The Promise and the Peril: The Social Construction of American Military Technology

by Michael W. Mosser

Since at least World War II, dominance in technology has been central to American conceptions of military power and doctrine.[1] While the Sherman tank's chief 'technological' advantage over its German counterparts was its production volume, the B-29's technological advances—such as a pressurized cabin and remote-controlled guns—made it particularly well-suited to the Pacific theater bombing campaign. Its technology meant it could fly higher and farther with more payload than earlier American bombers, enabling the US Army Air Forces to hit the Japanese home islands from bases farther out and with fewer losses from anti-aircraft fire or enemy fighter attacks.

By the time of the Vietnam War, American military technology was unrivaled in the world, especially in the air. The B-29 had long since evolved into the B-52, a jet-powered high-altitude strategic bomber which was able to carry three times the bombs at twice the range with half the crew. American fighter aircraft carried the most advanced weapons then available and pilots employed tactical doctrine developed to maximize the advantages of this weaponry. Ironically, however, the reliance on such technology as air-to-air missiles led to a marked degradation in combat skills (such as dog-fighting) among American pilots. It was not until the release of the Phantom F-4E, with its nose-mounted cannon, that American pilots were able to close in and engage with enemy pilots in classic aerial dogfights and regain the favorable kill ratio that American pilots had enjoyed in every conflict since the introduction of the airplane to modern combat.[2]

As the twentieth century ended, American military forces continued to exploit asymmetries in warfare. In 1991's Operation Desert Storm, a 38-day bombing campaign was followed by a 100-hour ground campaign, the combination of which led to the achievement of American military objectives with little loss of life. For the first time, American and coalition forces employed a radical new operational doctrine known as AirLand Battle, which emphasized rapid and synchronized movements of

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ground and air forces. Coalition forces commander General Norman Schwarzkopf became the public face of the war, appearing in daily press briefings with a flip-chart and video footage showing the pinpoint accuracy of allied bombing raids and 'smart' munitions. The footage was so compelling, and the technology so dazzling, that for many observers it seemed like the technology was the star of the show. At other times, the Patriot air-defense missile appeared to be hogging the spotlight. Promising to be the long-sought shield against incoming ballistic missiles, Patriots were shown intercepting Iraqi Scud missiles on their way to Israel or toward coalition forces. On the face of it, then, Operation Desert Storm seemed to be an unmitigated success, in terms of both technology and doctrine. But in fact, the technology employed in Operation Desert Storm proved to be a chimera: the anti-missile technology that so dazzled the viewers at home (in the world's first 'live' war) proved to be less accurate than portrayed, and the smart munitions, while making for compelling viewing, actually only accounted for around 10 percent of all bombs dropped during the campaign.[3]

WHILE OPERATIONAL DOCTRINE BEGAN TO CHANGE TO REFLECT THE REALITY OF A POST-COLD WAR WORLD, THE US ACCELERATED ITS USE OF HIGH TECHNOLOGY TO WIN BATTLES AND WARS QUICKLY AND WITH LITTLE LOSS OF AMERICAN LIFE.

The success of AirLand Battle and its attendant technologies enraptured the US military decision-makers and government policymakers. While operational doctrine began to change to reflect the reality of a post-Cold War world, the US accelerated its use of high technology to win battles and wars quickly and with little loss of American life. By the time of the air war in Kosovo in 1999, the toppling of the Taliban in Afghanistan in 2001, and the ground invasion of Iraq in 2003, the US military's use of technology had reached the point of saturation. High-altitude bombers were employed in precision strike missions, owing largely to the development of bomb guidance systems that allowed pinpoint accuracy from ten miles up. Ground forces, including the M1A1 Abrams tank (the modern Sherman, though no way comparable in terms of capability) no longer have to rely on mass quantity to overcome the enemy—now, the armor is as advanced as the weaponry. Troop transports and Humvees are crammed with technology, leading one article from *Wired* magazine, written not long after the initial ground phase of Operation Iraqi Freedom in 2003 to carry this priceless headline: "If We Run Out of Batteries, This War is Screwed."[4]

