Shaping Force XXI Engineers

By Members of the Engineer School Task Force XXI

It had been a long night while his platoons worked feverishly to prepare the defense. Now, at 0330 hours, the engineer company commander looked up to see the first enemy elements appearing over the southern ridge line. He knew the entire task force was viewing the same picture, not through binoculars but on monitors depicting near real-time enemy movement that was digitally reported by division and corps intelligence assets and transmitted throughout the task force. The enemy appeared as icons on a topographic line map background. Just 24 hours earlier, one of his squads had conducted a route reconnaissance using their terrain reconnaissance tool (TRT) to update the compact disk map-background data used by all members of the task force. Using the TRT, it had taken only an hour to collect the information and digitally transmit it to the division's terrain team. That team digitally transmitted it throughout the division and to other friendly units. During their mission planning and rehearsals, task force commanders had relied on the updated digital map, which showed the new bridge and road network leading into the task force's defensive sector.

The enemy seemed to be attacking with unexpected strength. Fortunately, his second platoon leader had emplaced hunter-killer teams along the route and they had rehearsed this contingency. To reassure himself, the commander clicked on two buttons beneath his monitor and pulled up both the obstacle overlay and the friendly locations. All was set. The digital FRAGO and overlay that all task force commanders were now receiving confirmed his notions. His second platoon leader, who had also received the FRAGO, began to execute the mission change by reconfiguring the hunter-killer teams. These electronic sensor teams, actually intelligent minefield clusters, were now beginning to monitor enemy movement. The minefield originally had been intended to disrupt enemy maneuver in the enemy's path. Now the platoon leader sent a signal to the minefield of internetted, communicating wide-area mines and munitions. The signal would reconfigure the minefield for a fixing obstacle, as directed in the FRAGO.

Force XXI engineers will add new multidimensional capabilities to the combined arms force. The above scenario provides a glimpse of future knowledge-based engineer operations. The Engineer School is moving along several fronts to form an engineer corps that can fight and win on the digitized battlefield.

Battlefield Digitization

A "digitized battlefield" has technologies that all elements of the force use to acquire, exchange, and employ timely digital information. Digitization allows deciders, shooters, and supporters at all levels to maintain a clear and accurate vision of their battlespace to support both mission planning

and execution. Graphical displays present a common picture for all users so they share situational awareness. From this vantage point, a commander gains the ability to employ forces and resources in a highly mobile, synergistic, and efficient manner.

Digitization technology enhances operations across the organization. Technically, it uses and integrates modern processing and display systems, communications, position/navigation systems (such as the Global Positioning System [GPS]), combat identification, sensor components, and distributed data-base management. Force elements transmit streams of digital data to create seamless connectivity across national, theater, and tactical grids. Operationally, this technology provides a clear and accurate picture of the battlefield. Army forces achieve this shared situational awareness in part through self-location/navigation and in part through friendly and enemy force tracking. Digitization technology aids force synchronization, reduces fratricide, and enables greater efficiency in target and obstacle integration. All elements of the force benefit.

From an operational perspective, digitizing the battlefield helps to create a synergistic effect through near real-time command and control. It yields an overwhelming operational tempo that is faster than the enemy's ability to react. Simulations show that digital capability, such as on-the-move FRAGO processing, increases tactical tempo and improves lethality and survivability.

We are applying digitization technologies in the engineer force in concert with other members of the combined arms team to form the future Force XXI Army.

Force XXI Campaign Plan

General Sullivan's vision of the Army that will fight on the digitized battlefield is Force XXI:

Force XXI is the reconceptualization and redesign of the force at all echelons, from the foxhole to the industrial base, to meet the needs of a volatile and ever-changing world. It will be a force organized around information and information technologies. Its purpose will be to deter those who oppose us, to compel when deterrence fails, and to reassure our friends and allies around the world that they can count on us.[1]

The central feature of Force XXI is its ability to exploit information.To win the information war, the total force requires a mature digitization capability.

The Army's campaign plan provides the construct to achieve Force XXI (Figure 1). This plan is based on three complementary efforts. "Joint Venture," the main effort, is led by TRADOC. It is a process to redesign the force through a series of virtual, constructive, and live advanced warfighting experiments (AWEs). Re-engineering the division is the initial focus. A second effort of the plan, supervised by the Vice Chief of Staff of the Army, involves the reinvention of the Institutional Army. The third axis represents the development, acquisition, and fielding of information technologies. The Army Digitization Office leads this effort by ensuring that these technologies are horizontally integrated across the force.

