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The Air War Lessons of Afghanistan: Change and Continuity

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Warfighting Lessons in an Era of Limited Wars, Limited Resources, and Limited Air Power

Drawing Lessons Without Hard Data

- **The Pentagon and British Ministry of Defense have provided limited statistics and details on the course of the war to date, and the Taliban and Al Qaeda have provided nothing but systematic misinformation.**
- **There is limited data on the numbers of forces involved, sorties flown, and weapons used. Most of the manpower estimates available for land battles count the total US and British forces in the area of engagement, rather than those actually engaged in fighting. Estimates of Al Qaeda, Taliban, and friendly Afghan forces – and their weapons strength – are little more than guess work.**
- **The data released so far on Afghan casualties, collateral damage, weapons accuracy, and battle damage assessment is vague or self-serving to the point of being worthless.**
- **Study teams, like the US Department of Defense's Defense Science Board and the 35-person Joint Task Force Enduring Look, are just beginning to make a systematic effort to gather the data needed to draw detailed lessons from this conflict.¹**
- **There are useful data on the number and type of aircraft flown and air munitions, and these data do have special meaning in this war. At least in its initial phases through the destruction of the Taliban regime, air power played a critical role in each battle, in making the advances of anti-Taliban Afghan factions possible, in destroying enemy infrastructure and facilities, and in allowing a relatively small number of special operations soldiers to successfully target Taliban and Al Qaeda forces in the field.**
- **Since that time, the near total level of US fixed-wing air supremacy over the battlefield, coupled to the use of US attack helicopters and heliborne air mobility, has made it almost impossible for significant Taliban and Al Qaeda forces to concentrate and survive.**

Conflicting Strategies that Lessons Must Be Applied To

- **Threat-based**
- **Capabilities-based**
- **Resource-constrained**
- **Power-projection**
- **National-priorities**
- **High-Low Force Mix Within and Between Nations**
- **Lead Technology**
- **Upgrade**
- **“Revolution in Military Affairs/Force Transformation**
- **Asymmetric Warfare**
- **Defense Industry**
- **Interoperability/Coalition Warfare**
- **Jointness**
- **Medium to Long Term Emergence of Peer Air Threats**

No Warfighting Lesson Matters without Effective Resource Management

- **Key lessons about war are pointless without effective planning, programming, and budgeting.**
 - **Money comes first in the post-Cold War world.**
 - **Capabilities-based planning, without urgent threats, tends to lose budget battles.**
- **Most Western Air Forces are Their Own Greatest Enemy:**
 - **They cannot estimate costs accurately or control them.**
 - **They lose key budget battles with unaffordable force plans.**
 - **They allow defense industry to compound the problem.**
 - **They go for leading edge systems they cannot afford.**
- **Unaffordability leads to steady force cuts, marginal force plans, and repeated major program cancellations.**
- **Lack of effective interoperability and jointness compound the resource problem. Even when air forces win on a nation-only and service-only basis, they tend to lose in the medium and long-term.**
- **Defense industry tends to be at least as much of an enemy as an ally: Not only compounds cost problem, but pushes grandiose or high cost projects, ties in national resource problems to ill-judged international projects and consortia.**
- **Vague talk about NATO and EU rapid reaction forces may do as much harm in terms of net force goals and resource flows as good.**

Consistent Evolution in Previous Wars

- **Value of Jointness**
- **Range-Payload**
- **Precision Strike**
- **Advances in ISR and C4I/BM**
- **“Closing the loop” in intelligence, targeting, sortie allocation, battle damage assessment, and sortie reallocation.**
- **Technology of Survivability vs. Counterair**
- **Night-All Weather Warfare Capability**

Consistent Problems in Previous Wars

- **Battle Damage Assessment.**
- **Strategic Doctrine and Targeting**
- **Characterizing Targets: Measuring the Effects of Air Strikes**
- **Deception, Decoys, and Camouflage**
- **Dispersal**
- **Hard Targets**
- **Civilian Casualties and Collateral Damage**
- **Targeting CBRN forces, facilities, and weapons**