As these examples demonstrate, the American military has long considered technology to be a 'force multiplier' that gives US forces a tactical and operational advantage on the battlefield. But what, really, is the relationship between technology and the military? Conventional wisdom holds that advances in military technology eventually trickle down into civilian life. Examples of this trickle-down effect are legion. To name but one, consider the Global Positioning System (GPS). Originally

a military technology, GPS satellites, once released to civilian use, allow one to know one's position with (more or less) pinpoint accuracy. The technology, once top-secret, allows Google Maps to function on smart phones, permits users to know the location of the nearest pizza place within a block, and is a key element of social media 2.0 applications such as Gowalla or FourSquare, which employ GPS to allow users to link up with friends automatically and effortlessly (privacy concerns notwithstanding).[5]

But the conventional wisdom only tells half of the story. For every military-derived GPS, there is a Blackberry or iPhone whose off-the-shelf capabilities rival high-end supercomputers of only a few generations ago, and whose functionality is viewed by the military with unabashed enthusiasm. Unfortunately, until recently, military procurement requirements—not to mention 'hardening' and security requirements—meant that a military-spec handheld with the capabilities of an iPod or iPhone looks more like a 1980s-vintage cell phone and acts more like a 1990s-era personal organizer.[6] Why, then, don't military units just buy off-the-shelf components?

A full answer to that question is complicated, and beyond the scope of this essay. But it is worth noting that the technology that the American military employs is, by and large, both distinctly *American* and distinctly *military*. With notable exceptions, such as the modified but still off-the-shelf hardware utilized by some special operations units, most military technology employed by American military forces is unique to them. American weapons technology is still technology, true. But what makes it special is that weaponry is a *type* of technology that is easily distinguished from a tool. As opposed to tools, which are used to accomplish work, weapons are used to harm or destroy. Where they differ is not in their intrinsic properties, but rather in their mode of employment. A tool can easily be employed as a weapon, and while it is arguably more difficult to go the other direction, it is most certainly possible.

DOES THE *NEW* AMERICAN WAY OF WAR, TRADITIONALLY DEFINED AS THE GRINDING STRATEGY OF ATTRITION USED TO OUTPRODUCE AND OUTLAST THE ENEMY, DEPEND ON THE AMERICAN LOVE AFFAIR WITH TECHNOLOGY?

With its specific operational requirements, the military may not be the ideal recipient of general-purpose devices that epitomize private-sector technological innovation. Nonetheless, if we broaden the analysis away from actual products to the concept of technology, we find that we are able to ask a provocative series of questions. Primarily, what if social conceptions of technology are driving military innovation? Carried to its logical end, the question becomes even somewhat troubling: do we fight according to the technology we have? Does the *new* American way of war, traditionally defined as the grinding strategy of attrition used to outproduce and outlast the enemy, depend on the

American love affair with technology?

This essay examines these questions, though developing comprehensive answers to them is also beyond its scope. The goal of this essay is to approach the issue of 'science and diplomacy' from a social construction of technology (SCOT) perspective, and relate it directly to military operations. Rather than rehash the considerable and multifaceted literature on American military capacity or capability,[7] the essay examines the intertwined relationship between American society's embrace of technology and American military thinking. In other words, the technological mastery exhibited by US armed forces today must be seen in the broader context of American society. Thus, the "American" way of war is shaped as much by the broader American acceptance/embrace of technology as anything else. The promise of technological 'quick fixes' lead military and civilian leaders to pursue military options to achieve those fixes even when 'better' (i.e., cheaper, more robust, but less 'sexy') alternatives present themselves.

AMERICAN SOCIETY SHAPES AND INFLUENCES BOTH THE DEVELOPMENT AND THE UTILIZATION OF AMERICAN MILITARY TECHNOLOGY.

American society shapes and influences both the development and the utilization of American military technology. An application of a SCOT approach to military doctrine will help to explain why the US is so enamored with conducting counterinsurgency (COIN) campaigns with technology. In effect, the *promise* of technology—its ability to do more with less—becomes the *peril* for American military doctrine.