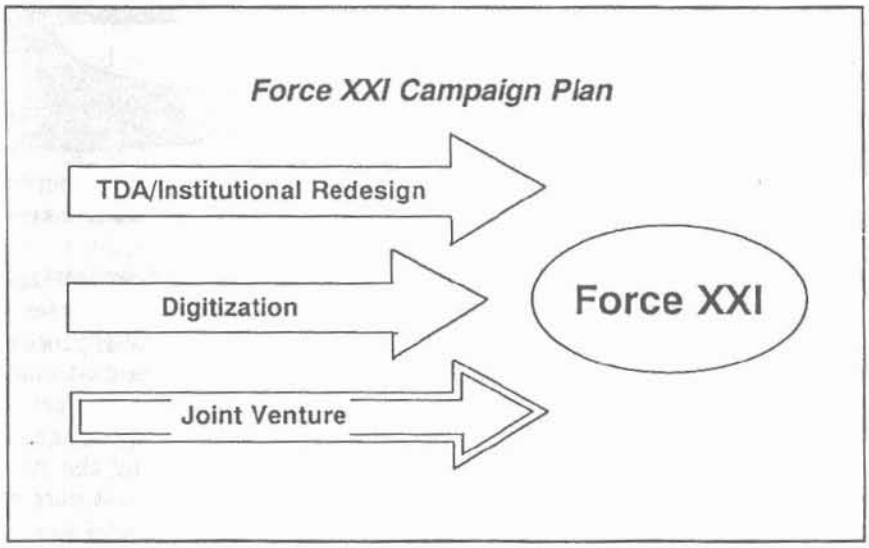

Figure 1

Participants throughout the Army are executing elements of the plan. For the engineer piece, the Engineer Center is developing a strategy to complement the Army's Force XXI Campaign Plan.

Engineer Force XXI Campaign Plan

The engineer force will evolve into the commandant's vision of a more versatile 2010 force. We must position ourselves in the year 2010 and gaze back to the present. First, create a vision, then throw a grappling hook to the present and pull ourselves forward. Our Engineer Force XXI Campaign Plan is the pathway to pull ourselves forward toward Force XXI engineers (Figure 2, page 4).

The commandant formed a task force to integrate engineer efforts across all doctrine, training, leader development, organizational, materiel, and

