Army Digitization: Making it Ready for Prime Time

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Today's emerging strategic environment and operational challenges demand that the Army develop a more responsive and mobile force while maintaining the lethality necessary to fight and win our nation's wars.[1] The Army is developing the Future Force as the long-term solution while the structurally-new current force, characterized by the Stryker Brigade Combat Teams, is a near- and mid-term solution for a more responsive, mobile, agile, and versatile medium-weight force.[2] Simultaneously, the current force, starting with the heavy mechanized and armored divisions, is digitizing and undergoing force structure changes to enhance its near-term ability to provide these operational capabilities.[3] Coupled with technical innovations, the structural changes—to include reduced platform density, indirect fire assets, and combat service support footprint—will purportedly allow modernized current forces to have greater capability through information superiority and the ability to conduct rapid, decisive operations.[4]

The Army's commitment to creating a digitized force elicits some key questions about how the Army will make the transition from an analog force in the face of rapidly changing technology while maintaining the capability to meet key strategic and operational challenges. For example, what are the force structure changes that the Army needs to make to best leverage powerful information systems? What is the phasing strategy to keep units interoperable and operationally viable during the transition? How fast should the transition occur given that digitized systems continue to mature? What is the appropriate level of embedding digital systems—is brigade/battalion-level the locus or should every soldier become an information node?

The current state of Army digitization is immature and not uniformly delivering the promised capability to justify the current changes in the force structure. Despite great expenditures and effort, the current state of the digital

"system-of-systems" and employment concepts makes clear the price of transformation, to "accept risk in the near and mid-term, causing turbulence and unexpected change . . . [while] freeing up sufficient resources for the Army to invest in new technologies that will enhance its warfighting effectiveness in the future."[5] The Army is accepting this risk, but there is uncertainty whether digitization is fully ready for prime time.

This article investigates critical challenges in the Army's current digitization efforts, including force structure implications, and provides recommendations to ensure the increasingly digitized Army maintains its capability and readiness as it moves from an analog to a primarily digitally enabled force.

Network-Centric Warfare and Digitization

The discussion on the merits and prudence of embracing network-centric warfare continues as a great debate both within the Army and across the Department of Defense. Yet, regardless of its merits, it is safe to say that network-centric warfare, a term with a constantly evolving definition but one firmly rooted in the concept of horizontal and vertical information-sharing using advanced information technology, is the chosen path for the transformation of the United States military, and the Army is incorporating its concepts. With network-centric warfare, the Army is shifting power away from an industrial-age focus on mass toward access and flow of information as an essential element of combat power.[6]

The business world has capitalized on leaps in effectiveness gained from digital communications, including dramatic information-sharing within established networks with real-time collaboration. The Army seeks to infuse these same qualities in its units in order to conduct rapid, decisive operations at the operational and tactical levels by using digital "information technologies to acquire, exchange, and employ timely information throughout the battlespace."[7] Success relies on proliferation of a near-universal situational understanding gained through a "Common Relevant Operating Picture" and near-to-real-time intelligence. There is access to both sensors and shooters through various grids that will allow rapid and precise identification and engagement of targets, which promotes the execution of dominant maneuver and precision effects.[8] Digitization also facilitates a streamlined, focused logistical

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system geared to anticipate rather than respond to requirements by perfecting dynamic inventory management and dispatching centralized assets to arrive "just in time."[9]

The Division XXI structure is the modernized structure for current heavy forces.[10] In it, the Army significantly reduced the number of tanks and mechanized vehicles in its armor and mechanized infantry battalions from 58 to 45, while expanding the assigned area of operations by 50 percent. This translates to a dramatic decrease of actually 25 percent (four to three platforms) in the fighting edge of the unit, the line platoons. Supposedly, "the new [digital] systems' enhanced capabilities, coupled with improved [situational understanding], make these smaller battalions more effective."[11] They are expected to be more agile, more mobile, and more deployable, while exercising more decisive dominant maneuver.

