procedure
SOSO	Support Operations and Stability Operations
STRAP	Capstone System Training Plan
TADLP	The Army Distributed Learning Program

TAPDB	Total Army Personnel Data Base
TASS	The Army School System
TATS	Total Army Training System
TDY	Temporary duty
TOE	Table of Organization and Equipment
TRADOC	U.S. Army Training and Doctrine Command
TSP	Training support package
UA	Unit of Action
USAR	U.S. Army Reserve
V-TOC	Virtual Tactical Operations Center
WMD	Weapons of mass destruction
WOES	Warrant Officer Education System
XP	Extreme Programming

CHAPTER ONE

Introduction

The Army is currently conducting an extensive set of diverse operations in response to a volatile and uncertain national security environment, and it is likely that such operational challenges will continue. In the future, the Army can expect to see the increased use of joint and combined arms capabilities at lower echelons and will need to leverage the advantages of networked information systems. As part of its response to these challenges, the Army is undertaking a process it calls Transformation, which involves reforming its organizations and operational concepts to improve responsiveness and lethality. All told, these ongoing and future changes will place increasing demands on Army training. Training will likely have to be accomplished while the Army participates in frequent and faster operational deployments and makes major force-structure and operational changes.

The Army School System (TASS) will play an important role in meeting the Army's expanded training mission. TASS is responsible for the vast majority of institutional training within the Army, providing training to soldiers in both the Army's Active Component (AC) and its Reserve Component (RC), which comprises the Army National Guard (ARNG) and the U.S. Army Reserve (USAR). TASS provides initial entry training (IET) and military occupational specialty (MOS) skill training, as well as courses related to Professional Military Education (PME), including those required by the Army's Officer Education System (OES), the Warrant Officer Education System (WOES), and the Non-Commissioned Officer Education

System (NCOES).[1] Each year, TASS provides approximately 75,000 student-years of training to Army personnel at a cost of some $6 billion.[2]

In organizational structure, TASS is a composite school system comprising the AC, ARNG, and USAR training institutions, although the training responsibilities and resources of each are largely divided. Centralized AC-operated proponent schools provide initial military training (IMT) for both AC and RC soldiers and training development for all components. AC schools also provide PME and most other courses needed by AC soldiers. Geographically dispersed RC-operated institutions and personnel provide much of the PME and other courses needed by USAR and ARNG soldiers. A major mission of the RC institutions is to provide reclassification training for enlisted RC personnel who change their occupations. Completion of this training makes soldiers eligible to become duty MOS qualified (DMOSQ), a requirement for deployment eligibility.

Despite a series of Army initiatives to achieve greater organizational integration within TASS, the training responsibilities and resources of the three types of training institutions remain divided along component lines. In 1994, the Chief of Staff of the Army called for an integrated training system to improve quality and increase efficiency in the face of declining training resources. Ongoing efforts since that time have sought to consolidate infrastructure, leverage resources, exploit technology, and augment capabilities across components. These efforts have led to significant changes, including the reorganization of RC training, improvements in the quality of training in RC institutions, and the removal of barriers to more integration of student loads across components. However, the makeup of training organizations and the distribution of student loads still reflect the traditional divisions.

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[1] TASS also provides a wide variety of other courses, sometimes referred to as functional training courses. For a complete description of the TASS mission, see TRADOC Regulation 350-18, *The Army School System.*

[2] Such statistics are reported in the *Military Manpower Training Report*, published yearly by the Department of Defense (DoD).

The RAND Arroyo Center, a unit of the RAND Corporation, was asked to assist TASS in developing policies and options for increasing TASS's contribution to Army readiness and to identify ways to improve the integration of the AC and RC training systems. These objectives are interrelated. Early in the project, we concluded that to be relevant, the integration issue must be examined not in isolation, but in the context of overall Army Transformation and the corresponding changes required within TASS.

The remainder of this chapter provides a more complete picture of the policy context for Army Transformation, describes TASS's current organization in greater detail, and explains how this research aims to help TASS improve its contribution to current and future Army readiness.

The Policy Context: Army Transformation Moderated by Contemporary Operational Challenges

What are the implications of current and expected future operational environments for the Army? To answer this question, we interviewed key stakeholders from across the Army and the Office of the Secretary of Defense (OSD), AC and RC units, and TASS. These interviewees included

- a wide range of staff from the U.S. Army Training and Doctrine Command (TRADOC), TASS, and the Army Training Support Center (ATSC)
- commandants of TRADOC's Armor and Military Intelligence schools and the staff of five schools (Armor, Infantry, Military Intelligence, Signal, and Ordnance)
- the Director and training staff, ARNG
- the Chief and training staff, USAR
- other Army organizations, including the training staff of Forces Command (FORSCOM) and representatives from the Objective Force Task Force

- various OSD personnel, including the Under Secretary of Defense for Personnel and Readiness.

We also consulted key documents and references relating to the Transformation and its training implications. These include "Army Transformation," *Concepts for the Objective Force*, *U.S. Army Transformation Roadmap, Actions to Enhance Transformation*, and *The National Security Strategy of the United States of America*.[3] Key documents regarding training include the *Army Training and Leader Development Panel* reports;[4] the *Capstone System Training Plan (STRAP) for the Unit of Action;*[5] Army field manuals (FMs) on operations, training the force, and battle-focused training;[6] *Objective Force Operational and Organizational (O&O) Plan, Maneuver Unit of Action;*[7] and *Objective Force Doctrine, Training and Leader Development (DTLD) Plan*.[8]

Through our review of relevant documents, together with extensive discussions with key stakeholders, we identified several challenges for the Army which will be particularly relevant for the training community.

Fast, frequent operational deployments and requirements. The Army can expect to continue to experience frequent deployments and a wide array of missions. A substantial portion of Army soldiers are currently deployed in some 120 countries.

A more complex mixture and greater density of skills. The Army can expect to see the increased use of joint and combined arms

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[3] See U.S. Army, 2000; U.S. Army, n.d.; Headquarters, Department of the Army, 2003b; General Accounting Office (GAO), 2002; The White House, 2002.

[4] See *The Army Training and Leader Development Panel Report (Officer)*, 2002a; *The Army Training and Leader Development Panel Report (NCO)*, 2002b.

[5] See U.S. Army, 2003a.

[6] See Headquarters, Department of Army, 2001, 2002, 2003a.

[7] See U.S. Army, 2003b.

[8] See U.S. Army, 2003d.

capabilities at lower echelons, together with an expanded range of missions, including peacekeeping and nation building.

In addition, as Army responsibilities for homeland security evolve, support to regional, state, and local jurisdictions—largely via the ARNG—is likely to increase. Such responsibilities will include assisting with domestic preparedness against the threat of weapons of mass destruction (WMD), engaging in operations to ensure or restore the continuity of government, providing border and coastal defense, and ensuring the continuity of military operations, including force protection, protection of mission-critical facilities and systems, and protection of headquarters operations.[9]

Force-structure changes. In light of the relatively small size of the total force along with its heavy commitments, the Army is facing large force-structure and operational challenges as it transforms. The conflicts in Iraq and Afghanistan have placed great demands on Army manpower. To respond to the needs of the operating environment, a larger force over the near term—with relatively more infantry and less "heavy" force structure—may become a practical necessity at some point. The Army could potentially see continued AC management of post-hostilities activities and nation building.

In terms of force composition, the AC is likely to require more infantry and Special Operating Forces (SOF) to combat dispersed, competent enemy fighters over difficult, complex terrain. The AC is also likely to require more Combat Support/Combat Service Support (CS/CSS) for the kinds of restorative activities that follow U.S.-led wars in regions such as the Middle East. Medical, civil affairs, construction, military police, language, and other functions will be critical to the management of post-hostilities periods. These force-structure changes could potentially generate changes in the structure of MOSs and branches, as well as the need for previously trained soldiers and leaders to become trained for new occupations.

Changes in roles and missions for the RC. Challenges will mount for the RC as well. RC units will likely modernize and un-

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[9] See Larson and Peters, 2001.

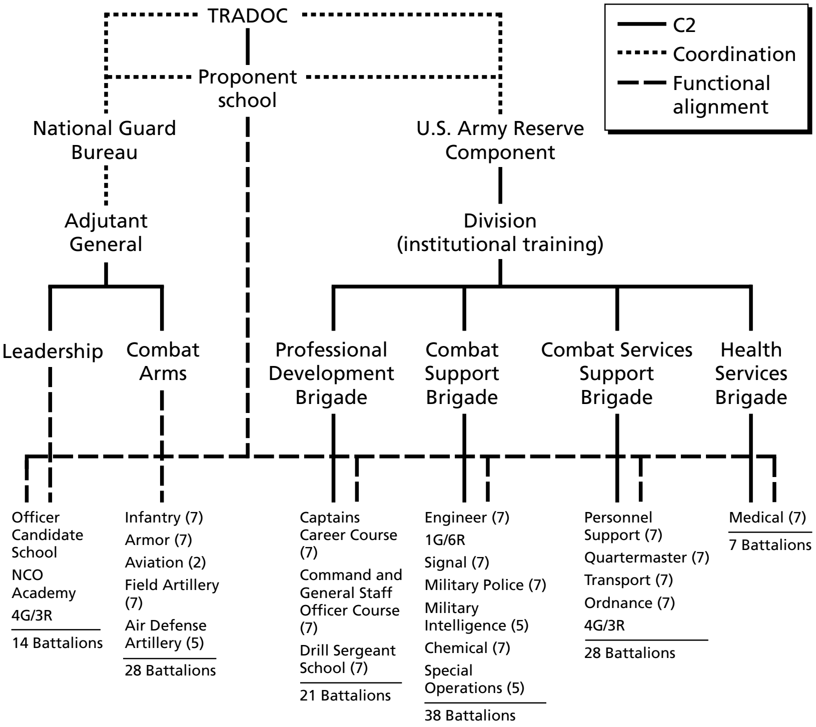
dergo conversions to modular Brigade Combat Team (BCT) organizations. Other unit conversions will be made to better align the force structure with the requirements of the operating environment. Like the AC, the RC is likely to experience changes and merges in MOSs to meet Transformation objectives. At the same time, the RC also has a new role in supporting homeland security. RC units are particularly well suited for such missions, especially given their localities and the support training (e.g., medical, legal, mechanical maintenance, logistics) already obtained in civil life or prior service. All these changes to the RC's role will occur in a context of ongoing mobilization.

Organization of TASS Across Army Components

To understand how TASS itself might need to transform in response to the Army Transformation and the current operating environment, we need to look in more detail at the current organization of TASS across Army components. Figure 1.1 shows how the AC and RC portions of TASS are currently organized.

TRADOC is responsible for developing Army training and doctrinal materials, and it conducts or oversees most Army training and education courses. Directly under TRADOC are 33 AC-run proponent schools on 16 TRADOC installations within the continental United States (CONUS). Each proponent school is organized around a branch or functional area (e.g., infantry, armor, chemical, combat service support) at an AC installation within the CONUS (i.e., there is one primary location per branch or functional area). The proponent schools employ mostly full-time AC personnel and Army civilians, and they provide instruction to both AC and RC soldiers and leaders. In addition to conducting a large number of training and education courses, the proponent schools supply training support to more than 130 distributed and functionally aligned RC training battalions (primarily by providing training-development products and quality assurance [QA]). The majority of these battalions are operated by either the ARNG or the USAR.

Figure 1.1
Organization of TASS Across Army Components



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RC-operated schools and academies are geographically distributed across seven CONUS regions. Instruction at the training institutions is provided primarily (though not exclusively) by part-time USAR and ARNG instructors. Within each region, the RC school system offers courses in various locations, including both AC and RC installations; specific locations are determined according to the nature of the Army training demand within the region. The USAR Command provides command and control to assigned USAR TASS training battalions and brigades through the USAR Division (Institutional Training), while command responsibility for ARNG units is vested in the state and territorial governors, who execute their responsibilities through state adjutants general.

As noted earlier in this chapter, AC and RC training responsibilities remain generally divided. As a result, the AC schools are responsible for the majority of the Army's student load. Overall, the RC portion of TASS accounts for about 6 percent of the entire Army training load, defined in terms of student-years of training. However, RC training accounts for 14 percent of the skill progression and functional training load.[10] Moreover, the RC manages a greater relative administrative burden, given the specialized course formats often required to train RC soldiers. For example, most AC courses are conducted in one continuous period, with courses averaging about 10 weeks in length. In contrast, many RC courses are about four weeks in length but divided into separate short phases, e.g., a pair of two-week phases or one two-week phase and six weekends over a six-month period.

Given the current organization of the AC and RC training systems within TASS, the question we must address concerns what further efforts in the area of integration will help maximize TASS's overall contribution to readiness in a rapidly changing environment. Potential changes to be considered include consolidation of infrastructure among the three components, an increase in the contribution made by RC training assets, and expansion of the geographically dispersed RC model to AC training.

Goals of This Research

Our analysis took a broad view of TASS's role within Army training in order to examine how TASS can increase its contribution to Army readiness while emphasizing improved integration of the AC and RC training systems.

The analysis focused on three questions:

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[10] Defense Manpower Data Center, 2002, Tables 3 and 4.

- What demands will the current and expected future operating environments place on the Army's overall training system and on TASS in particular?
- Which training enablers can help TASS support the Army's current and future training needs? What are the advantages and challenges associated with each of these enablers?
- Which issues should TASS emphasize in moving forward, and what implications do these high-priority issues have for improved integration of the AC and RC training systems?

To answer these questions, we developed a construct that links the challenges facing the Army to specific demands on the Army's training system in general and TASS in particular. The construct considers the expected impact of these demands on TASS's future role and identifies key enablers that can assist TASS in fulfilling that role. Building upon this construct, we then examined selected enablers in greater detail and explored further the issue of improved AC/RC integration. On the basis of our findings, we recommend ways by which TASS can most effectively implement change.

Organization of This Report

Chapter Two of this report discusses current and likely future demands on Army training, identifies key training enablers that can help TASS, and describes our construct for assisting TASS in meeting future challenges. The subsequent three chapters discuss key issues that TASS should emphasize in moving forward, along with the implications of these high-priority issues for improved integration of the AC and RC training systems. Chapter Three focuses on an important issue regarding the use of technology in training, i.e., how TASS might improve the process for developing interactive multimedia instruction (IMI) software to implement training. Chapter Four focuses on how TASS might use a system of local TASS schools to help meet Army training needs, an important issue for training delivery. Chapter Five identifies opportunities and methods for improving AC/RC integration in a transformed Army training system. Chapter Six then brings key recommendations together, explains how TASS might implement change, and describes some potentially useful pilot studies. The appendixes provide expanded information on training technologies, the results of our analysis of current RC TASS training, and potential pilot studies.

CHAPTER TWO

A Construct to Assist TASS in Meeting Future Training Challenges

In this chapter, we describe a construct for understanding how TASS can anticipate and meet future training needs. We first discuss in detail the implications of Army Transformation and current operating conditions for Army training in general and TASS's role in particular. We then identify some key enablers that can assist TASS in meeting current and future training demands and make an initial assessment of the costs and benefits of these enablers. Finally, we identify several issues of particular importance to TASS as it transforms. These issues will be analyzed further in Chapters Three, Four, and Five.

Army Transformation and the Current Operating Environment Will Increase Demands on the Army's Training System

Army Transformation and the demands of current operations are creating extreme challenges to the Army's training system. Our analysis has identified four broad ways in which training will be particularly affected: Rapid changes to Army doctrine, operational capability, force structure, and missions, together with a higher operational tempo (OPTEMPO), mean that training will have to

- cover increasingly complex skills for leaders, as well as a wider range of conditions
- cover a wider range of technical skills and more specialized types of training

- be rapidly adaptable to continually evolving missions, organizations, technology, doctrine, MOS/branch requirements, operations, and stationing
- support the achievement and maintenance of high training readiness in all AC and RC units.

We discuss each of these concepts in turn.

Training Must Accommodate the Increasing Complexity of Required Leader Skills

Conducting tactical operations under Transformation concepts is becoming increasingly complex; as a result, the tasks and skills required of leaders are also becoming more complex. For example, the wider array of operating conditions significantly expands the number and complexity of tactics, techniques, and procedures that leaders need to learn. Moreover, the greatest relative increase will likely be at platoon and company levels—levels at which leaders have relatively limited time-in-service experience.

Leaders and staff at all echelons will need to be trained to integrate a larger array of combined arms, joint, and civil support functions. This integration will occur across a wider array of uncertain operational conditions, requiring leaders to quickly adapt. Therefore, leaders must be able to capitalize quickly on the products of digital systems for joint command and control, computers, communications, intelligence, surveillance, and reconnaissance (JC4ISR) and other information technologies. Current efforts in this area indicate that developing and maintaining digital skills requires frequent retraining.[1]

Training is also needed for the special leadership challenges of operations other than war (OOTW) (e.g., counterinsurgency, peacekeeping, stability, and support). Moreover, pure combat missions must be expected to be the exception rather than the norm, so leaders must be prepared to conduct operations in conjunction with multi-

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[1] See Johnston et al., 2002, for a more complete explanation of this impact on training.

national forces and government and non-governmental organizations (NGOs).

In general, the training community recognizes that for leaders to learn how to adapt to complexity, they must participate in a large number of training exercises that provide experience across a wide range of likely conditions. To be effective, these exercises must realistically reflect the range of actual operations and provide useful feedback to the training participants.

Training Will Need to Cover a Wider Range of Technical Skills and Specialized Types of Training

To support the likely direction of Army change, the training system will need to deliver an expanded range of training covering both a wider range of technical skills and more specialized types of training. For example, the merging of MOSs and branches could increase the potential skill sets needed by both soldiers and leaders. Even when MOSs do not change, soldiers are likely to need training on a wider range of equipment sets and software systems, as capabilities are expected to rapidly evolve. Likewise, the creation of multifunctional units will mean that leaders in these units will have to supervise soldiers in a greater range of MOSs and will have to execute a larger set of collective tasks. These factors will create an increased requirement for "catch-up training" to help soldiers and leaders deal with continually changing tasks and conditions. Changes in Army occupational needs and in the roles of the AC and the RC will greatly increase the need for reclassification training to prepare soldiers for new occupations.[2] Moreover, many leaders will also need reclassification training, including training to improve skills in supervision as well as operations.

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[2] For example, the Sgt. Major of the Army recently estimated that more than 100,000 soldiers will change jobs due to Army Transformation (*U.S. Army News Service*, February 11, 2005).

Training Must Be Rapidly Adaptable

As Army missions, organizations, doctrine, and technology evolve at an accelerated pace, Army training will also need to be rapidly adaptable. For example, the Army is transforming its current 33 AC combat brigade structure to 43 or more "modularized," more easily deployable Brigade Combat Teams. These organizations will be modernized and will have enhanced digital command and control, intelligence, surveillance, and reconnaissance capabilities. The Army needs to provide training now for these new brigades but must also be prepared to adapt training as needed as the brigades evolve over time.[3] The rapid pace of technological and organizational change will place additional pressure on Army training organizations to keep pace by updating training content.

The Training System Must Support Higher Readiness

The training system's effectiveness will also need to be increased to support the achievement and maintenance of higher readiness levels. Previously, the Army's training paradigm reflected relatively predictable war-fighting requirements. Soldiers would be alerted of the need to deploy, at which time they would participate in training to rectify any known deficiencies and to prepare for any deviations from existing plans. However, in the current operating environment, Army units must be better prepared for a much wider range of potential scenarios. Moreover, to support the need for faster deployments, the Army is replacing its "alert, train, deploy" paradigm with one of "train, alert, deploy." The new paradigm means that certain Army soldiers, leaders, and units must train to a high level of readiness and remain fully trained in preparation for an alert to almost immediate deployment. The Army will also need to be prepared to rapidly develop and implement any training specifically needed for contingencies.

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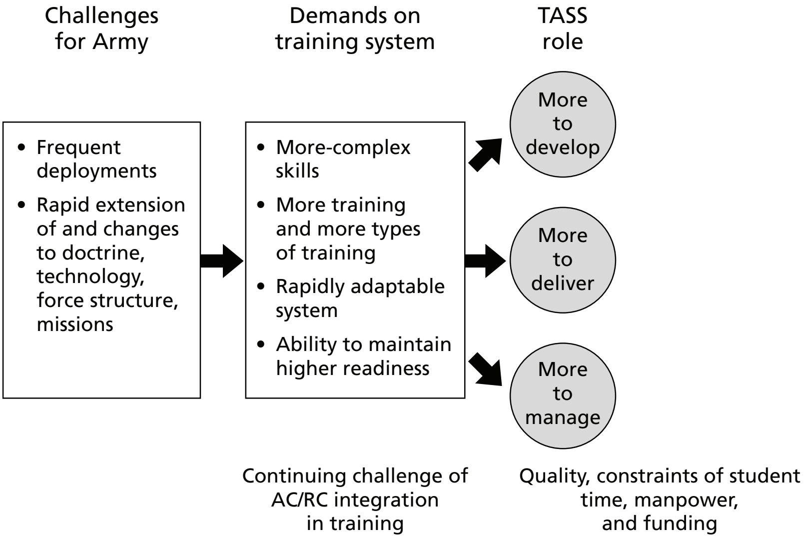
[3] The process for change is called spiral development, or planned evolution, a concept discussed further in Chapter Six.

TASS Will Need to Achieve More in Order to Meet the Army's Future Training Needs

The challenges faced by the entire Army training community mean that TASS will need to achieve more in several areas to meet future training needs. TASS provides two critical inputs to operational units: (1) it supplies soldiers and leaders who have the basic skills, knowledge, and abilities they need to be effective in their assigned positions, and (2) it provides a wide range of training-support products to maximize the effects of both the individual and collective training conducted by the units. What TASS will need to achieve in the future is illustrated in Figure 2.1. Changes brought by Transformation and evolving operational requirements, together with the related demands on the training system, will require TASS to develop,

Figure 2.1
The Challenges Facing TASS



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deliver, and manage more training. These changes must take place within the context of the ongoing challenge to improve integration of AC and RC training. In addition, TASS will need to achieve more without compromising quality and while facing limitations in the availability of key training resources (e.g., student time, manpower, funding).

TASS Faces Significant Challenges in Training Development

TASS will face the most significant challenges in developing materials to support training and education provided in units and at its schools. The need for a wider range of technical skills and more specialized types of training (including training to prepare for joint operations and the current operating environment) means that TASS will need to develop more courses, training support packages (TSPs), and other training products. Further, the finite nature of student training time will place a premium on improved training-development products to support a rapid training pace.

The requirement to train more-complex skills (both individual and collective) will translate into the need for TASS to develop more and better experiential exercises (primarily in the form of virtual and constructive simulations), including a large set of scenarios, as well as diagnostic and After Action Review (AAR) capabilities. The rapid pace at which organizational designs, equipment, and operational software are being introduced and modified means that TASS's training-development capacity must also be able to rapidly adapt courses as needed. To support the required changes, the training-development community will need to capture, improve, and disseminate the procedures and practices developed by field units.

Additionally, the more units are called upon to prepare for, train for, and execute unexpected contingencies, the greater will be TASS's requirement to rapidly develop training material to support these efforts and to conduct an effective "lessons learned" program to adapt training for follow-on forces.

TASS Will Need to Deliver More Training and More Types of Training

TASS will also face challenges in the provision of training in its resident and distributed learning (DL) courses. Improving the abilities of soldiers and leaders implies the need for TASS to deliver more training. This will be difficult, however, given the limit on students' time for institutional training and resource constraints within TASS. Further, force-structure changes might require TASS to have an improved surge capacity to deliver training. For example, if force-structure changes lead to large-scale unit reorganizations or MOS/branch strength changes, TASS will be called upon to deliver the additional reclassification courses needed to implement the changes in both the AC and the RC.[4]

Given the need for a greater range of skills and more specialization, TASS will also likely need to develop the capacity to deliver more types of courses. This, in turn, will require more instructors (and equipment) or an increased capacity in the existing instructor pool to train a wider variety of skills.

TASS Will Also Need to Manage More Information

TASS will also face challenges in training management. The need for more courses means that more information will have to be managed to ensure that the right training is delivered at the right time to the individuals who need it, and to ensure that both soldiers and leaders are aware of new training requirements. This management burden will be shared with the personnel community and the unit chain of command, which are responsible for timely scheduling of individuals into courses to ensure that they are qualified for assignment to a complex matrix of authorized positions. TASS's role in addressing these management challenges will be to set up and continually coordinate a flexible course schedule that can satisfy a more-complex set of customer needs.

