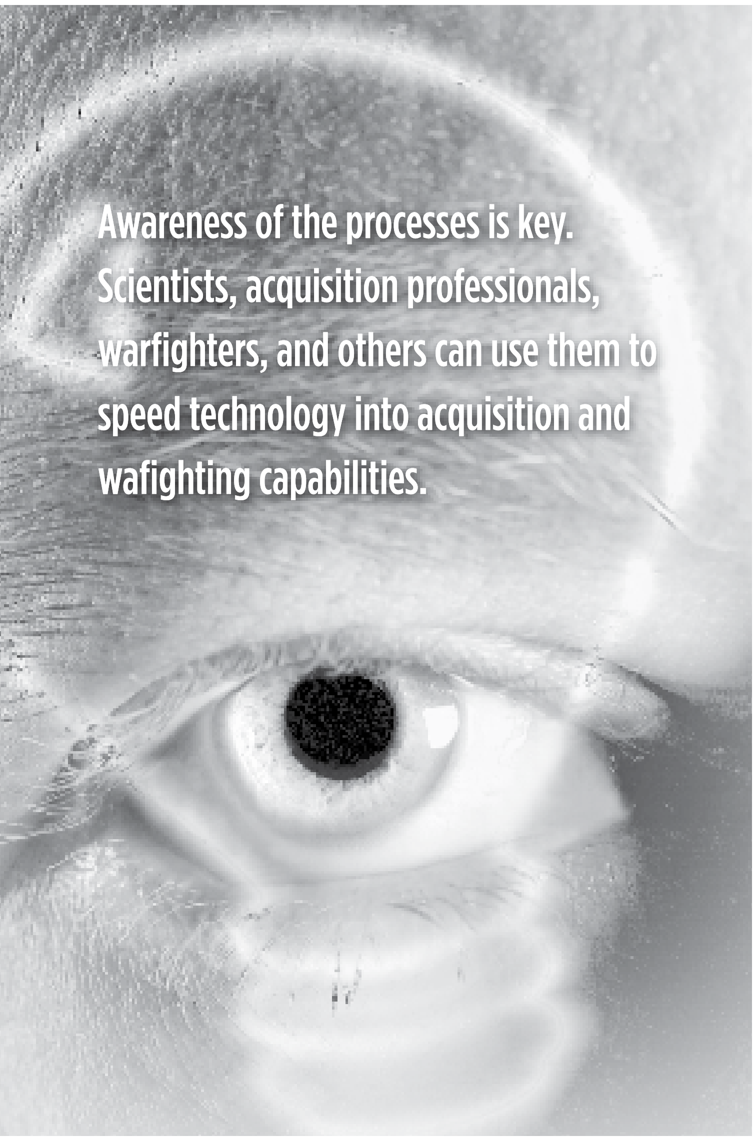
The Rapid Insertion of Technology in Defense

John J. Kubricky



In Iraq, U.S. forces used jammers to disrupt enemy radio transmissions. But the jammers interfered with friendly radio communications, so troops turned them off, taking their chances with attack. "There is a burning need for a joint entity to police the battlefield and bring organization to the jamming," stated *Aviation Week*, and combatant commands wanted it met. In 2006, a Joint Capability Technology Demonstration (JCTD) was launched. In a year, it had frequency management technology ready for field trials.

Technology transition has become of utmost importance, stated Deputy Secretary of Defense Gordon England. It must rapidly meet the warfighter's needs and stay ahead of adversaries. There are processes that can rapidly insert technology into defense materiel, and awareness of them is key. If you do not know about the processes, then they cannot help you exploit technologies to maintain the warfighter's advantage.

A Fast, Tough Game

Technology transition—also called innovation—is about moving an invention out of a lab and into use. The time between invention and innovation is shrinking. The electric light bulb, invented in 1800, was improved and commercialized by Thomas Edison later that century. By comparison, personal computing software, invented in 1973, saw exploding use in the next decade. Today, development of consumer electronics takes six months.