This change, as well as the reduction in organic indirect fire assets and significant reduction in combat support and combat service support units within the division, was made for several reasons. First, there is an increasing need to make the mechanized and heavy forces lighter and more deployable. By reducing the total number of heavy assets and the combat service support package within the division, the division can deploy faster. Next, the assets garnished from these units can be spread across the entire force to modernize reserve component units or support other programs. Finally, it is believed that the power of the digital systems employed by the unit can provide the information overmatch to not only compensate for the loss of more traditional measures of combat power,[12] but also actually produce a net increase in combat power while operating over a dramatically expanded battlespace.[13]

Associated with these reductions is an increase in the number of communications systems, particularly relay/retransmission vehicles used to establish and maintain the tactical internet. Mounted primarily on soft vehicles, the relay/retransmission and additional satellite systems are normally devoid of any self-protection and are absolutely critical to digital communications within the division and subordinate units. Vulnerable and truly high-value assets, they require significant protection.

The Stryker Brigade Combat Team (SBCT) is a new organization, optimized for complex and urban terrain and the ability to leverage complex command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR)[14] systems. The SBCT has many of the characteristics of the modernizing mechanized force: increased battlespace, reduced combat platform density, reduced indirect fire assets, reduced organic combat service support, and increasingly soft communications assets compared to comparable formations. Again, the thought that network-centric enablers are sufficient force-multipliers drives much of the force structure.[15]

The Digital Promise Not Fully Realized

Reports from the field indicate that current digitization efforts may be unable to match the needed operational capabilities. There are sufficient issues with digital systems and integration across the Doctrine, Training, Leaders, Organization, Materiel, Personnel, and Facilities (DTLOMPF) to question the ability of these units to fully match needed operational capabilities.

Reports also indicate that digital skills are neither easily acquired nor retained and require a steep learning curve for both soldiers and leaders. "It takes a long time for human crews to learn how to intuitively operate" these complex systems-of-systems.[16] The current generation of complex digital tools has only added to an already heavy individual and collective training burden. Accordingly, commanders must make hard choices about the amount of training that soldiers receive and often find the time by sacrificing other training. The lack of an institutionally based, Army-wide digitization training strategy makes the situation worse. When it comes to digitization, civilian contractors fielding the systems or their numerous modifications do most of the training.[17] Digital expertise, the knowledge to effectively use the systems in combat, rests with highly talented contractors, not with uniformed soldiers. There is no influx of trained, digitally aware soldiers, and this will not happen in the foreseeable future.

Within the Army training base overseen by Training and Doctrine Command, often referred to as the "Institutional Army," there are scarce digital assets to train system operators and leaders in time- and resource-intensive digital skills and employment principles. However, since there is minimal effort at personnel stabilization (there was some stabilization during the establishment of the initial SBCT, but not for key leaders), an inordinate amount of time is required to ensure new operators and leaders are digitally trained. This is particularly important with leader training that is focused on employing the systems as battle command tools as opposed to operator training that involves system manipulation. The turnover of key leaders dramatically affects the units' continued ability to use the systems effectively.

The Army Battle Command System[18] is a training-intensive family of software. Even the most rudimentary software changes require extensive retraining.[19] Though efforts are in place to control the pace of software updates, maintaining a stable training platform is very difficult. Subsequent versions of the software do not assure backward compatibility and interoperability, while a rigid and inflexible address book tied to individual functional area computers in the unit makes rapid task organization difficult. In short, "legacy systems using dissimilar software and communication protocols are barriers to seamless exchanges of information."[20]

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The current tactical network is complex, very maintenance-intensive, and built around static, line-of-sight nodes that must go off-line during movement. Managing the node locations over complex terrain becomes extremely challenging. The network is optimized for operations in open areas and has difficulty supporting extremely fluid operations in complex and urban terrain, such as the mountains of Afghanistan or the streets of Baghdad. Relying on exposed nodes that require protection and depend on reliable power, the network's physical structure is extremely vulnerable. Electronic interference, power surges, nuances of terrain, and system crashes of individual, complex computers all contribute to the network's vulnerability. Maintenance of the network and sustainment of digital systems continue to rest primarily with an expansive cadre of civilian contractors. As the results of the preponderance of digital training exercises demonstrate, including the Fort Hood Digital Capstone Exercise and the US Joint Forces Command joint training event Millennium Challenge 2002, establishing the network and keeping it running is a highly specialized talent.