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[4] Historically, the AC has had a relatively modest reclassification need. However, this need is likely to grow in proportion to the tempo of force-structure changes and to continue as long as frequent force-structure changes occur.

AC/RC Integration Is an Important Enabler for Increasing Training Efficiency

Although the Army has for some time recognized training-system integration as an enabler for increasing training efficiency, meaningful change in this area has proven difficult. The difficulties are likely related to the differing needs and constraints of AC and RC units, as well as to cultural barriers within the Army (e.g., the perception that courses taught in RC institutions are of inferior quality). Thus, a new approach may be needed to surmount these barriers and to realize training-system integration within a time frame that can accommodate future Army training needs.

TASS Must Improve While Maintaining Quality and Addressing Funding Constraints

TASS must be able to expand its capacity while maintaining the quality of training. The higher demands placed on soldiers and leaders will require them to reach current or higher performance levels on an increased set of skills, knowledge, and abilities. Although the school system will need to achieve more, TASS can expect to see only a limited increase in resources, if any. Indeed, the school system is likely to face continued constraints of student time and available military manpower.[5] These constraints look even more challenging in light of reports from school staffs that today's TASS budgets, especially those for training development, are significantly underfunded.

Enablers Can Help TASS Achieve Its Future Training Mission

To fulfill its role, TASS will need to leverage available training enablers, i.e., tools or methods that allow TASS to achieve more in spite

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[5] The Army's goal of increasing the percentage of its military manpower assigned to units means that it is unlikely to increase either the amount of time students spend in resident courses or the number of instructors. Indeed, the trend is to shorten course length to reduce both student time and the number of instructors required.

of constraints on resources.[6] Our research has identified three enablers that will be particularly relevant for TASS: just-in-time/assignment-oriented training (JIT/AOT), training technologies, and decentralization of training delivery methods. These enablers are highlighted either because of their impact in helping TASS meet its training challenges (i.e., JIT/AOT has a potentially large impact on the challenge of "more to deliver") or because of the range of that impact across all challenges (i.e., training technologies and decentralized training delivery methods have a potentially significant impact on developing, delivering, and managing training). But while these enablers can provide considerable help for TASS, each of them creates challenges of its own. We discuss these benefits and challenges below.

JIT/AOT Can Satisfy More Training Requirements Without Increasing Delivery Time

JIT/AOT is training in specialized skills that occurs just before the skills are applied.[7] It differs from traditional school training, in which soldiers receive training in a wide range of tasks involved in an occupation even though they might not need to carry out many of those tasks in the near future or at any time in their careers. Figure 2.2 highlights some of the advantages of JIT/AOT.

Delivery and Management. JIT/AOT can help TASS respond to the increased demand for more training by allowing TASS or units to provide smaller pieces of training in only those areas that are relevant to the soldier's current or next assignment. Because such training is more focused and occurs only if needed, it requires less time and reduces the total volume of training to be delivered. Because there is less training to deliver, there is also less to manage at the course level.

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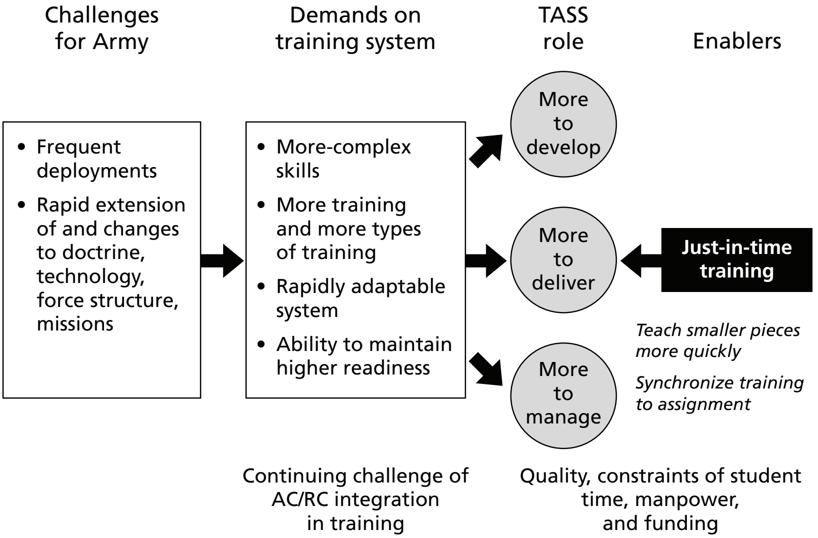
[6] Training enablers are not the only source of help. For example, in the personnel arena, efforts to stabilize units can potentially reduce the training requirement by reducing the need for sustainment training.

[7] JIT training refers to training on a skill or set of skills just as, or just before, those skills are needed by the soldier. AOT is training given during advanced individual training (AIT), where the soldier is trained only for the needs of the unit programmed for assignment, and not in a full set of tasks or on a full set of the equipment for which the MOS is responsible. Here, the term JIT/AOT indicates that we are referring to both concepts.

Figure 2.2
JIT/AOT as an Enabler



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Challenges. However, JIT/AOT could increase the need for training development (to the degree that new material is needed), and it is likely to increase the training-management burden for TASS, the Army, and units. Further, JIT could potentially create another force-wide management burden due to the need to coordinate appropriate training with personnel assignments. In particular, switching to JIT/AOT could significantly reduce the flexibility afforded to the personnel assignment process by more complete training. Currently, the personnel community can assign soldiers to MOS positions based on immediate Army needs at the time they have completed training; in other words, soldiers can be assigned to positions at the last minute. However, if JIT/AOT trains only those MOS tasks needed in the next assignment, assignments may have to be determined before training begins, possibly even weeks or months in advance of their execution.

Technology Can Increase the Army's and TASS's Ability to Develop, Deliver, and Manage Training

New training technologies can potentially assist TASS in all three of its roles: training development, training delivery, and training management (see Figure 2.3).

Indeed, a broad spectrum of technologies can be used to support instructional designers, training-product developers, trainers, students, managers, and evaluators of training. Table 2.1 lists the classes of technology that might be used to increase training potential at each stage of the process. A more complete explanation of the roles of specific training technologies and their potential payoffs is provided in Appendixes A and B.

Figure 2.3
Technology as an Enabler

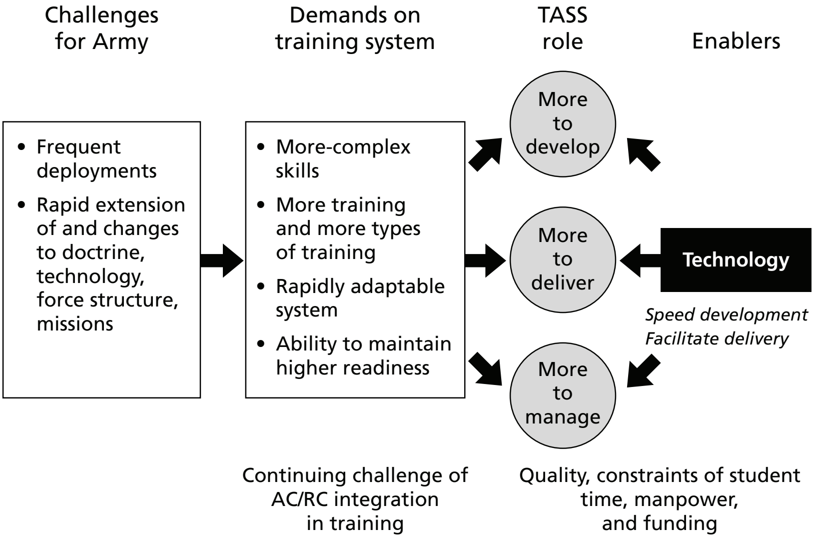

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Table 2.1
A Typology of Training Technologies to Support Training Development, Delivery, and Management

Training Role	Available Technologies
Development	Instructional design and instructional authoring software suites Cost-estimation tools Media tools and graphical rendering tools Programming environments, including programming languages and database languages Assessment systems Quality-assurance (QA) tools
Delivery	Collaboration environments Content delivery systems and technologies Training-implementation technologies Computer-based training (CBT) or interactive multimedia instruction (IMI) Intelligent tutoring systems (ITSs) Training simulations (constructive and virtual) Training simulators Collaborative learning tools
Management	Learning management systems. Usage-tracking tools

Development. Technology can be used to speed the training-development process. For example, it can increase the productivity of training developers in conducting needs analyses, designing training content, and developing training products. Although most training technologies are relatively immature and not effectively integrated, their capabilities are improving. In the past five years, advancements have been made in the tools used to support training development, including programming tools and environments for animated graphics and simulations. In many cases, what used to require a large special-effects budget can now be done inexpensively on a personal computer.

Management. Technology can also assist the training-management process. For example, the Army's investment in its Learning Management System (LMS), which it plans to interface with the new personnel system, the Defense Integrated Military Human Resource System (DIMHRS), will allow both the training required by individual soldiers and the training completed by them to be centrally tracked.

Delivery. Two main types of technologies are relevant to training delivery: those that store and provide training content to the student (i.e., the “pipes") and those that implement training (i.e., technologies that allow learners to interact with instructors, other learners, or media). With regard to the former, technology is already providing dramatic payoffs to businesses and educational institutions through content delivery systems and related technologies. For example, the now common delivery of training products via the Internet eliminates many of the problems associated with the distribution of media, including the need to make multiple versions of a training product available for different platforms and the need to replace physical media for every update or change to a product. The Army is also seeking to manage huge repositories of training materials for quick and easy access all over the world and to use networks to establish connectivity among training domains.

Technologies to implement training are also providing payoffs. IMI is an asynchronous method of implementing training that assists students by guiding them through lessons, providing multimedia content, and allowing some preprogrammed interactivity within the training module. IMI is developing at a rapid pace and promises to enable students to learn more tasks and skills and to learn them more quickly. Virtual and constructive simulations are also supported by technology. Simulations can be used to increase the frequency of experiential training exercises and to enhance the Army’s ability to teach leader adaptability and train leader skills in planning and conducting operations in complex environments. Advances in artificial intelligence (AI) capability are improving the training value of both IMI and simulation technologies.

Challenges. Despite the significant promise of technology, there are challenges inherent in using it to deliver more training. Perhaps most important, using training technologies for delivery creates an additional development burden, part of which comes from the need to develop and maintain a large set of current scenarios for virtual and constructive simulations. Modeling of friendly, enemy, and noncombatant forces to allow automated or semiautomated behaviors and the development of automated diagnostics and AAR capabilities are also resource-intensive. The requirement to convert training content into effective IMI software programs is likewise additive, and updating materials and tests is a more time-consuming function than that for traditional instruction. In addition, the training-development cost of developing IMI increases dramatically for training tasks and skills at higher levels of complexity.

In addition, both IMI and simulations are suitable for only certain kinds of new training. For example, IMI is currently best suited for some of the knowledge and comprehension levels of learning; it is less well suited to achieving higher levels of learning, such as synthesis and evaluation.[8] Moreover, while technology increases what students can learn without an instructor, some students will require additional computer-skills training to effectively use IMI. Finally, even AI capabilities are not likely to allow simulations (or advanced IMI systems that employ intelligent tutors) to reach standalone capabilities for training most complex tasks, either now or in the 2010–2020 time frame. A more detailed review of the capabilities of simulations and AI is given in Appendix B.

A More Decentralized TASS Can Increase Training Effectiveness

The final enabler we identified is decentralized training, individual training that takes place away from a centralized schoolhouse. As discussed in Chapter One, TASS provides a large part of its training (including the majority of individual training for AC soldiers) through

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[8] These terms referring to levels of learning come from Bloom's taxonomy. In the early 1960's Benjamin Bloom led a committee of experts that identified three domains of learning: cognitive, affective, and psychomotor. Trainers often refer to these as the learning goals of knowledge, attitude, and skills. Within the cognitive domain (which involves knowledge and the development of intellectual skills), the committee further subdivided learning into a six-level hierarchy that begins with the simplest (or least difficult) learning goal and proceeds to the most complex (or most difficult). Further, embedded in the hierarchy is the idea that one level must be mastered before the next one can take place. The six levels are knowledge (i.e., recall information from memory), comprehension (i.e., understand meaning enough to restate in own words), application (i.e., apply a concept to a new situation), analysis (i.e., logically separate concepts into component parts for increased understanding), synthesis (i.e., build a new concept from diverse elements of known concepts), and evaluation (i.e., make judgments about the value of related ideas or materials). See Bloom, Mesia, and Krathwohl, 1964.

centralized proponent schools. We evaluated how TASS's training effectiveness might be improved if more training were provided at locations other than the proponent schools. To assess the potential of decentralized individual training as an enabler for TASS, we considered three options for decentralization:

- **Training conducted by operational units.** Units are currently responsible for conducting individual training in specific areas that are not covered through institutional means but are needed by soldiers and leaders to perform in their assigned positions. Units are also responsible for providing individual training to sustain soldiers' capabilities in tasks and skills already learned.
- **DL supported by training technologies.** In The Army Distributed Learning Program (TADLP), individual training is delivered to soldiers via the Internet, CD-ROMs, and other means. Currently, this training is provided primarily to RC soldiers. Collaborative technologies also support communication between centralized instructors and decentralized students. In addition, DL is supported by technologies that provide ready access to training materials and that, at least eventually, will connect the training domains.[9]
- **Training conducted by local TASS manpower.** Some TASS instructors and other staff conduct face-to-face instruction at unit locations rather than at proponent schools. These training staffs are either permanently stationed at the unit location or travel for temporary duty. This option is widely used by RC TASS, where instruction is often conducted in or near soldiers' weekend or annual training locations.[10]

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[9] See Appendix A for a more complete explanation of training technologies.

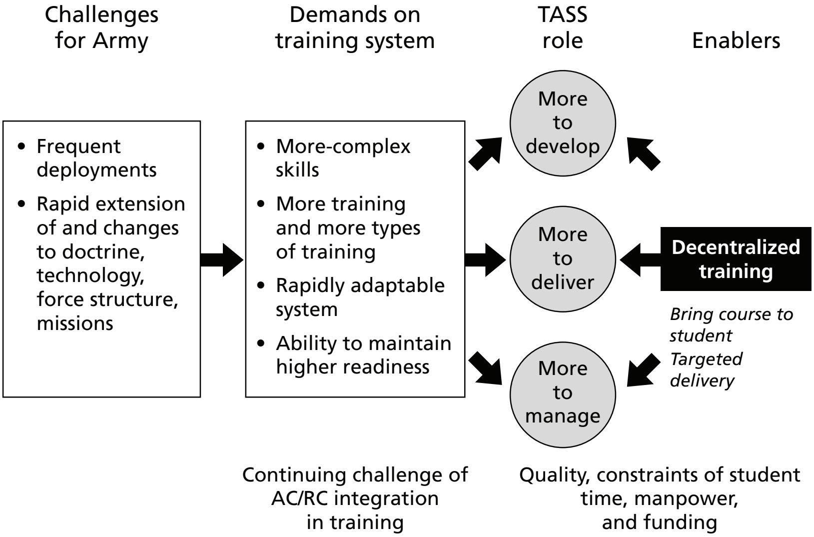
[10] Use of this option for the AC can be seen in New Equipment Training Teams (NETTs) and Mobile Training Teams (MTTs). The Army has also occasionally established specialized TASS organizations at unit locations, e.g., an air assault school at Fort Campbell and training organizations at Fort Lewis to support Stryker Brigade Combat Team (SBCT) training.

These three options are not mutually exclusive. For example, training technologies can be used in combination with the other two options. Figure 2.4 highlights some of the advantages of the three decentralized training options.

Decentralized training can help TASS in meeting all three training challenges—developing, delivering, and managing.

Development. Training conducted by local TASS manpower could potentially help TASS address the development challenge. By observing, supporting, and understanding unit training and operational practices and methods, local TASS personnel could provide quick input to proponent schools to update doctrinal and training products, thus capturing the informal training-development activities of the field. They could also provide feedback on the adequacy of doctrine and courses.

Figure 2.4
Decentralized Training as an Enabler



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Management. All forms of training decentralization could address the extra management burden created by JIT/AOT. In particular, decentralized training allows JIT/AOT to be delivered to soldiers and leaders after they are assigned to new positions and at the locations of their new assignments.

Delivery. Decentralized training could allow TASS to greatly expand the number of locations and times at which training can take place. The added flexibility would allow much more training to be delivered in the time available to soldiers.

Advantages and Challenges. Because each type of decentralized training has different advantages and drawbacks in delivery, we consider each separately.

Technology-supported DL. Technology-supported DL adds the greatest amount of flexibility for the soldier, in many cases allowing training to take place anytime and anywhere. Moreover, IMI and online training libraries provide the greatest potential for training standardization, because once the technology delivery systems are developed, every student gets the same instruction. The largest limitation to technology-supported DL is the associated training-development cost, which is considerably higher than that of face-to-face instruction by experienced instructors, who can provide effective instruction and make needed changes in course content even with only general guidance in course materials. In addition, only a portion of most courses is suitable for IMI (or other technology-based delivery means) at reasonable costs. In particular, technology-supported DL appears much more useful for gaining knowledge than for knowledge application and synthesis.

Unit training. Individual training conducted by units (in contrast to institutional training) provides soldiers with greater flexibility and efficiency, since the instruction can be integrated with unit training and targeted to the skills and tasks most needed by the organization. Such training also has the advantage of providing a collective (or "real world") setting in which soldiers and leaders can learn within the context of their actual positions in the organization. However, unit-conducted individual training becomes inefficient when it cannot be effectively integrated into collective training, and it can fall below quality standards when it cannot be properly supervised. Such instruction (like technology-supported DL) also adds significantly to training-development costs, as TASS must provide effective TSPs to facilitate preparation of the training by unit instructors.

Local TASS instruction. Local TASS instruction gives soldiers another way to obtain individual instruction without the travel costs and relative inflexibilities of centralized training. It has the unique advantage of providing an effective link between proponent schools and units at times when effective feedback between the two is needed for training success. Moreover, it can efficiently and effectively combine with a unit-based individual training program by filling in what units cannot easily provide on their own (e.g., quality control, targeted TSPs, supplemental instructors). One disadvantage of local TASS instruction is a potential loss of scale economies. This might occur, for example, if permanently stationed staff cannot be fully utilized, if extra equipment or facilities have to be procured, or if more training overhead is required. Moreover, maintaining training quality can become problematic for dispersed training sites. Finally, there is currently no organizational structure for carrying out such training in the AC context. While the RC already has an extensive distributed training system in place, the AC is only just beginning to use decentralized TASS manpower (e.g., in SBCT training).

This Report Examines Three Key Challenges in More Depth

This evaluation of key enablers provides a brief view of some of the options available to TASS to meet current and expected future training demand. As this discussion has indicated, the effective use of any of the enablers will require TASS to overcome some significant challenges. In this study, we were not able to examine all of the issues associated with these enablers at great length. However, to provide a more detailed view into how TASS might address some of these challenges, we selected three issues of particular importance (these issues are examined in detail in the next three chapters[11]):

- **The need for TASS to build a more responsive training-development capacity.** Our evaluation indicates that training technologies, including technology-supported DL, have an important role to play in helping TASS meet the demands for new and more kinds of training. However, as indicated above, increased use of training technology is likely to significantly increase the development burden on TASS. Meeting this challenge will be particularly difficult given the acknowledged shortfall in current training-development resources.[12] To explore these issues further, we focus in Chapter Three on how TASS might meet the training-development challenge in an important area, IMI technology.
- **The need for TASS to develop a more effective local training system.** Our evaluation of training decentralization options considered various ways in which TASS might expand training capabilities through increased use of decentralized delivery methods, including unit training, DL, and deployment of TASS manpower at units and other dispersed locations. Although current TRADOC plans largely focus on DL, we believe the other

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[11] While JIT/AOT is not identified in this report as an area for additional analysis, we believe our analysis of current RC reclassification training (see Appendixes C and D) holds lessons for solving the management issues that arise with JIT/AOT. In particular, both areas require close coordination between Army personnel systems and training systems in order for training to be accomplished in a timely way. A set of well-defined metrics might be used to help guide units, training institutions, and personnel organizations in maintaining training readiness.

[12] During the interview phase of our project, we obtained consistent feedback from TRADOC staff, school staff, Mission Support Training Facility (MSTF) staff, and units regarding the significant shortfalls in current training-development capability. These shortfalls occur especially in updating resident courses to account for emerging concepts and technologies (e.g., command, control, computers, communications, surveillance, and intelligence [C4SI] systems and Support Operations and Stability Operations [SOSO]) and in obtaining relevant training development products for training conducted outside resident schools (e.g., individual training conducted by RC schools and by operational units, individual training conducted through DL, and collective and leader training conducted by units).

two options have a significant unexplored potential to help TASS meet training needs. In Chapter Four, we discuss how a system of local TASS schools not only could add to overall TASS capacity for delivering training in its own right, but could also reduce the risk and optimize the output of the other forms of decentralized training, as well as help TASS meet other challenges.

- **The need for TASS to achieve better integration between AC and RC training systems.** One task of this research effort was to identify ways to improve the integration of the AC and RC training systems. The need for improved integration has remained a continuing challenge for TASS. The evolution of training technologies and organizations to satisfy future training requirements suggests both greater benefits from training system integration in the future and a wider role for the RC portion of TASS. Moreover, the development of a system of local TASS schools that serves the entire Army will naturally foster cost-effective AC/RC training-system integration and appropriate training-resource consolidation. These issues are discussed in Chapter Five.

CHAPTER THREE

Improving the Training-Development Process: Building More-Responsive Capacity, Quality, and Productivity

In this chapter, we discuss a key aspect of meeting the training-development challenge. An examination of the entire training-development process was beyond the scope of this project, so we focus on IMI, which the Army plans to use for a substantial portion of its future force training.[1] IMI is currently and will continue to be the least expensive and most prevalent type of interactive instruction available.[2] It is also the type of technology-based instruction the Army currently uses most broadly.[3] Although we focus on IMI, we acknowledge the importance to Army training of other types of technology-based approaches, including live, virtual, and constructive simulations. In fact, many of the findings and recommendations concerning IMI also apply to developing simulation-based training.

In developing IMI training, TASS could benefit from understanding and emulating software-development and software-publishing organizations in the private sector, which have already faced many challenges similar to those now facing the Army. TASS could also benefit from integrating technologies that can assist not only with the IMI training-development process, but also with the development of classroom/face-to-face instructional materials (e.g., via Internet access to shared materials for TSPs) and virtual and con-

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[1] See Annex F of U.S. Army, 2003b, which notes that 50 percent of the Army's technology-based instruction is IMI.

[2] See Rossett, 2002.

[3] Based on an informal review in 2002 of courses in the Reimer Digital Library.

structive simulation-based training materials (e.g., writing and sharing scenario descriptions, initial orders).

Training Development Under TASS Could Gain from Understanding and Emulating Software-Development and Software-Publishing Organizations

By 2015, a large proportion of TRADOC's training will probably be delivered through IMI or other software. It follows that TRADOC's training-development and -delivery community could gain insights about developing, delivering, supporting, and managing quality software-based training products from software-development and software-publishing organizations. To succeed, those organizations must stay aware of customer demands, must react quickly to changes in those demands, and must produce high-quality products with speed and efficiency.

Similarly, TASS can benefit from understanding and addressing the needs of its two key "customers": units and individual soldiers. TASS must consider the needs of both of these customer groups in developing its training products and must be prepared to resolve conflicts that may arise between their differing needs. It must listen to representatives from both groups and include their perspectives in its software-development processes.

Our analysis has identified three ways in which TASS can benefit from ensuring that it uses a version of private industry's approach to software development and publishing in the development of its software. These concepts are relevant whether TASS develops the software itself or uses a commercial software developer:

- Embrace the best practices used by software-development and software-publishing organizations to satisfy fast-changing customer needs.
- Adopt an overarching organizational model similar to that used by software-development and software-publishing organizations to ensure quality products.

- Adopt new methods and team structures in the software-development process to increase speed and efficiency.

Before we discuss how TASS might incorporate these concepts, we must first consider two models for providing software products, each of which has different implications for organizational structure and for those functions that are resident in the organization or are outsourced:

- **Software-development organizations.** In this model, most resources are organic to the organization, including market research, software product design and development, QA, marketing, sales, software maintenance, and product support.
- **Software-publishing organizations.** In this model, some functions, such as market research, contracting, oversight of software production, QA, marketing, and sales, are usually organic. Other functions, including design, development, software maintenance, and product support, tend to be outsourced. Software publishers often work closely with subcontracted software-development organizations to ensure that high-quality products are produced.

