LESSONS OF THE GULF WAR: ASCENDANT TECHNOLOGY AND DECLINING CAPABILITY

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Working Paper 91-22

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> The videotape of [the] initial [air] attack, replayed endlessly over those first euphoric days, is the image that most Americans will remember from this war ... At long last, a successor has emerged to the mushroom cloud as the emblem of America's military prowess, and good riddance.
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> *Newsweek* special issue, "America at War," (Spring 1991) p. 68.

Introduction

In the mid-1980s, the Reagan administration made a deliberate choice for 'high-technology' conventional weapons systems for the US military, emphasizing their development and purchase even at the expense of building up military stockpiles and other more conventional reserves. The policy, made in the face of growing budgetary restraints and growing deficits, was controversial even at the time, adding force and urgency to the debate over "quality" vs. "quantity."[1] Now those who promoted the high-tech strategy argue that it has been vindicated by the performance of US forces in the "100-hour" ground war in Kuwait.[2]

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In the immediate wake of the Iraqi defeat, actors, analysts, and pundits alike rushed to generate catalogs of "lessons learned" -- lessons about technology, about weapons, about tactics, and about how, when, and why to apply the use of force. The relative ease of the ground victory, and the amazingly low cost in US and coalition casualties prompted widespread cheering for "high tech" systems.[3] The simpler weapons of the Iraqis were outfought by those more advanced weapons of the allies and, so the logic goes, the best future investment is in "brilliant" weapons.[4]

Critics of the high-tech policies have responded with cautionary notes about the conditions under which success was demonstrated, emphasizing that after the first few days of air combat, both the air war and the ground war bore more resemblance to structured training exercises than the intense conflict that we had been warned to expect.[5] But their voices have been few, and go against the general trend of American euphoria about the state of US military power.

The evidence for and against the performance of both the high-technology military weapons and the surveillance, information, logistics and command networks that supported and directed them is still coming in. It is clear that some of the weapons, and some of the associated systems, were indeed highly effective. The performance of others may prove to have been overstated as the evidence accumulates.[6] But our primary purpose here is not to debate the pros and cons of weapons performance, but to use the Gulf experience as a basis for contemplating the implications for the US military of continuing uncritically the emphasis on high-technology that has characterized the conventional military build-up of the past ten years.

Our analysis differs from most in taking a primarily organizational perspective. From the early evidence, we argue that the US military may be evolving on a path in which it will be able to fight successfully only against smaller and smaller enemies. Two ingredients encourage this trend: first, the necessity for establishing and maintaining the immense social organization required to support the newer high-tech weapon systems; and, second, the recent organizational redefinition of success away from traditional measures of balancing cost, risk, and objectives into minimizing friendly casualties almost regardless of other costs.

We extend the argument about exercising caution in judgment beyond the simple question of whether the US victory would have cost so little if the Iraqis had effectively fought back. Our chain of reasoning is based on analyzing the modern US military as a complex, highly interconnected, integrated system demanding intensive logistics and information support.[7] Setting out the notion of militaries as social organizations increasingly integrated by the demands of advanced technologies, we argue that the high technology weapons were effective because their support systems were allowed to train and operate without hindrance, and almost without time or resource constraint. Because of these special circumstances, the conflict did not test the combat robustness of US forces adequately, and there are some reasons for caution about system vulnerabilities. At the same time, there is a demonstrable reluctance among senior American officials to suffer US casualties, and a strong desire to substitute technology for people regardless of cost, or considerations of cost-effectiveness.

This combination of factors leads to concern that the US, stripped of the central military focus on Europe and the Soviet Union, will be drawn into building a force suitable only for intervention against relatively small powers with negligible capability to interfere with logistics and C^3I. But the apparent US performance and success in the 1991 conflict will have a two-part demonstration effect. First, the definition of a "small" and therefore easy target for US forces will inch upwards to include countries close to the size of Iraq. Second, the 'lessons learned' by prospective opponents are more likely to draw them into developing strategies and weapons directly aimed at countering or offsetting the source of US advantage. Under such circumstances, the US would be building a force capable of inflicting greater and greater damage, at ever increasing costs, that could be used with assured success only on opponents who have diminishing, rather than increasing, technical capabilities. Furthermore, the hubris of the 1991 victory may lead to fights against less accommodating opponents: those who are too large or too technically knowledgeable for the intricately integrated US systems to defeat with the required minimal casualties.

High-Technology Weapons: Lessons of the Gulf War?

The combat experience in the Gulf provided little in the way of conclusive evidence for either side in the quality-quantity debate. Having

seriously over-estimated both the number of Iraqi troops in Kuwait and their stamina and morale, the coalition forces carefully geared up to fight a fearsome foe, accumulating military resources far in excess of what was eventually required. Given the actual conditions of the conflict, the US would probably have prevailed even with fewer, less technologically superior weapons and less advanced tactics. The only thing for which they were not fully prepared was taking care of the large number of prisoners who put down their arms at the first sign of combat.