Digital combat service support (CSS) systems, aimed at tracking, anticipating, and pushing logistics, are lagging well behind operational systems. Digital units currently use the old, decentralized, and more manpower-intensive "legacy" CSS management tools. Meanwhile, the CSS structure has not only been reduced in overall size, but has been pulled back from forward units and centralized at brigade-level and higher.[21]

The Secretary of Defense's 2002 report to the President charges that land forces must remain capable of "undertaking major combat operations . . . across a wide range of conditions and geographic settings."[22] Unfortunately, the major training experience associated with the digitized units considers operating them within a digital-only battlespace that is far from taxing. When working in a static, desert environment with plenty of contractor support, the digital tools still experienced a great deal of difficulty, enough to question their battle-worthiness. Whether during the Division Capstone Exercises, National Training Center Rotations, or during Millennium Challenge 2002, the digital units operated in a digital box that included extensive provisions to compen-

sate for the static and brittle nature of the network. They never had to fight in a city, pick up and move 150 kilometers, keep the network operational, or maintain contact along the way. They never had to seriously conduct operations integrating analog forces or directly responding to a non-Army, non-digitized headquarters.

The Interoperability Challenge

The current digitization strategy radically increases the interoperability challenges of forces both within the Army and across the joint and combined community. Command and control of digital forces, particularly the Stryker Brigade Combat Teams, is a vexing issue that is not fully answered. Recently, US Army Forces Command established a "digital bridge" augmentation package for I Corps at Fort Lewis. The intent is to literally have a full Army Battle Command System suite that can be readily integrated into the I Corps command and control structure in order to allow simultaneous command and control of a digitized SBCT and an analog unit. The bridge will allow the transfer of analog information into the digital vernacular used by the SBCT, and vice-versa.

A part of the force structure without a clear plan for digital modernization in the near- to mid-term is the great density of echelons above division and echelons above corps forces—both active and reserve component—representing the modular combat support and combat service support enablers expected to work in close conjunction with the modernized current forces. The SBCT is incredibly austere and, based on the situation, is expected to receive augmentation from engineers, military police, civil affairs, and psychological operations units, among others. It is highly likely that these units will arrive without any digital assets, and there is no guarantee that they will have any digital training, to include leader training. Since the digitally disenfranchised units will not show up on the digital "screen," their interoperability is limited. Either they risk a significant chance of fratricide, or stringent control measures are required to prevent mistakes. In fact, there is evidence of a "higher number of friendly-fire kills at the National Training Center" by digitized than by analog forces.[23] Clearly, the ability of non-digital assets, such as military police and combat engineers, to function effectively in concert with digital units is severely limited.[24]

There is also a substantial and glaring digital gap at the individual soldier level. Despite years of development, the still embryonic Land Warrior system—the system designed to link the individual soldier into the network—is not only not ready for fielding, but still has such significant problems that it is likely several years from fielding. This presents some challenges and limitations. Since soldiers and leaders must now be with their platforms to stay in

the digital network, the ability of a leader to dismount and maintain the situational understanding demanded of the doctrine (and upon which much of the system-of-systems employment is predicated) is now contested. In fact, during training exercises at Fort Lewis, some leaders' battlefield circulation was extremely hamstrung by this requirement to stay tied to the platforms' computers. Units are also challenged to track the location of both dismounted units and individual soldiers, a particularly acute problem in close and urban terrain. Fratricide and the complex challenges with clearing fires over a mixed digital-analog network (where accurate information on unit locations is essential) become increasing concerns, while the tactical flexibility of the ground-based elements becomes hindered.

Current Efforts to Mitigate the Problem

As the Army moves towards the Future Force, it is rushing to ensure that the current force is postured to take full advantage of the eventual promise of digital systems and network-centric warfare. In doing so, it has greatly overestimated the capability of this first-generation C4ISR infusion and grossly underestimated the difficulties in both training and sustainment. The result is units that are expected to have significant operational capabilities, but they currently lack the mature digital tools necessary to justify the changes in force structure. These units are in the dangerous position of ensuring digital systems are employed to show they work, while simultaneously ensuring that their units can overcome shortcomings in key areas such as combat service support so they can actually fight when called upon.