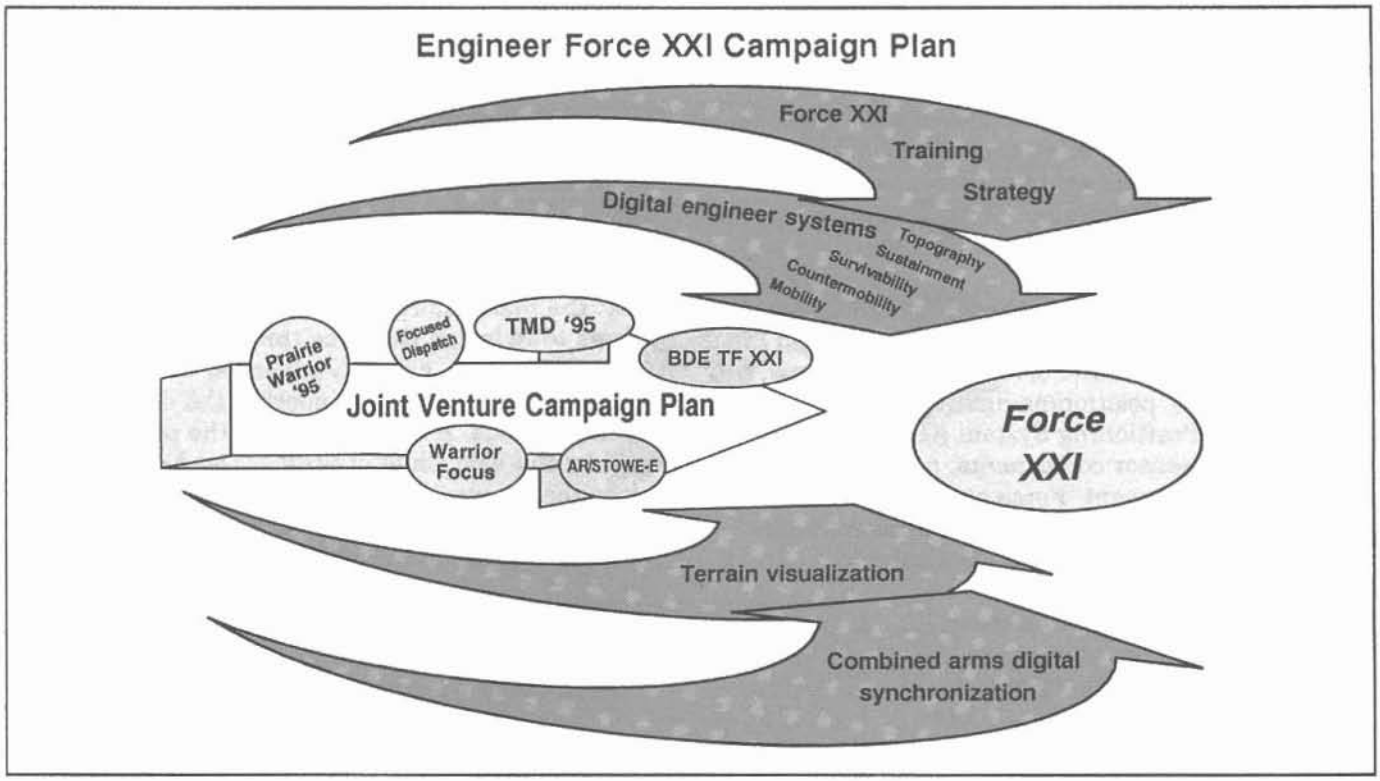

Figure 2. The Engineer School's plan has five axes to reach Force XXI.

soldier (DTLOMS). The task force developed the Engineer Force XXI Campaign Plan to synchronize Force XXI efforts. The plan's objective is Engineer Force XXI, a modernized and knowledge-based digitized engineer force capable of full and enhanced partnership with the Army's Force XXI.

Five complementary and interactive pathways lead to Engineer Force XXI. Each contains distinct characteristics, but all are interrelated and critical to the campaign's success. Our main effort is participation in TRADOC's Joint Venture Campaign. This effort will evolve organizational and operational capabilities for Force XXI engineers. Four supporting axes ensure total synchronization of the plan. Engineer digital synchronization integrates engineer command and control and information functional capabilities into the Army Battle Command Systems (ABCS) at all echelons. Training strategies being developed today ensure that our soldiers and leaders are prepared to fight the 2010 battle and succeed in operations other than war. Another major effort digitizes current and developing engineer systems. The fifth axis, terrain visualization, embeds terrain visualization capabilities throughout Force XXI and within ABCS. A discussion of each axis follows.

Joint Venture. The most important effort centers on redesigning the current total Army structure to produce the best possible force for tomorrow's Army. Joint Venture is a partnership between the Department of Army, TRADOC, and the other Major Army Commands (MACOMs); TRADOC Headquarters and the Battle Labs synchronize the effort. At the Engineer School, the Directorate of Combat Developments' Battle Lab Division is the school's lead element. The Battle Labs use the AWE process to test proposed operational and organizational strategies.

The primary purpose of the AWEs to provide insights into critical decisions the Engineer School and the Army must resolve. For example, we must determine how to equip, train, and develop doctrine and organizational structure for Force XXI. AWEs are sponsored by one of the TRADOC Battle Labs. They are culminating efforts focused on developing major increases to warfighting capabilities. AWEs impact across the TRADOC domains of DTLOMS and the battlefield operating systems (BOS). Additionally, advanced technology demonstrations and advanced concept technology demonstrations may feed technological assessments into the AWE process.

The Joint Venture Campaign Plan consists of three overlapping phases, as shown below. The centerpiece of the initial phase is the Task Force

Joint Venture Phases

1. **Early experimentation to establish the initial baseline; it includes currently scheduled AWEs and ends with a final Division XXI design.**
2. **Force design, beginning with Task Force XXI (February 1997) and ending with Corps XXI.**
3. **Fielding and refinement, beginning with the Division XXI design and ending with the fielding of the first Applique-equipped corps in the year 2006.**

XXI AWE, slated for February 1997. This AWE will utilize a brigade from the newly formed experimental force (EXFOR) from the 2d Armored Division; it will be digitally equipped and reorganized to leverage information-age technologies. Insights and lessons learned from this AWE will influence the interim design of the brigade and the division.