But even if one asserts that our military "high technology" worked, just what does that mean? It is rarely clear in any instance whether the term is being applied to individual pieces of hardware, integrated technical fighting components, a fighting unit, or the integration of the force by the web of communication, surveillance, and interdependencies required. Equally praised in the Gulf War, for example, were laser-guided bombs, the Tomahawk, the F-117A 'stealth' fighter, satellite communications, and the doctrine of 'AirLand battle.' But smart bombs are by no means as advanced, expensive, or demanding of organizational resources, as a Tomahawk cruise missile, or the F-117A itself. And AirLand battle depends more upon the performance and integrity of advanced, electronic communications and information systems than it does on specific weapons.

The US and its allies had superiority not only in both quantity and quality, but, most importantly, in the ability to establish and maintain logistics, repair and intelligence support to a degree unprecedented in modern warfare. As a result, the advanced weapons were not used in the context of a standing start, outnumbered, high intensity war -- conditions which were used to justify their high costs. In particular, the US military had ample time to set up and debug its vast and elaborate electronic network of satellites and spy aircraft, information gathering and data processing, intelligence, coordination, and command and control systems before hostilities began.

Because of the available time and the lack of opposition, the combat lessons of this war were in fact few. In contrast, the more general organizational lessons were many, and potentially disturbing. The US was able to mobilize without pressure a force structure intended to fight one and a half wars simultaneously, and to use it to fight a half-war under maximally favorable conditions. The combat theater was given adequate resources, even

at the cost of stripping Europe and the US of systems, spares and maintenance that were allowed by Iraq to operate almost without interference.[8] Whether the coalition would have been able to act as well, and with such small losses, if it had been denied the time to mobilize, train, and prepare, and the freedom to use its advanced intelligence and communication technologies without hindrance, remains very problematic.

In retrospect, it was these latter "software" or relational aspects of the modern military organization that were most critically dependent upon the performance of newer, high-technology systems of great technical sophistication. Far more vulnerable to design failures or enemy action than tanks and aircraft, the cumulative performance of intelligence, communications, command and control links is integrally dependent upon organizational integrity and integration. The units handling these systems have less redundancy and less duplication of function, and replacements are far scarcer and more costly. The ability to protect these systems from disruption was a better key to the success of the allied forces than the new weapons technologies used.

Militaries as Social Organizations

Militaries are more than collections of people and technologies; their organizational structures are highly complex.[9] In a modern combined military force, there is not just one type of weapon at the front but many, each of which has distinct and often narrowly defined missions and tasks that must be monitored, evaluated, and integrated. And, for every element in the fighting 'tooth' there is a large logistic, informational, and command-and-control 'tail' that creates its own problems.

In the time of Napoleon, each component of the Grande Armeé (infantry, cavalry, artillery) was composed of many identical small units such as artillery batteries; formations could continue to fight, at some level, even after sustaining enormous losses. Moreover, their tasks were pre-designed; as communication during battle was at best imperfect, they were not only capable of, but expected to fight on their own even if communication with commanders were delayed or severed.[10] By the end of World War II, the transition to nearly-instantaneous 'wireless' information and communication systems allowed the US to advance across Europe with forces that roughly integrated armoured cavalry, infantry, and tactical air-power into an

enormous force that placed unprecedented demands on logistics and communications networks. The force was more powerful, and more efficient, but individual units were less capable of fighting independently if logistics or coordination failed.[11]

Modern integrated combat systems, such as naval battle groups, armoured divisions, or tactical air wings, require not only an enormous amount of direct support to keep supplies and spare parts flowing in and to actually perform repair, but also place increasing demands on information and communications to keep the flows ordered and arranged. Moreover, as the individual weapons become more expensive, and therefore increasingly scarce and valuable, it is more important to extend the information and command net not just to formations but to individual units, or even individual pilots or commanders. What were once relatively simple military hierarchies that could communicate and coordinate flexibly, fighting together or separately according to the flow of battle, have become networks of force whose coherence and integrity must be preserved at all costs to maintain the level of fighting effectiveness anticipated.

The assumption that centralized control and concentration of power are better than decentralized forms in the efficient use of resources and individual specializations has a long history in industry and government. In peacetime, militaries may look far more efficient, as well as effective, if their managers eliminate duplication and overlap, increase specialization, distribute the tasks to specialized units, and then re-integrate the components with elaborate electronic networks. These cost-cutting practices are often established in peacetime to compensate for the enormous initial and continuing costs of high tech weapons.[12]

But these notions of efficiency are built upon the examples of civilian organizations who are not subject to the sudden loss of staff as a part of their daily tasks. They rarely face a malicious enemy trying to physically cause as much trouble as possible to critical communication or information links. For military organizations, operational conditions differ dramatically between peace and war. Wartime militaries justify their 'inefficiently' duplicative resources in terms of 'slack' -- unused reserves that they will be able to draw upon and orchestrate when the inevitable disruptions occur. The cost of reducing slack to increase efficiency is to increase the necessity for integration and control. The result is a military

organization that needs relatively predictable conditions to perform successfully, and is less likely to be effective in a hard fought conflict. A centralized military may turn out to be 'brittle' in war -- powerful if intact, but greatly vulnerable to disruption of critical links or functions.