After a short introduction to the idea of technology as social construct, this essay will look at three brief examples of the social construction of American military technology, from tactical to operational to strategic: the rise to prominence of unmanned aerial vehicles (UAVs) and their attendant moral quandaries; 'Blue Force Tracker,' the military technology that allows commanders at a safe remove to follow movements of their soldiers in contact on the battlefield; and AirLand Battle, which became the US Army doctrine for fighting Operations Desert Storm and Iraqi Freedom. When shown in the context of the American embrace of technology more generally, each of these, in its way, reveals another facet of how American military technology is shaped by the societal embrace of the technology it uses. None of the examples, on their own, are enough to show that technology *drives* society, but collectively they underscore the interconnected nature of American technology, the American military and American society in general. Because technology cannot be separated from the society that employs it, and because the American military establishment is in many ways a society unto itself, the social meaning of the technology employed by the military is as important as its tactical, operational or strategic function.

SCOT: A BRIEF PRIMER ON THE SOCIAL CONSTRUCTION OF TECHNOLOGY

The field of the social construction of technology (SCOT) arose as a subset of the larger field of science and technology studies (STS). Though STS became established earlier and became institutionalized via the publication of the first edition of the *Handbook of Science and Technology* in 1977, SCOT traces its lineage to a seminal 1984 article by Trevor Pinch and Wiebe Bijker.[8] Using the now-famous example of the development of the modern form of the bicycle as their test case, Pinch and Bijker put forth the fundamental premise of SCOT studies: technology cannot be understood without reference to the human action that shapes it. In other words, SCOT *problematizes* technology, and treats it as a social construct rather than an objective fact.

How does SCOT envision technology as a social construct? On the surface, technology appears to be the antithesis of anything social: it is merely 'the practical application of science to commerce or industry.'[9] But the seeds of a social understanding of technology are inherent in its definition. Commerce and industry arise from society; that is, the organization of human beings into some recognizable economic or cultural pattern. Thus, technology does not arise in a vacuum, but rather is contingent upon the social environment in which it is developed. Moreover, technology requires application; otherwise, it is 'pure' science. With no society in which to apply the science, there can be no technology.

There are important caveats when using a SCOT analysis to explain linkages between technology and society. Linking a specific technology to society does not impute a causal relationship from one to the other. One should be especially careful of inferring causality from the employment of technology to social organization, known in its general form among SCOT scholars as the 'stirrup thesis.'[10] Referring to Lynn Townsend White's publication in 1962 of *Medieval Technology and Social Change*, the 'stirrup thesis' argues that the utilization of the stirrup shaped (and indeed, even permitted) the development of the feudal age in Europe. For White, technology—in this case the stirrup—caused the social change of feudalism. Unfortunately for White, much of the basis for his assumptions was found to be historically inaccurate, and his thesis was soundly refuted by subsequent works.[11] In much the same way, this essay is not arguing that American military technology is reshaping American society as a whole. Rather, it is more plausible to argue that American military technology is shaped by and influenced by American society's embrace of technology in general.

The military aspect of SCOT studies reached prominence with Harvey Sapolsky's seminal contribution to the original 1977 edition of the *Handbook of Science and Technology*. In his essay for that volume, Sapolsky argued that "new weapons, it would seem, are less the product of technological forces than they are of institutional and socio-political factors."[12] Sapolsky posited that the rapid advancement of American military technology of the late 1970s owed much to the

re-shaping of American society brought on by the Cold War. The effects of increased military funding to universities, their (supposed) shift from basic to 'applied' science and the attendant moral quandaries that such a shift entailed were used both by Sapolsky and later by Smit (1995) as empirical examples of the increasingly tight connection between science, technology and the military.

However, despite some work linking traditional security studies to military aspects of STS, there has been little in-depth research undertaken on problematizing innovation, and even less done on placing innovation within a societal context. As Rappert, Balmer and Stone point out in their contribution to the most recent Handbook, "[a]wareness of the social content of science and technology has not been a conspicuous feature of strategic studies analyses…."[13]

This brief essay can be seen as the beginning of a response to Rappert, Balmer, and Stone's call to action, but in a very specific way. It problematizes technology's social meanings, in much the way Wiebe Bijker's most recent work has done. For Bijker, 'technological culture' is what matters. He notes that "[t]echnologies do not merely assist in everyday lives, they are also powerful forces acting to reshape human activities and their meanings."[14]