Unfortunately, the AWE comes too soon to leverage the modernization of the heavy engineer force with the Grizzly (Breacher) and the Wolverine (Heavy Assault Bridge). Other modernization initiatives, however, will be incorporated into the EXFOR: terrain visualization, ground robotics, Airborne Standoff Mine Detection System (ASTAMIDS), Ground Standoff Mine Detection System (GSTAMIDS), intelligent minefields, and the Assault Breach Marking System (ABMS).

A series of AWEs will build on each other and culminate in the Task Force XXI AWE. Prairie Warrior '95, hosted by the Battle Command Battle Lab, Fort Leavenworth, occurs in May 1995. Designed to leverage digital technology, it will help redesign the future division through simulation. One tool for doing this is the Mobile Strike Force portion of Prairie Warrior, where Command and General Staff College (CGSC) students equipped with 2010 technologies will organize and fight a 2010 battle using experimental force designs.

Prairie Warrior offers a great opportunity for engineers to demonstrate their added value to the battle as part of the combined arms team. Besides evaluating a myriad of new systems being integrated into the exercise, such as the Tactical Engineer Command and Control System (TECCS), the CGSC participants are evaluating experimental organizational structure.

The Mounted Battlespace Battle Lab will sponsor Focused Dispatch AWE in August 1995 at the Greenville Training Area, Kentucky. Focused Dispatch will evaluate an armored task force. Company C of the 19th Engineer Battalion has been designated as the engineer force. The hypothesis to be tested is that procedural, functional, and organizational changes in the different BOSs within the task force will result in enhancements to lethality, survivability, and tempo. Additionally, Focused Dispatch will evaluate digital connectivity requirements for battle command in brigade-and-below units.

Focused Dispatch has three phases: a constructive simulation, a virtual simulation, and a live exercise. Grizzly, Wolverine, and wide area munitions (WAM) will play in the constructive simulation. The intelligent minefield/WAM will play in the virtual simulation, as does ASTAMIDS. The live exercise will consist of WAM training munitions; the combat terrain information system with a terrain-visualization package; the assault breach marking system; and five Intervehicular Information System (IVIS) appliques for the engineer squad vehicles, platoon leader, and task-force engineer.

General Sullivan designated the Dismounted Battlespace Battle Lab's Warrior Focus AWE as the showcase experiment for 1995. Scheduled for November at the Joint Readiness Training Center, it will evaluate the organizational designs and tactics of a digitized and modernized light infantry task force. Key issues to be evaluated include en route battle command, own-the-night enhancements, survivability, joint digitization, SOF/conventional force interface, and battle command links from the brigade to the soldier. B Company, 41st Engineer Battalion, 10th Mountain Division, is designated as the engineer force in Warrior Focus. Engineer initiatives include enhancements in the countermine arena, a terrain visualization package, five digitized soldier systems, and night-vision enhancements.

In short, Joint Venture is an aggressive collection of AWEs on a tight time line. The AWEs represent an excellent opportunity to showcase and evaluate future engineer initiatives. Close ties between the Engineer School and tactical engineer units are necessary to ensure successful AWEs. But, what great training opportunities the AWEs provide for those units to field test and employ these new engineer initiatives!

Engineer Digital Synchronization. Engineers of 2010 will conduct knowledge-based operations with fully digitized command and control (C2) capabilities. They will be full partners in the Army's seamless C2 system called "Army Battle Command System" (Figure 3, page 6). The ABCS provides a single system C2 architecture. It integrates real-time situational information and sensor data into the force-level data base, with simultaneous display and near real-time access to the commander and the staff. The system provides the commander assured access to a relevant, seamless, and tailorable strategic-to-foxhole common picture.

The Engineer School is focusing most digital synchronization efforts toward integration into ABCS. Primary goals are to ensure that—

- Engineer digital C2 systems are inserted into the proper ABCS echelon.
- Appropriate engineer functions exist at all levels of ABCS.
- Engineer interests are fairly and correctly represented in all ABCS.