Technology transition and innovation are also global, reflecting a "fierce global scramble for supremacy," according to the President's Council of Advisors for Science and Technology. Today, many innovations swing between the marketplace and battlespace. Consider cell phones: They can transfer money and detonate explosive devices.

Defense must now move technology faster than before. In the Cold War, defense only had to be faster than a ponderous Soviet Union bureaucracy. It is estimated now that Iraqi insurgents develop countermeasures to our capabilities in less than two weeks.

"Accelerating the transition of new technologies into systems and products will be crucial to the Defense Department's development of a lighter, more flexible fighting force," according to the National Academies. Recently, defense established 25 transformation priorities, many requiring technology transition.

Yet, moving technology is hard. "Bureaucracies were not supposed to innovate," wrote Harvard University's

Kubricky *is the deputy under secretary of defense for advanced systems and concepts and formerly the Department of Homeland Security's director of systems engineering and the Homeland Security Advanced Research Project Agency. A Vietnam veteran, his career in the defense electronics and systems industry spans four decades.*

Stephen Rosen. Many corporations follow their technologies into obscurity. In defense, it is evidenced by slow technology adoption. Unmanned aerial vehicles were used in Vietnam but were not widely used until the late 1990s.

Technology transition and innovation face obstacles. Dr. Raymond Damadian was called a lunatic for pursuing magnetic resonance imaging in medicine. An early laptop computer was quietly built after its developer's corporate executives opposed it. Referring to the now widely used UAV, President George W. Bush noted the "Predator had skeptics because it did not fit the old ways."

Many transition and innovation initiatives fail because of inadequate processes. From 1976 to 1995, 146 companies were in the computer disk drive industry, with all attempting rapid technological change. Twenty-one survived. Many developed new technologies, but they did not get to market. They "stalled when it came to allocating scarce resources among competing product and technology development," wrote Clayton Christensen in *The Innovator's Dilemma*. Similarly, defense cancelled nine unmanned aerial vehicle programs before 1995, largely because of deficient processes, reported the General Accounting Office (GAO).

Technology Transition in Defense

In 1994, the Department of Defense established what is now the Office of Advanced Systems and Concepts. It introduces innovative technologies inside the traditional planning, programming, budgeting, and execution process. It has defined transition processes based on lessons learned. For example, its Advanced Concept Technology Demonstration process took the Predator UAV from concept to operational system in 30 months, with the GAO reporting, "the ACTD approach to UAV acquisition is consistent with the best practices of leading commercial developers."

AS&C's processes complement service acquisition, helping transition technology into programs at varying acquisition stages. Some move technology from different origins to evaluators, who assess potential use. Other processes move technology into and through production. These processes also may work together. One process demonstrated a fratricide-reducing system for coalition forces, while another cut its manufacturing costs. The processes vary, but have the following commonalities:

Needs-driven—Soldiers and Marines evaluated urban warfare technologies in one initiative, just as combatant commands assessed theater displays in another. The processes are about them, not us. They solicit needs annually. User needs are also known through monthly meetings with combatant commands and the Joint Capabilities Integration Development System.

Awareness of technology—Processes are connected with technology development organizations, formal technology searches across defense, other agencies, industry, academia, and other nations.

Venture capital—This has launched commercial endeavors like overnight delivery, cable television, and biotech firms. Many defense processes similarly fund ventures. And, like venture capitalists, AS&C does not manage projects. It finds and oversees skilled program managers from high-performing DoD organizations.

Sense of urgency to deliver—In January 2003, the Army vice chief of staff directed a platoon-level UAV be rapidly fielded. An existing initiative was accelerated and the first Raven UAV was in Afghanistan in 20 weeks. AS&C's people and processes strive to deliver a capability, usually in one to three years.

Awareness of the processes is key. Scientists, acquisition professionals, warfighters, and others can use them to speed technology into acquisition and warfighting capabilities. In some cases, they were not used, and critical transitions were delayed or did not occur.