Major Lessons Directly Related to Afghanistan

- **Too limited and unique a conflict for major lessons in many areas.**
- **Did get convincing proof of principle in some key areas:**
 - **GPS-guided precision weapons: Bombs and cruise missiles.**
 - **Value of many new ISR assets.**
 - **Proof of principle in Unmanned Combat Aerial Vehicles (UCAVs)**
 - **Tests of communications-data bandwidth.**
 - **Value of near real time air combat management, in flight retargeting.**
 - **Role of new communications, GPS, lasers in allowing Special Forces, rangers, etc. to redefine the role of “Forward Air Controller.”**
 - **Value of near real time cycles of intelligence and National Technical Means at field combat to national command authority level.**

Setting The Stage: A Unique War

The Unique Conditions of the Conflict

- **Very small enemy force with virtually no airpower or surface-to-air missile defenses.**
- **Enemy had virtually no electronic warfare and ISR assets, limited to wheeled ground mobility.**
- **Largely infantry target base with limited fixed facilities of military value.**
- **No strategic target base in normal sense of term: Leadership highly mobile, no military facility of great value.**
- **Significant internal allies to handle ground fighting.**
- **Small cadres of US ground forces managing targeting, liaison with friendly ground forces, and bribery could achieve decisive firepower advantage while outbidding Taliban and Al Qaida.**
- **Dispersal, low target density and visibility, low value of most individual targets key challenges.**
- **Sharp constraints on civilian casualties and collateral damage.**
- **Significant hard target problems with caves.**
- **Major power projection problems in terms of initial basing, range, and refueling.**
- **Serious endurance problems in most tactical situations.**
- **Monopoly of Intelligence and Strategic Reconnaissance (ISR) Assets aided by generally localized enemy operations, but major strain on area coverage.**
- **Chronic Identification of Friend or Foe (IFF) problems in terms of own forces, Afghan allies, civilians, and other allies.**
- **Battle Damage Assessment (BDA) made extremely difficult because of caves, uncertain value and character of most fixed facilities, large numbers of dead or abandoned vehicles, failure of BDA to cope with infantry losses and human casualties.**

The Limitations of the Afghan Conflict and Lessons for “Iraq”

- **Iraq is a far better organized, and stronger tyranny. It is also a power with modern internal security services and 2,200 tanks, nearly 400 aircraft, and heavy armored forces capable of serious war fighting.**
- **It retains an active air force and, more importantly, has rebuilt much of its land-based air defense net and has large numbers of surface-to-air missiles, radars, underground command centers, and redundant optical fiber command and control communications.**
- **It has at least some chemical and biological weapons, and probably some surviving Scuds and extended range Scuds.**
- **Afghanistan is not Iraq, and that the military lessons of Afghanistan may at best have only limited applicability.**
- **At the same time, the fighting in Afghanistan provides a warning about the dangers of putting too much emphasis on force strengths, military history, and the outcome of military analysis, and ignoring the fact that “intangibles” can suddenly and unexpectedly change the outcome of wars.**
- **The size of Taliban and Al Qaeda forces -- and the performance of Afghan forces in their struggle with the forces of the former Soviet Union -- proved to be a poor measure of actual Taliban and Al Qaeda war fighting capability and endurance.**
- **It was not possible to predict how long Serbian forces would hold out in Kosovo, or to tie estimates of battle damage either to confirmed kills or to Serbian political behavior.**
- **Similarly, the force ratios at the start of the Gulf War gave a greatly exaggerated picture of Iraqi military strength. So did Iraq’s performance in the final battles of the Iran-Iraq War.**
- **The US and British military experience in Afghanistan do show that factors like political and military leadership, morale, adaptability, and other intangibles could again lead to a far more rapid Iraqi collapse than force numbers would suggest.**
- **“Intangibles” can work in two directions. They can also favor opponents. For example, Iraqi nationalism, and hostility to the US because of the Gulf War and sanctions, could work to harden Iraqi resolve, and produce much stiffer resistance than during the defense of Kuwait. Events like the catalytic collapse of the Taliban and Al Qaeda were always *possible*, but were not *probable* or *certain*.**
 - **The Afghan fighting has shown that US air and missile power, intelligence assets, and targeting capabilities have become far more advanced than at the time of the Gulf War. They have not shown, however, that the US can *count* upon their shock effect to weaken Iraq in the same way as they did the Taliban and Al Qaeda forces.**