To achieve these goals, the Engineer School is focusing efforts at two levels. At the tactical level, the Army is pursuing a digitized C2 system called "Applique." It is a computer system that can be installed on platforms or vehicles to provide the maneuver force with the functions required to prepare

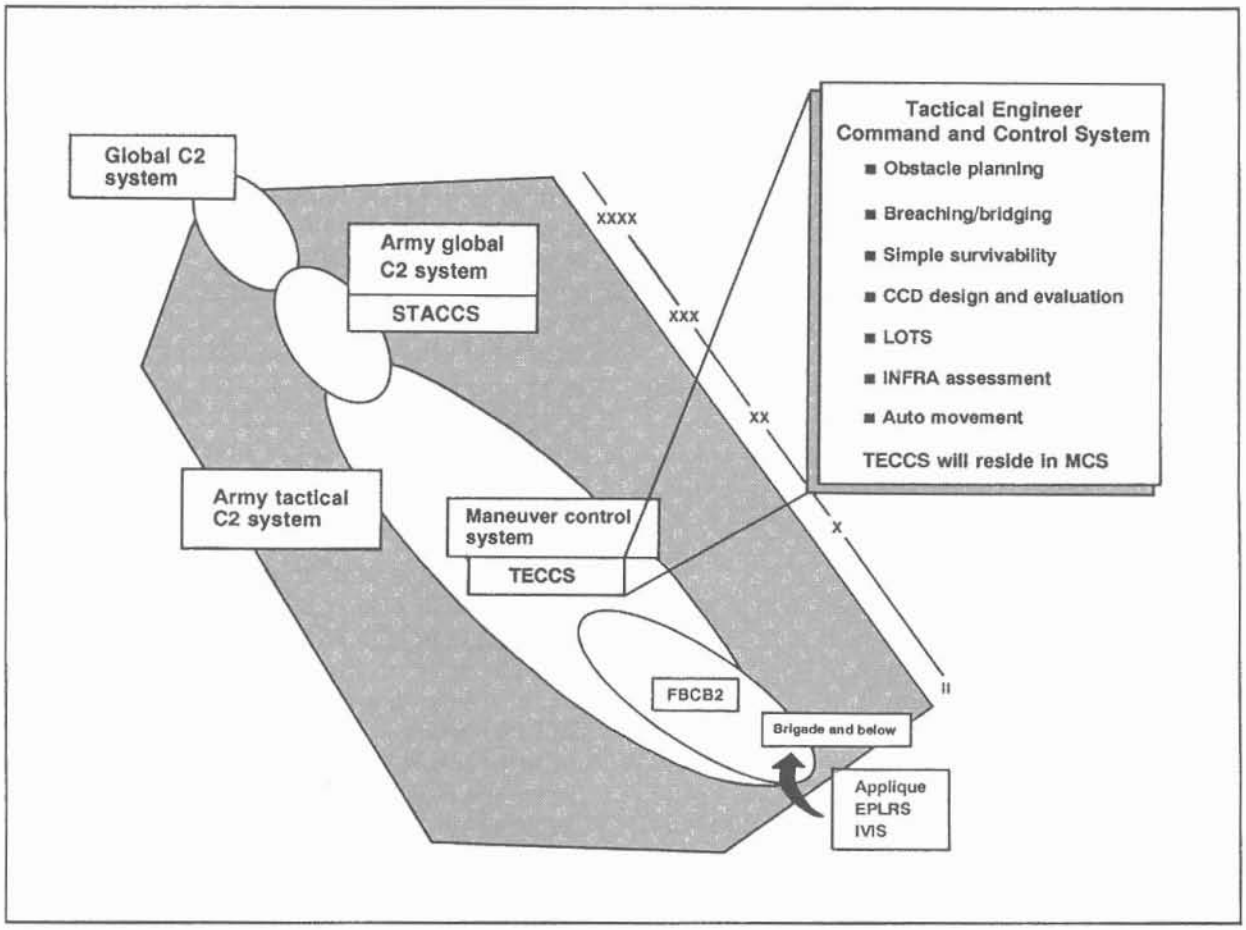

Figure 3. The Army's planned C2 architecture, from global systems (upper left) to the individual soldier and platform (lower right). TECCS and emerging engineer systems will be integrated within ABCS.

for and execute warfare and operations other than war. In general, Applique will be inserted at brigade and below levels. Components include a computer unit, a display, and input and auxiliary devices such as position/navigation tools. Applique systems support battle command and provide situational awareness, communications management, and battle command management. Task force elements will exchange orders and graphics, and maintain situational awareness in near real time. This equipment will be fielded to EXFOR engineers and the entire Task Force XXI at Fort Hood.