Disruption of large, complex, tightly integrated, highly specialized, high-technology military can be accomplished even with relatively simple technologies. The classic examples come from the VietNam and Afghanistan wars in which relatively primitive opponents were able to bring down expensive, highly capable helicopters with small arms and man-carried SAMs. Their actions caused large-scale changes in tactics and operational momentum on the part of the more technically capable combatants.

Some of the war's success stories become more problematic when examined in this light. Effective use of the Tomahawk cruise missiles required the six months preceding hostilities so that key terrain information could be digitized and programmed into their guidance computers.[13] As many as eight electronic warfare aircraft were used to cover a dozen F-16s on a raid, making the support component almost equal to the combat component in the operation. High-technology weapons systems using black boxes operated smoothly, but only at enormous expense, and at the cost of moving almost all of the US reserve repair capacity into enormous, sprawling Saudi bases that would have been quite vulnerable to an Iraqi attack.[14]

Although the Iraqis did not disrupt the operations to a serious degree, many surprises, close calls and deadly accidents occurred. Tactical aircraft and tanks working in daylight hours produced casualties by "friendly fire".[15] Satellites passing overhead mistakenly identified a flight of B-52 bombers as a barrage of *Scud* missiles. Airborne Warning and Control Systems aircraft (AWACS) had to intervene to prevent allied fighters from attacking their own returning bombers.[16] And, in the few cases when tanks did become entangled in more traditional battles, close air support had to be foregone in order to avoid indiscriminate attacks on friend and foe alike.[17]

The Iraqis were also able to disrupt coalition operations to a certain extent, using low level anti-aircraft and small-arms fire and with a few relatively primitive *Scud* missiles.[18] Fifteen percent of the aircraft missions flown during the war had to be diverted to finding *Scud* launchers. Fighter pilots had to be retrained to fly at higher altitudes to avoid antiaircraft fire; before doing this, British forces lost 5 of their 12

Tornadoes on the low level missions for which they were designed and trained.[19]

Our criticism of 'high technology' military systems stems from such organizational complications. It is not technological advancement per se that is the problem, for, as we have seen with the personal computer, technological 'sophistication' can as easily provide autonomy as centralized control. What is at stake is the persistent and increasingly visible tendency for the US and its NATO allies to adopt weapons systems of increasing technical complexity, and to embed them in ever larger and more elaborate doctrines that allocate resources via complex command-and-control links.[20] The resulting elaborate socio-technical system may well be frail and non-adaptive. The lessons of military history suggest it is highly undesirable to allow military units to depend for their survival and performance on complex, external linkages not under their direct control.[21]

The Crucial Six-Month Build-Up

Ample preparation time and high levels of redundancy were the keys to the coalition's success in the Gulf. Six months were needed to test, adjust, maintain, and make fully operational many of the high-technology weapons systems. For example, US and NATO helicopter pilots fly close to the ground (so-called "nap of the earth" flying) in order to surprise the enemy. This requires night vision goggles, which in turn led crashes in low-level flying over the flat desert terrain.[22] Helicopter losses might have been costly if the war had started before new procedures could be devised and practiced, and pilots acclimatized to the distortions created by the goggles; in the interim, helicopters did not fly at night or at low levels. Without adequate time and resources, night operations would have had to be restricted, undercutting the effectiveness of the forces as a whole.

Much of the *matèriel* and logistical support accumulated in the Gulf during these critical six months were obtained by stripping units in Germany and the US. Maintenance bases in Saudi Arabia had virtually unprecedented access to parts and diagnostic equipment and expertise. Furthermore, military skills were augmented when necessary by special teams of civilian experts who helped to diagnose problems (such as that of the night goggles) and to supply and, in some cases, design or build needed parts to order.[23]

These unusual support relationships provide one key organizational lesson of the war -- the amount of expert support needed to achieve high levels of availability. The M1 tank, for example, was reported to have 90% reliability during the combat period, although as recently as 1988 the US Army announced that it was having difficulty troubleshooting its M1 tanks in Europe and in training sufficiently skilled maintainers.[24] But a similar level of M1 availability during the 1982 Reforger exercise was later shown to have come from very non-standard maintenance and supply channel; during the exercise a C5A shuttled between the manufacturer and a close airbase in Europe carrying parts for the tank, while the contractor located one of its own maintenance teams with each battalion.[25] Such support relationships, developed and refined over the six months preceding hostilities, contributed significantly to learning how to use and maintain complex equipment in a strange environment. They were not, and could not have been, in place on August 2, 1990. Had hostilities come much more quickly, these important links would not have had time to mature. And, had the US forces been required to construct and use forward bases under the constant threat of serious enemy attack, the security and effectiveness of these bases would have been severely compromised.[26]

During this time, many other things that would have presented problems if the conflict had occurred earlier were 'fixed.'[27] The transfer of personnel to the theatre provided the combat forces with rapid access to the whole spectrum of key technical and maintenance skills available in the entire US military establishment, wherever located and however scarce. Missing personnel for critical slots, always in shortage, were sought out or mobilized and brought to the theater. Maintenance and supply units had time to be brought up to wartime strength. The US Army's VII Corps, for example, nearly doubled in size.[28] Highly skilled maintenance, so scarce in Europe in 1988, was fully available in the Kuwaiti theater of operations. With the more than half of the US Army stationed outside of Saudi Arabia being used as a depot, no specialty needed to remain unfilled.[29] Even so, many personnel were placed on alert and retained on active duty even though there was no immediate need for them.