Bridging the "Valley of Death"

New technology needs testing to answer application questions so it may be used. That takes money. But often, the money is not budgeted, does not come, and the invention hits the "valley of death." It is a big problem for industry developers of micro-electromechanical systems, tiny actuators, and sensors in systems. Hundreds are demonstrated in labs, but only a few cross the valley.

The defense department has this problem. Its labs develop technology, but the budgeting process cannot fund transition fast enough. Thus, the Technology Transition Initiative was established in 2003 to fund selected DoD technologies. For example, it accelerated the transition of digital tools for planning asymmetric warfare. The First Marine Expeditionary Force and 101st Air Assault Division used versions in Iraq in 2006, with full capability transitioning in 2007. (See <www.acq.osd.mil/ott/tti/>.)

Fast Technology Insertions in Systems/ Programs

Technologies come from everywhere—defense labs, industry, universities, and other countries. Their insertion into programs and systems may extend service life, reduce operating costs, increase reliability, improve performance, and/or provide new capabilities. Two processes "test with intent to procure," enabling such transitions.

The Defense Acquisition Challenge Program permits those with faster, better, and cheaper ways of equipping our forces to challenge what is acquired. Software was proposed that allows one Marine to plan communications for an upcoming operation in 20 minutes that took two Marines almost 24 hours. The Defense Acquisition Challenge Program funded the proposal's evaluation, and today, Marines use it in Iraq. The process reduces spiral development risks and provides a mechanism for nontraditional suppliers to enter the DoD marketplace. The return on investment is 9:1.

The Foreign Comparative Testing program is similar, but seeks friendly nations' technologies for warfighting needs. Nations' acquisition leverages mature technologies for economic and speedy buys and may be bought from vendors or manufactured under license in the United States. An example is the South African-developed Buffalo mine-clearing vehicle. Following testing in 2002, vehicles were sent to Afghanistan and later to Iraq. In a protected cab, operators uncover roadside bombs using a hydraulic arm. Buffalos are now made in South Carolina. The acquisition avoided more than $35 million in research and development and has saved lives.

Since inception, the Foreign Comparative Testing Program has enabled more than $8.5 billion in procurement, avoiding an estimated $6.9 billion in R&D costs. It has participation from 28 friendly nations and vendor partnerships in 33 states. (See < www.acq.osd.mil/cto/ >.)

Technology Transition for Multi-Service, Joint, and Coalition Capabilities

In Iraq, U.S. forces used blue force trackers to display friendly units, but Army and Marine systems were not interoperable. A transition initiative enabled shared pictures.

U.S. Transportation Command needed just-in-time delivery because units were ordering multiple items for just-in-case delivery. A transition initiative is enabling a tracking architecture.

Allied forces' surveillance systems were not interoperable and had difficulty finding moving targets. A transition initiative set standards and enabled cooperation on new sensors.

These are ACTDs, replaced by JCTDs. They rapidly find, prototype, demonstrate, and transition concepts and technologies for multi-Service, joint, and coalition needs. They provide a try-before-buy approach, seeking to show a capability is available for combatant commanders and acquisition. This is done in demonstrations with warfighters that determine what works. The goal is an 80 percent solution, which can make enormous contributions, rather than more lengthy and costly 100 percent solutions.

This process has accelerated. ACTDs did final demonstrations in three to four years. JCTDs will normally demonstrate 50 percent of all products in two years, with all demonstrations completed in three years. Since 1995, 182 ACTDs and JCTDs have been initiated, and products from nearly 70 of these are deployed in theater. (See < www.acq.osd.mil/jctd >.)

Demonstrating Game-Changing Technologies

"The revolution will be in uninhabited robots that search and shoot under amazing modes of self-control," wrote Navy Capt. (retired) Wayne P. Hughes in *Fleet Tactics and Coastal Combat*. The Spartan Scout ACTD is enabling that revolution by transitioning technologies to naval unmanned surface vehicles.