Most software organizations represent a hybrid between these "pure" versions of the models and include both in-house and outsourced activities; moreover, there is great variation among organizations.

The Army currently uses both models. For example, some schools include small curriculum-development/programming teams that develop technology-based training in the form of IMI. However, in the majority of cases, the Army appears to contract with software-development organizations to provide IMI-based training content. Both kinds of models can be appropriate for the Army, given its need for rapid turnaround of some products along with its need for longer-term or larger projects that require larger development staffs.

Although this chapter focuses on practices used by software-development companies, an understanding of such methods is useful even for Army organizations using the software-publisher model.

Understanding rapid development methods can help Army training "publishers" carry out several tasks, including

- contracting for well-integrated support of training products
- appropriately funding the life cycle of software products
- providing appropriate, highly integrated oversight of product development
- providing appropriate QA testing.

We will next identify several key practices that TASS should use in the development of its IMI software.

Software-Development Best Practices Can Help Satisfy Fast-Changing Customer Needs

The ways in which software-development organizations view the development, delivery, and management of their products have some potentially important implications for the ways training software might be developed, delivered, and managed to provide large-scale, effective training for the current and future Army. Of particular importance is the need to adopt practices that allow products to be adapted over time to meet changing customer needs. TASS needs to ensure that such practices are used in the development of its training software.

Software-development organizations generally view their products as continuously evolving: The products have long life cycles, must evolve in response to changing customer needs, and must be continuously supported and maintained. Success requires an ability to react quickly to changes in market demand. The commercial sector has established several important requirements for the software-development life cycle, as described below.

Rigorous quality assurance is a must. To ensure the reusability of software components, ease of maintenance, and the ability to test and evaluate them, quality cannot be "inspected in"[4] at the end of the development cycle—it must be designed from the outset.

High-quality hosting is necessary if a product is to be used via the Internet. Web-based software must be capable of supporting "24/7" access around the globe.[5] If a user goes to a website that has poor performance or finds that the site is down, he or she will return only so many times before giving up on the site.

Organizations that provide their services or content via the Internet, whether as retailers (e.g., amazon.com), brokers (e.g., ebay.com), or training content providers (e.g., Skillsoft.com, MIT's Open Courseware at ocw.mit.edu), understand the importance of accessibility and reliability. Such organizations often outsource the hosting of their websites to organizations capable of providing state-of-the-art support. Among the key features of high-quality support are redundant servers with automatic roll-over, maximum bandwidth into and out of the hosting facility, and proximity of the served content to the client machine that requests the web-based content.[6] High levels of accessibility and reliability can also be ensured by locating server facilities (known as server farms due to their racks upon racks of servers) close to the Internet backbone and pushing frequently accessed content to the "edges" of the Internet by collocating content servers with ISP servers close to users. These organizations recognize the importance of appropriately allocated resources to support high performance.

Customers require effective support and resources for using the content. Customers require support to understand website content and to use the enabling technologies. For example, if a customer using an income tax preparation program notices that part of the software (e.g., the video regarding whether or not to write off part of

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[4] See McConnell, 1996.

[5] See Schank, 2002.

[6] For example, content for Toyota Japan would be housed in server farms at locations in the Far East, while that for Toyota North America would be housed in the United States. The general goal is to host content using the fewest "hops," or router handoffs, between the client machine and the server.

one's home as a home office) appears not to work, he or she can call an 800 number or go to a customer-service area of the company website for technical support. The customer can use similar support mechanisms to pose questions about content, e.g., to find out how a deduction is amortized. Responses to content questions typically do not have to be immediate, although customers appreciate responsive service. Dedicated, well-trained, accessible support staff are essential. Although sophisticated computer users might have success mining the online product-support sections of software company websites, less-sophisticated users need to talk directly to a person to get their questions answered.

Software requires continuous maintenance and updates. Software products are released in versions, each of which builds and improves upon prior releases. Software developers know that every software product contains some bugs that must be discovered, tracked, and fixed.[7] When enough bugs have been fixed or a critical flaw has been identified and fixed, then either a software "patch" or a new version of the software is released. With software updates available on networks (including the Internet), updating software becomes a nearly continuous process.

Because software is never "finished," it does not have to be complete before it is released. For example, given the time constraints involved in launching a piece of software, companies often decide to include certain features only in later versions or to release software with known bugs, typically noncritical ones.[8]

The Organizational Model Used by Software-Development Organizations Can Help Ensure Quality Products

TASS's approach for developing, delivering, and managing its training products can also benefit from ensuring that the organizational model it uses provides adequate opportunities for quality control, customer feedback, and updates. To examine how the software

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[7] See England and Finney, 1999; McConnell, 2004.

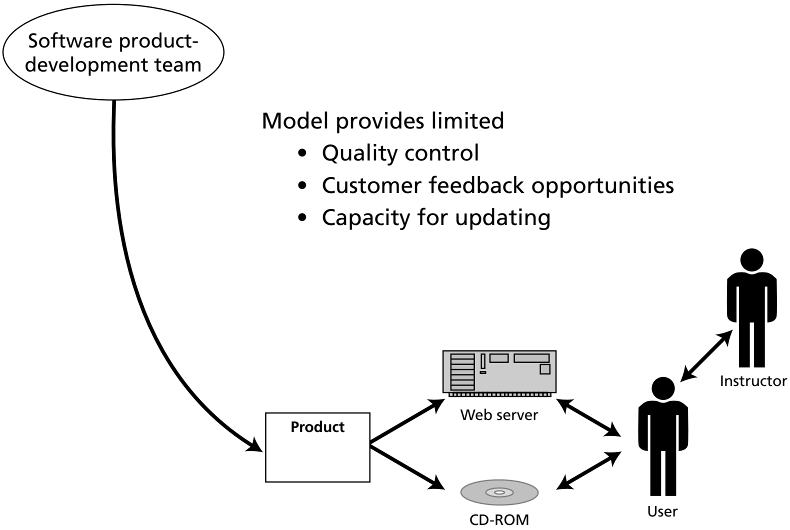
[8] See McConnell, 2004; Strauss, 1997.

development-delivery-management cycle can flow effectively, we consider two models.

We first need to look at some of the problems that organizations can encounter in the software cycle. Figure 3.1 shows a simplified depiction of a common, but less-than-effective, model for training-software development, delivery, and management. This model is often found in small, less-formal organizations.

The methods and processes pictured in Figure 3.1 are generally informal. The software-development team creates a curriculum using whatever tools are available. The software is then transferred to CD-ROM or a web server, where it is accessed by users, sometimes in conjunction with input from an instructor. These informal methods tend to be used by organizations that have severely limited resources (time and development dollars).

Figure 3.1
Simplified Illustration of an Informal Model of Software Development, Delivery, and Management



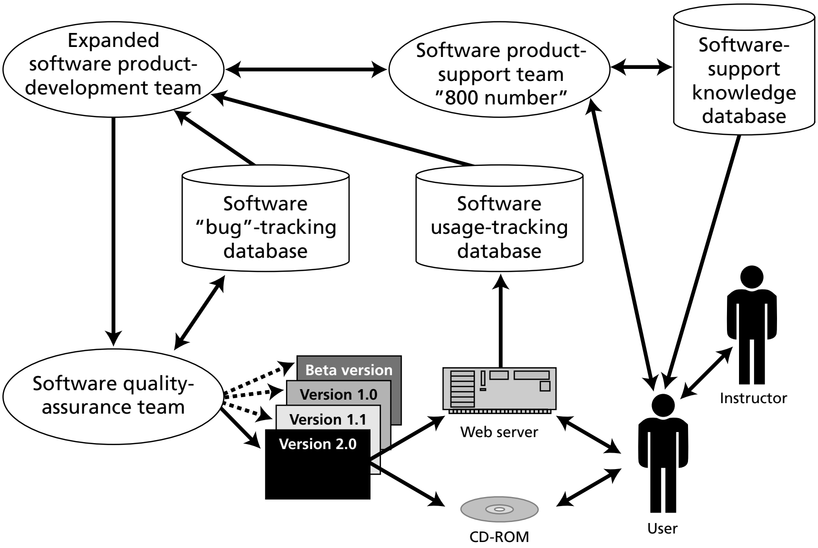
RAND *MG328-3.1*

This model provides limited opportunities for quality control. There is little if any feedback from the learner or course administrators about how the course is performing in terms of content effectiveness or technical aspects. With limited feedback and possibly no funding for software maintenance, the course software is never really updated for later versions.

An alternative model for software development, one that incorporates the best practices of leading software-development companies,[9] is shown in Figure 3.2. This more-robust model includes several key features to ensure the effective development, delivery, and management of training software.

An expanded software-development team. An effective software-development team includes software users as well as cur-

Figure 3.2
A Software-Development Model with Proven Technologies and Practices



RAND *MG328-3.2*

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[9] See McConnell, 1996.

riculum designers, web programmers, subject-matter experts (SMEs), database programmers, and any other specialized programmers (e.g., for dynamic graphics/animations or simulations).

A separate activity to provide quality assurance. Whether working as individuals or as a team, QA personnel are not part of the development team and do not report directly to the software-development organization. The separation of software evaluation from software development facilitates honest evaluation and consequently higher-quality software. This does not mean that there is animosity between the organizations; indeed, there should be close collaboration and communication between them.

A team to support the technical and content questions associated with using software. Human support is key to overall effective software-support resources (including web-based information) and customer satisfaction. Support teams not only help the users, they also provide extremely valuable feedback to the development team on how the product is actually being used and how it can be improved. For example, what might have initially been deemed an insignificant known bug in a release could end up being a significant source of calls to software support.

There are many options for providing support. Among the most popular are

- free 800-number call centers available 24/7
- annual corporate accounts that contract for call-center support to a specific organization
- by-the-minute fees for expert customer support.

Customer support organizations can be geographically distinct from the development team, but they need to communicate regularly; in fact, daily communication is required in the early weeks of the release of a new version. Software support can also be outsourced to call-center support providers.

Databases and database-access tools. The software life-cycle model in Figure 3.2 includes three distinct databases and database-access tools to improve the quality of the initial software development, customer support, and usage tracking for web-based software:

- **Bug-tracking systems.** A number of companies produce specialized software to support the development and QA processes of commercial software-development efforts. As bugs are either encountered by the QA team or reported by the software-support team, they are entered into the bug-tracking system and assigned ID numbers as well as initial classifications. As progress is made in resolving a software problem, the record of the bug caused by that problem is updated, with information included about the eventual solution or the ways in which the bug was "squashed." Experience has shown that organizations that produce software of any complexity need to be careful in tracking, categorizing, and assigning importance to bugs, as well as in fixing the software problems.
- **Software-support knowledge base.** The software-support knowledge base is the repository for all information relevant to a software application, both technical features and content. When providing support to users, the software support team uses this database to identify similar problems and learn about their subsequent resolution. When a caller describes a problem, the customer-support representative typically uses a keyword to begin a search of the software-support knowledge base. The knowledge base is updated regularly with new information about common problems, solutions, and workarounds. Customer-support representatives often receive updates from the knowledge database regarding new fixes or reported problems when they log on for their shifts. The same knowledge databases are also often available to the user for keyword searches via the Internet.
- **Usage-tracking databases and analyses.** Web-based software provides developers with a unique opportunity to gain detailed information regarding how their content is being used. The standard logging capabilities built into web servers provide a potentially rich database about who is touching the software, for

how long, and on what pages, and about what users are selecting and where they exit the application. This information can be invaluable for improving the effectiveness of the course content.

For example, say that a specific web-based IMI course has a dropout rate of 20 percent. A review of the logged usage data shows that all 20 percent of those users drop out of the application at the same web page; this provides a strong indication that something connected to that web page is making users opt out of the course. Knowledge of when or where users drop out does not indicate *why* they are exiting the application, but it does provide a pointer to a potential problem area which then can be studied further through focus-group input or other means.

Usage-tracking data can be gathered, aggregated, and analyzed by near-real-time analytic tools at very low cost. Although such logged data are rarely used to evaluate the usage of web-based training applications, these data have been of great interest to the marketing community, which has incentives to understand the behavior of buyers on retail websites. There is a large and growing market of software packages that allow marketers to quickly analyze web-usage logs.

Multiple versions of training content. The final aspect of this software-development model that is significantly different from the model presented in Figure 3.1 is the assumption that there will be multiple versions of any piece of software. At its initial development, software should be Beta-tested by a sample of sophisticated future users. This testing allows developers to get pre-release feedback on all aspects, from interface design to the product's ability to provide value to the consumer. It is assumed that the initial release of the software will be followed by later releases that include fixes, patches, and new features.

New Methods and Team Structures Can Increase Speed and Efficiency

Specific methods used by software-development teams in private industry have proven valuable for increasing speed and efficiency without compromising quality. In this section, we examine new methods of rapid development and project-based, short-term teams, both of which can speed up and potentially improve the effectiveness of the IMI training-development cycle.

All curriculum development has certain basic steps or phases, listed below:[10]

1. Analyze training needs and define learning goals.
2. Design training, choose methods, and estimate costs for development.
3. Develop training and training products.
4. Deliver training to the trainee.
5. Implement training by having the trainee use the materials and interact with instructors.
6. Manage the training by capturing and recording training outcomes and gathering data on how the content is being used.
7. Evaluate the content by analyzing the training effectiveness in detail and evaluating the usage patterns of the content.

The final evaluation step then feeds back into the next iteration of training development.

New methods the Army could potentially use to speed up this cycle of training development (and potentially make it more efficient) come from a growing movement in software engineering called Extreme Programming, or XP.[11] The XP method draws strongly on research and development efforts in traditional curriculum design, product development, and software engineering. XP offers a disciplined approach to software development that has been used by a number of large corporations, including Ford, Daimler Chrysler, and Credit Swiss Life. Although methods for implementing XP vary greatly, they typically share several common features, discussed below.

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[10] A similar list is included in U.S. Army Training and Doctrine Command, 1999.

[11] See Baer, 2003; *Extreme Programming: A Gentle Introduction*, 2004.

A particular usefulness with certain types of software-development projects. XP is best applied to projects that are not very technically detailed (such as the development of training software, as contrasted to F-18 target-acquisition-radar software). XP methods also work best with projects that have dynamic requirements, i.e., projects for which the requirements will be refined or changed across the course of the development. Such projects also often emphasize early customer involvement, from which they gain useful input for decisionmaking concerning the inevitable iteration. XP emphasizes many rapid, small cycles of "design, implement, test" throughout the development effort.

An emphasis on designing for reusability, as appropriate. XP methods emphasize the development of reusable components of code. XP supports this goal through close collaboration between the coder and other teammates or fellow programmers, who assist in keeping the coder focused on both the code development at hand and the "big picture" of what the software aims to achieve. In some cases, design for reusability can be significantly eased if appropriate decisions are made early in the development of components or content objects. Once a design is well under way, it is typically much more difficult to reengineer content for reuse.

The physical, close-proximity collocation of development teams. One of the classic methods for speeding up development processes (or any process, for that matter) is to reduce the number of delays and handoffs involved. One way to minimize delays is to collocate development teams at adjoining tables in the same room, so that developers can literally reach out and touch one another. This technique offers the opportunity for immediate guidance and feedback from teammates. Instead of having to schedule a meeting—with all the concomitant delays that can be involved—developers can raise an issue almost immediately, discuss it with relevant players around the table, and resolve it.

Taking this approach to a radical extreme, some advocates of XP actually have two senior programmers share a single computer and program together, one at the keyboard carrying out the coding and the other sitting next to the coder, watching, consulting, questioning, and providing input while the code is being written.

Tight, intensive management of the programming effort. XP projects are often aggressively managed through daily gatherings to establish goals for each team member. Progress toward these goals is then discussed at end-of-day progress reviews, when new goals are set for the next day. Regular meetings allow for close management of progress and identification of potential delays, and they also provide social/group motivation for setting and meeting aggressive but achievable goals. This kind of intensively managed project operation might not be sustainable on a year-round basis without talented teams and managers. Some groups use these methods for short (several-month) projects and then revert to more traditionally managed projects to prevent burnout.

Multiskilled teams with customer representation. Designing and developing quality training-software content and even moderately complex IMI content requires, by definition, a variety of skills that come into play at different stages of the process. Project-based, multifunctional teams are therefore needed. Central to the team is a technology-savvy curriculum designer who might also be the project/team manager. This person typically negotiates and arbitrates the many tradeoffs inherent in the development effort while also keeping track of the potential impact on the learning and training effectiveness of the product. On a dynamic team, team members—including programmers, database administrators, designers/graphic artists, web developers, and customer representatives—often express strong opinions. Effective leadership can ensure the appropriate allocation of project resources and can help meet the overall training goals of the curriculum.

How might the Army adapt XP methods to meet its own needs? To answer this question, we must keep in mind the difference between the training cycle outlined in TRADOC TR 350-70 (U.S. Army Training and Doctrine Command, 1999) and that implied by XP. Perhaps the biggest difference lies in the speed of development, including piloting and revisions. TR 350-70 defines a process for developing training content that, in practice, can literally take years to carry out as specified. In contrast, XP achieves speed by collocating teams with the appropriate expertise (including SMEs and members of the user community) and tightly managing the development process. In addition, design for reusability is not currently a hallmark of the processes in TR 350-70, but it is an important idea behind XP.

The process defined in TR 350-70 allows for some flexibility in implementation. Proponents of the regulation will assert that when necessary, the time needed to complete a process can be condensed from years to months. In addition, anecdotal evidence from people in the Army training-development community suggests that the process may not be followed to the letter, with 350-70 being instead used as a "reference book." Indeed, the Army often requests that its commercial development providers turn training content from ideas into materials quickly.[12] Shortcuts and skipping steps in detailed instructional design processes are advocated, whenever appropriate. In this context, use of an approach like XP would provide TASS with reasonably high-quality training materials that are developed in days or weeks instead of months or years.

New Supporting Technologies Can Further Improve the Speed and Efficiency of IMI Development

TASS can also benefit from new technologies that are available to speed and rationalize the process of developing web-based training products. Although multimedia training software[13] has been authored for decades, current web-based standards (e.g., HTML, DHTML) and products to support development of web-based software are only seven or eight years old. The markets for these tools are still immature, but they are beginning to grow, and a trend toward the convergence of training-development technologies will soon dramatically increase the technologies' overall utility.

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[12] See Piskurich, Beckschi, and Hall, 1999.

[13] HTML-based content can also be delivered by CD-ROM in many cases.

A Number of Training-Development Technologies Can Be Incorporated into Current Software-Development Processes

Several kinds of technologies, discussed in this section, are available to support rapid training development.[14]

Instructional design and authoring tools. A variety of commercial software applications can support the analysis and design steps in the training-development process (for either technology-based curricula or traditional curricula). These instructional-design/authoring tools assist in structuring the curriculum's objectives and outcomes. They can also be used to assist in defining learning goals and in linking those goals to methods and interventions, and subsequently to assessments.[15]

Cost-estimation tools. Cost-estimation tools enable rapid estimates of the instructional approaches and media that can be incorporated into training to teach certain skills while remaining within the project budget. Every commercial firm has internal costing tools, and academic researchers are exploring how estimation tools might be used in training development.[16]

Cost-estimation tools could help determine how much it might cost to produce 10 minutes of moderately high-quality instructional video to demonstrate how a component should be disassembled; encode and stream a video over the Internet to 1,000 learners; or create a simple animation of a moving part on a mechanism. Such tools could also be used to identify the most cost-effective media to use for certain learning objectives, expected student load, and project budget. Granted, the typical, and often the most appropriate, response to the question, "How much does it cost?" is, "It depends."[17] However, even if a complete answer to this question is not possible, there are

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[14] See Appendix A for further information.

[15] See Nantel, 2003.

[16] See Clark, 2002; Sugrue and Clark, 2000.

[17] The commercial provider's answer to the question, "How much does it cost?" is often, "How much do you want to spend?"

bounds to development costs that well-informed customers should know and leverage when designing training content.

Web-development tools. A number of commercial, highly sophisticated suites of software are available to speed up and otherwise support the development of web-based content. Macromedia's Dreamweaver and Microsoft's Frontpage account for large shares of the market and offer a wide variety of templates, drag-and-drop authoring, and debugging support, among other features.

Content-management systems. Content-management systems can organize, protect, track, and document changes to software. They can also provide automatic "builds" of software systems from components, providing control over what has changed between versions. The content-management system stores all the code (on either a local server, an intranet server, or an Internet server), which can be "checked out" for work and then "checked back in" after changes have been made. Without the disciplined use of these tools, there can be little control over the quality of code written or the versions of software releases.

Quality-assurance tools. QA tools speed software testing. Systems are available to automate the process of finding unconnected links, identify problems with the code, and provide graphical site maps of the overall website structure for debugging. Other suites of tools provide capabilities for testing whether web-based code meets specifications for platform, operating system, browser, and other plug-in compatibility.

Assessment systems. Assessment systems automate the process of developing student assessments. For example, they can help to automate the creation of different question types for online applications and to implement computer-adaptive testing to make assessment faster and more accurate.[18] In addition, these systems provide seamless hosting of the assessment items on a separate server and also collect, store, analyze, and report the data.

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[18] See Van der Linden and Glas, 2000; Wainer, 2000.

Although some of these tools are being widely used in the software-development industry, we saw little evidence of use within TASS. While most of the costs of acquiring, installing, and maintaining the tools tend to be relatively high, the investment can pay off in reduced development time and higher-quality products. Developing proficiency in using the tools can require a substantial investment of time and effort, and consistent use would be required to keep skills fresh.

Our assessment suggests that three of the tools described above would be most important for assisting TASS in its efforts to improve the speed and efficiency of IMI courseware development. Cost-estimation tools will allow the design team to make tradeoffs to get the most instructional "bang" for the course-development dollar. Web-development tools can provide significant increases in speed over the "cottage industry" approaches used in many small development organizations, where web programmers still write and debug their code by hand. Finally, content-management systems will allow shared, protected access to the training content. While perhaps of only marginal use in the short term for individual products, content-management systems will be necessary to realize large future payoffs in training development via content reuse. The longer-term promise of savings from reuse of content via "learning objects" that comply with evolving standards (e.g., the Sharable Content Object Reference Model [SCORM]) will be realized only if developers learn to work with content-management systems to establish effective object repositories. Such repositories can allow collaboration face-to-face or at a distance to revise and adapt training content for alternative uses, even long after the initial development phase.

TASS should begin now to modify processes to incorporate the use of content-management systems. Moreover, this should be done in the context of a larger effort to design training content in a way that maximizes the possibilities for reuse. More broadly, to make effective reuse possible, the following questions need to be answered within TASS:

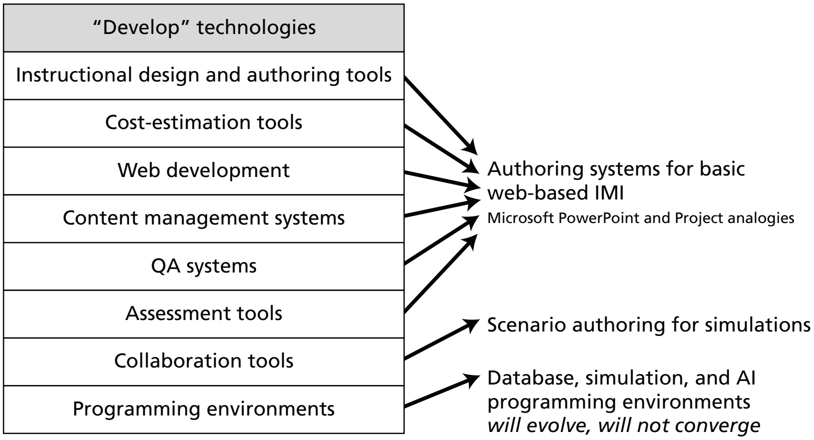
- How can training be efficiently and effectively designed for reuse?
- How can training content be indexed in ways that allow retrieval of desired objects?
- How can content best be shared? How can different models of content repositories be leveraged?
- What incentives can be created to encourage training developers to design for reuse and to share content?