Indeed, the concentrated preparation that preceded hostilities was very similar to the frenzied activity that precedes annual exercises in every American military unit. Maintenance is intensively done before each exercise

and after, but rarely during. Parts are stockpiled, and equipment is borrowed from sibling units. Critical personnel shortages are met by temporary reassignment of individuals from other units. It is not unusual for a brigade to ravage the inventories of others in its division before annual exercises in order to make sure equipment is functioning, missing personnel replaced, and vacant slots filled.

Moreover, the preparation for the ground war differed from the usual round of programmed training activity in several key respects. First, there were few distractions from training, such as schools, home leave, or, in Saudi Arabia, alcohol or other temptations. Second, a major difficulty of most units is the constant turnover of personnel. In the Gulf war, people went to their unit and stayed in place for the duration. An enormous amount of in-place, system and theater-specific learning accumulated over six months. Most importantly, it was not disrupted by rotation, by leaves, or by the enemy.

Given time to cope with surprises and access to the resources of the entire US military structure, the military organization supporting the advanced weapons adapted and matured in the theater in which it was going to operate. Moreover, it was given ample resources throughout the process. In 1989, for example, the entire US defense establishment's operations and maintenance budget was $85 billion. The initially published figure for the operations and maintenance costs of the total seven months of the Gulf war was $26 billion, although recent reports suggest it may be closer to double that amount.[30] While wars are always expensive, the bulk of these expenditures took place before the hostilities began, primarily to gather unprecedented 60-day inventories.[31]

This vivid demonstration of the depth and breadth of support necessary to support a large, complex military organization equipped with advanced, complex, and often fragile technologies and machines is perhaps the single greatest unrecognized lesson of the war in the Gulf.[32] It is not clear if even six months would have been adequate if Iraq had been willing (or able) to actively disrupt the growth and training of the organization. It does appear, however, that six months preparation was not excessive. Equipment had to be brought in; Tomahawks needed to be programmed; helicopter pilots had to retrain on night goggles; even the Marines, newly given the M-1 Abrams tank, wanted several more months to learn the machine before they went

into conflict.[33] Fortunately for the coalition, the rapid Iraqi collapse did not test whether the required whether the command and logistics infrastructure was really robust.

Redefining Effectiveness

Not only did the rapidity of the Gulf war prevent testing the social system behind the advanced weapons, it crystallized a different definition of military effectiveness. For most of its history, the United States has been willing to expend resources and people in large amounts in attrition warfare in order to achieve political objectives. Doubts about the value of the sacrifice of an American life in a military conflict began with the Korean war and flowered during the VietNam conflict. The unsatisfactory outcome in both cases fueled a broader public debate, which became focussed on the emotional issue of American casualties.

Vietnam heavily emphasized the role of casualties in undermining public support for military actions. The lessons drawn by senior military leaders was that public support remained at acceptable levels only so long as casualties, and the information about them, were kept low. This meant that operations that kept casualties low were acceptable, as were force postures that substituted technology, and money, for American lives.[34]

The primary lesson being drawn from the Gulf war is that advanced technology spectacularly achieved these goals. This perception creates an incentive to vigorously pursue complex technologies to meet all military contingencies while still intending to mass fire in "overwhelming force" in order to assure satisfactory outcomes. In short, success will then depend on the massive application of systems and weapons whose high costs were originally justified on the basis of their ability to apply force surgically with minimal allied casualties.[35]

This focus on reducing casualties through force-multiplying advanced technologies is becoming enshrined in the military establishment just as the military is becoming smaller. But a smaller military has less redundancy and is less able to absorb shocks than a larger, more robust one. Hence, it is less tolerant of casualty losses and more interested in programmes that promise the delivery of massive, accurate firepower (enemy attrition) at a distance (less friendly vulnerability). Given the demanding requirements of these new weapon systems, however, more of the force must be involved in any

exercise, and accordingly more people placed at risk. The incentive then perversely grows to increase both the striking power and the distance between enemy and friendly troops. As the distance between the forces grows larger, the organization with supposedly superior technology will grow more confident of its ability to use its forces with low risk of friendly casualties, making it less likely that the use of force will be restrained. Thus, a force designed for surgical strikes may be used massively in attrition warfare conducted at a distance from friendly troops. An example of this attitude was the repeated call during the Gulf War to win the war by airpower.

This attitude towards casualties is rare -- save in Israel. Most militaries throughout modern history used the lowest social classes for war-making and were largely indifferent to the costs in lives. There was, of course, a preference to conduct wars far from home territory and, to the extent possible, leaders attempted to use conquest and domination to avoid paying for what they gained. But, even if the leaders of these armies been interested in minimizing loss of life, they did not have the ability to project massive destructive force a great distance from their troops. But, as individual lives even of common soldiers came to be valued as highly as the destruction of crops and commerce, it became increasingly difficult for any rational leader to propose war as an *inexpensive* alternative to diplomacy.