The Army is aware of the shortcomings faced by digital units and is employing a twofold approach to address the problems while struggling to sustain combat readiness. First, the materiel and training developer communities are attempting to solve the problem one system at a time by resolving very specific concerns as they arise. This presents several challenges: (1) this is an extremely costly and bottom-up approach that teeters between modification and experimentation; (2) spillover problems are rampant due to the lack of a consistent, holistic approach from a system-of-systems perspective; and (3) it requires the unit to cease operations and training to integrate the change, which often requires substantial training time in an already crowded schedule. The Army's second approach is to charge the unit to "make it work" by developing alternate methods to mitigate shortfalls, commonly called "workarounds." Good units will always do this. However, it often results in masking critical problems under the guise of getting the job done while pursuing imperfect, highly localized tactics, techniques, and procedures. The solution may solve the problem for the short term, but not deliver the kind of result needed to meet the long-term operational requirement, and subsequently complicating inter-

operability. Units tend to isolate those systems that do not work well and leave them behind, while promoting systems such as the platform-level computer, the Force XXI Battle Command Brigade and Below (FBCB2), which works very well and is now wired into most command posts. This solves the short-term problem, but doesn't advance learning on the bypassed concepts.

Finding a Better Way

A multilayered approach is needed to mitigate digital shortfalls in the near- to mid-term, thus ensuring that the Army's near- to mid-term digital forces stay ready. Meanwhile, the Army will stay on the path to creating an effective, digitized Future Force. The following proposals suggest such a comprehensive approach.

Reinstitute an Experimental Unit

Despite the provisions of the National Security Strategy calling for "experimentation with new approaches to warfare," the Army has no field unit currently dedicated as a platform to experiment with digital systems and concepts.[25] At one time, Fort Hood's 4th Infantry Division served as an experimental unit. However, it was returned to the pool of operational units in September 2002. Given the immaturity of the systems and the work to be done, that was premature. Because units cannot afford a serious loss of readiness, those that receive what are really experimental systems, as well as experimental doctrinal concepts, are constrained to employ them in a manner that keeps the unit fully operational. Though lessons-learned are gathered from all units, only with an experimental unit can the Army focus intensely on ensuring that new concepts and systems-of-systems are ready for force-wide introduction without constraining an operational unit with the significant effort currently required to fully test digital systems and concepts.

The Army needs an experimental unit of at least a brigade combat team strength to rigorously test digital systems and operational concepts. Experimental units serve to move the inherent risk of rapidly infused digital technology out of the operationally employable force. Though this may be perceived as slowing the transformation effort, it would in fact ensure that transformation stays on track because it can move forward unfettered by near-term operational concerns. In fact, the speed of digitization may actually increase as more experimentation will facilitate using spiral transformation to bridge concept development to final solution with incremental steps.[26]

This is clearly an ongoing debate. Recently, the Office of Force Transformation called for operational experimentation to accelerate the pace of what it calls "rapid, spiral transformation."[27] Unfortunately, this concept denies that good commanders and good units who are in the midst of ongoing

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operations will not allow the failure often necessary to not only make systems and concepts better, but to weed out potential dead-ends.

Additionally, the Army needs to dramatically expand and stress its digital experimentation program within the joint environment. Millennium Challenge 2002 notwithstanding, services are routinely exploring information dominance under fairly compartmentalized conditions with only minimal interface while they perfect information systems within their comfort zone. Of particular interest is the digital gap the Army suffers with respect to urban warfare. The Army should promote joint experimentation in this area to capitalize on programs such as the Marines' Project Metropolis, aimed at addressing command and control problems in urban areas.[28]

The Army should make every effort to leverage the digital work done by the other services. For example, both the Army and the Air Force are exploring unmanned aerial vehicles (UAVs) for both reconnaissance and combat missions. However, the work is being done in parallel, with limited interface between the two services' efforts, despite the fact that the technologies are the same.

Reduce System-of-Systems Complexity Below Brigade Combat Team

The overall systems-of-systems are much too complex below the brigade combat team. In a battalion command post, leaders and key staff are forced to integrate a myriad of C4ISR systems, to include a complex network and assorted specialized computer systems. Many of these tools require the lean battalion leadership to process and analyze information rather than receive and use it. The battalion task force should be pure units of action that receive fully digested and relevant information and then execute their missions. The battalion needs a single command and control tool to receive the bare bones of the Common Relevant Operating Picture and execute rudimentary orders. Currently, the proven and significantly cheaper FBCB2 fills this need, and it should replace the battery of computers in the Army Battle Command System that austerely manned battalion and brigade operations centers must now contend with. In fact, most digital battalions are now remoting

spare FBCB2s into the battalion and brigade command posts to the exclusion of the assigned ABCS systems that are in many cases being left behind. This will not only clarify the picture coming into the command post, but also will allow the now-ponderous command posts at battalion and brigade to become smaller and more mobile. Additionally, the FBCB2 network has a much simpler and more survivable backbone than the ABCS network. Easier to establish, maintain, and troubleshoot, it will reduce the network management requirements at the battalion and perhaps brigade. The counterargument is that the complete suite of the Army Battle Command System is necessary for commanders and leaders to gain full situational understanding. That may be so in the future, but current system limitations outweigh any gains.