Forces within a digitally equipped task force currently use the IVIS to exchange digital information. The IVIS may be configured differently to meet specific user requirements. The C2 package provides basic situational awareness, mutual position/navigation, and plans and overlays. Additional packages add autonomous navigation and far-target identification. The current version of IVIS software allows countermobility planning, including obstacle overlays and five engineer reports. When integrated with the SINCGARS/digital radio system, IVIS provides commanders and staff the capability to pass and receive both digital and voice messages. It also allows for the horizontal and vertical exchange of critical battlefield C2 information, increased situational awareness, and the synchronization of other combat elements. M1A2 tanks are equipped with IVIS. The Engineer Center is pursuing ways to equip designated units, especially those participating in AWEs and early deploying contingency forces, with IVIS-like capability.

At brigade, division, and corps levels, engineer C2 will be integrated into the Maneuver Control System (MCS). It is one of a suite of automated C2 systems that make up the Army Tactical Command and Control System. MCS links commanders from corps through brigade and separate battalion levels. It gathers, synthesizes, presents and distributes information more effectively than manual methods. It reduces the time commanders need to acquire critical information and helps them make decisions and control mission execution. Within MCS, engineer-specific applications reside in the TECCS. It is a Windows-like automated system for mission planning that focuses on support to the warfighter. Several menu- or icon-driven mobility, countermobility, and survivability planning tools in TECCS automate many manual staff-planning tasks. They facilitate quick command decisions, leaving more time to execute engineer missions.

Some TECCS modules are complete. Trainers and developers at the Engineer Center are testing

one module, called the Obstacle Planning System (OPS). This mission-planning system assists commanders and their operations staffs in planning the synergistic effects of obstacles with direct and indirect fires. It draws digital terrain data from the MCS data base to form a terrain-visualization "platform" for automated planning. Among its many capabilities, OPS graphically depicts terrain elements (including 3D representation), calculates and overlays mobility corridors, allows the user to design and graphically portray obstacle overlays, and allocates resources. The overlays may be printed in hard copy or be sent digitally to others within MCS.

Additional TECCS modules, such as bridging, survivability planning, and munitions effectiveness assessment tools, are in various stages of completion. The program manager for MCS will integrate TECCS into MCS during FY 96.

Training Strategy. The Engineer School has a clear and important mission to prepare our soldiers for the challenge of operating in Force XXI on the digitized battlefield. The commandant has provided his vision of attributes needed by engineer officers in the 21st century:

- Firm leadership foundation
- Solid base in doctrine
- Computer literacy
- Technological awareness
- Skill in information management
- Ability to synchronize multiple systems
- Versatility

The school has taken the first steps to fulfill expectations associated with that vision. Engineer officers and noncommissioned officers in the Department of Tactics and Leadership (DTL) are training soldiers assigned to combat divisions in the skills required to participate in AWEs. DTL has teamed up with the Joint Countermine Demonstrations Office, at Fort Belvoir, to train engineers in the 101st Airborne Division to use the Thermal Mine Avoidance System, which is a high-tech infrared camera. Engineers will use that system to support mine detection and main supply route clearance during an engineer-focused rotation at the Joint Readiness Training Center this year. The same trainers are writing tactics, techniques and procedures (TTPs) and participating in the train-up of engineers in the 10th Mountain Division for the AWE Warrior Focus. There, engineers will use digitized communications and several new engineer systems, including the close-in man-portable mine detector and the Antipersonnel Obstacle Breaching System. Additionally, engineers will use all of the new own-the-night equipment available for light forces, including improved night-vision equipment with third-generation imagers.

Concurrently, DTL is preparing TTP for the heavy engineer force. Exercise Focused Dispatch, scheduled for August 1995, will provide engineers in the 19th Engineer Battalion with the seamless connectivity of the IVIS. Engineers will test several of the experimental engineer systems mentioned earlier. Here, too, the Engineer School is providing experimental doctrine and participating in training soldiers.

While participating in the train-up and the AWEs, instructors and writers will quickly capture lessons learned and inject them into doctrine and the lesson plans used to train officers, NCOs, and

The Operations NCO of Company C, 317th Engineer Battalion, uses a situational awareness terminal of the Enhanced Position Location Reporting System (EPLRS) to track the company's movement.

soldiers. They will promulgate some "initial thoughts" through fact sheets and post after-action reports to the Engineer School Bulletin Board; ultimately the lessons will proceed through the Center for Army Lessons Learned (CALL) system and end up in official lessons learned for the entire Army.