Along those lines, we must consider military technology as most certainly a powerful force 'reshaping human activities.' The technology used by US military forces in the air, on the ground and via operational and strategic doctrine is not employed in a vacuum. Rather, it takes place in a social context that relies much on an inter-subjective understanding between the military (at every level of war) and the society from which it is drawn. As the society becomes more technologically savvy, the military's employment of technology becomes less problematic, or even less newsworthy. Indeed, one study done by researchers at MIT has shown that "America's Army," the video game created by and for the US Army to showcase its use of technology on the battlefield, has become a potent recruiting tool.[15]

In the air: JDAMs, UAVs, and modern aerial combat

As noted in the introductory paragraphs of this essay, some of the most visible applications of American military technology have come in the area of airpower. One application that has not received as much attention as the high-tech aircraft employed by the US, but which is arguably just as important, is the Joint Direct Attack Munition (JDAM). Essentially just a 'dumb' iron bomb with a GPS-enabled guidance package strapped to it, the JDAM was developed in the mid-1990s as a way to overcome some of the initial problems with the original generation of smart weapons. These weapons, guided by laser or infrared (IR) sensors or television cameras, could be confused by clouds, fog, sandstorms or simple smoke pots. Moreover, the original targeting systems required additional human interaction, at increased risk. The systems required either a spotter on the ground 'painting' the target with laser light, or else the launching aircraft platform to remain continually engaged, potentially leaving it vulnerable to enemy anti-aircraft defenses. JDAMs

solved all of these problems at once, making it possible to launch a weapon from a bomber or fighter aircraft from up to 15 miles away and achieve a circular error probable (CEP) range of less than 20 meters when GPS remained unjammed, or less than 50 meters even when GPS jamming forced the weapon to rely on internal guidance sensors.[16]

JDAMs achieved prominence in the most recent US and allied bombing campaigns, first in Kosovo in 1999, in Afghanistan in 2001, and Iraq in 2003. Unlike the smart weapons employed by American and coalition forces in Operation Desert Storm, JDAMs are removed from the public consciousness. The reason for this is quite simple: JDAMs, unlike their predecessors, do not have TV cameras in their nosecones. As a result, they do not generate the kind of footage that American audiences found so mesmerizing in 1991.

The other visible technology—both literally and figuratively visible—that deserves mention in this analysis is the unpiloted aircraft colloquially known as 'drones,' but more appropriately called unmanned aerial vehicles (UAVs). Originally designed to replace the vaunted but aging SR-71 in surveillance activities, UAVs in recent years have morphed from mere surveillance platforms to armed stand-off weapons delivery platforms able to fire missiles at targets while remaining out of sight or hearing, giving commanders options never previously available.[17]

Bringing a socio-political analysis to the JDAM and to UAVs reveals some interesting elements of their use and characterization. Both are portrayed very consciously to the American public as being more effective than their predecessors in terms of operational capability while costing far less. More importantly, they are also portrayed as protecting (or saving) American lives. JDAMs allow the aircraft releasing the weapon to avoid loitering in the area, while UAVs give commanders 'eyes' on the battlefield from a safe distance (including strategic distances), and also give them strategic, operational, and tactical strike options without putting pilots' lives at risk. Importantly, the technology that comprises the heart of the JDAM and that of the UAV is easy for Americans to understand. GPS, as noted earlier, has become so tightly integrated into modern society that GPS use in cars (built-in, dedicated portable units, or resident on mobile phones) is projected to rise from 7 percent in 2006 to more than 50 percent by 2015.[18] Americans have no problem understanding GPS as an assistive device; it aids drivers (or bicyclists, or pedestrians) in finding their way more accurately and safely. It is not problematic for American society to understand, then, the addition of GPS units to weapons.

THE TECHNOLOGY THAT COMPRISES THE HEART OF THE JDAM AND THAT OF THE UAV IS EASY FOR AMERICANS TO UNDERSTAND.