Commit to Interoperability

The lack of interoperability between digital and analog units must be addressed. One method is providing minimum digitization across the entire force with a universal, inexpensive Blue Feed Tracking device such as the Maneuver Tracking System currently used by many logistics units. This will require resource tradeoffs, but the current situation of digital haves and have-nots is creating a force that can't communicate with itself, while the risk of fratricide to digitally unseen units makes an already challenging force protection and survivability problem on a complex and confusing battlefield even more acute. Because of the "vast differences in command and control capabilities, digital and analog units cannot seamlessly integrate and respond to orders in an equivalent manner."[29]

An alternative is to not equip every unit, but to have digital augmentation units (referred to as "hooks") on standby, with trained operators, which can deploy with an analog unit that will work as part a digital force. There is an argument that digital-to-analog interoperability must be worked out, on the ground, with the units involved. The Army no longer has the luxury of many expensive training events (a dedicated, experimental unit could help flesh out tactics, techniques, procedures, and doctrine), nor do we recognize the need for long-term habitual relationships, particularly when it involves combat support and combat service support units augmenting divisions. With task organization often done at the arrival port or airfield, augmenting forces are often reserve component units and arrive in small modules, often company- and platoon-sized elements. They become easy to miss. These digital hooks—which must be part of a digital unit's organization—can also be used to assure interoperability between sister service and coalition forces. In fact, this requirement is addressed in the National Security Strategy, which stresses interoperability to "maintain the ability to work and fight together as allies," particularly within NATO.[30]

The Army sees the corps headquarters as the basis for the Army-led Joint Task Force headquarters. Non-digital corps will require substantial last-minute digital augmentation and integration that will be extremely difficult during operations when rapid task organization may be necessary. The Army should look to create corps augmentation packages akin to the I Corps digital bridge to ensure it can conduct effective command and control of digital forces. Certainly, this establishes a new element and structural modification to the corps. However, the corps, as already mentioned, are moving to digitize on their own. It will be much more favorable for the Army to bring them on-line and ensure they are fully integrated rather than employing ad hoc solutions using commercial, off-the-shelf products. This problem will become even more acute with the dispersed nature of future combat.

Structure for Today's Logistics

Though the Army recognizes the challenge to reduce the logistical footprint, it needs to come to grips with the immaturity of its digital combat service support structure to provide both total asset visibility and just-in-time logistics. Operating over a much-expanded battlespace with dramatically fewer assets, the now austere maintenance, supply, and transportation elements will have difficulty supporting engaged digital forces that are themselves spread out over an increasingly empty battlespace. In fact, this deficiency is well noted with the austere Stryker Brigade Combat Teams.

In 2001, to address this shortfall, the Army created 205-person combat service support companies (CSSC) to be attached to the 392-person brigade support battalions in each Stryker Brigade Combat Team. These companies are primarily transportation, maintenance, and supply augmentation and represent the Army coming to grips with the shortfall in the physics of logistics. The Army must look to reengineer what it has done with the current force and investigate restoring some of its logistical capability, either by putting it back into the maneuver units or augmenting the brigade forward support battalions with habitually associated units such as the Stryker Brigade Combat Team's combat service support company.