ACTDs and JCTDs also demonstrate game-changing technologies that may dramatically change warfare's speed, lethality, and/or cost. Past examples include the radio, airplane, and computer. Such ACTDs and JCTDs often represent a technology push—a developer's belief that a technology offers greater effectiveness or efficiency than current systems. Today, ACTDs and JCTDs are demonstrating such game-changing technologies as directed energy systems; unmanned systems; and networking for situational awareness, targeting, and logistics.

Accelerating Technology to Industry

The battery in your watch—defense helped develop it. But it had to move to industry before it could be widely used. In the Cold War, moving defense technology was slow and uncertain. Today, it must be fast, enabling quick production to address rapidly emerging needs such as countering anthrax threats or new explosive device tactics. Otherwise, technology's value is eroded by delay.

Technology transfer processes rapidly move defense technologies to industry. Once, many companies were unwilling to invest in federal technologies because their investments were unprotected. Today, defense labs protect technology using patent licensing agreements with manufacturers. Technology transfer is also enabled by cooperative research and development agreements between defense labs and industry. These R&D partnerships include nanotechnologies, medical technologies, and biological and chemical defense. (See <www.acq.osd.mil/ott>.)

A corporate executive once complained about defense technology transfers: "What we do is spend an awful lot of time calling people and visiting with people. It can be literally months before you come up with the correct answer." Today, defense technology transfer uses intermediaries to make known and move defense technologies to industry. These are:

TechLink, at Montana State University—Facilitates technology transfer agreements between defense labs and industry. It helped move Army-developed software for hand-held computers, used by battlefield medics to transmit a warfighter's injuries, receive diagnoses, and initial treatments. Systems were produced and deployed to Afghanistan and Iraq. (See <www.techlinkcenter.org>.)

FirstLink, at University of Pittsburgh—Connects defense labs with companies to commercialize technologies for first-responders. FirstLink helped transfer a DoD robot, initially used for under-vehicle inspections in Afghanistan and Iraq. First responders have used it for security at the U.S. Capitol, the Super Bowl, and high-profile trials. (See <www.dodfirstlink.com>.)

DoD TechMatch, part of the West Virginia High Technology Consortium Foundation—Provides an Internet portal, informing industry of available defense technologies, lab capabilities, and R&D opportunities. The Air Force developed a remote-controlled "bombot" that approaches suspected bombs, drops off an explosive, and races off, all for under $5,000 (and most robots in its class cost $100,000-plus). TechMatch made it known to a company that produced it for use in Iraq. (See <www.dodtechmatch.com>.)

Facilitating Manufacturing of New Technologies

Large aircraft like C-130s and C-17s face missile threats in Iraq. A system was developed that tracks a missile and directs a Viper™ laser to jam its guidance system. The ManTech process increased the Viper laser's production from two per month to 15 to 20, increased laser efficiency by 30 to 50 percent, improved reliability, cut acquisition costs more than 50 percent, and enabled use a year ahead of schedule.

Moving technology to warfighters means moving it through production. The ManTech process speeds manufacturing and looks for ways to produce more capable and affordable systems. Some initiatives improve fabrication. One helped fabricate composites in F/A-18 aircraft, enabling a 40 to 50 percent increase in range. Others improve sustainment. One provided spray-on stealth material for B-2 aircraft, replacing 3,000 feet of tape and caulking on access panels, which were manually removed and reapplied for maintenance. This cut maintenance hours and increased mission-capable rates by 50 percent. (See <www.dodmantech.com>.)