It is also not hard for Americans to grasp the fundamentals of employing UAV technology on the battlefield. By way of example, consider the humble video game. In recent years, the rising penetration of increasingly powerful video game consoles

into American households has brought computing power previously available only to governments or researchers with access to supercomputers into the living room. Many of these consoles feature game titles that have some bearing on military combat, and of those, a notable subset are flight simulators. Many UAV pilots grew up playing video games, and while the aforementioned 'stirrup thesis' makes it inadvisable to draw a causal connection between game consoles and the strategic employment of UAVs in Afghanistan, it must be noted that the increasingly technological savviness of American soldiers makes certain aspects of training easier. The fact that the controllers used to fly UAVs operating in Afghanistan and Pakistan (Af/Pak, in military parlance) are reworked PlayStation controllers does not hurt, either.[19]

Thus, the technology employed by American forces abroad is not alien or frightening to American society. Quite the opposite, in fact; it is familiar and comforting. In the end, however, the technology utilized by American air forces must be employed in a battlefield context. In Afghanistan, that context is one of counterinsurgency (COIN). The battle space over which UAVs operate, especially in Af/Pak is remote, isolated, and fluid. On the ground, American and NATO forces are engaged in a counterinsurgency fight that employs modern combat techniques with age-old 'population security' measures. In the air, UAVs—the epitome of twenty-first century technology—are increasingly being used as the first military option to prosecute the air war.

Attendant to that option, however, are moral quandaries, which are not generally taken into account when technological advances are discussed.[20] The technology of remotely piloting a vehicle flying in Afghanistan from as far away as the United States is imperfect; and optics, while considerably better than they were 10 or 15 years ago, still only provide a two-dimensional view of the battlefield. Moreover, UAVs do not have consciences (though their pilots do); they cannot determine whether an action is morally or ethically valid. UAVs respond to orders as machines do: as functions. Unlike a human soldier, UAVs do not have the option to question a morally ambiguous order. Further, for the very reason that UAVs are often employed in regions where the terrain is too harsh for ground spotters, there are usually no 'eyes on' the ground to ensure the target is the appropriate one. News stories abound of airstrikes (both manned and unmanned) gone wrong, where technology has failed (either in operator error or in technological failure) and where non-combatants have been killed. Critics, while generally appreciative of UAVs as force multipliers on the battlefield, have expressed reservations in using them as stand-off weapons delivery platforms in a COIN fight. They tend to, in the words of David Kilcullen and Andrew Exum, "personalize this conflict with Al Qaeda and the Taliban."[21] This juxtaposition—high-tech being used to fight a COIN fight—is seen even more clearly in the ground campaigns of Iraq

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and Afghanistan.

On the ground: "Blue Force Tracker" and net-centric warfare

If JDAMs and UAVs represent the increasing 'technologization' of the American air force, "Blue Force Tracker" can be seen as the embodiment of the high-tech approach to modern ground combat. The difficulties encountered in using UAVs to prosecute a high-tech counterinsurgency are, if anything, magnified on the ground. Yet, as with the air campaign, examining the ground war in light of the social construction of technology sheds some light on why the US has chosen to conduct operations in this way.

Ground forces are the most visible elements of the American military presence in Iraq. Because of the lack of an effective Iraqi Air Force (either as an opposing force under Saddam Hussein or as a complementary force under the new democratic Iraqi regime), the ground campaign has received the bulk of attention in the popular and scholarly press. The ground forces comprising this campaign, however, use technology that would be familiar to any young American raised on a steady diet of video games or social media technologies. US Army Humvees, the modern-day Jeep, are so crammed with electronics that it is difficult to turn sideways in the front seats. Much of those electronics comprise the various elements of what is known as "Blue Force Tracker," or BFT. Designed to show units a twenty-first century view of the battlefield, BFT utilizes modern technology to highlight friendly forces (blue) as well as enemy forces (red). It functions as both map and compass, and is updated with input from both soldiers on the ground and data analysts operating behind the lines or in the air in orbiting command platforms.

Blue Force Tracker, part of the Army's Force XXI Battle Command Brigade and Below (FBCB2) communications platform, is itself part of the Defense Department's move toward what is called 'network-centric warfare.' Originally promulgated as the 'systems of systems' by Vice Chairman of the Joint Chiefs of Staff Admiral William Owens in 1996, network-centric (or net-centric) warfare envisions combat taking place not as a series of isolated events among discrete units on a battlefield, but rather as part of an interconnected network.[22] In this characterization, Owens wrote that:

> *Conflict is chaotic, confusing, and messy. We will never have perfect understanding of a battlefield, our systems and weapons will never work flawlessly all the time, and the forces we ask to wage war will never do everything correctly every time. The system-of-systems does not offer omniscience or omnipotence. It has demonstrated the ability to reduce the fog and friction of war and promises to do even more so in the future. What counts in war is the relative influence on the opposing side of what some have called the fog and friction of conflict. The side that can reduce the effect of that fog and friction significantly, relative to its opponent, will win.*[23]