Tied to logistics, but arguably worthy of separate study, is the issue of contractors on the battlefield. How to deal with contractors is a large issue that affects both digital system employment and sustainment. System complexity—particularly with the Army Battle Command System and its network—necessitates the need to deploy contractors for some time. The issue of contractors on the battlefield is not a new one for the Army, but it has changed with respect to both the number of contractors and the extent of contractor support. The Army must continually examine how it will integrate contractors into units during active operations. One solution is to include

them on a unit's organizational tables as augmentation. This will ensure they are factored into overall unit deployability and that essential life support and combat service support are provided. Additionally, there is a host of administrative, legal, and command and control issues currently under review associated with contractors on the battlefield.[31]

Train and Track Digital Soldiers

At present and for the foreseeable future, trained digital soldiers and digitally cognizant leaders are at a premium. Unfortunately, trained soldiers and leaders are transferred under normal Army rotation policies. Though there is a renewed discussion by the Secretary of the Army concerning stabilization, the Army needs to do something soon to ensure that it tracks digitally trained soldiers and ensures they go to digital units as much as possible in order to take advantage of their skills while they remain scarce. This tracking can be accomplished by adding a skill identifier similar to that added for parachute-qualified soldiers.

This recommendation has several arguments against it, including disadvantaging the soldier by giving him repetitive tours in one spot and actually limiting the spread of digital knowledge. The first argument is losing steam as increasingly more units are digitized. The Army plans to expand Division XXI beyond Fort Hood to include units in Georgia and Germany. Digital Stryker Brigade Combat Teams are standing up in Alaska, Hawaii, Louisiana, and Germany, as well as Washington state. Thus, soldiers will have many opportunities to serve within an increasingly digitized Army.

Without question, the ingraining of digitization must extend into the Army's education system and go beyond a mere descriptor. Soldiers and leaders need to not only understand how to operate digital systems, but also need to come to grips with how to use new technology effectively. Units must focus on the warfighting mission and do not have the time or resources to grow digital soldiers and leaders from the ground up.

Current Operations—An Opportunity

Operations in both Afghanistan and Iraq are serving as excellent proving grounds for digital systems. In Afghanistan, the Army employed limited digital systems tied to special operations and intelligence forces who were able to share information with fire support assets and able to dramatically synchronize joint effects. Still, despite these successes, the networks suffered from bandwidth shortage and line-of-sight issues that will need resolution.[32]

Iraq will likely provide a more complete look at whether larger formations can use the current digital systems to good effect over an extended time and distance. The digitized 4th Infantry Division is fully deployed, and

the primarily analog 3d Infantry Division was modified to include limited Army Battle Command System suites at battalion operations centers and higher. Though initial reports reflect that the "level of 'digital' operation in land forces . . . almost certainly fell far short of its future potential,"[33] the extent to which commanders were able to employ digital systems and their effects at the tactical level—to include mitigating interoperability challenges with the host of supporting analog combat and combat service support units—will require detailed analysis in the months to come.

Conclusion

Today, the Army must consider the limitations and strengths in employing digital formations. Given the limitations of its established network—fragile, training-intensive, and constrained to operate only with a legion of civilian contractors—the current digital force will have difficulty nesting itself in a larger Army formation or a joint or combined force. With reduced firepower and more vulnerable command and control systems, digital forces may in fact be a handicap compared to more robust and rugged analog forces that move with the confidence of well-established tactics, techniques, procedures, doctrine, and capabilities. As the Army examines the still-unresolved depth of digital battle command, it must wrestle with its appropriate level compared to traditional analog methods such as a voice-over-radio network. At what level—soldier, company, or battalion—should digital systems be the primary means of transmitting information and exercising battle command? It is not a question of pure technology, but of effectiveness in the fight. The Army needs to work hard to resolve this issue.

Yet, the Army can take measures to assist it in answering these questions and to ensure its forces remain ready by insisting on continued experimentation to test equipment and concepts, ratcheting down overall system complexity to something manageable to soldiers in the field, embedding digital training, and ensuring interoperability and sustainment across the force—to include providing the tools to integrate within joint and combined formations. Though full digitization and network-centric warfare may be the ultimate bright light at the end of the transformation tunnel, the Army must ensure it maintains a force structure that is able to fight today while not jeopardizing the future.

NOTES

1. US Army, *Army Transformation Roadmap* (Washington: Department of the Army, 2002), http://www.oft.osd.mil/library/library_files/document_201_army_transformation.pdf, pp. 2-3.

2. James M. Dubik, "The Army's Twofer: The Dual Role of the Interim Force," *The Land Warfare Papers*, No. 39 (Arlington, Va.: Association of the United States Army, Institute of Land Warfare, October 2001), p. 1.