Officers and NCOs in DTL also are working with the computerized Obstacle Planning System developed by the Waterways Experimentation Station. They are participating in the development of the Combat Arms Tactical Trainer and a standard electronic reporting system for the Army. Their efforts ensure that future digital engineer systems are fully interoperable, that developmental systems are addressed in doctrine, and that the systems are user friendly. Our training developers will quickly incorporate the required skills, knowledges, and abilities into the programs of instruction for engineers.

In the area of training development, the entire school, led by the Directorate of Training (DOT), is preparing for Force XXI. DTL is coordinating school input to the Force XXI training program being developed by the Armor School, at Fort Knox. DOT personnel are working closely with the Simulation, Training and Instrumentation Command to develop an engineer training system that can be used to simulate the Grizzly, the Wolverine, and other systems. Most importantly, the DOT is systematically reviewing the program of instruction for officer training. As a result of that review, a redesigned program of instruction for FY 96 will capture the commandant's guidance for Force XXI engineers.

The Engineer School is actively involved in developing and testing new systems. Instructors/writers are providing training and TTPs to make the systems work. They are capturing lessons learned and analyzing the results. In short, the DOT is developing forward-looking doctrine and training and is participating in the development of organizations and systems to equip engineer leaders and soldiers for the 21st century.

Digital Engineer Systems. Many digital technologies with potential combat engineer applications either exist today or are evolving. Combat developers at the Engineer Center are examining promising digital system concepts with the Battle Labs, other branch proponents, and private industry. These technologies span operational applications from the close fight to theater-level engineering.

Emerging systems with embedded digital technologies will provide close combat engineers with enhanced information-based capability to ensure full partnership on the 2010 battlefield. For example, both the Grizzly and the Wolverine have embedded IVIS-like equipment, including GPS, a monitor, and a computer. Grizzly and Wolverine crews will share situational awareness with other task force elements; their capabilities will enhance battlefield synchronization. When conducting a breach, task force commanders will have complete confidence both in the Grizzly's minefield-breaching capability and in the crews' ability to navigate precisely to the right breach site.

The Engineer School is exploring other digital system ideas. For example, the intelligent minefield system promises to transform obstacle doctrine. It centers around smart munitions, such as WAM, coupled to a C2 gateway. WAM is capable of indirect firing, discriminates between targets, and seeks and destroys prioritized targets autonomously. The gateway is emplaced near the WAM and can exercise control of as many as 12 munitions. When a GPS transceiver is integrated into the gateway, it becomes an autonomous sentry that can take reports of enemy activities from subordinate WAMs. The gateway is, in effect, the squad leader of a cluster of munitions.

Another system under study is the Terrain Reconnaissance Tool (TRT). A GPS-based, geographic data-collection system, its primary function is to quickly capture data that support other geographic information systems. Collected data are relayed digitally to terrain teams to update maps. Intelligent minefields and TRT are just two examples of technology that will help engineers perform their missions faster and more efficiently.

In the rear battle, digital engineer systems allow faster and more efficient planning and execution. The Theater Construction Management System is one such tool. Already in use by higher level engineer commands, such as engineer brigades and groups, it automates the theater construction design process. The system has both custom and commercial software packages, including project management, CAD, data-base management, and an underlying Army Functional Component System (AFCS) data base. A 1995 version operates as a Windows system. While using units must purchase their own computers, units on the fielding distribution plan will receive a 230Mb Bernoulli external hard drive unit, AUTOCAD LT, Microsoft Project 4, and Close-Up 6, as well as customized software and an AFCS data base.

Combat heavy engineers will rely more on automation, laser technologies, and location/navigation systems to execute their missions. Laser-grade control devices, sensors, GPS, digital transmitters/receivers, and display screens will be installed in construction equipment. These technologies will simplify earthmoving tasks, mission planning, and project management.

Terrain Visualization. As the TRADOC proponent for terrain visualization, the Engineer

Figure 4

Center is responsible for ensuring that terrain-visualization requirements are identified, developed, and integrated throughout the Force XXI Campaign Plan.

Terrain visualization, which portrays natural and cultural features within an area of interest, is the engineers' responsibility. While important, terrain visualization alone does not meet all of a commander's needs. He also needs battlefield visualization, which adds operational graphics (overlaid information) to terrain visualization to provide situational awareness. Commanders have indicated they want maps, map backgrounds, a fly-through capability, real-time analysis of the terrain, a playing field for mission planning and rehearsal systems, and models and simulations. The models and simulations should use the same data base as the operational systems. Commanders want all systems tied together to give their forces a common picture of the battlefield. The ABCS will use the Terrain Evaluation Module to provide both the map background for command and control plus the capability to develop 10 tactical decision aids. While that sounds good, the current lack of available digital data worldwide (see Figure 4) may affect mission planning and execution in the near future.