As the tactical employment by ground forces of the net-centric approach to warfare, Blue Force Tracker purports to give commanders better visibility of units, both friendly and enemy, allowing them to make better force deployment decisions. In theory, as Admiral Owens noted in the quote above, it reduces the 'fog and friction' explain of war to reduce the effects of chance on the outcome of battles, operations and campaigns. The reality, however, has been a bit less positive. In a COIN fight, it is impossible to know with certainty where the 'enemy' is or who it is. Warfare conducted among the population is characterized by ever-shifting alliances and practices. Unit-level critics of BFT note, for example, that it is updated too infrequently to take note of recently-emplaced improvised explosive devices (IEDs), and that the ability of units to edit what is displayed in a military version of Wikipedia does nothing but clutter the unit so that it is impossible to tell what is relevant from what is not.[24] Operating from (and relying on) old information is a dangerous course of action for units engaged in urban combat. Finally, the technology on which BFT relies (and in which it is embedded) is military-specific and thus expensive and cumbersome. The insurgents against whom the US forces are operating have their own networks, but these rely on off-the-shelf components that are easily acquired and employed.[25]

One is then faced with the same question as that of the airpower section. Why has the US military chosen to conduct its ground operations in Iraq and Afghanistan using methods that appear to be singularly unsuitable for COIN or urban combat? There is no shortage of purported answers to that question, but in keeping with the theoretical predisposition of this essay to look at the questions from a socio-political angle, it is worth quoting Admiral Owens again:

> *In the past, we used the perception of the threat (e.g., we developed new capabilities to keep ahead of our peer competitor, the Soviet Union) or the realization that things inside the military were broken and need fixing. The Department went through such a period of introspection after Vietnam. Now, however, neither of these rationales is particularly relevant: there is no peer competitor and we won the last war. So the Occam's razor has changed. Today's rationales are: 1) maintaining an adequate defense today while building superiority for the 21st century; 2) what the American people will support and the economy can sustain over the long haul.*[26]

It is instructive that an article written in 1996 places net-centric war in its societal context ('what the American people will support…'). While this is not the same as saying that the American people 'like' technology and thus see no problems with its application to military endeavors, Admiral Owens' quote implies that technology is a net positive in terms of increasing American capability on the battlefield, as long as the context in which that technology is employed is supported by the American people. In the context of the late 1990s, when the stateless, amorphous, and fluid threat faced by the United States in the form of radical extremism had not yet been

made clear, it appeared that networked military units would be best able to function on a modern battlefield. The rise of insurgencies in Iraq and Afghanistan, which encouraged a shift in strategic doctrine from high-intensity combat to counterinsurgency, was not accompanied by a shift toward 'low-tech' options. Indeed, quite the opposite: FBCB2 and BFT are now openly discussed as COIN ground force multipliers, in much the same way as JDAMs and UAVs are discussed as air force multipliers. SCOT theory gives one potential and powerful explanation for why this is so: American society believes in its technology and believes its technology can be adapted to overcome any obstacle. Insofar as the American military is a reflection of American society, that attitude has carried over wholesale.

THE RISE OF INSURGENCIES IN IRAQ AND AFGHANISTAN, WHICH ENCOURAGED A SHIFT IN STRATEGIC DOCTRINE FROM HIGH-INTENSITY COMBAT TO COUNTERINSURGENCY, WAS NOT ACCOMPANIED BY A SHIFT TOWARD 'LOW-TECH' OPTIONS.

Moreover, the level of advanced technology available for the American people to utilize has increased dramatically, but the capacity to understand that technology may not have increased with the same speed. And technology has a habit of failing at the most inopportune times. The issue is that the technology employed by the military fails in many of the same ways it fails in everyday society. When a computer crashes in an American household, priceless personal data may be lost or corrupted but American society continues to function. When a computer crashes that happens to be controlling a piece of military hardware, however, the consequences may be much direr.