3. US Army, *Army Transformation Roadmap*, p. viii.

4. Ibid., p. F-1.

5. Ibid., p. C-5.

6. William B. Scott and David Hughes, "Nascent Net-Centric War Gains Pentagon Toehold," *Aviation Week & Space Technology*, 27 January 2003, p. 50.

7. US Army, Program Executive Office Command, Control, and Communications Tactical (PEO C3T), "Battlefield Digitization," at PEO C3T website, http://www.monmouth.army.mil/newpages/vCpeoc3s.html.

8. Paul Murdock, "Principles of War on the Network-Centric Battlefield: Mass and Economy of Force," *Parameters*, 22 (Spring 2002), 92.

9. US Army, *Army Transformation Roadmap*, p. 17.

10. US Army, "Army Modernization and Digitization Overview," Army Digitization Office at Legacy Force page, https://ibct.army.mil/library/LegacyForce.xml.

11. John J. Twohig et al., "Structuring Division XXI," *Military Review*, 78 (May-June 1998), 2-6.

12. US Army, Field Manual 3-0, *Operations*, 14 June 2001, reflects information superiority as a key element of combat power that has an exponential impact on the traditional elements of maneuver, fire power, protection, and leadership.

13. US Army, *Army Transformation Roadmap*, pp. 26-27.

14. The "tactical infosphere" is a framework that graphically portrays the C4ISR assets and connectivity affecting the battlespace. Key components include the Information Transport System or "backbone" that carries the network traffic along the tactical internet (TI); the Army Battle Command System (ABCS), an integrated series of computer subsystems to track and manage the battle organized around Battlefield Functional Area Computers (BFAC); and the Logistics Management System which is tied to ABCS, but is developing and operating distinctly. Additionally, intelligence, surveillance, and reconnaissance assets are tied into the network, while command posts serve as analysis and dissemination hubs.

15. Dubik, p. 12.

16. Defense and the National Interest discussion board, "Will Army Digitization Work? – Mud Soldiers Sound Off," http://www.d-n-i.net/fcs/comments/c416.htm.

17. Brigadier General Robert Mixon, Assistant Division Commander, 4th Infantry Division, interview with author, May 2001, PEO C3T Materiel Developers Review, Atlantic City, N.J.

18. The ABCS suite at battalion level includes the Maneuver Control System (MCS), All-Source Analysis System (ASAS), Advanced Field Artillery Tactical Data System (AFATDS), and Combat Service Support System (CSS-S). The long-standing and well-tried AFATDS system is proven when working as a singular system. The challenge for it is working as a sub-system within the broader ABCS.

19. Colonel John T. Zoccola, Chief of Training, Army Transformation Task Force, telephone conversation with author, October 2002.

20. Scott and Hughes, p. 53.

21. The Global Combat Service Support System – Army (GCSS-A) is the purported capstone system for logistical battle tracking, forecasting, and centralized resourcing. It will reportedly be a joint system with total asset visibility and management from foxhole to depot. Repeated delays have pushed it back to 2007 and beyond.

22. Donald H. Rumsfeld, *Annual Report to the President and Congress* (Washington: Department of Defense, 2002), p. 53.

23. Defense and National Interest discussion board, "Will Army Digitization Work? – Mud Soldiers Sound Off."

24. Christopher J. Toomey, "Leveraging the Power of the Regiment," *Engineer Magazine*, October 2002.

25. George W. Bush, *The National Security Strategy of the United States* (Washington: The White House, 2002), p. 30.

26. John Hanley, "Rapid Spiral Transformation," *Transformation Trends-3 February Issue*, Office of Force Transformation (Arlington, Va., 3 February 2003), p. 5, http://www.cdi.org/mrp/tt-3feb03.pdf.

27. Ibid., p. 2.

28. Don M. Snider and Gayle L. Watkins, *The Future of the Army Profession* (Boston: McGraw Hill, 2002), p. 144.

29. Ibid., p. 140.

30. Bush, *The National Security Strategy*, p. 26.

31. US Army, Field Manual 3.100-21, *Contractors on the Battlefield*, January 2003, is an attempt to define the role and status of contractors on the battlefield. However, the continued emergence of professional military contractors and the Army's reliance on them will necessitate a continual revision of policies.

32. Anthony Cordesman, *Instant Lessons of the Iraq War: Main Report* (Washington: Center for Strategic and International Studies, 14 April 2003), p. 8.

33. Ibid.