The lessons currently being drawn from Gulf War, however, contain within them the danger of suggesting to some that military force can be used as an alternative to diplomatic efforts without incurring great costs, that surgical interventions against small powers are again possible, as they were thought to be during the height of colonial expansion.

But even if attempted surgical war is a realistic probability for the future, how well will it work? Hints of the long-term risks of increased dependence upon advanced technology were already manifest in the Gulf. One of these is the growing inability of Western military organizations to conduct small-scale operations. If current trends continue, even the deployment of a relatively small fighting force will require major portions of an immense support system to be mobilized and deployed as well.

Furthermore, the replacement of 'dumb' weapons and bombs with smarter ones is cost-effective only so long as one can prove that the probability of getting a 'hit' per dollar spent is increasing. But, even in the Gulf, it is not clear that every 'smart' weapon was truly cost effective.[36] Because of

their higher cost, smart weapons are necessarily scarcer, pressing the military to create elaborate systems of target surveillance and identification, and delivery system allocation and control. Hence, the force-multiplying aspects of these weapons are also multipliers of budgets and minimal levels of deployed forces.

Conclusions

Ultimately, the characteristics of the individual high-technology weapons are less important than those of the elaborate electronic and intelligence network responsible for the effective use of their 'intelligence.' Yet, arguments based on the positive risk-benefit of modernizing military forces are almost always based on the performance of the weapons, neglecting both the costs and the vulnerabilities of the increasingly complex organization needed to support them. Since this overstates benefits, and understates risk, it almost always leads to the conclusion that small numbers of new systems with greater individual capabilities should replace larger numbers of older, 'dumber' ones, even if that locks the forces into networks of mutual dependency through their enforced integration into large-scale tactics and doctrines.

This approach goes against the grain of a tradition the US Army claimed to have evaluated, learned from, and adopted -- the German Army's tradition of *Auftragstaktik* which emphasizes allowing individual commanders considerable freedom of action. And it goes against those who still believe that confusion and disorder, the "fog of war" will remain the natural state of combat, however advanced new systems might appear to be in peacetime. But the US seems to be abandoning the notion of loosely-coordinated small-group autonomy, which calls for considerable logistic and maintenance independence and the ability of front commanders to marshall their own air support and artillery, for a more integrated doctrine that could prove tragically fragile in the face of an enemy capable of interfering with the elaborate command networks.

As the Gulf war experiences blend with the lessons drawn from Vietnam, the deployment of 'overwhelming force' is likely to be seen simply as insurance against the possibility of higher friendly casualties. More firepower and longer preparation will also be necessary to assure the safety of the large numbers involved. And the cycle is likely to work as long as

the prospective enemy does not learn to interfere with the vulnerable logistic and communication links.

Yet, this is exactly what the likely foes will do to threaten Western forces. Hussein's *Scud* missiles are merely a foretaste of the probable response. Military technologies, like civil ones, are subject to the familiar drive of the 'product displacement cycle.'[37] The US can attempt to maintain dominance by continuing to generate ever-more advanced and complex weapons systems, even as the last generation is sold to or co-produced by our allies. If the historical cycle holds, European powers will then buy or co-develop the equivalent of today's high-tech, while the US continues its search for newer, more advanced, and far more expensive systems. In turn, the Europeans will seek to keep their costs down by marketing their technology, or their skills, to the richer of the developing countries. This, at least, would replicate the history of the arms race in the Middle East.

Pursuit of the chimera of a clean, professional war carries with it the potential for future military disaster. The British struggled for most of this century (and some of the last) to pursue exactly this combination to maintain their empire. Secure behind their channel, favored in both World Wars with allies who could absorb initial shocks, the British returned each time to the notion that their advanced industrial base and technical leadership could hold the Empire together. But, despite their elan, their efforts overseas became increasingly problematic over time -- although in each case it took a major defeat to prove it.

As the cost of weapons systems continues to escalate along with their increased capabilities, there will be greater pressures to trim back the military budget, to scale American forces back to no more than those required to meet more 'realistic' assessments of potential threats to US security and interests. With no threat in Europe, US force posture may be trimmed back from one-and-a-half-wars to one war, or even to something like "three-quarters" of the force that needed to fight in the European theater. And, given present trends, there would be an increased tendency to pursue more tightly integrated C^3I systems, to depend increasingly on the performance of scarce, individual weapons, on elaborated electronics and computers, and on integrated coordination of even the smallest details of battle.

What could matter in the future is a belief that modernized, high-technology US forces have proved suitable for intervention against countries less technically advanced than we assumed the Soviets to be. The success in Iraq is likely to be taken as an invitation to greater boldness not only in the 'third world,' but also against a variety of other Middle Eastern, Latin American, African, and South and Southeast Asian countries of varying military capabilities and resources, including some that are among the most prosperous and developed of the less-industrialized. And, if the reduction in US forces continues apace, the same temptation might in the future extend to a France or Britain less sure of US willingness to intercede on behalf of their oil supplies or other vital interests.