Even more disturbing than computer crashes are the 'false positives' that arise when bad data produces bad conclusions. Elementary computer science students are taught the maxim "garbage in, garbage out (GIGO)." Applying net-centric, techno-wizardry solutions to complex, anthropologically-driven questions may be generating the right answers to the wrong questions. Technology, in this case, prolongs, rather than mitigates, conflict.

Conclusions: 'Catastrophic success,' the technological triumph of American military power and its implications for COIN

The US military's overwhelming victory in Operation Desert Storm was unquestionably the high point of American military dominance in the 1990s. Similarly, Operations Enduring Freedom in 2001 and Iraqi Freedom in 2003 can be considered in the same light. The ease with which the US military toppled the

Taliban in 2001 and drove to Baghdad in 2003 served notice to the rest of the world that the American armed forces had not lost the technological advantage that they showed to such great effect a generation earlier. If anything, the rapid increase in technological advances from 1991 to 2003 in such areas as networked armor units and stand-off munitions made the toppling of the world's then-fifth largest army all the easier. After the 'TV war' of Operation Desert Storm, Americans got the 'shock and awe' of Operation Iraqi Freedom (OIF), much of which was predicated on the massive employment of American military technological prowess. But there was a hidden peril in this reliance on technology to accomplish military objectives: complacency and short-sightedness. Accomplishing regime change in Iraq in 2003 was reasonably straightforward and was completed so rapidly and effectively that a new phrase entered the military lexicon: 'catastrophic success.'[27]

The doctrine which underpinned the success in Operation Desert Storm and OIF, known as AirLand Battle, was developed by the US Army in response to the threat of Soviet invasion in Europe in the 1980s. Coupling 'deep strike' operations with network-capable units, AirLand Battle achieved stunning success when faced with a conventional enemy on a conventional battlefield. As the 1990s progressed, increasingly technological innovations were justified on the basis of the success of AirLand Battle in Iraq in 1991. If one technological system was good, the argument went, two were more than twice as good. And if one service (e.g., the Air Force) went high-tech with GPS-enabled JDAMs and UAVs, the other services (e.g., the Army) needed to follow in whatever way possible in order to remain operationally relevant. In this way, much as technology companies appear to generate a kind of 'forced obsolescence' in products by bringing out 'new and improved' products on a regular basis, military services engaged in a kind of internecine technological arms race to see which could claim the mantle of the most high-tech.

American society, increasingly technologically sophisticated and comfortable with next-generation equipment, grew just as comfortable with military leaders employing high-tech strategies and tactics in warfare. In military briefings conducted around the world, technology was given pride of place in determining courses of action, and military options almost invariably included one option where technology was meant to save American lives or prevent the loss of American service people. There was just one problem: the relevance of AirLand Battle and its attendant technologies to a counterinsurgency campaign is unclear, to say the least. As this essay has shown, it is impossible to examine American military technology at a level removed from its place in American society. Any discussion of American military power and the technology on which it is based should, it seems, take note of its social origins. These social underpinnings can shed light on how and why military force is used, and might allow us to better predict the future direction of the military element of American national power.