The Trend Toward Convergence of Training-Development Technologies Will Greatly Increase Their Overall Utility to TASS

Long-term trends in training-development technology hold further promise for productivity gains within TASS. Although developed to support different aspects of content development and web-based training, many of the tools discussed above are rapidly converging into more-general "authoring systems" (see Figure 3.3), thus becoming more efficient and easier to use and, in turn, speeding IMI development and supporting the retooling of development capability. This convergence can potentially lead to significantly larger gains in the speed and efficiency of training development within TASS than would be possible by incorporating one technology at a time.

For example, ToolBook, an instructional authoring tool, combines basic instructional authoring, limited web development, and assessment tools. Some companies that are not specifically oriented to the training market offer web-development tools bundled with rich media capabilities and integrated, web-based content-management systems. The bundling of tools into aggregated authoring environments specifically for web-based training will likely become more common, particularly as the market for rich media and training-development tools matures and the costs of the separate tools decrease. As competing software producers buy out their competitors, the offerings will converge into a small number of market-leading applications from large software providers. There are some indications

Figure 3.3
Convergence of Technologies



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that instead of a more training-specific product evolving into one of the leaders, one of the more-general web-based authoring tools will acquire elements specific to instructional design.

Some more-complex tools will continue to evolve independent of the converging tools for web-based training development. These include database programming languages to perform sophisticated storage, manipulation, and retrieval of learning-related data, as well as simulation languages for creating complex, dynamic graphical or mathematical simulations. Such tools will continue to mature and will become easier to use but will remain as standalone authoring environments that can produce content to be integrated into educational and other applications, such as entertainment and marketing. Other programming environments (suites of resources, including a programming language and compiler, libraries of subroutines or objects, and sophisticated debugging tools) will also continue to evolve but not converge. This category includes programming environments for building AI into entities in simulations as well as into tutorial expertise to guide learners.

Concluding Observations: New Organizations, Support, and Processes Are Possible

This chapter has argued that TASS could improve the quality, speed, and efficiency of IMI software development by understanding and emulating the organization and practices of software-development organizations as well as by integrating training-development technologies into Army processes. Even if TASS outsources training-development tasks, it will benefit from ensuring that its contractors are using practices and structures like those described in this chapter. Training development within TASS will also benefit from practices we are recommending, including the following:

- Assemble teams with the right skills.
- Support close interaction within the development group, including both SMEs and users of the learning content (i.e., customers).
- Support customers while simultaneously capturing information to improve later versions.
- Conduct systematic, planned, reasonably funded updating and revision.
- Provide sufficient resources for QA.
- Adopt training-development support technologies.

There is reason for optimism regarding the potential for large improvements in IMI training-development quality and adaptability within TASS. However, such improvements will take significant investments of time, money, and organizational will. These investments will be difficult given the current level of funding for training development within TASS. Moreover, some testing will likely be required to determine exactly how these concepts should be implemented in the Army context, what kinds of variability in the processes might be appropriate across development groups, and how much investment will be required. Pilot studies of training-development options (examining current DL/IMI products and identifying options for building and disseminating experience in rapid training development) are discussed further in Chapter Six.

The changes suggested here will not provide the savings in time or increases in efficiency necessary for TASS to fully meet the large training-development challenges it currently faces. Although the techniques discussed can significantly increase the speed of the training-development process while maintaining quality, significant increases in the efficiency of Army training development will depend on the cost-effective implementation of new processes across the entire Army. Moreover, even if marginal improvements can be achieved in training-development production and efficiency, the proposed improvements are more likely to reduce the rate at which unresourced requirements are increasing than they are to eliminate the increases altogether.

Nonetheless, we believe that moving toward these changes in the near term will lay the foundation for larger potential payoffs in the future. In particular, by investing in appropriate technologies and process changes now, TASS can leverage future capabilities and can even become a leader in key aspects of training development, such as the reuse of training content.

Because TASS has limited resources available to implement change, there are some key areas in which TASS should invest first. In particular, TASS should focus on investing in training-development tools with lower up-front development costs. TASS should do the following:

- Build locally tailorable, spreadsheet-based cost-estimation tools to allow designers to explore the cost tradeoffs involved in developing different types of instructional media. These tools would be valuable regardless of whether the development is outsourced or done in-house.
- Invest in the rapid development and fielding of a web-based training content-management system. Such a system will allow the Army training community to start understanding how to own, design, and effectively share digital training content. It will take a significant amount of time to develop practices that will lead to easily reusable content that is well designed and indexed. Although efforts to design and build such systems are under

way, we recommend that the Army select an option that can be implemented soon and simply and that will allow the training community to evolve processes and procedures for sharing content. The sooner the Army starts trying to do this complex task, the sooner it will identify the many important, difficult issues inherent in the problem, and the sooner it can address those issues. In particular, the Army will be able to explore how incentives to share training content can be built into the training-development process.

- Invest in pilot studies of training-development options (as described above and in Chapter Six), particularly options for building and disseminating experience in rapid training development.

CHAPTER FOUR

Developing a More-Effective Local Training System

As discussed in Chapter Two, the individual training requirement for the future Army will be greater than today's requirement. The Army has four basic options for increasing the amount of individual training conducted:

- Option 1: Increase the amount conducted at centralized, proponent schools
- Option 2: Increase the amount conducted in operational units
- Option 3: Increase the amount conducted via DL and supported by training technologies
- Option 4: Increase the amount conducted by local TASS manpower

To determine the optimal solution, the Army needs to move ahead, not by choosing one option over the others, but by finding the best combination of options to satisfy future training needs.

Current TRADOC plans call for a heavy emphasis on Option 3, increased use of technology-supported DL.[1] Under these plans, technologies will be used to deliver training, provide access to training materials, interconnect the various training domains, and assure interoperability across product lines. In contrast, Option 4 has received far less consideration in current plans, and Option 2 has not been fully investigated.

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[1] For example, see U.S. Army, 2003b, Chap. 3.

In this chapter, we focus on the potential of using Option 4 and a combination of Option 4 and Option 2, i.e., increasing the amount of individual training conducted by local TASS manpower and increasing the amount conducted in operational units with support from local TASS manpower. We discuss these options in terms of establishing a system of local TASS schools owned and operated by TRADOC both to conduct training directly and to support training conducted by the unit chain of command and through DL. We lay out the advantages of establishing a system of local schools and offer a description of one way that such a system might work.

Local TASS Schools Offer Several Advantages

Local schools could serve four main functions: (1) conducting selected types of individual training, (2) supporting more individual training conducted by units and through technology-enabled DL, (3) supporting TRADOC training development, and (4) supporting collective and leader training by units. Local schools might also be able to serve other training needs as they arise.

Local TASS Manpower Can Fill in What Technology-Supported DL and Proponent Schools Cannot Provide

While we see a large potential benefit from leveraging technology-supported DL for the implementation of individual training, expert trainers and training support personnel will remain critical. In our view, technology-delivered individual training in the 2010–2020 time frame will not serve as standalone training for most individual tasks. Moreover, in many cases, expert trainers will be able to deliver training most cost-effectively in a face-to-face local setting. This is especially true for instruction in complex skills.

Most Army tasks would be difficult to train using technology alone.[2] For example, most soldier-level operator skills require an ap-

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[2] Clearly, a large number of basic knowledge and skill domains can be trained using learning technologies that do not involve instructors. However, many tasks (especially the more complex tasks) cannot be trained using technology alone, and many that are theoretically suitable

plication phase that involves psychomotor skills (i.e., use of physical movement, coordination, or motor skills), and many soldier tasks and virtually all leader tasks require the application of complex cognitive skills (e.g., synthesis and evaluation).[3] These types of training often require the presence of an expert trainer to demonstrate skills, evaluate student performance, and provide appropriate feedback. Moreover, expert trainers are needed to provide tutoring and AAR capability. In addition to the material presented in a simulation or in IMI, relevant lessons tailored to the learner's needs must arise from the situation and be identified, practiced, and reinforced.[4] These factors will become increasingly important if the future Army requires training on a greater number of complex skills for leaders at lower echelons, as seems likely.

The degree to which IMI can become a complete task trainer will be a function of potential advances in intelligent tutoring systems and AI. While significant advances in these areas will undoubtedly occur,[5] it is unlikely that AI will progress in the 2010–2020 time frame to the point where it can cost-effectively be incorporated into a large number of standalone, or near standalone, training modules. One reason for not expecting too much too soon from these technologies is that the potential of AI has fallen short of promises in the past.[6] Moreover, it is currently not commercially cost-effective to produce automated, AI-based tutoring systems to teach complex skills that are not well defined. While AI-based tutoring systems have been

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for technology would not be cost-effective for the Army in practice. The cost-effectiveness issue is discussed further in the following paragraphs and at various points later in the chapter.

[3] See earlier explanation of Bloom's taxonomy of learning.

[4] See Chatham and Braddock, 2001, p. 20.

[5] For example, advances in AI should significantly improve the realism of battle results in simulations (e.g., by making the automated opposing forces "smarter"), as well as provide the ability to analyze planning and operational actions to provide relevant training feedback. This will, in turn, reduce the requirements for training support during simulations. Moreover, improved graphics capabilities and more-powerful PC graphics cards will likely allow far better representation of complex terrain and other elements of battle realism (e.g., smoke, urban terrain).

[6] See Scientific American, 2002.

successful for the relatively well-defined world of high school mathematics,[7] few commercial applications have been available for teaching less-defined skills such as executing a company-level assault. Although strides are being made toward providing automated tutoring of Army combat planning and command skills,[8] there is still much to be done before a reasonably affordable, AI-based effective tutoring and AAR capability can be demonstrated for the skills required in the contemporary operating environment (COE). Such capability will not be available in the near term.

Training-development resource requirements will constrain the use of training technologies for individual training. The increases in training-development resources potentially required for the development of IMI software were described in Chapter Three. In addition to the difficulties of obtaining large up-front investment resources, two factors suggest caution with regard to the determination of the optimal investment in training technologies:

- If specialization occurs in the future Army, it will lead to smaller student pools for the average training module, making it more difficult to justify a heavy investment in training technologies on the basis of cost-effectiveness.
- The expected rapid rate of change in Army organizations, equipment, and missions will mean that courses will require more-frequent updates, significantly increasing the total investment required for courses that are heavily dependent on training-implementation technologies.[9]

All the issues discussed in this section suggest a strategy for delivering training (especially in complex skills) that targets training

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[7] Koedinger et al., 1997.

[8] See Stottler and Pike, 2002.

[9] For example, in 2003, when the Armor School used the RC DL course to examine how it might implement DL in a company course for active duty Armor captains, it found that the course materials were already outdated, even though they were only two years old.

technologies with lower up-front development costs.[10] In addition, the strategy should assume that technology can reduce but not eliminate the need for expert trainers and other manpower.

Collaborative learning environments offer an important option for providing expert trainer input to technology-supported DL.[11] Even today, Armor School trainers, using the Virtual Tactical Operations Center (V-TOC),[12] have demonstrated that expert trainers can teach some complex cognitive and communication skills to RC captains dispersed in a variety of geographic locations. However, widespread use of this method may present difficulties. A heavy reliance on collaborative DL for large portions of Army training might slow down the rate at which soldiers and leaders are trained and decrease the amount they learn. While collaborative learning environments have been shown to be effective in academic settings, the participants who use these tools are often self-selected and have a strong personal preference for that method of instruction. The same success is not assured if the method is applied to all students.

Moreover, heavy reliance on collaborative DL could prove problematic for less-experienced soldiers. For example, collaboration at a distance via technology is more effective for communicating about concrete information that has a "right answer" than it is for information that is equivocal.[13] Consequently, an overreliance on such technology will make it more difficult to communicate and instill norms and values, which are important functions of training for less-experienced soldiers.[14] Moreover, while recent advances in synchronous DL methods (e.g., real-time chats and blackboard environments) have improved the effectiveness of such training, it may be

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[10] For example, the University of Phoenix employs a low-investment strategy in the implementation of its DL courses.

[11] See Appendix A for more information on collaborative learning environments.

[12] See Sanders, 2002.

[13] For example, see Straus and McGrath, 1994.

[14] Technology by itself may be more suitable for experienced soldiers and leaders who are completing refresher and sustainment training.

difficult to schedule students and instructors for synchronous DL classes across different units and installations.

If it combines some face-to-face local training capability with self-paced learning technologies and collaborative learning environments, the Army will be better positioned to coach, mentor, support, and advise a greater number of soldiers taking DL courses (even those experiencing initial difficulty using training technologies). Local TASS personnel might offer, as needed, supplemental subject-matter support or assistance and training on computer skills for soldiers needing help with DL products. TASS personnel might also help commanders monitor students' progress in using DL material and could assist in ensuring that students receive the "fenced time" needed to complete DL training.

Local TASS manpower could further increase the efficiency of technology-supported DL as it is envisioned today. The current model for using DL in Army courses employs DL modalities for the knowledge requirements of Army tasks, followed by traditional face-to-face residential instruction at the proponent school for the higher levels of learning (synthesis, evaluation) required to achieve task mastery. However, in practice, centralized-school scheduling limitations often result in self-paced instruction preceding residential instruction by a period of weeks or months. As a result, a certain level of skill decay (and thus a decline in efficiency) is associated with this strategy, and the knowledge material must be reviewed and even partially retaught in the residential phase of the course at the proponent school. By centering course scheduling around unit needs, local TASS schools could avoid this efficiency loss by planning training so that task application immediately follows self-paced learning.

The optimal level of investment in training technologies might be considered from the point of view of the "production function" for Army training. In basic economic terms, an overdependence on the use of new learning technology to substitute for labor (i.e., training manpower) as a factor of production can result in less savings than would be possible with a more prudent combination of the two.

Local TASS Instruction Is the Best Individual Training Option in Certain Situations

While it is clear that traditionally delivered proponent school and DL training will be key components of the future individual training system, some types of future training can be made more cost-effective through the use of local face-to-face delivery methods within TASS. For example, new digital skills have been found to require frequent sustainment training, which is far less costly if done locally.[15]

Sound decisions concerning which individual training could best be conducted at proponent schools, with local TASS instructors, or via DL will be key to having an effective individual training system in the future. Table 4.1 lists course and unit characteristics that are best suited to different methods of institutional training delivery.[16] The first column presents features of training modules or units. Across the top and to the right, the table distinguishes between centralized training delivery and two methods of decentralized training delivery, one using local schools, the other using DL supported by technology. The characteristics best suited to each type of instruction are listed for each feature. The comparison is intended to be made one row at a time, assuming, in each case, that all other rows are held constant.[17]

Course length is one important criterion for determining the best delivery method for a training module. Shorter courses are generally better suited to decentralized training. It is difficult to justify

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[15] See Johnston et al., 2002. Also see U.S. Army Training and Doctrine Command, 2003.

[16] Table 4.1 does not directly address the traditional decision that must be made as to which individual training tasks should be taught by the unit rather than by TASS. However, an examination of expanded methods for institutionally delivered training suggests that more individual training could be delivered and controlled by TASS. It is important to remember that the unit becomes responsible for any necessary individual skills, knowledge, and abilities that are not taught by TASS. To the degree that individual training requirements expand and resources limit expansion of TASS instructional capability, the unit chain of command will have an even greater role in training unit-critical tasks.

[17] In practice, the decision of which delivery method is most appropriate in any particular case would involve consideration of the combination of course and unit features.

Table 4.1
Selected Course and Unit Characteristics Suited to Different Training-Delivery Methods

Feature of Training Module or Unit	Training-Delivery Method Central School	 Local School	 DL Supported by Technology
Course length	Long	Short	Short to medium
Student load/site	Low	Locally high	High Army-wide
Equipment/software	Common	Specialized	Minimal
Instructor skills	High/specialized	Normal	Normal to high
Need for standardization	High	Normal	High
Operational and organizational (O&O) concept for unit	Stable	Emerging	Stable
Proficiency-level goal	Synthesis	Up to synthesis	Knowledge
Need for sharing of experiences	High	Normal	Not key

travel to a central site for such courses, since travel costs become a larger proportion of total costs. Short courses arising from JIT/AOT concepts and involving hands-on applications or synthesis levels of learning would be better suited to a local school environment than to DL alone. As argued above, such skills are difficult to train by technology alone.

Student-load density is another important consideration for determining the best delivery method for training. If the student load is highly concentrated at selected installations, such as might be the case for some reclassification and Non-Commissioned Officer (NCO) courses, economies of scale might be attained by using local schools rather than centralized institutions. In contrast, a course with a relatively small student load at any one location can make more cost-effective use of instructional capacity at a centralized school (unless the course is self-paced), where efficient class sizes are more likely to be maintained. DL can also provide decentralized training for a dispersed student load; however, if the overall density for a course is low, the development of the IMI needed to support DL instruction might not be cost-effective.

The density and complexity of equipment and software throughout the Army should be considered in choosing training-delivery options for operator and maintainer training. If the graduates of a course will use the same equipment regardless of the unit of assignment, training these skills at a central course can make sense. However, if units have specialized and difficult-to-train equipment or software, local school training can be more effective from both a resource and a management point of view. From a resource point of view, the central schools would not have the expense of owning equipment to train a relatively small number of soldiers. From a management point of view, training could take place after soldiers arrive at their new assignments, thereby affording the personnel system more flexibility in assignment of personnel.

Local instruction would also likely be preferable for units with emerging O&O concepts, such as would be expected for the initial set of Future Combat Systems (FCS) Units of Action (UAs). In such units, local instruction can be more effective than centralized instruction because the content of the training is likely to change often, according to the ongoing lessons learned in the emerging unit. Units with stable designs and courses with stable training content can better accommodate training at central schools or through DL means.

When specialized instructor skills are needed (i.e., skills beyond those of normal MOS/branch competency), centralized instruction has advantages over decentralized training related to scale economies, especially when the skills are expensive to train. For example, central schools would be preferred for courses requiring specialized medical or aviation credentials. DL technologies can also embed specialized instructor skills into training material, but, as argued above, most Army tasks would be difficult to train using technology alone.

"Need for standardization" refers to the extent to which course standards must be enforced during training delivery and verified afterward. While standardization is required for all courses, the requirement is especially high for some course types, such as IMT. High requirements imply a need for additional instructor training and more-extensive QA programs. Standardization in these cases can be maintained more easily at a centralized school. It is also possible to achieve standardization in centrally developed DL modules; however, establishing the quality-control mechanisms to ensure standardization then becomes an additional local responsibility.

Goals for training proficiency can also determine the best method of training delivery. For example, if the goal of a training module is merely to impart knowledge (perhaps in preparation for more-complex training), DL-delivered training may well be cost-effective. If a subsequent hands-on application or higher levels of mastery are needed (e.g., if a course requires students not only to absorb data, but to synthesize information and apply the knowledge), then DL instruction might be combined with local or proponent-school instruction to coordinate the cost-effective delivery of both phases of instruction in close proximity.

Finally, courses that require shared experiences (e.g., when "education" rather than "training" is the goal) benefit from delivery at a centralized school. Such courses typically bring together students with varied backgrounds and experience to interact and discuss issues. While e-mail and other collaborative technologies can help students share experiences, and local student groups will have a range of prior experience, centralized courses still maintain an advantage in this aspect.

Local TASS Schools Could Cost-Effectively Support Improvement of Individual Training Conducted in Operational Units

As previously mentioned, operational units already conduct a large portion of the individual training load and could potentially be called upon to conduct more. TASS local schools could cost-effectively support such an expansion.

In the past, uncoordinated handoffs of individual training responsibilities to units have led to unmanaged compromises in the quality and completeness of individual training as a whole. This can result from a kind of chain reaction. First, proponent schools reduce the amount they teach at the institution (due to decreasing resources, mandated course-length reductions, or increased training requirements), leaving relatively more for units to train. Units then strain to pick up the additional load, because they are limited by the availability of both unit and leader time to develop, prepare, conduct, and manage the training. While Army regulations anticipate this problem and call on TASS to assist units by providing training materials to support easier implementation, resource shortages within TASS (and higher priorities for other training products) often preclude the production of the required training products, according to interviews with local training developers at proponent schools. As a result, units are effectively left to make their own decisions, trading off individual training against other unit needs. Thus, individual training can potentially be compromised if TASS does not provide coordination and support. Moreover, this scenario could become more common in the future and more detrimental to individual training as more deployments and increased collective training requirements place more demands on units and their leaders.

TASS local schools could provide important resources for units conducting individual training. Local TASS personnel could provide train-the-trainer instruction and research and could adapt proponent-developed training products to specific unit needs. They could also provide direct training support to units—conducting classes or other training that is needed but beyond the unit's capabilities (e.g., in a post-alert situation). If the local school does not have the resources, it could coordinate with TRADOC for support from other TASS organizations.

Local TASS schools could provide important resources for unit-conducted equipment transition courses, i.e., courses using specialized equipment. Courses in which the equipment is more complex (e.g., those of the Force XXI Battle Command—Brigade and Below [FBCB2]) or applies to only a few MOSs in the unit may require a local set of supplemental TASS instructors. Unit leaders alone could teach courses involving simpler-to-operate, higher-density equipment (e.g., Stryker vehicles), although in some cases, local TASS instructors might provide train-the-trainer instruction at the outset. While such training arrangements have been successfully implemented with Mobile Training Teams (MTTs) and New Equipment Training Teams (NETTs) in the past, the increased rate of equipment transition expected in the future could well justify a more permanent TASS presence, especially when there is a substantial sustainment-training requirement.

Local TASS schools could provide an important link between proponent schools and units by helping to improve the feedback between the two. For example, local TASS organizations could communicate units' most pressing needs for training-support materials and products to proponents. They could also provide input regarding decisions about what individual training should be conducted by the institution and what should be provided by the unit, allowing a better matching of task to training location. This type of feedback could thus improve the quality of individual training as a whole.

A Local TASS Capability Could Assist the Army in Accomplishing Other Training-System Goals

In addition to playing a vital role in increasing the amount of individual training delivered, a local TASS capability could assist the Army in accomplishing other training-system goals. Such assistance would help ensure that local schools maintain a sustained workload despite their smaller size and decentralized locations.

Supporting collective and leader training exercises, especially simulations training. To adequately train the large number of complex tasks that units will have to perform in the future, the Army must substantially expand the number of experiential collective exercises conducted. Due to time, maneuver area, and OPTEMPO dollar constraints, most of the required expansion will likely be in the area of virtual and constructive simulations. Local TASS personnel could play an important role in enabling this expansion.

Army units currently underutilize existing simulation capacity. For example, units make far less use of virtual and constructive simulations in training than is outlined in current combined arms training strategies (CATS). An unpublished RAND study of unit training programs found that heavy battalions average fewer than two instances of constructive simulation-supported home-station training events per year. Moreover, almost all of this simulation-supported training occurs in conjunction with the six-month preparation for a National Training Center (NTC) rotation. The average number of home-station constructive simulation exercises for light battalions is even lower—only about one out of five light battalions does this type of training each year. Tank companies also average fewer than two annual platoon- or company-level virtual simulation exercises with the sophisticated Close Combat Tactical Trainer (CCTT).

Although the reasons for this low usage have not been studied, our discussions with commanders and S3s suggested that they might include support requirements, the time needed to prepare for the exercises, and a belief by some that the simulations lack realism and thus provide limited training benefit. A more robust simulations-center support staff could help address all these issues.

Local school personnel could help units set up and conduct simulation-supported training and other exercises. These personnel would also enable local schools to assist units in adapting TSPs, developing exercise plans, training and augmenting observer controllers, and supporting exercise execution and AARs. Local school personnel could also assist the unit chain of command in assessing results and developing (and implementing) remedial training plans.

Supporting training development. Units can provide additional perspectives and insights to help proponent schools develop doctrinal tactics, techniques, and procedures, as well as training methods and products. They could also share a portion of the development workload. In the future, rapid changes in missions, organizations, and equipment will increasingly require units to use spiral development—that is, an iterative process of trial, assessment, refinement, and new trial—during both training and actual operations. A more closely integrated feedback process between units and proponents will make it easier for proponents to provide responsive support.

A local TASS presence could provide the needed connection between TASS and units to effectively support unit training-development needs. Because of their direct role in conducting institutional training and supporting unit training, local TASS trainers would have firsthand knowledge of doctrinal and training products, as well as unit operational and training practices. Leveraging these personnel for training development would provide a mechanism by which proponents could capture best practices in units more quickly and could translate that information into training products (doctrinal publications, TSPs, and courseware) that effectively support units' needs. Just as important, local instructors, trainers, and developers could serve as conduits to keep units updated on the latest thinking in proponent schools and in other units and could assist in assuring immediate implementation. The same collaborative technologies that support DL could be leveraged to support networked training development.