If the focus on "high tech" continues to be directed at the weapons themselves, the massive social system behind these weapons will remain invisible to public debate. One possible consequence is a political belief that wars can be fought with smaller forces by continuing to substitute technology for people. The cycle of the past decade of American defense budgets would then replayed, with purchases of weapons given priority over the operations, maintenance, and personnel budgets to sustain them. But without the massive support provided in the Gulf, there is every likelihood that the next war will be quite a bit more costly in lives -- unless the opponent is smaller and less capable than Iraq was presumed to be.

Our ultimate concern is that the US, able to purchase fewer and fewer of the new systems in times of budgetary restraint, will increasingly shape its forces for intervention. Claiming to have learned the double lesson of high-technology and low-cost intervention from its success in the Gulf, it might well build a smaller, high-technology 'surgical' force directed primarily against weaker and less sophisticated countries. To do so without providing a proportionately larger support system will produce a military that lacks robustness and resilience against errors, against surprises, and against clever, if unsophisticated, countermeasures. Even as adventurism appears more attractive, risks will increase. Without the massive support provided in the Gulf, the next war could be more costly in lives and equipment -- unless the opponent is as incapable as Iraq turned out to be. Over time, military operations would therefore be assured of success only with continued good fortune, or against smaller and smaller enemies.

NOTES

1. See, for example, Asa A. Clark IV, Peter W. Chiarelli, Jeffrey S. McKittrick, and James W. Reed, eds. *The Defense Reform Debate* (Baltimore: The Johns Hopkins University Press, 1984). The Reagan administration's position is well set out by William J. Perry, "Defense Investment Strategy," *Foreign Affairs*, Spring 1989, vol. 68, no. 2, pp. 72-92.

2. Presentation by and interview with John Lehman, former Secretary of the Navy, at U.C. Berkeley, April 16, 1991. According to the US Congressional Budget Office, *An Analysis of the President's Budgetary Proposals for Fiscal Year 1992* (Washington DC: USCBO, 1992): " Overall, the Administration's defense budget emphasizes the next generation of weapons ... Funding for these weapons would exceed the CBO baseline by $ 6.1 billion, or 13 percent, while funding for the current generation of weapons would fall short of the baseline by $5.6 billion, or 10 percent. ... At the same time ... military personnel are to be reduced by about 320,000 from the active- duty force and by about 270,000 reservists by 1995. .. O&M will be reduced $68 billion below the CBO baseline -- a reduction of 14 percent."

3. For example, Defense Secretary Richard Cheney, as cited in *The Economist*, 9 March 1991, p. 27. Also see: "The Gulf War's Decisive Lessons," *Aviation Week and Space Technology*, 28 January 1991, vol. 134, no. 4, p. 9; Craig Covault, "Desert Storm Reinforces Military Space Directions," *Aviation Week and Space Technology*, 8 April 1991, vol. 134, no. 14 (1991): pp. 42-47; Keay Davidson, "Desert Storm to be a Primer for Warriors," *San Francisco Examiner*, March 3, 1991, p. A11; John G. Roos and Benjamin Schemmer, "Desert Storm Bares "Roundout" Flaw but Validates Army Modernization Goals," *Armed Forces Journal International*, April, 1991, pp. 14-35. Expert analyst John D. Morrocco even reversed his position between December and March: see, John D. Morrocco, "Beware of 'Lessons' From the Gulf In Reshaping the US Military," *Aviation Week and Space Technology*, 24 December 1990, vol. 133, no. 26 (1990), pp. 32-33, and John D. Morrocco, "Gulf War Boosts Prospects for High Technology Weapons," *Aviation Week and Space Technology*, 18 March 1991, vol. 134, no. 11 (1991), pp. 45-47. See also Ken Adelman, "Star Wars in the Desert", *Newsweek*, 4 February 1991, p.14. This theme also pervades the *Newsweek* special issue "America at War" (Spring/Summer 1991), as shown by the epigram to this essay.

4. For example, Air Force General Merrill McPeak, as quoted in the *Washington Post*, 15 March 1991; John D. Morrocco, "Gulf War Boosts Prospects for High Technology Weapons," *Aviation Week and Space Technology*, 18 March 1991, vol. 134, no. 11, pp. 45-47.

5. See, for examples: David H. Hackworth, "Lessons of a Lucky War," *Newsweek*, 11 March 1991. p. 49; Jeffrey Record, "Why the Air War Worked," *Armed Forces Journal International*, April 1991, pp. 44-45; John D. Morrocco, "War Will Reshape Doctrine, But Lessons Are Limited," *Aviation Week and Space Technology*, 22 April 1991, vol. 134, no. 16, pp. 38-43.

6. See, for example, Patrick E. Tyler, "Did Patriot Missiles Work? Not So Well, Scientists Say," *The New York Times*, 17 April 1991, A6.

7. The story of communications networks and their effectiveness has yet to be told but it is likely to be the single most important problem area for the military in the future.