Notes

[1] See, for example, Max Boot, *War Made New: Weapons, Warriors, and the Making of the Modern World* (New York: Gotham, 2007), Antoine Bousquet, "The Scientific Way of Warfare: Order and Chaos on the Battlefields of Modernity," ed. Tarak Barkawi and Shane Brighton, *Critical War Studies* (New York: Columbia University Press, 2009), Barton Hacker and Margaret Vining, *American Military Technology: The Life Story of a Technology* (Baltimore: Johns Hopkins University Press, 2007), John M. Staudenmaier, "Rationality, Agency, Contingency: Recent Trends in the History of Technology," *Reviews in American History*, no. 30 (2002), Martin Van Creveld, *Technology and War: From 2000 B.C. To the Present* (New York: The Free Press, 1991).
[2] Craig C. Hannah, *Striving for Air Superiority: The Tactical Air Command in Vietnam* (College Station, TX: Texas A&M University Press, 2001).
[3] Anthony H. Cordesman, and Abraham R. Wagner, *The Lessons of Modern War, vol. iv. The Gulf War* (Boulder: Westview Press, 1996).
[4] Joshua Davis, "If We Run Out of Batteries, This War is Screwed," *Wired*, Nov. 6, 2003.
[5] See http://www.gowalla.com and http://www.foursquare.com for more on this merging of GPS and social media.
[6] There are indications that this is changing. See Benjamin Sutherland, "Apple's New Weapon," *Newsweek*, April 27, 2009. See also Jeremy Hsu, "iPhone Application Controls Military Drones, Aids Training," http://www.popsci.com/technology/article/2010-04/video-using-smartphones-control-aerial-drones (accessed April 12, 2010).
[7] For good recent examples of works in this literature, see Risa A. Brooks and Elizabeth A. Stanley, eds., *Creating Military Power: The Sources of Military Effectiveness* (Stanford: Stanford University Press, 2007), Benjamin O. Fordham, "A Very Sharp Sword: The Influence of Military Capabilities on American Decisions to Use Force," *Journal of Conflict Resolution* 48, no. 5 (2004).
[8] Trevor J. Pinch and Wiebe E. Bijker, "The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other," *Social Studies of Science*, no. 14 (1984).
[9] "Technology," definition from Princeton University's *WordNet*, available online at http://wordnetweb.princeton.edu/perl/webwn?s=technology (accessed April 12, 2010).
[10] In essence, the stirrup thesis has made it incumbent on SCOT theorists to consider technology as one contributing factor to societal change, rather than the prime cause of it.
[11] Bousquet, *The Scientific Way of Warfare: Order and Chaos on the Battlefields of Modernity*, for a thorough discussion of the stirrup thesis and the problems it caused for SCOT theory.
[12] Sapolsky 1977:453, quoted in Brian Rappert, Brian Balmer, and John Stone, "Science, Technology and the Military: Priorities, Preoccupations, and Possibilities," in *The Handbook of Science and Technology Studies*, ed. Edward J. Hackett, et al. (London; Cambridge: MIT Press, 2007).: 720.
[13] Ibid., 732.
[14] Wiebe E. Bijker, "How Is Technology Made? - That Is the Question!," *Cambridge Journal of Economics* 34, no. 1 (2010): 67.
[15] Zhan Li, "The Potential of America's Army the Video Game as Civilian-Military Public Sphere," http://cms.mit.edu/research/theses/ZhanLi2003.pdf (accessed April 12, 2010).
[16] See "JDAM" entry, http://www.fas.org/man/dod-101/sys/smart/jdam.htm (accessed April 12, 2010).
[17] The SR71, unlike the U2, was never shot down. It set (and holds) numerous altitude and speed records, and provided the US intelligence community with data that satellites or human intelligence could not manage.
[18] See Joanne Blight, "Global Automotive Vehicle-Device Connectivity Forecast 2008-20," http://www.strategyanalytics.com/default.aspx?mod=ReportAbstractViewer&a0=5289 (accessed April 13, 2010).
[19] See Peter W. Singer, "Video game veterans and the new American politics," *Washington Examiner*, Nov. 19, 2009. See the expansion of this argument in Peter W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (New York: Penguin, 2009).
[20] Armed UAVs can be operated by both the military or US intelligence agencies. Those operated under civilian (intelligence) command operate under a different set of rules of engagement (ROEs) than those that are operated under military command. For the purposes of this essay, only those operating under military command will be discussed.
[21] David Kilcullen and Andrew Exum, "Death From Above, Outrage Down Below," *New York Times*, May 16, 2009.
[22] See Adm. William A. Owens, "The Emerging US System-of-Systems," http://www.ndu.edu/inss/strforum/SF_63/forum63.html (accessed April 12, 2010).
[23] Ibid.
[24] One blog post that made its way around the internet in 2008 was written by Lance Corporal David

Goldich, who wrote eloquently about the problems faced by his unit in attempting to integrate technology into the modern battlefield. See
http://forums.military.com/eve/forums/a/tpc/f/6261946761/m/9380026171001 (accessed April 12, 2010) for a representative re-posting and commentary on the post.
[25] See Schactman, Noah. "Winning-and Losing-the First Wired War," *Popular Science*, June 2006.
[26] Adm. William A. Owens, "The Emerging US System-of-Systems,"
http://www.ndu.edu/inss/strforum/SF_63/forum63.html (accessed April 12, 2010).
[27] In essence, the success of the first phase of the war caused enormous unintended consequences for later phases, none of which had been adequately thought through.