Supporting the implementation of JIT/AOT. Decentralized training could be key to making the JIT/AOT concept of training work from the viewpoint of personnel management. As discussed in Chapter Two, although JIT/AOT could enable TASS to teach smaller pieces of training, it could also create significant management burdens in the personnel assignment process by requiring soldiers' assignments to be determined in advance of their training. The personnel system has no such current requirement, and in assigning personnel, it makes full use of the flexibility provided by a system in which all soldiers within an MOS are trained alike. A system of TASS local schools could help restore flexibility to the personnel system by allowing JIT/AOT to be delivered to soldiers and leaders after they are assigned to new positions and at the locations of their new assignments.

Facilitating AC/RC school-system integration. A system of AC/RC local schools will improve the integration of the AC and RC training systems. The benefits of such integration include (1) increases in overall training efficiency, (2) a greater unity of effort among the components, and (3) improved AC understanding and support of RC training needs. This issue is discussed further in Chapter Five, which focuses specifically on AC/RC training integration.

Supporting effective "reachback." When a unit deploys, the local school could be task-organized to provide in-theater, "reachback" support (e.g., information to help plan and execute ongoing operations), which in turn could facilitate rapid feedback to proponent schools. Units would benefit from having a local school organization immediately available for specific support rather than having to depend on a "from scratch" Center for Army Lessons Learned (CALL) effort.

Helping units gain efficiencies through synchronization of individual training with unit training cycles. To the degree that individual training can be conducted locally, disruptions to unit training programs caused by the need to send soldiers and leaders to "temporary duty (TDY) and return" courses at proponent schools would be reduced. Courses, or portions of courses, could be taught at times that minimally disrupt unit training. Moreover, conducting courses locally reduces the time soldiers and leaders are separated from their families.

How Might a Local TASS School System Work?

The specific design of a revised individual training system, which includes an expanded local AC/RC TASS capability, will need to evolve based on experience. That experience might come from experiments with new concepts or from other TRADOC experience in operating on other Major Army Commands' (MACOMs') installations. For example, the design of local schools might be informed by the way the operations groups work at the NTC and the Joint Readiness Training Center (JRTC).[18] In this section, we describe one way that a local TASS school system might work. The purpose is not to propose a specific solution but to provide a basis for further discussion.

Figure 4.1 illustrates the potential relationship among local schools and proponents.

The key difference between this system and the one now in place is the addition of AC/RC local schools. Under the local AC/RC schools system, proponent schools would continue to direct the de-

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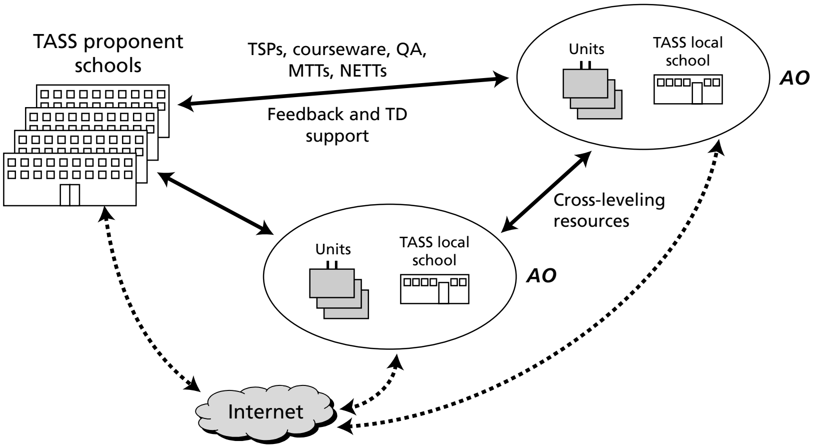
[18] The primary mission of these installations is the conduct of collective training exercises for FORSCOM units. The training organizations at these installations, the Operations Groups, are TRADOC assets, but an installation's commanding general and most of its support structure are under FORSCOM. The result is a close, effective working relationship between FORSCOM and TRADOC to achieve a common goal.

Figure 4.1
A Way Local Schools Can Work: The Relationship with Proponents and with Local Schools in a Different Area of Operations (AO)



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velopment of courseware and training support materials, the execution of QA, and the training and certification of instructors. They would also continue to handle a large part of the training load, either through face-to-face instruction, multiple DL means using the Internet, or, when warranted by surge and modernization requirements, MTTs and NETTs. Proponent schools, through coordination with TRADOC headquarters, would also oversee and coordinate the activities of local schools.

As described above, local schools would, under the direction of TRADOC and in coordination with units, take on a portion of the instruction load associated with individual training (e.g., JIT/AOT, sustainment, and refresher training). In addition, local trainers might be leveraged to carry out other TASS responsibilities, such as supporting collective training and training development. The level of local school involvement would vary from location to location, depending on local needs and the opportunity to achieve training efficiencies.

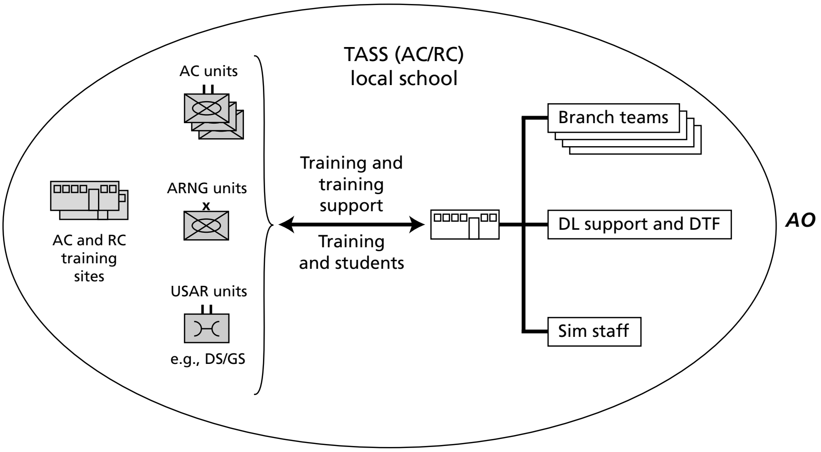
If support of local unit training programs exceeded the local schools' capabilities, the schools would identify their needs to TRADOC. In turn, TRADOC would coordinate the cross-leveling of resources among other local or proponent schools to meet the requirement and maintain a more balanced workload across organizations. For example, local schools could help each other manage the training surges caused by the large number of unit reorganizations expected in the future force. Moreover, during sustainment periods, instructors, trainers, and training developers from multiple local schools could support collaborative training-development processes orchestrated by proponent schools. Such processes would place TASS in a better position to quickly and directly capture and assimilate lessons learned from operational units.

Effort will be needed to effectively implement collaborative teaching and training development and to gain the associated benefits. Proponent schools will have to learn to make extensive use of collaborative technologies to interact with local schools from a distance. To some extent, teaching through local schools is an extension of DL practices, except that in this case the proponent-school instructors are distributed rather than the students. However, the accumulated experience and continuity of school organizations make them better suited than the students in short-term courses to take on this risk. Thus, the presence of local schools has the distinct advantage of relieving individual trainers and students from some of the responsibility for making collaborative learning environments work within the time period of individual courses.

Figure 4.2 shows one possible way that local schools could operate within an AO.

As shown on the left side of Figure 4.2, the local school would provide training to AC and RC students and training support to AC and RC units. The local school would be designed as an AC/RC

Figure 4.2
A Way Local Schools Can Work: The Relationship Between Units and Internal Organization



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organization with AC and RC instructors and would make use of both AC and RC equipment and facilities in delivering training.[19]

One potential organization for the local school is shown at the right side of the figure. The key elements are the branch teams. The branches would provide instructors and trainers and would support all school functions described above. Branch teams would be manned based on the concentration of MOSs in each AO. The branch teams could maintain a direct link to their proponent schools and could serve as conduits for additional support. Trainers for branch teams would also be task-organized to support unit training events. Local-school branch teams could support live, virtual, and constructive exercises conducted by units and simulations facilities and would also support unit operational and mission-rehearsal capacity. A DL cell could provide local support for students engaged in DL training, and

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[19] Establishing a tri-component local school organization would pose major difficulties from a funding and manning perspective. But the USAR's current Training Support Divisions show that an effective USAR/AC organization can be achieved.

it could draw on the branch teams for supplemental subject-matter support.

While Figure 4.2 shows part of the potential organizational structure of local schools, it is important to emphasize that local schools should have a flexible design. Varying forms would be needed to serve diverse local needs and to maintain schools' individual efficiency. When it is cost-effective, local schools would be instructor-intensive, depending on unit and installation facilities, equipment, and support personnel, wherever possible.[20] Finally, it is important to emphasize that manpower levels at local schools should be determined on the basis of sustainment-training workload and could incorporate the new Battle Command Training Centers (BCTCs), with surge training needs filled by MTTs and NETTs.[21]

Concluding Observations: A Local Training System Could Help TASS Expand Individual Training and Meet Unit Needs

This chapter has argued that TASS could effectively expand individual training and become more adaptable and responsive to unit needs by developing a more effective local training system. This system would include the creation of a networked system of TASS local schools in locations where a "business case" can be made for their operation. Serving both AC and RC units in tri-component TASS institutions, i.e., institutions that combine the assets of the AC and those of both the USAR and the ARNG, local schools could not only provide selected types of individual training, but could also support the expansion of individual training conducted in units and via technol-

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[20] For some courses, units might provide all resources, including instructors. The local TASS school in such cases would run a QA program to ensure that training is conducted to standards, and it could provide some additional support when needed. This option also exists today, represented in the RC-run "in-unit" training programs and the AC's training for Stryker brigades.

[21] BCTCs are local training organizations designed to conduct sustainment training for digital operators and leaders in digital units. See Headquarters Department of the Army, 2004.

ogy through the Army's DL program. Such expansion in local training would help the Army implement JIT/AOT by allowing training to occur after personnel have been assigned to new units. In addition to their role in providing more individual training, TASS local schools could support units' individual and collective training programs and could help TASS fulfill some of its other missions, such as providing effective reachback. Of special interest in this study, TASS local schools could also provide a mechanism through which the training-development community could achieve the type of rapidly adaptable and customer-oriented feedback system needed for future Army training. Finally, as we will discuss further in the next chapter, the creation of TASS local schools offers an opportunity for the Army to improve its efforts to integrate the AC and RC training systems.

We have described one vision of how local schools might work, but we do not try to define precisely the percentage of TASS resources or student workloads that could be decentralized in this way or the percentage of training staff that would be assigned for TDY or permanently stationed locally. The manner in which these changes are implemented will need to evolve, as discussed in Chapter Six.

In addition, implementation of a local school system would need to occur within the context of a well-defined concept for transforming individual training. Such a concept would include a broad outline of how future individual training will be conducted and how the school system would be reorganized to support the required changes. The concept would also involve broad decisions concerning

- the goals of institutional training (e.g., the balance in future leader training between general education and more-specific, task-focused training)
- the amount and types of individual training that would be directly or indirectly provided by the school system
- the balance between institutional training done via technology-supported DL and that done in traditional student/instructor groups
- the extent to which schools can employ training technologies (e.g., simulations) to train complex leader skills

- the amount and types of institutional training that would be provided prior to promotion (as in today's NCOES and OES courses)
- the amount and types of institutional training that would be provided just before assignment to a position
- the types of individual training to be conducted at the proponent school and the types to be conducted at the student's home station
- TASS organization for delivering training (e.g., whether training organizations would be tri-component, whether they would be aligned primarily along functional or geographical lines, and where training-development responsibilities would lie).

In sum, while much still needs to be decided, our assessment leads us to conclude that TASS can benefit from pursuing a cost-effective local school presence while it goes about transforming itself to meet the needs of the future Army.

CHAPTER FIVE

Achieving Better Integration Between the AC and RC Training Systems

This chapter focuses further on training-system integration. Changes in Army training needs, in combination with changes in training development and delivery required to meet those needs, provide an opportunity for the Army to realize its long-term goal of more closely integrating AC and RC training systems. The chapter details the increased advantages of better integration in future Army training and describes the increased role that RC schools might play in a new, more integrated training system.

Training-System Integration Offers Advantages to the Future Army

At present, AC and RC institutional training-system responsibilities are mostly divided. AC proponent schools conduct IMT and training development for both the AC and the RC, as well as PME and other courses for the AC, while RC schools have reclassification and PME for the RC as their largest mission. The RC portion of TASS (expressed as student-years of training) accounts for about 6 percent of the total Army training load. Discounting IMT, RC TASS accounts for 14 percent of the skill-progression training and functional training.[1]

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[1] Defense Manpower Data Center, 2002, Tables 3 and 4.

The Army has long cited the potential for increasing training quality and efficiency through the cross-leveling of training requirements and capabilities across components.[2] Considerable previous RAND research has also found potential for increased cost-effectiveness through integration.[3] For example, RC training capacity was found to be underutilized because of less-than-optimal average class sizes. Moreover, some studies have indicated that if RC training resources were partially devoted to AC as well as RC training needs, the training system could make better use of the full potential offered by RC assets. The need to realize such efficiencies will become even more pressing in the coming era of increased training demand and increasingly constrained budgets. Thus, training-system integration might be thought of as another enabler for Army training.

The creation of local TASS schools on AC installations (as described in Chapter Four) to coordinate AC and RC training resources and missions in their AO could increase the advantages of integration. For example, local schools will have the potential for greater increases in efficiency than were possible in the past. In particular, the creation of local schools would make it easier for the Army to realize new efficiencies through the cross-leveling of student loads, training staff, and other training resources across the components.

In the past, the RC's 39-day-a-year cycle, with 24 of those days occurring on weekends, made it difficult to coordinate the use of RC instructors for AC courses. However, recent training initiatives (designed to meet the mobilization requirements of preparing RC units for deployment) have shown that some part-time RC manpower can be made available on a more continuous basis. In particular, the RC

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[2] For example, when the TASS initiative was implemented in 1994, the Chief of Staff of the Army called for an integrated training system to improve quality and increase efficiency in the face of declining training resources.

[3] The results of this research are summarized in Winkler et al., 1999b; Schank et al., 1999; and Thie et al., 2004. The first two documents are summarized in "Improving Performance and Efficiency in the Total Army School System," 1999; and "Bridging the Gap: Consolidating Active and Reserve Training," 1999. More-detailed companion reports include Winkler et al., 1996, 1999a; Shanley et al., 1997; and "Improving Training Efficiency: Lessons from the Total Army School System," 1999.

training system has successfully converted some of its traditional weekend training to continuous courses in order to better meet the needs of many RC soldiers and units. Moreover, new forms of participation are being developed for the RC that could increase the flexibility of RC part-time resources.[4]

Advances in training technologies are also removing some of the obstacles to effective training integration under RC terms of participation. For example, collaborative learning environments and web-based SMEs and instructors make it possible to reduce, if not eliminate, the separating effects of time and space between AC proponents and RC schools. Moreover, the use of central repositories for training materials and new training products (supported by web-based IMI and simulation) has increased the ability of both the AC and the RC to maintain training standardization and to control training quality in courses conducted away from proponent schools.

An integrated local training system can also help the AC improve its support to RC units, thereby improving overall training quality and readiness. Although AC TASS has traditionally been assigned the mission of supporting RC schools, the physical separation of AC and RC training has remained an obstacle to effective support. The more TASS can move toward tri-component training institutions (i.e., institutions that combine the assets of the AC with those of both the USAR and the ARNG), the closer the RC can make a direct link to proponent schools, helping to bring RC training into the mainstream and to make RC training missions a TASS priority. In addition, the increased joint efforts of AC and RC training staffs in local school systems will make it easier to coordinate and receive feedback for the cross-component production and maintenance of better training products, such as appropriate RC courseware.[5]

The AC and the RC have always had—and will continue to have—somewhat different training needs, which in turn require dif-

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[4] See Office of the Assistant Secretary of Defense for Reserve Affairs, 2002.

[5] More generally, if AC and RC students can attend some of the same courses and receive instruction from a mix of AC and RC instructors, they can share a wider range of experiences and views and achieve greater AC/RC interchange and understanding.

ferent implementation. As a result, integration of AC and RC training will not be advisable for every situation. While integration makes sense for situations in which RC and AC missions overlap, it does not when the missions diverge. RC assets can probably be more effectively employed when units and equipment remain relatively stable. It will be more difficult for RC instructors to maintain the needed currency to be effective for units undergoing spiral development or rapid equipment modernization. Nonetheless, by identifying and carefully delineating the areas of opportunity, the Army can design an effective integrated system.

The RC Could Take on Additional Responsibilities in the Future Army Training System

As noted above, RC schools handle about 6 percent of the total Army training load and 14 percent of the load discounting IMT. We believe that the RC portion of TASS could cost-effectively take on a number of potential additional roles in the future Army training system. This view is supported by the RAND studies cited above. Specifically, rebalancing the current training workload to provide a larger role for the RC could add capability and provide added flexibility to TASS. With the anticipated changes to the future Army, these contributions become even more important. Our analysis of the current RC portion of TASS (see Appendixes C and D) also supports the view that RC schools could expand their role in the Army institutional training system and that the current RC system has demonstrated flexibility in responding to varying customer training needs.

RC capacity in a more integrated TASS could potentially expand in several ways, discussed below.

RC Can Further Help Deliver Training

Allowing for greater flexibility in training delivery. One area in which RC capacity might expand is that of training delivery. The formation of tri-component institutions would allow the Army to leverage the existing RC schools to inform and support the development of more training options for AC training. For example, Regional Training Site—Maintenance (RTSM) has already established local schools at many active installations. These RC TASS organizations have DMOSQ and NCOES capabilities nationwide and could expand their present RC mission to include the training of AC students.

More broadly, RC-sponsored reclassification and transition training for a wide range of MOSs could be made available to AC soldiers, providing added flexibility in training choices. In many cases, it makes little sense for AC units to send their soldiers back to AIT courses at proponent schools when local—and usually more compressed—training could be available. Some AC soldiers are already getting local training from the RC TASS today, for example, in the medical 91W MOS conversion. But the practice of AC/RC integration in reclassification training could be expanded to add flexibility to the training system. Moreover, such training options will become increasingly important to TASS as a whole if Transformation and future force-structure changes lead, as expected, to still more force-structure changes, thereby generating increased MOS/branch reclassification student loads.[6]

Providing support in meeting specific future training needs. Specific AC future training needs offer additional areas where the RC could potentially be leveraged to provide support for both AC and RC students. For example, with the advent of JIT/AOT training needs, AC soldiers will need more shorter-duration training events, which RC school staff could effectively support.[7] Moreover, RC school staff could provide training surge capacity, helping make the

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[6] This is not to say that the RC TASS would simply take over the reclassification mission. Some AC instructors might be needed to fill the needs of AC units. But the RC TASS has reclassification capabilities that could pick up much of this mission without a proportional allocation of AC instructors.

[7] The analysis in Appendix C suggests that RC training institutions have provided flexible training options to meet customer needs for short-duration training. However, it also shows that adaptable training alone cannot accomplish training in a timely way. Effective coordination is also required between the training system and the personnel system and customer units.

overall school system more readily adaptable to rapid development and change.

Supporting students in technology-based DL courses. Finally, RC school SMEs could effectively support students in technology-based DL courses. RC soldiers could serve as web-based instructors or facilitators as well as on-the-ground trainers to provide the "application" parts of Army DL courses. In fact, RC soldiers serving as web-based trainers can be imagined for the current V-TOC application at Fort Knox. Using retired Army contractors to provide instruction via the V-TOC web-based collaborative learning environment, the Armor School provides interactive, DL-based training in battle staff operations and the Military Decision Making Process (MDMP) to ARNG officers taking the Armor Captains' Career Course. There is no reason that RC soldiers could not serve as instructors in future courses that leverage collaborative-learning DL technologies.

The RC Can Contribute to Training Development

RC capacity might also expand in the area of training development. Previous RAND research has argued that the RC could become more heavily involved in the mission of developing, maintaining, and continuing to modernize relevant courseware.[8] Many RC instructors have the qualifications and are also closer to the actual training than are developers in the proponent schools.

The role of the RC in training development could expand even more in future Army training. Returning to our suggestions for reengineering the training-development process, Figure 5.1 presents a modified version of Figure 3.1, showing how a software organization views the life cycle of software products and illustrating the ways in which the RC could potentially contribute in an integrated training system.

Serving as part of a course-development team. One potential role for the RC is participation in short-duration training-

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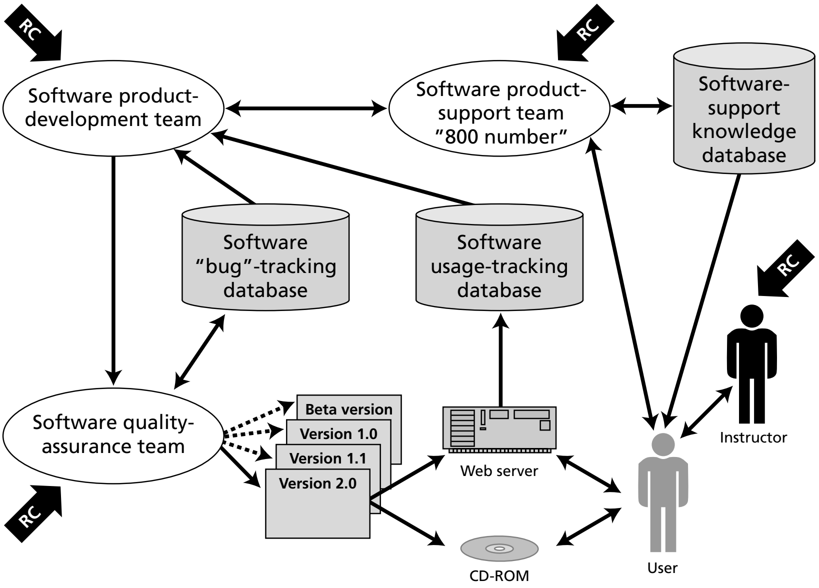
[8] For example, see Thie et al., 2004.

Figure 5.1
Potential Roles for the RC in the Training-Development Cycle



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development teams. A team might be brought together for 30 to 90 days to develop a new course or to convert an existing one. Ideal candidates for this task would be RC instructors who are teachers at the high school, junior college, or college level and therefore would potentially have summers available. RC instructors could go to the geographic location where the development team is based (at a unit or school) and provide both educational expertise and their Army training expertise.

RC instructors might also use web-based collaboration technologies to contribute to the development or maintenance of DL courses. Such technologies would allow RC instructors to participate in training-development efforts without physically deploying to a geographic site during the initial development process. RC instructors could also provide course support from their homes, using e-mail, phone, or collaborative learning tools.

Serving as part of a training QA team. All software requires QA testing before each release. For web-based applications, the testing breaks down roughly into two components: testing for technical quality and testing for training-content quality. Though seemingly straightforward, each of these areas is actually quite complex; both could potentially benefit from the participation of reservists, as explained below.

Testing for technical quality. Tests of technical quality require several key questions to be answered:

- Do all the links on the web pages connect to the right destinations?
- Does the application run appropriately?
- Does the database collect and store the appropriate data on student interaction and quiz/test performance?

With some training and technology support, reservists could certainly carry out all aspects of technical QA.

Testing for training-content quality. Other questions are relevant to the testing of training-content quality:

- Is the training content complete to specification?
- Are the grammar, spelling, and formatting consistent and correct?
- Do the questions assess the concepts and skills as planned?
- Are all aspects of the content understandable?

With respect to the "surface-level" features of the training content (grammar, spelling, formatting), RC soldiers could play a complete QA role. In terms of content quality, RC soldiers would need to have appropriate domain expertise to provide QA, which is possible but not guaranteed.

Serving as part of a training-support team. Another clear opportunity for RC participation in DL-based training is in providing support to the courses, by either e-mail, Internet chat/Instant Messaging, or phone. Just as in a distributed call-center operation to support software, reservists could provide shifts of synchronous or asynchronous support to learners taking Army training courses via DL.

A different, less traditional support model is one initiated and still actively used by About.com, a website that provides practical advice and solutions to problems. About.com is a network of hundreds of specialized sites, each run by a carefully screened and trained professional "guide." These guides generally work from home and are located literally around the world. They build a comprehensive environment around each of their specific topics, including the best new content, relevant links, how-to's, forums, and answers to just about any question. The guide sites cover more than 50,000 different subjects with, according to About.com, "over one million links to the best resources on the Net and the fastest-growing archive of high quality original content." Topics range broadly from "pregnancy to cars, palm pilots to painting, weight loss to video game strategies."