8. See, for example: *Newsweek*, "America at War;" James C. Hyde, "MAC Flying Nonstop to Support Desert Storm," *Armed Forces Journal International*, March 1991, pp. 12-13; James C. Hyde, "Logisticians Pave Way for Desert Storm Troops," *Armed Forces Journal International*, March 1991, pp. 28-29; Michael Mecham, "US Bases in Germany Reconfigure Maintenance Shops to Support Gulf Forces," *Aviation Week and Space Technology*, 28 January 1991, vol. 134, no. 4, pp. 61-63; Rick Atkinson, "A Knockout 'Left Hook' Around Iraq's Western Flank", *Washington Post Weekly*, (25-31 March 1991), pp. 10-11.

9. For a discussion of complexity in military organizations, see Chris C. Demchak, *Complex Machines, Complex Organizations: Modernization in the US Armed Forces*, Cornell series on security studies (Ithaca, New York: Cornell University Press, 1991); Martin Binkin, *Military Technology and Defense Manpower* (Washington, D.C.: The Brookings Institution, 1986); Paul Bracken, *The Command and Control of Nuclear Forces* (New Haven, Yale University Press, 1983).

10. See, for example, Martin van Creveld, *Command in War* (Cambridge MA: Harvard University Press, 1985), especially on Königräätz. See also Hermann Balck, Translations of tape conversations with General Hermann Balck, unpublished manuscript, (Columbus, Ohio: Battelle Tactical Technology Center, January, July, November, 1979).

11. Thus, Patton had to stop the advance across France when he outran his supply train, and the US troops caught in the Battle of the Bulge had to await clear weather for the air support they required. See also Charles Whiting, *Death of a Division* (New York: Stein and Day, 1981).

12. See, for example: United States General Accounting Office, "Army Force Structure: Lessons to Apply in Structuring Tomorrow's Army," GAO/NSIAD-91-3 (Washington, D.C.: U.G. GAO, November, 1990).

13. "As You Were?," *The Economist*, 9 March 1991. pp. 26-27. Also, from the *Newsweek* special issue "America at War": "Schwarzkopf had to improvise a credible defense from whatever he could scratch up. At one point he phoned the Navy to ask what Iraqi targets the USS Wisconsin could hit with its sea-launched Tomahawk cruise missiles. The answer came back: zero. The Tomahawks must be programmed with electronic terrain maps to home in on their targets. The CIA and DIA, preoccupied with monitoring the Soviet Union's withdrawal of conventional forces in Eastern Europe, hadn't programmed their satellites to make such maps for Iraq. The maps didn't arrive until the end of August."

14. Vulnerabilities in Dhahran and Riyadh were critical according to General Norman Schwarzkopf, as cited in *Time*, 11 March 1991. Also see Joseph D. Douglass, Jr., "Critical Questions Loom in Assessing Gulf War," *Armed Forces Journal International*, April 1991, pp. 46-47. David Segal, "Whatever

Happened to Rapid Deployment?," *Armed Forces Journal International*, March 1991, pp. 39-40, quotes a Marine officer as saying the Iraqis "could have cleaned our clocks" if they had attacked in August or September. The defense analytic community were also aware of this early vulnerabilities; see Sean D. Naylor, "AirLand Battle Doctrine Draws Rave Reviews", *Army Times*, 11 March 1991, p.12.

15. While friendly fire casualties averaged five percent for previous American wars, 9 of 17 British soldiers killed in action were killed by friendly fire along with about 14 of 79 American KIAs. See "Operation Desert Storm: The 100-Hour War", *Army Times*, 11 March 1991, pp.14-16, 36-46. The American figures are a compilation of several news reports since official figures have not yet been published.

16. Eric Schmitt, "Unforeseen Problems in Air War Forced Allies to Improvise Tactics," *New York Times*, 10 March 1991, p. 1.

17. See "Operation Desert Storm: The 100-Hour War", *Army Times* 11 March 1991, p.46.

18. Moreover, there were early reports of successful electronic interference by Iraq as well. See, for example, David A. Fulghum, "U.S. Searches for Electronic Equipment Used by Iraqis to Foil Allied Attacks," *Aviation Week and Space Technology*, 18 March 1991, vol. 134, no. 11, pp. 27.

19. Jeffrey M. Lenorovitz, "Air National Guard Unit's F-16 Pilots Say Small Arms Fire is the Primary Threat," *Aviation Week and Space Technology*, 25 February 1991, vol. 134, no. 8, pp. 42-44. Also see *Newsweek*, "America at War," pp. 76-77, on the Tornado losses. Note that these were the missions for which the Tornadoes were designed, and that all the losses were due to non-"smart" but very heavy traditional small-arms and other forms of anti-aircraft fire. British Air Vice Marshall Bill Wratten was later to claim that: "There was no justification for continuing with an offensive air campaign which demanded low-level penetration." (Carole A. Shifrin, "Britain's Gulf Role Highlights Value of Flexible Tactics, New Technology," *Aviation Week and Space Technology*, 22 April 1991, vol. 134, no. 16, 104-106. But that was not what people were saying at the time. Compare, for example, Jeffrey M. Lenorovitz, "Air National Guard Unit's F-16 Pilots Say Small Arms Fire is the Primary Threat." US A-10s and F-111s designed for close air support and low-level attack were also kept to medium altitudes. In "Flexibility of Attack Aircraft Crucial to Crushing Iraq's Military Machine," *Aviation Week and Space Technology*, 22 April 1991, vol. 134, no. 16, pp. 46-47, General John M. Loh, the new commander of the US Tactical Air Command is quoted as saying that any officer who had suggested a similar plan of operations before the war probably would have been fired.