The commandant sees three challenges for terrain visualization: consistent requirements, data availability/collection, and data dissemination. Through Force XXI initiatives, engineers have identified opportunities to work in specific efforts to address these challenges. Much of the work entails refining what commanders need for battlefield visualization to allow better situational awareness.

With the shift to contingency-based operations, the Army has re-evaluated existing capabilities. We now must develop and provide additional tools for planning, command and control, modeling and simulation, and training systems. Commanders and staffs require these systems to distribute up-to-date digital terrain data.

The recent crises in Rwanda and Haiti demonstrated the need for a better and more responsive capability to provide updated map products and digital terrain data. The need is two-fold: Commanders require rapidly produced paper maps as well as digital terrain data to use as map backgrounds. The latter reside in future C2 systems and simulations. The simulations provide rapid training and rehearsal tools for force training exercises prior to deployment.

The Engineer School's Terrain Visualization Center is working with other agencies to meet these challenges. For example, the school hosted a series of meetings in the summer of 1994 with the Battle Labs, the proponent schools, and the MACOMs to identify and define digital terrain data requirements for operational forces. The participants formed a team to incorporate information derived from those meetings into a terrain visualization master plan. It addresses the commandant's terrain-visualization challenges and provides a road map for terrain-visualization initiatives. The Engineer School will integrate efforts such as these with those of other agencies for evaluation in an AWE.

The AWEs in which initiatives will be inserted to test and improve battlefield visualization for the commander are shown on the table, page 10. These tests and the resulting lessons learned are critical in developing Force XXI requirements. Engineers are leading the Army in articulating and meeting Force XXI terrain-visualization requirements. This must be an Armywide coordinated effort. Lacking a coordinated effort, commanders will seek costly and inefficient nonstandard solutions to their needs. Therefore, a major mission of the Terrain Visualization Center is to ensure that data-collection and dissemination efforts are integrated throughout Force XXI.

Terrain Visualization Insertions

Battlefield Visualization Capabilities	USACOM Exercise	Prairie Warrior	Focused Dispatch	Warrior Focus	Brigade TF XXI	Division XXI	Corps XXI
Split-Based Operations	X		X	X	X		X
Situational Awareness		X		X			
MPRS				X			
Terrain Analysis			X			X	
BCDSS	X	X					
3-Dimensional Fly Through				X			

The Road Ahead

By way of five pathways, we have embarked on the road toward Force XXI engineers. Most of the journey lies ahead. The entire engineer community must work with the combined arms team as we proceed through Joint Venture AWEs. Our supporting efforts (combined arms digital synchronization, training strategies, digital engineer systems, and terrain visualization) are essential to the success of this campaign. Each effort requires extensive resources. Understanding that resources are limited, we must organize around purpose, not physical limitations. Our purpose is to persist as joint partners in moving beyond what we have stylized as the American way of conducting ground warfare (maneuver warfare) toward control warfare. To do that we must employ the synergistic power of integrated information and communications.

This journey will have extensive implications throughout DTLOMS. Engineer doctrine will incorporate the effects of digitization and the TTP that flow from the application of digitized processes. Training engineer soldiers and leaders to become reflexively comfortable and highly competent in digitized procedures will be the single largest challenge. The conversion of "doing engineer business" by voice and paper reports to a digitized, integrated information system that works primarily through a computer screen must be seamless. While we expect a lot of tinkering and fine tuning of engineer organizations, we believe that the basic engineer structure of the heavy division will not undergo dramatic change. The engineer force must receive comparable, concurrent, and compatible fieldings of common digitized command and control suites. Our desired end state is fully digitized equipment Armywide. Fiscal constraints, however, will impede the transformation of the total Army force and our combined partners from an analog mode to a digital mode well into the 21st century. Most importantly, we must keep faith with our soldiers and give them the most effective doctrine, training, leaders, and materiel that America can produce.

The revolution has barely begun. Where the industrial revolution harnessed energy and machines to enhance muscle power, the information revolution will harness communications, sensors, and computers to enhance brain power. This is the power of Force XXI engineers.

Reference

[1]Office of the Chief of Staff, Army, "Force XXI...America's Army of the 21st Century," 15 January 1995, page 1.

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