This same model could be used to support Army DL courses. A guide or team of guides representing some mix of reservists, AC, civilians, and retirees could provide high-quality course support, all from a distance, via the Internet.

Concluding Observations: Training-System Integration Offers Advantages for the Future Army

As the Army makes major changes in its training strategy to accommodate changes in training needs, it has an opportunity also to move toward its long-term goal of integrating AC and RC training. In this chapter, we have argued that training-system integration will have even more advantages for future Army training than it has in today's environment. In addition, the existing RC school capacities can be leveraged to inform and support the development of local training options for AC training. We have also detailed a number of ways in which RC participation in future Army training can be leveraged to increase training efficiency and overall system effectiveness.

Whatever role the RC plays in an integrated system, TRADOC should make training-system integration an acknowledged component part of the overall plan for TRADOC training transformation. At present, RC training is little discussed in Army Transformation plans. While training-system integration may not seem as pressing as other issues before the training community at present, the need to address cultural resistance to change gives some urgency to action in this area. The cultural issue is evidenced by the fact that nearly 10 years after the reorganization of TASS, the AC and the RC still have a largely dual school system, even though many of the original obstacles to an integrated system have been addressed (e.g., revised courseware, functionally aligned schools, revised QA program, clearance for AC participation in RC reclassification courses). However, the convergence of AC and RC training needs (in the sense that both need more localized training) makes it more likely that the integration issue can now be successfully addressed. As the AC finds local training more attractive for its soldiers and leaders, it will increasingly see the advantages of integrating the local RC assets already present in the overall training system.

Earlier chapters introduced the concept of experimenting, piloting organizational concepts related to local schools, and making changes in training development in order to evolve changes in the training system. Training-system integration could naturally become a part of this training evolution, since organizational development is a recognized way to manage cultural change.[9] Smaller, parallel organizations could be set up (e.g., the TASS local school concept) to evolve different methods of achieving the goals of the existing, larger organization. Once a new concept is developed and shown to work, it can be introduced into the larger organization. This approach reduces the risk of failure and has been shown to have a greater chance of accep-

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[9] Schein, 1992, Chap. 16.

tance within the culture of the larger organization.[10] It also fits into a broader discussion of how to implement change, addressed in Chapter Six.

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[10] Another approach to achieving integration would be to make dramatic changes all at once, such as reorganizing the school systems for integration from the top down. However, such a strategy runs the risk of compromising missions that are currently being accomplished successfully in the dual school system, while not achieving the desired result in integration. Training-system integration could falter because it is not clear how to broadly implement the integration "on the ground" and because proponent schools generally do not give AC/RC integration a high priority. In the absence of a perceived current crisis or immediate need, cultural resistance is not likely to give way.

CHAPTER SIX

Recommendations for Beginning the Process of Change

In the previous chapters, we discussed several kinds of changes that TASS might make to improve its training-development and -delivery capacity in key areas and to achieve better integration between the AC and RC training components. In this chapter, we explore how TASS might move forward with the process of change. In our view, TASS will be best served through an evolutionary approach, one that allows for immediate implementation of changes on a small scale, together with ongoing opportunities for feedback and revision.

The process we recommend is similar to the spiral development process currently used by the Army to develop new Table of Organization and Equipment (TOE) organizations for the future Army. Such a process is consistent with the DoD Training Transformation Plan.[1] The spiral development process applied to training would allow potential changes to be evaluated through the use of structured implementation research and high-payoff exploratory pilot studies. The approach of "change a little, test a little" is also an ideal approach for moving ahead despite the resource constraints faced by the Army today. Options for three such pilots are presented later in this chapter.

Table 6.1 summarizes the key options and recommendations presented in the previous three chapters. TASS could assess the impact of these options further by using an evolutionary approach to implementation.

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[1] See Department of Defense, 2004.

Table 6.1
Summary of Key Options and Recommendations

Training-Development Process
Training development of IMI products under TASS could gain from understanding and emulating software-development and software-publishing organizations
Embrace software-development best practices to satisfy fast-changing customer needs
Adopt the overarching organizational model to ensure quality products
Adopt new methods and team structures to increase speed and efficiency
New supporting technologies promise further improvement in the speed and efficiency of IMI development
Incorporate relevant training-development technologies into current software-development processes
Local Training System
Local TASS manpower can fill in what technology-supported DL and proponent schools cannot provide
Local TASS instruction is the best individual training option in certain situations
Local TASS schools could cost-effectively support improvement of individual training conducted in operational units
A local TASS capability could assist the Army in achieving other training-system goals
AC/RC Training Integration
The RC could take on additional responsibilities in the future Army training system
RC can further help deliver training
RC can help with training development

TASS Needs an Evolutionary Approach to Change

The process of change within TASS is complicated by many ongoing changes within the Army in areas such as personnel manning systems, missions and roles within the Army as a whole and for the AC and the RC, C4SI technology, and recruitment in an era of frequent deployments. The end result of these changes—and even the intermediate outcome of each—is difficult to predict. What is certain is that each major change within the Army will have an effect on both training requirements and TASS's own evolution.

Any organization facing a rapidly changing marketplace and new technologies must adapt or risk becoming irrelevant. Successful adaptation traditionally has several components, including a strong commitment to change on the part of senior leadership, a "champion" or "change agent," a clear understanding communicated within the organization of the need to change, an evolving plan for change, and resources to enable change.[2]

The investment of resources is particularly important to enable the organization and personnel to learn new business practices, acquire new skills, and acquire and embrace new technologies.[3] Evolutionary change provides a cost-effective method of moving forward, even in an environment involving significant resource constraints (such as that of today's Army). A "change a little, test a little" approach can be implemented in a resource-constrained environment, and its evaluative aspect can provide considerable assurance of success and a sound argument for shifting resources when larger changes become possible.

Moreover, because current TASS methods have proven successful, change should be carried out in a way that avoids disrupting a reasonably effective, functioning system. Making major changes in a system as complex as the current Army school system is a serious undertaking. The quality and quantity of school training must be maintained during the transition. This is especially true to the extent that many of the factors driving change in the school system are themselves in flux. By employing an evolutionary approach, TASS can accelerate the process of change while providing opportunities to test and evaluate the effectiveness and efficiency of new approaches and the ability to alter plans as needed.

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[2] See March, 1988; Larkin and Larkin, 1994; Stoner and Wankel, 1986.

[3] See Burgleman and Sayles, 1986; Hamel, 2000.

Spiral Development Offers an Effective Way for TASS to Begin Implementing Change

Spiral development is a method of rapidly implementing change, a process of planned evolution when both requirements and the potential means for meeting those requirements are in rapid flux. Under spiral development, an initial version of a product or program is developed as a work in progress. The working prototype is fielded early, enabling feedback on its performance and allowing it to be refined and revised in stages, even as requirements and capabilities are also evolving.

During spiral development, developers and users observe and assess the performance of the prototype and use those assessments as an input in the production of a revised, improved version. Once an improved version of the product or program is fielded, the process of assessment and revision starts again. Each step in the process results in further improvements to the product or program.

Spiral development has been applied to organizations, equipment, software, training methods, and other programs and products. It can be applied to individual products or programs or groups of them. For example, the Army used spiral development for the SBCT, a multidimensional concept involving a new organization, vehicle system, tactical concept, C4SI systems, and training-support organization. Program assessment and revision for the SBCT was the responsibility of a dedicated organization, the Brigade Coordination Cell (BCC). The BCC recommended many modifications to the SBCT, some of which were made on-site, while more difficult issues were sent back to the material or training developer. Using this process, the Army was able to implement rapid, effective improvement, resulting in the validation of the entire SBCT system to a level sufficient for the Army's leadership to commit the first two SBCTs to stability operations in Iraq.

The Army is now using the spiral development process for the UA. The 3rd Infantry Division and the 101st Air Assault Division are both employing this evolutionary process rather than attempting to implement the kind of revolutionary change originally envisioned for the UA.

Spiral development can be effectively used for implementing changes in the Army's school system. It offers a useful means of moving the process of change forward when truly significant changes are likely to be required, even as training requirements are still evolving and severe resource constraints are in effect. Because it allows for adequate testing and revision before larger-scale implementation, spiral development allows major issues to be resolved over time, while initial changes can be made immediately.

TASS Needs a Transition Plan with an Evaluation Component

The process of spiral development assumes that a product or program will change and adjust as evaluations are conducted and experience and understanding are gained. A key component of an effective spiral training-development process is ensuring that a structure and system are in place to enable rapid, flexible assessment and revision. Central to the evaluation process is a phased, flexible transition plan and a strong evaluation component that provides a means for continuous assessment.

The importance of an evaluation component is exemplified by our study of reclassification training provided by the RC training structure within TASS (see Appendix C). We concluded that the lack of a means to evaluate training has led to insufficient understanding of the performance of the training system and an inability to identify options for improving that training. Our analysis indicates that these gaps can be filled through the use of a system of metrics, which would help the main stakeholders—units, training institutions, and personnel organizations—collaborate to optimize the production of timely training. Such a system of evaluation could become more critical in the future, as reclassification and additional skill training become more important (e.g., as the Army attempts to produce more multifunctional soldiers). Moreover, we think a somewhat parallel evaluation effort might apply to the management of JIT/AOT training in the future, given that the same stakeholders would have to carefully coordinate to address the training-management challenges in that area.

A flexible transition and evaluation plan will allow for the early involvement of stakeholders who can provide a range of insights to guide overall implementation. By seeking stakeholder participation during early implementation, TASS will not only receive a wider range of input, but will also be able to take steps toward building consensus.

We recommend four steps for developing a transition plan:

- Program needed resources early, using pilot studies to inform.
- Develop an evaluation plan that provides regular feedback for continuous improvement.
- Seek wide participation to build consensus, examine the full range of options, and facilitate integration.
- Begin to implement the plan on a small scale by identifying effective changes that satisfy specific needs.

Evolutionary change needs to come in small steps, but steps that proceed in the right direction. Early moves also provide insights to guide overall implementation. The transition plan and end state will likely need continuous adjustment. A wide range of participation in early implementation efforts not only results in a wider range of input, but also serves the objective of consensus building.

Concluding Observations: Potential Pilot Studies Offer Opportunities for the Army to Understand Costs and Tradeoffs

In this section, we provide suggestions for potential pilot studies—low-cost demonstration projects that provide an understanding of the costs and tradeoffs involved in the overall change strategy. Investments in demonstration projects now will not only allow the Army to quantify the costs and benefits of different approaches for reengineering training development, but will also provide a strong rationale to support any new Program Objective Memorandum (POM) requests for increased resources to enable change. We believe that

TASS can realize a high payoff through low-cost implementation research and exploratory pilots.

We briefly sketch three sample pilots the Army might pursue in light of the recommendations derived from this research. These pilots are meant to be illustrative rather than exhaustive. A more detailed discussion of the pilots is presented in Appendix E.

Pilot 1: Identify Opportunities to Develop a TASS Local School Concept

One or more pilots might explore the potential benefits and challenges of a decentralized TASS that uses local schools to satisfy future training needs. Such pilots could build upon existing programs. For example, the Army's transition to modular Brigade Combat Teams (BCTs) represents an opportunity to take advantage of a "natural experiment" for the local school concept. The Army is implementing a new organizational design built to increase the number of deployable units and leverage networked C4ISR systems.[4] It is planning to establish local digital training organizations and home-station operating centers to support these organizations; thus, it would require only a modest effort to evaluate decentralized TASS elements.

A more comprehensive pilot of this sort would evaluate a more integrated system of AC/RC TASS local schools. Such a pilot would require the selection of a major AC installation to support training for a range of AC and RC units, as well as the support of a USAR and ARNG chain of command willing to work toward an integrated approach to conducting TASS courses.

Pilot 2: Examine Current DL/IMI Products to Strengthen Future Products and Training-Development Processes

Another set of pilots could seek a better understanding of the benefits and drawbacks of current DL/IMI products, as described in Chapter Four, to guide the development of future products. These pilots could explore some of the issues raised in Chapters Three and Four. For example, the Army might compare existing Total Army Training

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[4] See Headquarters, U.S. Army Training and Doctrine Command, 2004.

System (TATS) DL courses and resident courses, including comparisons of RC and AC performance and of AC performance in TATS and AIT. Within TATS, the Army might study factors that make DL more or less effective.[5] This research could have high potential payoff and requires only moderate investment.

Pilot studies might be used to explore a number of important issues, including transfer of training in DL, arguably the most essential outcome in evaluating training effectiveness, or students' experience with instructors and technology in DL courses. Future DL pilot studies could include measures appropriate to distributed context, such as computer self-efficacy and learning style. The Army might also consider exploring the extent to which DL can reduce training time, effectively train complex skills, and enhance quality of life for soldiers. It might also examine how DL affects course completion and DMOSQ rates; which technologies or combinations of technologies are most effective and how these technologies interact with characteristics of the course topic, students, and instructors and aspects of the training environment; and what aspects of student-instructor and student-student communication contribute to better outcomes. Finally, pilot studies might be used to develop or apply existing cost models to DL efforts or to examine the learning effectiveness of DL (e.g., to determine which variables are associated with performance on knowledge or skill tests).

Pilot 3: Build and Disseminate Expertise in Rapid Training Development

Other pilots might explore additional concepts raised in Chapter Three, including how rapid training-development methods, teams, and supporting technologies can best be implemented to help address future challenges in training development and support. For example,

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[5] An additional, low-cost approach to augmenting knowledge on DL effectiveness would be to leverage findings from other organizations, such as the Navy, which have established DL research agendas. However, if the Army pursues this option, it must actively track emerging results because of the long possible lag time before research findings from other organizations are published.

a rapid-development pilot could be used to determine the kinds of increases in development speed to be expected from this method; the potential costs in quality associated with rapid training development, if any; the comparative costs of rapid and conventional development; and the potential for rapid development to increase the reusability of training content.

The cost of this research could be minimized by using one of TRADOC's current course conversions as a test bed. Such a pilot study would require defining appropriate metrics for evaluating the speed and quality of development, then putting in place ways to gather quantitative data on how the process performed so that potential outcomes and lessons could be evaluated. For a pilot study of converting a course using rapid methods, it would be greatly beneficial to go beyond simply converting the course material itself. The pilot should develop the other aspects of determining what would make a web-based Army training course sustainable over time. The study should also have appropriate support for users, usage tracking, and revisions. A follow-up study might investigate the same training development and support issues but use distributed technologies with the same team of developers.

These pilots and others would provide a means for TASS to move forward to provide needed support for future soldiers, while at the same time developing an immediate stock of lessons learned, which will have ongoing value in future projects. Through the spiral development process, TASS can begin to implement changes step-by-step while simultaneously assessing their impact on its training programs and practices.

APPENDIX A

Typology of Training Technologies

This appendix examines how technology supports training now, where it promises to go in the future, and how it might influence the different organizational structures into which the TASS organization might evolve.

The Parts of Training: Development, Delivery, Management

Technology can potentially affect TASS's role in training development, delivery, and management. Training development has three main parts:

- Conducting a needs analysis to determine who will get the training, what should be included in the training, how the training should be structured, what resources are available for development, etc.
- Designing the training content, i.e., creating a "blueprint" for the training that addresses such issues as where and how the training will be delivered and what resources are available for delivery.
- Developing the training products, including training material, aids, and evaluations, and ensuring that instructors are trained and facilities are prepared to deliver training.

These parts can be further disaggregated into a number of components, including evaluation, analysis, design, resources, validation, and revision. These components align fairly closely to the phases found in the Army's systems approach to training, as laid out in TR 350-70.

Training delivery has two main components:

- Delivering the technologies and content to the learner (through CD-ROM or via a network and client-server architecture for web-based training) or providing the training-specific infrastructure that allows learners and instructors to collaborate.[1]
- Implementing the training, i.e., allowing the learners to interact directly with the instructor(s), content, and/or other learners, at which point learning actually takes place.

Training management also has two parts:

- Managing or administering data related to all facets of the learning process, including student registration for courses, progress within courses and usage of course materials, and performance on quizzes and tests.
- Supporting the evaluation of training by capturing lessons learned about how the training content is being used by the learners and aggregating and displaying this information so that it can be used by designers and developers to fine-tune and improve the content of the training on a continual basis.

Technology can be leveraged in various forms and at various points during the develop-deliver-manage cycle. It can be used by a number of stakeholders, including instructional designers, training-product developers, trainers, students, personnel managers, commanders, and training evaluators.

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[1] Web-based environments can employ collaborative learning tools that allow geographically dispersed learners to interact directly in real time by keyboard or voice, to share content, to share virtual white boards, etc.

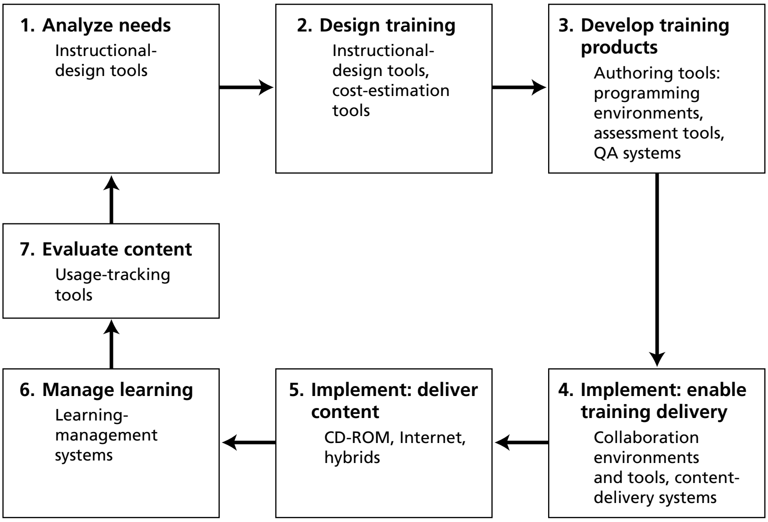
A Typology of Training Technologies

A broad spectrum of technologies supports training development, delivery, and management. Thus, a typology is needed to fully understand how technology can help TASS fulfill its training role. Figure A.1 lists the classes of technology that might be used to increase training potential within the three main components of training and at each stage of the process within components.

Boxes 1, 2, and 3 all relate to training development. The classes of technology that might be used in the development process are described below.

Instructional-design and instructional-authoring systems provide templates for organizing, specifying, and linking needs and learning goals. They can also link instructional design to the specifics of the created content by managing storyboard, curriculum goals,

Figure A.1
How Different Technologies Assist at Different Parts of the Develop-Deliver-Manage Cycle



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and assessment outlines. These tools can also aid in managing the process, structuring reviews, controlling versions, and sharing content.

Cost-estimation tools can support needs-analysis decisions regarding different instructional approaches that involve different applications of technology.

Media tools and graphical rendering tools can be used to develop training products. Media tools can be used for graphics, sound, animation, video, and web pages, while simulation and graphical rendering tools can be used to produce landscapes, equipment, autonomous agents, and other features of simulation environments.

Programming environments are used to produce interaction, database manipulation, and AI agents for simulations and AI tutoring entities. Programming environments include programming languages, which can be used to create complex interactive learning with detailed branching, and database languages, which can store and retrieve learner interactions and tailor instruction to learner behaviors.

Assessment systems can automate the creation of different question types for online applications and can implement computer-adaptive testing to make assessment faster and more accurate.

Quality-assurance tools can speed the process of testing applications to ensure that they function as designed on various platforms (e.g., PC, Macintosh), operating systems (e.g., Windows, Macintosh, Linux), browsers (e.g., Explorer, Netscape), and plug-ins (e.g., graphics plug-ins for Flash animations).

Boxes 4 and 5 relate to training delivery. The technologies most useful for supporting training delivery, described below, include software that can be used as a conduit for instruction.

Collaboration environments enable learning interactions and project work among multiple learners and instructors, i.e., they allow learners to "meet" and work on projects in a shared, web-based environment using generic communication tools, such as e-mail, shared white boards, and chat windows. Collaborative learning environments can be either custom-tailored for the learning goals to which they are applied (e.g., V-TOC) or more generic (e.g., Microsoft's

NetMeeting). Both types of applications share the basic features of interaction/collaboration.

Content delivery systems and technologies store content and move it to the learner via a solid medium like CD-ROM or DVD or via a network of servers and client machines. There are also hybrid delivery technologies that provide local content on CD-ROM (e.g., video or simulations) and network access to other content, resources, or interactions.

Training-implementation technologies use different methods to deliver instruction so that learning can take place:

- **Computer-based training (CBT)** uses simple branching to guide a learner through a lesson, as well as some preprogrammed interactivity and often multimedia content.
- **Intelligent tutoring systems (ITSs)** provide feedback to learners engaged in self-paced instruction. ITSs use AI to guide the pedagogical decisions and feedback and are sometimes called generative teaching systems because not all the responses are preprogrammed; that is, ITSs can generate new instruction for new problems without human intervention.
- **Training simulations (constructive and virtual)** support experiential and "guided discovery" methods of instruction by presenting a problem that allows learners to try different solution strategies and see their costs and benefits.
- **Training simulators** use a combination of software and hardware to provide various degrees of realistic interaction with simulated equipment.
- **Collaborative learning tools** use collaboration environments built specifically to allow learners and instructors to interact with each other and with training-related content from a distance.

Training-implementation technologies are often combined in practice. For example, combinations are apparent in multimedia aspects of simulations or collaborative learning tools, AI built into the behavior of “agents” in a simulation, or IMI that has a tutorial component or that uses simulations to teach a certain skill.

Boxes 6 and 7 in Figure A.1 relate to training management. Two types of technologies are particularly useful for this part of the training process:

Learning-management systems administer all aspects of access, scheduling, use, and performance for individual learners (e.g., course catalogs, precourse evaluation and requirement checking, registration, access to course resources, assessment reporting, and student tracking).

Usage-tracking tools, i.e., server-based tools and learning management systems that provide data on detailed patterns of content usage as well as individual and group performance, provide graphical aids that can alert designers and developers to potentially interesting usage patterns.

APPENDIX B

Assessment of Technology Payoffs for Current and Future Training

The technologies described in Appendix A vary greatly in current maturity and effectiveness, as well as future promise. In this appendix, we provide an overview of all the technologies and an example of a more detailed assessment of simulations—in this case, simulations intended for the training of complex skills needed by Army leaders.

Overview of Technology Payoffs

Technology is already providing dramatic payoffs in training delivery. Delivery of training products via the web has eliminated many of the problems associated with their distribution. It is no longer necessary to make multiple versions of a training product for different platforms, nor is there a need to resend physical media for every update or change to a product.

In addition to what has already occurred, payoffs from technology are now emerging at other points in the process:

- **Development.** In the past five years, great improvement has been seen in the tools used to support the development of training products, including programming tools and environments for animated graphics and simulations. In many cases, what used to require a large special-effects budget now can be done cheaply on a personal computer.

- **Delivery.** Collaborative learning tools and environments were rare and primitive just five years ago. Today, tools for sharing elements such as video, documents, web content, and virtual white boards are commercially available and inexpensive. Custom versions of such environments are also being built, e.g., V-TOC, developed and used within TASS by the Armor Training Center at Fort Knox.
- **Management.** The Army is investing heavily in a learning management system, which it plans to interface with the new personnel system, DIMHRS. This will allow the Army to centrally track the training completed by individual soldiers and the training currently required for those soldiers.

Future innovations will come from improvements in the reusability of training components, as well as increases in the effectiveness of automated tutoring based on simple AI (already used in commercial settings). Additional improvements will be made in the ability of technology to create realistic simulations and to provide detailed feedback on how learners are using web-based training products.

Application of Training Technology

The potential of technology to help TASS fulfill its role can be illustrated by an example. In order to teach complex or higher-order thinking skills to meet the training and skill needs demanded by future doctrine and scenarios, TASS will increasingly need to provide experiential learning, or “learning by doing.”

Technology can contribute to both the development and delivery of such training. Simulation- or game-based learning can provide some aspects of experiential learning via artificially constructed environments. Technology can assist in the process of developing the tools needed for such training. The ability to create graphics and simulations has been dramatically improved through low-cost authoring tools which can be used on personal computers and commercially available game consoles (e.g., Microsoft's Xbox, Sony Playstation II). Tools to support the authoring of simple AI tutoring components for learners using simulations are also now emerging. Delivery technologies can provide this training at low cost over the Internet.