20. This differs in considerable detail from the 'centralization' of the Iraqi defense forces that was criticized by US commanders. There is some irony in the quote from a Pentagon official that: "If the Soviets didn't like air-land battle and if they believed in centralized command and control, you can forget that now." (John D. Morrocco, "War Will Reshape Doctrine But Lessons Are Limited", *op. cit.*). The Soviet/Iraqi system involves horizontal centralization of command in which individual units have little discretion to act independently. The type of centralization embedded in the new US

doctrines is vertical; although US commanders have far more discretion to move and fight independently, they must request and draw their resources and support from a few centralized sources.

21. The M-1 Abrams tanks, buttoned up tightly against CBN (chemical, biological, nuclear) threats, rely on satellite downlinks to determine the location of other tanks in their own units. Vincent Kiernan, "Guidance From Above in the Gulf War," *Science*, 1 March 1991, vol. 251, pp. 1012-1014.

22. David S. Harvey, "Aviator Night-Vision Goggles Rack up Combat Successes," *Armed Forces Journal International*, February 1991, pp. 52- 54; David S. Harvey, "Night-Vision Fixes Came Quickly for Troops in Saudi," *Armed Forces Journal International*, February 1991, p. 20.

23. See, for example, David F. Bond, "Army Speeds Helicopter Enhancements in Response to Desert Storm Problems," *Aviation Week and Space Technology*, 1 April 1991, vol. 134, no. 13, pp. 24-25.

24. See Jim Tice "Rumble of Too Many Tanks Stilled in Europe by Poor Mechanic Skills," *Army Times*, 19 September 1988, p.6.

25. Chris C. Demchak, *War, Technological Complexity and the United States Army*, dissertation, (Berkeley: University of California, 1987), chapter 6.

26. Segal, "Rapid Deployment," *op. cit.*

27. See, for example: Tom Mathews, "The Secret History of the War," *Newsweek*, 18 March 1991, pp. 28-39.; Lenorovitz. "Small Arms Fire is the Primary Threat," *op. cit.*; Bond, "Army Speeds Helicopter Enhancements", *op. cit.*; Mecham, "US Bases in Germany Reconfigure Maintenance Shops", *op. cit.*; Schmitt, "Unforeseen Problems, *op.cit.*

28. Atkinson, "Knockout," *op.cit.*

29. Mathews, "Secret History," p. 28.

30. According to the US CBO (*An Analysis of the President's Budgetary Proposals for Fiscal Year 1992*) the Administration requested $21 billion to cover the costs of building and sustaining forces through March, $7 billion for in-theater costs as combat phased down, and another $12 billion dollars for withdrawal -- prior to the recent upheavals in Kurdistan. CBO ultimately estimated the total cost of Gulf operations as about $45 billion. These figures make the operations and maintenance costs about two-thirds of the costs of the entire conflict -- where they are normally one-third.

31. The accumulation of 60 days of supply was extraordinary. During WWII, logistics planners in the European theater considered 5 days ration supply "excellent" and, for maintenance, allocated no more than 6 days. See Roland G. Ruppenthal, *Logistical Support of the Armies: The European Theater of War, September 1944-May 1945*, United States Army in World War II series, Office of the Chief of Military History, vols I-II, (Washington DC: United States Army, 1959), p.531 (I); pp. 3, 434 (II).

32. Except for a few analysts. See, for example, Douglass, "Critical Questions," *op. cit.*

33. James C. Hyde, "Marines in Saudi Get M-1A1s Just as Desert Storm Begins to Blow," *Armed Forces Journal International*, February 1991, p. 28. These were lent to the Corps by the U.S. Army. The Corps, which originally held out against the M-1 as being too heavy for mobility, has now reconsidered, and will be getting its own M1A2 towards the end of 1991.

34. John Lehman interview, *op. cit.* Also see, for example, "A Textbook Victory", *Newsweek*, 11 March 1991, at p. 42, quoting Army Vice Chief of Staff Gordon Sullivan: "We have rethought everything since Vietnam."

35. Morrocco "Beware of Lessons," *op. cit.*

36. F-117A GBU bombs at $30,000 to $40,000 are hardly more cost effective than equivalent 'dumb' bombs at $2,000 each if the latter are even 10% on target. And this excludes the costs of the F-117A itself. A single Apache carries $900,000 in Hellfire missiles every mission (and most Apaches in the Gulf war came back empty). Similarly, a Tomahawk costs $ 1.3 million, so that a single salvo from, e.g., the USS *Wisconsin* might represent $ 50 million in flight. Although this may minimize enemy casualties under some conditions, it is expensive surgery.

37. Raymond Vernon reference. Not found yet.