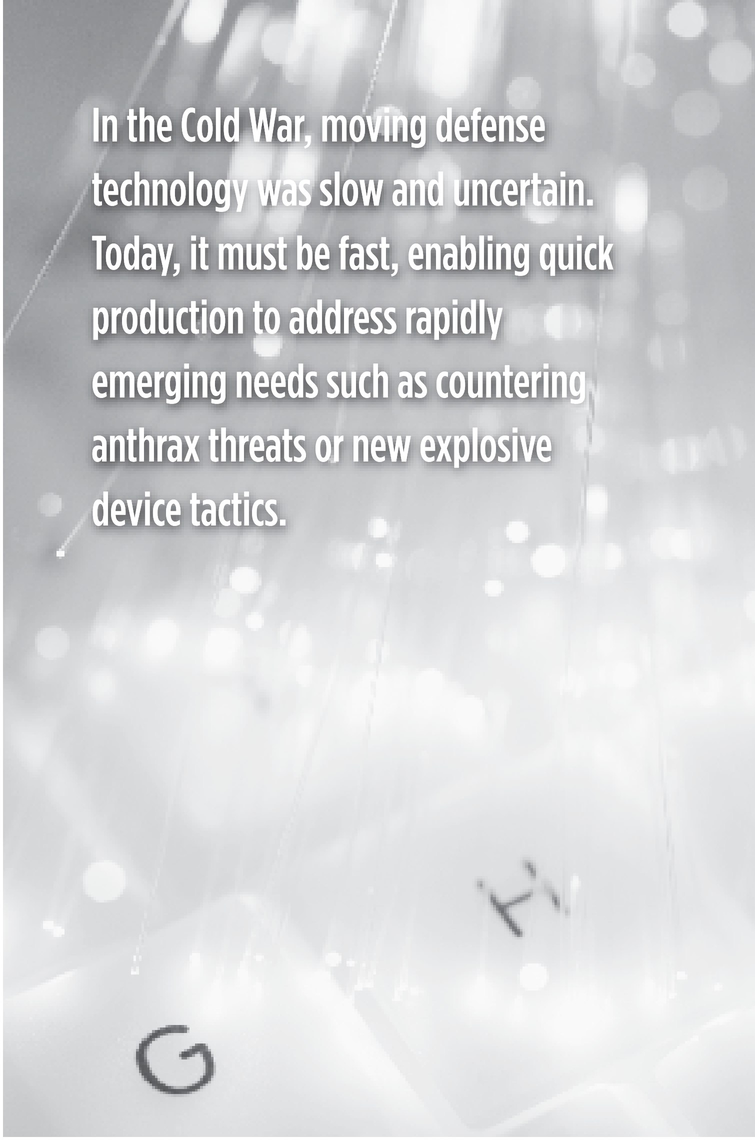
Ensuring Transition of Critical Technologies

Rapid transition of some systems may depend on critical technologies that may not be domestically made or may be too costly to produce. Such was the case with superconducting tape, made of yttrium barium copper oxide. Wrapped around electrical conductors, it can help deliver more electricity than copper wire—enabling more efficient powering of directed energy systems, ships, and aircraft. However, it was too costly. The Defense Production Act Title III program helped two U.S. companies lower the tape's cost, and it is now used in second-generation superconducting for Columbus, Ohio, and Albany, N.Y.

DPA Title III ensures affordable, domestic production of critical defense technologies. It may provide incentives such as a commitment to buy, help firms install equipment, or improve processes. It also may promote substitute technologies. Generally, the program seeks production of stronger and lighter structural materials, which enhance system speed, range, and/or payload capacity; advanced electronic materials leading to smaller, faster, and more reliable micro-electronic devices; and advanced electronic devices or components that enhance system performance. (See <www.acq.osd.mil/ott/ dpatitle3/>.)

We Are All Innovators

Technological superiority has long differentiated U.S. forces from the world. However, that superiority is al-



ways being challenged. Around the world, a race is on for technology superiority, market domination, and economic resilience. "The big winners … will not be those who simply make commodities faster and cheaper than the competition. They will be those who develop talent, techniques, and tools so advanced that there is no competition," according to the President's Council of Advisors for Science and Technology.

Within defense, technology transition programs are fostering talent, technologies, and tools to hasten innovation, and therein lie their greatest contributions. They are enabling a climate of constant innovation, which will increasingly be needed to maintain our nation's leadership in technology, and ultimately, our nation's security. These processes help innovators—and that is why awareness of them is important. In an age of mass innovation, we are all innovators now.

The author welcomes comments and questions, which can be e-mailed to annette.beacham.ctr@osd.mil.