While technology has much to offer in helping TASS provide experiential learning, the costs of such technology must also be considered. The development of realistic simulations is not inexpensive; however, the costs will drop over time and can be amortized over repeated use.

In our visits to Army proponent schools and research labs, we saw a number of interesting examples of how the Army training-development communities have devised innovative applications of technology to train complex skills. One example of a state-of-the-art simulation-based training aid is Full Spectrum Command (FSC), which is being developed for the Army by the Institute for Creative Technology and is currently being tested in the Captains' Career Course at the Infantry School at Fort Benning.

The use of FSC replaces a paper-and-pencil exercise designed to teach captains how to plan an attack. Formerly, instructors would present a scenario in written and verbal form, students would write or brief a plan, and instructors would provide a critique. With FSC, students can not only write a plan, they can also implement it on a simulated battlefield with simulated AI forces at their command and against an enemy with some ability to react. The student gets experience of the sort encountered in actual situations, e.g., experience in changing plans in the face of unexpected events and taking appropriate actions in real time with limited resources, information, visibility, etc. The simulated soldiers under the student's command have some appropriate behaviors and "morale," e.g., when they take fire, they drop, seek cover, and return fire—all while continuing their mission. The opposing force (OPFOR) can be a preexisting plan executed by AI OPFORs, or it can be guided by another human player controlling simulated AI forces.

FSC contains a number of attributes that make it an interesting prototype, including

- extensive guidance from Army SMEs at Fort Benning to ensure accuracy of simulated doctrine, equipment, and standard operating procedures (SOPs)
- high-quality graphics
- relatively good automated forces (FSC 1.0 uses three times the processor power of typical games, i.e., typical games use 20 percent of processing power for automated entities, whereas FSC 1.0 uses more than 60 percent of the processor power for the actions of automated soldiers, OPFORs, and civilians)
- basic support for learners who review information about the learning experience in formatted AARs
- the ability to review and rerun learning sessions to try different actions at different points
- customizable scenarios
- the ability to be used by an individual in a decentralized setting or by a group learning together in a classroom
- far less overhead than other simulations, such as JANUS (a two-sided force-on-force ground-combat model) and the Brigade/Battalion Battle Simulation (BBS).

FSC and similar simulators can be used by TASS instructors today to train complex tactical tasks, such as how to plan an effective assault. Used via today's technology, FSC can provide an opportunity for experiential learning. Simulation-based systems offer students the chance to practice skills, and some of the basics can probably even be self-learned.

Simulation products of this quality remain expensive to develop. Furthermore, to teach beyond the basic skills, an expert human trainer is needed to guide and interpret the training. This is due, in large part, to the limited ability of current technology to simulate realistic battle outcomes. For example, today's simulations do not fully portray the "fog and friction" of engagements, especially in close terrain. The hit/kill probabilities in the simulations often do not appear to replicate those on actual battlefields. Combat complexities such as smoke and complex terrain are also not well portrayed. More generally, simulations produce less randomness than would be found in a real situation involving organizations with hundreds of human components, each making complex decisions on how to engage in ground combat.

The sum of these shortfalls is that current simulation products are unable to teach all the necessary lessons without human expert instructors. Problems with the verisimilitude of the simulations could even lead to the "wrong lessons" being learned if the simulations are not properly used.

Another shortfall of today's simulations is that they can provide only limited feedback to students after the exercise is complete. The simulations are still heavily dependent on an expert trainer for AARs. In fact, even among expert trainers, the ability to analyze a battle to assess what went right and wrong and to convert this analysis into an AAR that improves the leaders' knowledge and performance remains an art.

However, the use of simulation technologies to train complex skills holds much greater promise for the future. By 2010, technologies will be able to provide better tutoring and more-realistic battle results as software and authoring tools become more powerful. Examples of improved tutoring include the following:

- The ability to build simple SMEs' tutorial "rules" into the simulations. These rules can look for basic patterns in planning and provide simple tutorial feedback (e.g., "You're taking casualties because you don't give your platoons positions with adequate cover").
- The ability to model and track the student's planning phase relative to "expert" planning processes from SMEs. The plans will also be causally linked to overall combat outcomes. This will afford the training system some capability to attribute an outcome to the original planning or execution step and provide more detailed, instructionally relevant feedback.

And although training complex tasks will likely still require input from expert instructors to effectively deliver training, the use of technology should substantially increase what the student can learn without the aid of an instructor and should provide the opportunity to gain deeper skills and more practice within a fixed course length.

The development cost involved in producing simulations should drop significantly, based on the continuing decline in the cost of authoring software and the increase in computational power of personal computers. For example, software to render complex geographic terrain is now available for a few hundred dollars for today's powerful PCs; eight years ago, this software was used only by movie special-effects studios on high-end graphics computers.

Despite the current shortfalls of systems such as FSC, these kinds of training tools can significantly help to meet TASS needs. In addition to having great potential to satisfy emerging and future TASS needs in training complex skills, simulation technologies can help meet other TASS goals. First, they can improve AC and RC integration. These training products (and potentially web-based SMEs and instructors) can be equally available to AC and RC soldiers. Second, the quality of training can be improved through the standardization and QA that the tools provide. This is especially important as training becomes more decentralized.

APPENDIX C

The Current RC TASS: Observations and Lessons Learned

TASS can better position itself to increase Army readiness levels across an expanded base in the long term and to further integrate its RC and AC portions by increasing its contribution to RC readiness in the short term. The RC portion of TASS has been undertaking a series of initiatives to improve quality and efficiency and pave the way for more integration with the AC school system. This appendix examines the current state of training in RC institutions.

A key issue for RC TASS is that of providing sufficient reclassification training to support the ongoing deployments of RC soldiers. The degree of success in managing reclassifications is captured in an important readiness indicator used by the Army, the Duty Military Occupational Specialty Qualified (DMOSQ) rate, which measures the percentage of RC soldiers qualified for their duty position at a point in time. The current failure to qualify enough RC soldiers is indicated by the stopgap efforts being made to raise the percentage of soldiers who are qualified. In a number of instances, RC school personnel have had to be mobilized to accomplish the required reclassification training.

Our analysis of whether modifications to TASS policies and procedures might increase the DMOSQ rate in RC units found that improved training alone will bring only modest improvement. The reason is that the DMOSQ rate is determined not only by the policies and procedures of TASS, but also by those of Army units (e.g., how proactive they are in enrolling students in needed courses) and Army headquarters staff offices (e.g., how quickly soldiers are assigned to a position once assigned to a unit). Further, we found that current data systems are inadequate for diagnosing problems and supporting effective collaboration among different organizations to bring about change. Therefore, as discussed in more detail below, we propose a system of metrics to help create the type of collaborative decision-making environment needed for improvement. Such an initiative is likely to also have further application for the larger TASS (including both the AC and RC portions) in the future.

Need for Strategic Evaluation of Training Performance in RC Institutions

To understand these issues, we first examined existing Army training and personnel data systems (specifically, the Army Training Requirements and Resources System [ATRRS] and the Standard Installation/Division Personnel System [SIDPERS]) to identify ways in which RC TASS performance could be contributing to low DMOSQ rates. We compared on a soldier-by-soldier basis changes in soldier DMOSQ status and occupation (from SIDPERS) with records of DMOSQ training available and courses taken (from ATRRS). At the aggregate level, we found no training factors (e.g., class cancellations, no-shows, unavailability of courseware) that would indicate a major failure in TASS performance. At a more detailed level, however, we found insufficient data to explain why soldiers who needed requalification did not achieve it. Moreover, we found ATRRS and SIDPERS too incompatible with one another to allow us to infer the reasons for the failure of soldiers to receive training. In particular, while we were able to obtain reliable data on the timing of training events, we could not obtain reliable matching data on the timing of key changes in personnel status (e.g., DMOSQ status, job changes, unit changes).

Thus, while improvements in TASS performance are possible, TASS appears to lack an adequate means of strategically evaluating the performance of RC training institutions or determining where improvements could be made. Thus, we propose, as one step in managing change, the creation of a system of metrics that can help explain the DMOSQ problem in greater detail and can identify solutions for improving performance.

Performance Metrics for Understanding the Role of Training in DMOSQ

A more comprehensive system of metrics for measuring the role of requalification in DMOSQ will be useful to TASS in several ways. Metrics can provide information about performance that can be used to support effective decisionmaking and can also lay the foundation for TASS to systematically make a sustained contribution to RC readiness. In addition, metrics can be used to judge the relative effectiveness of current and future requalification initiatives for increasing the DMOSQ rate. By providing common standards of measurement, metrics can help create a collaborative decisionmaking environment in which the school system, Army units, and the staffs of MACOMs and Army headquarters can work together to achieve systematic improvement. Metrics would provide insights into TASS performance issues in both the near and long terms, since a significant amount of future Army training for both the AC and the RC is likely to have much in common with today's reclassification training. For example, reclassification training is done in short training periods that cover a wide range of occupations and that take place at times and locations that fit individual customer needs; this format is likely to become increasingly common in training for both the AC and the RC.

In the following, we identify some potentially useful metrics for understanding the role of requalification in DMOSQ and then present the results of our analyses using these metrics. We focus on changes to reclassification training rather than IET because the former is a mission of the RC TASS, while the latter is not; however, the general conclusions apply to both types of training. We found that key performance areas to track include time to qualification (or requalification in the case of RC-sponsored training) and DMOSQ status (percent reclassified and reasons for not training the rest).

Time to Requalification

The primary metric needed to determine the overall performance of the training system in improving the DMOSQ rate is time to qualification, i.e., the time needed to qualify a soldier for a new occupation. Since, as explained above, we focus on reclassification training in this appendix (and exclude IET from consideration), we are primarily interested in time to requalification. Time to requalification might be considered a "supply-side" factor in that training supplies the remedy for a non-qualified soldier.[1] Of course, "demand-side" factors, including the loss rate (the rate at which soldiers leave the Army), the job-change rate (the rate at which soldiers change jobs), and the prior service (PS) match rate (the rate at which PS personnel can be recruited into positions for which they are already qualified), also influence the DMOSQ rate. To explore the relative importance of demand- and supply-side factors, we created a systemwide DMOSQ model based on inputs from Army personnel and training databases. Results of that exploration are summarized in Appendix D.[2] A major conclusion is that significant improvement in the DMOSQ rate depends on improvement in both demand- and supply-side factors.

To evaluate RC TASS performance, we must isolate the effect of time to requalification—the training factor—from that of the other factors affecting the DMOSQ rate. We first estimated the distribution of time to requalification for recent reclassification courses (Figure C.1). By combining ATRRS and personnel data, we identified soldiers who were successfully requalified at the end of FY01, and using historical data, we measured (to the nearest six months) the

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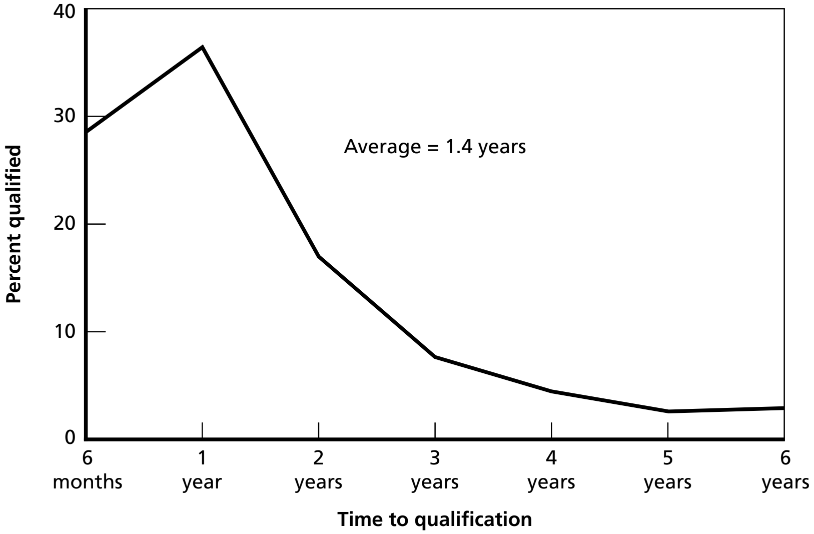
[1] Time to requalification is influenced by both the training system and the personnel system. The training system provides and executes needed courses. The personnel system determines what training is needed, gets the soldier to the right course, and repositions the soldier in a position for which he or she is qualified.

[2] The analysis in Appendix D lumps together the time to qualification for RC soldiers initially entering the force and the time to requalification for RC soldiers needing reclassification training. However, the conclusions in that appendix apply to both types of training.

Figure C.1
Average Time to Requalification



SOURCE: ATRRS and SIDPERS data.
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time it took them to become so.[3] We found that, on average, the time to requalification was nearly one and one-half years, far more than the standard (one year). In some cases, requalification took as long as six years.

It is important to note that the long tail of the distribution in Figure C.1 might be due in part to problems incurred in tracking soldiers who change units. We discovered that soldiers in the tail of the distribution changed units at a relatively high rate. When this happens, times to requalification can become "invisible," as Army processes related to training currently do not track soldiers across units.

The time-to-requalification metric provides a foundation for further efforts to understand and improve the DMOSQ rate. A key

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[3] Another component of time to requalification not represented in the figure is the time soldiers spend in the Army before deciding to leave without requalifying.

problem for the Army (and for TASS) is how to reduce the average time to requalification. Two questions must be addressed: First, how many of the approximately two-thirds of soldiers requalified within a year could be requalified within something like six months? Second, how can the tail of the distribution be reduced?

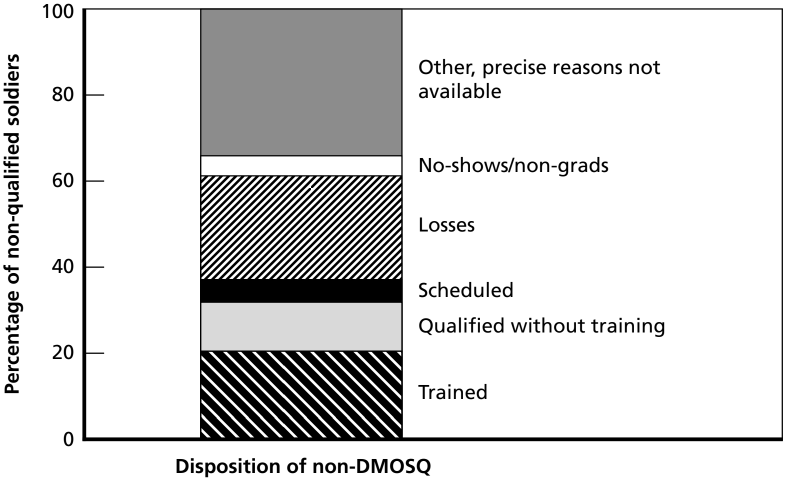
DMOSQ Status (Percent Requalified and Reasons for Failure to Be Requalified)

The DMOSQ-status metric tracks specific categories of soldiers requalified and not requalified. Its purpose is to provide insights into the reasons why some soldiers do not complete their requalification within a year. Currently, the training community regularly monitors only the no-show and non-graduation rates, both of which have been reduced significantly since the mid-1990s.

Results of our initial attempt to construct the DMOSQ-status metric using available data are summarized in Figure C.2, which shows the disposition after one year of soldiers who were found to be non-qualified (and were not in IET) at the beginning of FY01. While available data are insufficient to determine the disposition of all soldiers, the results nonetheless lead to relevant conclusions. For example, the no-show/non-graduation population makes up only a small percentage of the non-qualified soldiers. Further, of those who were not qualified within a year, only about 20 percent were trained and requalified one year later. Moreover, nearly 10 percent of non-qualified soldiers become requalified without training by changing their duty position into one for which they already were qualified.

About 20 percent of the non-requalified soldiers ended up leaving the Army; these individuals would not have been good candidates for reclassification training unless their exits were partially due to the difficulty they experienced getting requalified. The percent not trained includes a small number of no-shows and soldiers who started a course but did not graduate (this number includes those who were not able to start the reclassification training because they did not meet course prerequisites). Other relatively small populations were scheduled but did not complete requalification within the one-year time period examined.

Figure C.2
Disposition of Non-Qualified Soldiers in FY01 and Reasons for Not Being Requalified One Year Later



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The topmost segment of Figure C.2 shows that fully one-third of the non-qualified population remained unqualified and unscheduled for reclassification training after a year. We attempted to shed some light on the reasons for the lack of requalification by using existing Army databases, but the data were insufficient for these purposes.

Use of a more complete DMOSQ-status metric (percent requalified/reasons not requalified) could provide the full range of reasons why many non-qualified soldiers remain unqualified for more than a year. Current monitoring of no-show and non-graduation rates is useful, but since individuals in these categories constitute only a small percentage of the non-qualified and the training seats available to them, these metrics offer only limited information that might help improve the performance of RC training institutions.

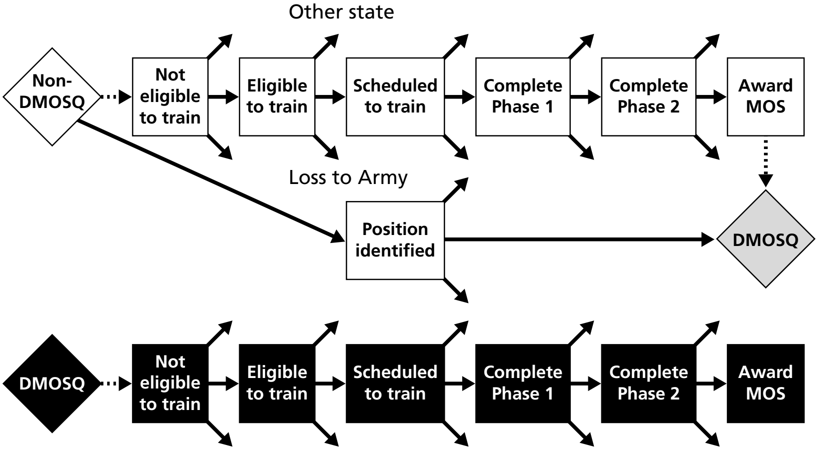
Diagnostic Metrics to Identify Options for Improving TASS's Contribution to Requalification

The performance metrics described above could be supplemented by diagnostic metrics, which can be used to identify those parts of the requalification process under TASS control and to identify alternatives that could improve TASS performance.

We have applied a process approach, adapting the define-measure-improve methodology that has been successfully used in the Army's Distribution Management (formerly Velocity Management) program.[4] In this approach, the steps in a process are defined and the inputs and outputs of that process are identified, along with metrics that can be used to measure the process. Those metrics are then used to track performance and identify opportunities for improvement.

Figure C.3 shows the steps in the requalification process and identifies three routes soldiers can take to become qualified in a new

Figure C.3
The Requalification Process



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[4] See Dumond et al., 2001.

MOS. This figure can be used to explain diagnostic measures needed to understand the requalification process, including

- the percentage of soldiers at each stage (indicated by the boxes)
- the time segments between the boxes
- the transition rates between states (movements either out of the Army or into another state, both of which are indicated by short diagonal arrows).

Percentage of Soldiers Within Each Training State

We first consider routes a soldier might take through the requalification process. The top row in Figure C.3 shows that once a soldier becomes non-qualified or enters the RC as a PS soldier in need of requalification, there is often a period during which the soldier is ineligible to train. This might occur while a soldier is waiting to be officially assigned to a position or has declared an intention to leave a unit (either to leave the Army or to transfer to a different unit) or when a unit is undergoing reorganization and soldiers have not been assigned to new positions.

Once a soldier is eligible to reclassify and knows what MOS to train in, he or she must enroll and be scheduled on ATRRS. Some unit administrators and training NCOs are proactive and work with soldiers to perform this step quickly, while others delay action due to a lack of emphasis on that task or the existence of special circumstances that prevent scheduling (e.g., a soldier may be unable to attend courses on the available dates). In some cases, a soldier may not meet the course prerequisites (e.g., weight or other physical requirements or required clearances).

After being scheduled for reclassification training, a soldier typically must wait for some period of time before the course starts. Ideally, this time period is short and no changes in the schedule occur that would cause additional delays.

The reclassification training itself can consist of one, two, or more phases (we have not considered courses that require more than two phases, because they are relatively unusual). Having completed all phases of training, the soldier may then have to wait an additional period of time until the school awards the MOS.

The middle of Figure C.3 shows an alternative route through the requalification process. A soldier may move into a position for which he or she has already trained. In such cases, no retraining or only a minimal amount might be needed, although the specifics of this process are not clear. Some soldiers might transfer to an MOS for which they are already trained after having difficulty scheduling training for a new MOS.

The bottom row of the figure indicates a third possible route to requalification. In this case, the soldier identifies his or her next position and gets reclassification training while still qualified for another position. This might happen, for example, when a soldier plans a specific MOS change in order to gain a promotion. Thus, the soldier goes through the normal retraining process while maintaining a DMOSQ status.

The requalification of a soldier who is still active in a different position is the best possible situation from the point of view of time to requalification, since in this case it is zero. A question for the Army is whether the number of soldiers who follow this route can be increased without negatively affecting the soldiers' current units.

Segment Times in the Requalification Process

We now consider the extent to which TASS can influence the time segments that make up time to requalification.[5] Figure C.4 attempts to approximate the proportion of time spent in the segments presented in Figure C.3. In other words, we have allocated the average time to requalification—1.4 years—to the different states a soldier

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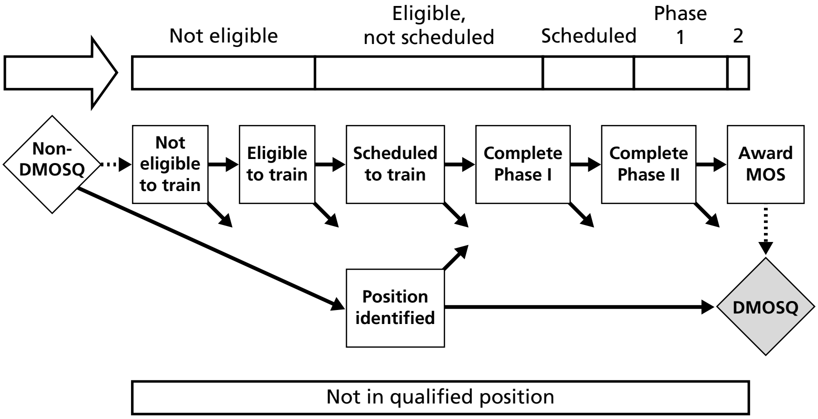
[5] As distinct from time to train, time to requalification is the total elapsed time from identification of a need for the training to the time the soldier is requalified as a result of that training. This includes scheduling time, waiting time, and possibly recycling time for soldiers who do not complete the course. The distinction is important, as our interpretations of Figure C.4 will show.

Figure C.4
Some of the Time Segments That Make Up Time to Requalification



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passes through while non-qualified. Although the data necessary to definitively analyze these segments are not currently available, we have calculated approximate times for soldiers in the USAR, using quarterly cross-sectional data from the Individual Training Requirements and Resources–Geographic Information System (ITRRS-GIS, commonly referred to as ITRRS). ITRRS, which is available in the USAR but not the ARNG, brings together data from disparate sources to serve unit management needs, especially with regard to personnel readiness or DMOSQ.

The bar at the top of Figure C.4 shows the proportion of time spent in each segment of the non-qualified stage and helps illuminate the potential effect TASS might have on time to requalification. More than a quarter of all the time not trained was spent in the not-eligible segment, where TASS has no real ability to reduce time. Another third of the time not trained was spent in the eligible-but-not-scheduled segment. TASS could potentially reduce this time by offering more training options, but it does not control the priority units give to working with soldiers to help them choose an option. Most of the remaining time not trained (about 40 percent) is time waiting for training to begin or complete. Again, TASS could potentially play a role in reducing this time. The more scheduling options TASS makes available and the more flexible the options are, the more likely soldiers will be to find a time to schedule prompt reclassification training and to schedule follow-on phases closer to each other. Of course, limited training availability and support from units are not the only factors potentially delaying training in the middle time segments. Soldiers' employment and family constraints also strongly affect their ability to schedule and complete reclassification training.[6]

Transition Rate Between Training Phases

The school system might also use metrics to better understand how TASS could increase transition rates between phases. The transition rate indicates, for example, the percentage of soldiers graduating from Phase 1 training who then complete Phase 2 training in the same MOS. Currently, about one-third of those who graduate from a Phase 1 course do not graduate from the Phase 2 course in that MOS within a year. This loss rate can exact a cost in terms of wasted training resources. In theory, there should be at most a few months between completion of the phases. When completion takes more than a year, some soldiers leave the force half-trained.

To improve this situation, it is necessary to understand why soldiers do not transition from Phase 1 through Phase 2. Proper corrective action can be inferred from soldier-specific data and focused inquiries or surveys. For example, if personnel data determine that a large majority of those who fail to complete Phase 2 leave the Army, change units, or change MOSs, the appropriate action may be to es-

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[6] A number of factors suggest that a lack of flexibility in current course offerings is not the major reason for longer times to soldier qualification. The TASS battalions we interviewed indicated that schools often communicate with their customers (units and soldiers) about scheduling options that best fit their needs and are often able to fill many of their requests. In addition, we found that the average time to qualification was not significantly affected by MOS course length or class availability.

tablish guidance for units to take greater care not to schedule soldiers to Phase 1 courses who might not stay in the unit and position.

However, if most soldiers are found to remain in their units or positions, special inquiry might be used to determine the reasons for failure to attend Phase 2 and to identify appropriate corrective actions. For example, if units do not request quotas for soldiers soon enough (e.g., until completion of the Phase 1 course), it might be necessary for the chain of command to change those procedures. Alternatively, if units find it difficult to register students for the second phase given the timing of the courses, the schools might need to adjust the set of course options.

Changes within TASS could improve the rate of soldiers transitioning to Phase 2. The TASS battalions we checked with indicated that schools often communicate with their customers (units and soldiers) about the type of Phase 1 courses that will work best, and offer a variety of options in response to customer needs. However, we found that neither schools nor units document the reasons for which students do not complete Phase 2 or how that failure might be connected to the training strategies used by the school system. To fill in this information gap, we devised a test to determine what Phase 1 training strategy TASS might use to maximize final Phase 2 graduation. Using a random sample of 300 soldiers who graduated from a Phase 1 course at the end of FY01, we determined the methods soldiers used to complete the course:

- Traditional IDT (inactive duty for training), in which soldiers take a course in their local area during their regular reserve weekends over a period of several months
- ADT Phase 1 course, in which soldiers take the Phase 1 course in a continuous mode (not necessarily in their local area) over a one- to two-week period while on active duty for training (ADT)
- A “2x2” course, in which soldiers take an ADT Phase 1 course immediately followed by the Phase 2 course.

We found that the greatest proportion of soldiers took a traditional IDT course on weekends.

However, when we looked at the training methods used by those who actually graduated from Phase 2 of the course within a year and a half after completing Phase 1, we found that the training strategy with the highest success rate was the 2x2 option—about 90 percent of those using this option graduated from the Phase 2 course within a year. The second most successful option was traditional IDT, where slightly more than 70 percent graduated. The ADT option worked least well, with only a little more than 50 percent completing Phase 2 within a year.

These results imply that diagnostic metrics could help the Army achieve the right balance of course offerings to best meet student needs. Even though the highest completion rate was achieved for 2x2 courses, these should not be the only courses offered, as many soldiers cannot arrange the necessary time off from their jobs. Moreover, although the ADT option has the lowest rate, it should not be eliminated, as it appears to have worked well for the 50 percent who did go on to complete Phase 2.

A mix of options will likely be necessary and could become more important in the future. Each option has a point of diminishing returns, a point that is unknown and highly dependent on local customer needs. The potential mix of options is likely to become more complicated in the future as practices such as in-unit training and DL become more commonplace. Metrics can help determine the optimal mix of options for getting soldiers to graduate and can help identify the point of diminishing returns for particular options. These determinations could be reached through the annual monitoring of completion rates.

Construction of a Monitoring System

The Army can capture necessary data to measure performance in the short term by expanding current information systems. Both the

USAR and the ARNG record the reasons for which soldiers do not show up for a training reservation, and the USAR collects data on the reasons for which soldiers are not scheduled to train. However, a new process would have to be created to understand why soldiers do not complete Phase 2.

Although much of the information needed is already collected in one form or another, the Army still needs more-accurate, more-complete, and better-integrated data sources. The Army could obtain the required data in two ways. In the short term, a great deal of the data for USAR soldiers could be obtained by extending the ITRRS database, for example,

- by maintaining historical records to construct a picture of training behavior over time
- by distinguishing and recording, for those in the eligible-not-scheduled state, whether unit or school action is needed
- by designing new reports to show and track metrics over time.

In the long term, TRADOC's Learning Management System (LMS), designed for commanders and managers, could be used to collect real-time personnel and training information to measure the time to requalification and the reasons for requalification failure. The LMS information could be combined with the data in DIMHRS. The time to act to influence the development of the LMS and the DIMHRS is now.

Over the longer term, the Army can shape the LMS and the DIMHRS so that performance metrics and diagnostic outputs are embedded into each. Over time, metrics could provide total soldier visibility with regard to training, a record of unit and DMOS changes, and improved information to explain the status of soldiers who are not qualified. By providing common standards of measurement, metrics could help create a collaborative decisionmaking environment in which TASS, Army units, and Army headquarters staff can work together to achieve systematic improvement.

Relevance of Short-Term Analysis to Training Transformation

We believe that our research, in addition to its relevance for increasing DMOSQ rates, provides insights into the management problems TASS will face in implementing JIT/AOT. As discussed in Chapter Two, implementation of JIT/AOT will be difficult because of the increased coordination required between the training and personnel systems to produce qualified soldiers for the right positions at the right time. Meeting this challenge will also likely require a collaborative decisionmaking environment supported by effective metrics. Thus, solving the DMOSQ problem in the RC now may well have application in the future training environment of the Army as a whole.

APPENDIX D

The Relative Importance of Factors Affecting the DMOSQ RATE

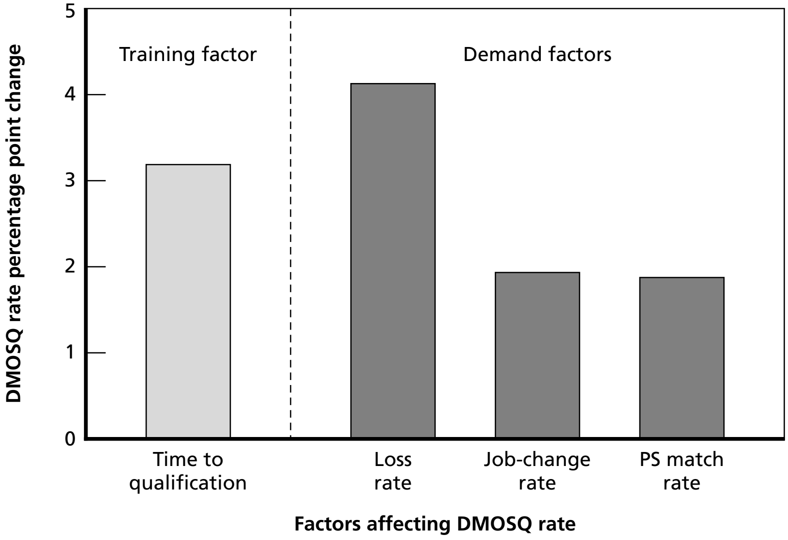
In this appendix, we explore the relative importance of demand- and supply-side (especially training-related) factors in determining the RC DMOSQ rate. To perform the analysis, we created a systemwide simulation model that estimates the DMOSQ rate.

In general, there are five force characteristics, or factors, that determine the DMOSQ rate at any point in time: the rate at which soldiers leave the force (loss rate), the rate at which initially qualified soldiers change jobs (job-change rate), the length of time needed for a soldier to become qualified (time to qualification), the proportion of new accessions that had prior service (PS rate), and the proportion of PS gains that could not be matched to soldiers' prior military occupations, thus requiring requalification upon entry (1 – the PS match rate).

The model was supported by inputs from Army personnel and training databases, in particular, from the Standard Installation/Division Personnel System/Total Army Personnel Data Base (SIDPERS/TAPDB) file and from extracts from the ATRRS. In each case, averages over the 1995–2000 time period were used as input values. We found that the model was able to estimate the average DMOSQ rate from FY95 to FY00 to within about 2 percentage points of the actual values of 64 and 69 percent (for the USAR and the ARNG, respectively).

Figure D.1 shows a wide variation in the relative effectiveness of the various factors and relatively high importance for the training factor, time to qualification. To compare effectiveness among factors, we examined the effect on the DMOSQ rate of 25 percent improvements in each of the model factors, taking one factor at a time. For example, if baseline loss rates were found to be 20 percent annually, we examined the effect on the DMOSQ rate of decreasing that loss rate to 15 percent. Figure D.1 shows the percentage point change in the DMOSQ rate given a 25 percent improvement in the training or demand factors. The percentage point change in the DMOSQ rate varied from about 4 percent for the loss rate, to 3 percent for time to qualification, to about 2 percent for the job-change rate and the PS match rate. The fifth factor (not shown in the figure), the PS rate, had no effect on the DMOSQ rate, because PS accessions often enter new occupations (and thus need new training) and have higher loss rates (especially in the first year) and higher job change rates than non-PS accessions.

Figure D.1
The Effectiveness of Time to Qualification, Relative to Demand Factors, in Improving the DMOSQ Rate (change in DMOSQ rate given 25 percent improvement in training or demand factors)



SOURCE: Unpublished RAND work.
RAND *MG328-D.1*

Figure D.1 also suggests that significant improvement in the DMOSQ rate will require more than improvements in the training factor (or any one factor by itself). Even a 25 percent change in an individual factor affects the DMOSQ rate by only a few percentage points. This is a relatively small change for baseline DMOSQ-rate values of less than 70 percent and a goal (expressed by some Army leaders) of around 85 percent.

However, improvements in the factors can combine to produce a greater overall effect. For example, assuming that the individual effects can be added, 25 percent improvements in both the loss rate and time to qualification could have a 7 percent combined effect on the DMOSQ rate. The actual change, as determined by the model, would be even greater, due to the interactive effect of the two factors. This occurs because soldiers who can be trained more quickly can be retained longer after their reclassification, thus giving the Army more for its investment and reducing the rates at which demands for more reclassification training are generated.

APPENDIX E

Sample Pilot Studies

In this appendix, we provide additional information about the pilot studies proposed in Chapter Six, including goals, key questions to be answered, and possible means of implementation. We also describe some relevant recent RAND pilots.

The pilots suggested here would provide valuable opportunities to test key concepts at a low cost. Many of them could be conducted in conjunction with ongoing programs or other research.

Pilot 1: Identify Opportunities to Develop a TASS Local School Concept

Goal. One or more pilots might explore the potential benefits and challenges associated with using TASS local schools to satisfy future training needs. Such pilots could begin a spiral development process for the local school concept.

Questions to be answered. At the highest level, the pilots would seek to answer the following questions:

- Which functions can be effectively accomplished or supported by a local school, and what are the best methods of implementation?
  - Which types of individual training are best implemented locally?
  - How could a local school support distributed training?

  - How might collective simulations and live exercises be supported, both in implementation and in the production of training-development products?
  - How can local schools support sustainment requirements for digital C4ISR (both operator and collective skills)?
- What local manpower would be needed to accomplish the functions listed above?
- What means and methods of collaboration and cooperation with proponent schools are needed, especially with regard to implementing training development, instructor training, and QA?

Implementation. A local school pilot to assess the costs and benefits of a decentralized TASS might be implemented in at least two ways. One set of potential pilots is provided by the reorganization of combat brigades into modularized organizations.[1] The Army will need to learn how to better support modular units as they simultaneously modularize, modernize, and prepare for deployment. One concept for providing this support is through the development of local BCTCs. The use of BCTCs for digital C4ISR sustainment training will be especially relevant to the local school concept, because this is individual training that the units are likely to have trouble supporting independently. More broadly, BCTC development will provide baseline organizations from which a more multifunctional training-support organization (or local school) might evolve.

Another set of pilot options could evaluate a more integrated system of AC/RC TASS local schools, testing and developing the potential to synchronize the use of AC and RC instructors to train soldiers of all components. In addition, it could seek to build a more cooperative training-development effort between the components and could present an opportunity to examine ways a local school system could support technology-delivered DL for all components.[2] This type of pilot would require a more comprehensive effort to imple-

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[1] See Headquarters, U.S. Army Training and Doctrine Command, 2004.

[2] Training development and DL are further explored in the next two pilots we propose.

ment than those described above. For example, it might require the selection of a major AC installation that could support training for a range of AC and RC units. It would also require the support of a USAR and ARNG chain of command willing to work toward an integrated approach for conducting TASS courses and sharing resources.

Pilot 2: Examine Current DL/IMI Products to Strengthen Future Products and Training-Development Processes

Goal. Another set of pilots could guide future development of DL/IMI products by analyzing the benefits and drawbacks of current products. Despite extensive ongoing programs involving DL in industry and educational environments, little can currently be verified about its training effectiveness or cost. Our current understanding of DL effectiveness is based largely on case studies and qualitative information, and many of the studies suffer from a variety of methodological weaknesses.[3] The need for systematic research on DL and its associated technologies for military training has been acknowledged in numerous sources, including the *Army Distributed Learning Program (ADLP) Plan* and work by researchers at the U.S. Army Research Institute,[4] the Army Science Board,[5] and the Navy, which has an ambitious DL research plan.

Questions to be answered. Pilot studies could provide information useful for formulating Army training strategy, such as the extent to which DL can reduce training time, effectively train complex skills, and enhance soldiers' quality of life. These pilots would address the following key questions about DL:

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[3] For reviews of past research see Phipps and Merisotis, 1999; Wisher et al., 1999.

[4] See Wisher et al., 1999.

[5] See Braddock et al., 1997.

- How does DL affect course completion rates and DMOSQ rates?
- What are the costs of DL?
- How does DL affect learning effectiveness, and how can that effectiveness be improved?

Research on the effectiveness of DL would require that the concept of effectiveness be broken down into its component parts so that student performance could be measured in each area. For example, student performance can be measured in terms of learning during training, knowledge retention after training, and transfer of training or job performance. Some important sub-questions to be explored include the following:

- How are student characteristics and instructor characteristics associated with performance in training?
- How do characteristics of the course, such as instructional theory (instructor-centered versus student-centered) and degree of structure, affect learning outcomes?
- What technologies or combinations of technologies are most effective, and how do they interact with characteristics of the course topic (e.g., skill complexity), students and instructors, and aspects of the training environment?
- What aspects of student-instructor and student-student communication (e.g., frequency, timing, media used) contribute to better outcomes? What mechanisms (e.g., peer tutors, online forums for students and instructors) can be used to overcome some of the problems of communicating and mentoring at a distance?

Implementation. Pilots to help guide future development of DL/IMI products might be approached in a number of ways, each of which would seek to achieve a high potential payoff with moderate investment by focusing on current courses and research.

The lowest-cost approach to augmenting Army knowledge on DL effectiveness would be to leverage findings that are beginning to emerge from other organizations. For example, the Navy has an ambitious DL research agenda and has conducted research on (1) non-face-to-face collaboration; (2) web-based mentoring, coaching, and knowledge management; (3) distributed team training; and (4) training dynamic tasks via DL. To capitalize on this research, the Army would need to make proactive efforts to track research results (e.g., attend relevant research conferences in training and technology). The Army would also need to identify gaps in research and conduct its own pilot studies to fill in information that is not covered, as well as information that is covered but in situations that are not relevant to the Army's circumstances.

Pilots to address the key questions regarding DL/IMI products could be designed to compare DL courses with residential courses. The cost of setting up parallel DL and residential courses for the purposes of conducting a pilot would be prohibitive in most cases. However, the Army could undertake this research within ongoing course schedules by comparing outcomes in TATS DL courses with comparable (i.e., within the same MOS) AIT courses. Student performance could be measured both within the AC and RC and across components. To compare the costs of DL and residential courses, the key would be to determine which costs to include.[6] Successful implementation of these pilots would require a number of research issues to be addressed, such as achieving random assignment of soldiers to courses and identifying modules within the DL and AIT courses in which learning objectives are comparable.

Another approach would be to conduct pilots on specific DL courses, focusing on what makes these courses more effective or less effective. This approach recognizes that the methodological demands of comparing residential and DL instruction (e.g., achieving sufficient sample size and random assignment) often make such research infeasible. Further, it recognizes that the Army has little choice—it has to move toward DL for a large number of courses in order to satisfy emerging training needs. In this case, the key questions would focus

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[6] Previous research has shown that estimating the cost of DL is not straightforward in that there is disagreement about what costs should be taken into account (Rumble, 2001).

on documenting the advantages and avoiding the pitfalls of DL and ensuring that investments are made in a way that maintains and enhances performance and also maximizes efficiency. This approach would work well in combination with our third pilot example, which involves an iterative process of using research results to rapidly change courses and then evaluating the new approaches as they emerge.

Recent research. Assessing DL/IMI products in low-cost pilots, especially assessing learning effectiveness, may appear to be challenging. However, RAND has demonstrated the potential of this approach for similar problems. RAND recently pilot-tested a set of learning measures in four AIT courses. These pilots assessed multiple aspects of learning, including knowledge, skills, and affective components (e.g., self-efficacy[7]). Results showed that self-efficacy, or confidence in one's ability to perform job tasks, improved after the training. The study also examined student characteristics that explain why learning occurs. Measures consisted of closed-ended (i.e., multiple-choice) responses to facilitate rapid scoring and were validated in previous research.

Moreover, the study delineated a web-based approach to building assessment instruments that emphasizes efficiency and objectivity and that supports local training evaluation. In this approach, a template of the measures, along with guidelines for their use, is made available online in a central location. Local training staff can select and modify questions to build evaluations for particular courses. The questionnaires can be administered to students online, which enables rapid scoring and feedback. The measures can be administered concurrently with course tests and therefore do not disrupt training programs.

Overall, the study concluded that useful data on learning and covariates of learning can be collected at minimal cost. This same approach could be used to examine many of the research questions relating to training effectiveness of DL/IMI products, as outlined above. For example, the web-based tool could include validated

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[7] See Kraiger, Ford, and Salas, 1993.

measures of hypothesized predictors of learning in DL environments, such as computer self-efficacy, mastery orientation, style of information processing, and need for cognition.[8] These measures can be used to test whether students' characteristics affect how well they perform in DL courses. The results, in turn, can be used to select students for DL training or to target interventions that help students learn effectively in this environment. This approach could also be used to examine how different characteristics of courses affect outcomes. For example, it could be used to test which types of instructor training, degree of course structure, or combinations of technologies are most conducive to learning.

Pilot 3: Build and Disseminate Expertise in Rapid Training Development

Goal. Focused pilot experiments could be used to explore how rapid-training-development methods, teams, and supporting technologies can best be implemented to address future challenges in training development. This pilot would best be completed in conjunction with Pilot 2.

Questions to be answered. A rapid-development pilot could address the following questions:

- What kinds of increases in development speed can be expected from using rapid-development methods?
- What are the potential costs in quality, if any? Or are there net quality gains?
- How do the costs of rapid and conventional development compare in the case examined? What could be expected from the next case of converting a course, given that the team would certainly have learned lessons from the first conversion?

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[8] E.g., Wang and Newlin, 2000.

- How does a team attempt to develop training content that is shareable or reusable? What are the costs of this extra constraint on design?
- What are the effects of moving to the use of distance-collaboration tools while doing rapid development?
- What roles might the RC effectively play in rapid development and maintenance of web-based courses?

Implementation. The cost of the pilot could be minimized by focusing on ongoing efforts, which can be combined with DL research. For example, TRADOC is currently paying for the conversion of portions of a number of Army training courses to a DL format. Much could be learned by using a subset of these course conversions as a test bed for rapid-training-development innovation. The study would require the development and use of appropriate metrics to evaluate the speed and quality of development. This would provide quantitative data on how the process performed so that potential outcomes and lessons could be evaluated.

In order for the Army training-development community to obtain the kind of organizational learning necessary for strategic decisionmaking, rapid-training-development studies require both appropriate financial support and an appropriate team. The development team should comprise motivated, innovative, collaborative, and technology-savvy individuals. The quality of the team will make or break the value of what is learned from such a pilot.

A pilot study of rapid development would be a "best case" or "proof of concept" study to determine the kinds of gains in speed and quality or reductions in cost that would be possible under the best conditions. The lessons learned would provide the TRADOC leadership with insights into how to navigate later, broader changes in training-development methods and would produce detailed, specific recommendations for methods, team structure, and technologies. Such a pilot could provide data on the costs and benefits of new methods for training development and could be used to justify increased funding in future years to support change.

A pilot study of rapid course conversion could also focus on other aspects of what makes a web-based Army training course sustainable over time, including appropriate support for users, usage tracking, and revisions. Such a pilot clearly requires more than just a course conversion. Reservists could potentially be used in the support effort during the fielding of the pilot course.

A follow-up study could investigate the same training-development and support issues, while using distributed technologies with the same team of developers. Such a study might focus on such questions as

- Can these now-experienced rapid-training developers learn to develop and support training via collaboration tools?
- What are the lessons learned and what follow-up studies are needed?

Recent research. RAND has demonstrated the feasibility and usefulness of low-cost, quick-turnaround pilots to evaluate rapid-development methods. The deputy to the Commanding General of the Combined Arms Support Command (CASCOM) requested a project to explore possible designs of a training-development system for the Combat Service Support (CSS) community that leverages electronic technologies to keep pace with the initiatives generated and skills required by Army Transformation. To address these issues, a RAND team carried out a pilot study of rapid-training-development methods and the sharing and reuse of training content. Here, we focus on the rapid-development aspects of the pilot.

An existing course on using an Army logistics management system called the Equipment Downtime Analyzer was converted from a face-to-face, instructor-led (contractor-delivered) course into a web-based, interactive course. This was done using rapid-development methods and a nontraditional team structure. The methods were based on those of XP,[9] as well as concurrent engineering[10] and other rapid-software-development methods.[11] The key to these methods is the use of many rapid cycles of design, development, and testing. The design is initially roughed out at the highest level, then prototypes are quickly designed, built, and tested with users. Although this methodology is clearly not appropriate for highly technical software, it lends itself well to projects that will involve multiple changes throughout the development process and that require human interaction as a key part of the software's effectiveness.

In the pilot study, the team structure and collocation were designed to maximize the speed, effectiveness, maintainability, and reusability of content. Such a team must have multiple skill sets, including instructional-design capabilities, subject-matter expertise, web-design skills, web-programming skills, programming/database analysis skills, QA skills, and team leadership skills. These skills do not have to reside in separate individuals; a single person may have several skills. In this pilot, three talented people provided the required skills (one was responsible for instructional design, subject-matter expertise, QA, and team leadership; another served as web designer and web programmer; and a third served as programmer/database analyst). Prototypes of the interface and some sample lessons were created and then piloted with Army officers to assess initial usability, comprehensibility, and interactivity of the learning content. With the lessons learned from this fast initial round of development, the project moved ahead to develop sample web pages with navigation, along with a web-based lesson. This lesson was piloted with a different set of Army officers, who accessed the content from a distance and teleconferenced with the development team.

User feedback provided the basis for a number of changes to structure, interactive features, and content. The course was then built to the point that it could be Beta-tested. The version Beta-tested was

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[9] See Baer, 2003; and *Extreme Programming: A Gentle Introduction*, 2004.

[10] See Backhouse and Brookes, 1996.

[11] See McConnell, 1996.

not complete or fully quality-assured, but it had approximately 90 percent of the content and interactive features in place. Missing from the course were some minor elements, e.g., a fully interactive glossary and some graphics, and some links to external references were not functional. The course was explicitly designed to fit into a four-hour block of instruction, which would be appropriate for RC training schedules. It contained approximately 98 web pages of content, not including pop-up feedback windows that provided responses to questions in the content.

The goal of the Beta test was to obtain initial assessments of the effectiveness of the interactive tutorial methods implemented, the usability of the interface, and the appropriateness and quality of the learning content. The course was Beta-tested by four logistics NCOs at a local Reserve unit, using their digital training facility.

Although the results of such a pilot are not scientific, they do provide some interesting data points. The conversion took approximately 50 person-days over the course of four months. The students provided positive ratings of the interface design and usability, the interactivity in the content, the effectiveness of the content, and the potential usefulness of the Equipment Downtime Analyzer.

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