Professionalism and Readiness: The Lesson that Underpins All Others

Military Professionalism and Readiness

- **The US and British forces involved could not have been nearly as successful if they had not been highly professional forces with very high levels of training, readiness, and sustainability.**
- **They were able to rapidly project power half way around the world and sustain a broadly coordinated set of air-land operations against foes in a rugged, landlocked country with severe topographic and weather conditions. The area in which most US forces operated includes Afghanistan, some of its neighbors who cooperated with OEF by allowing the US basing and/or overflight rights, and a portion of the Indian Ocean, and is roughly six times the size of Texas.**
- **The ground forces involved could not have functioned as they did without highly specialized training and expertise in special operations, mountain warfare, and highly mobile combat. The intelligence officers engaged could not have been as successful if the cadres involved did not have the language and area skills necessary to sustain coalition warfare.**
- **The US Air Force, Marine Corps, and Navy air units that dominated the fighting had an amazing safety record. They demonstrated an ability to operate in spite of much longer missions than are normal -- US carrier missions averaged more than twice the length of normal peacetime training and past combat missions.**
- **Additionally, they demonstrated equal skill in executing parts of the support effort provided by refueling; intelligence, surveillance, and reconnaissance (ISR); and support aircraft. While some fixed-wing and helicopter crashes did occur, and some were the product of high pilot workloads and fatigue, the overall performance was excellent in spite of long missions, frequent refuelings, poor weather, and difficult mountain flying conditions.²**
- **In practice, the same result could probably not have been achieved with something approaching Gulf War levels of technology, but could not possibly have been achieved without the Gulf War's extremely high level of professionalism, tactical flexibility and innovation, and use of force elements with high sustainability and readiness.**

The Size of the Air War and Forces Engaged

US Airpower in Recent Regional Conflicts

	<u>Desert Storm</u>	<u>Serbia/ Kosovo</u>	<u>Afghanistan</u>
Area of Operations in Square Miles	176,000	39,500	250,000
Length of War in Days	43	78	?
Total Sorties During Period Reported	118,700	37,500-38,000	29,000-38,000*
Percentage of Total Sorties Flown by US*	85	60	92
Offensive Strike Sorties	41,300	10,808-14,006 ³	17,500
Sorties per Day	2,800	200, climbing to 2,000	25, climbing to 200
Total Bombs Delivered*	265,000	23,000	22,000
Precision-Guided Bombs Delivered*	20,450	8,050	12,500
Percentage of Total Munitions that are Precision-Guided	7-8%	35%	56%
Percentage of Precision-Guided Weapons Delivered by US	89	80	99
Combat Losses	38	2	0

* Data based on Michael O'Hanlon and an estimate of 38,000 total sorties flown

Note: Significant definitional problems exist in making such counts and historical sources differ. This count is based on the work of Thomas Keaney at Johns Hopkins University and on an article authored by Michael E. O'Hanlon entitled "A Flawed Masterpiece" (Foreign Affairs, Vol. 81, No. 3, March/April 2002, p. 52). O'Hanlon evidently reports on a longer period than Keaney does.

The Reemergence of the Bomber and the Limited Role of Cruise Missiles

The Reemergence of the Bomber? ⁴

- **Ten B-52s and eight B-1s were deployed at Diego Garcia - approximately 2,500 miles from Afghanistan.**
- **Air war commanders could rely on having approximately four B-1 sorties and five B-52 sorties each day.⁵**
- **Comparisons of fighters to bombers may not be “fair” in terms of airframe-to-airframe comparisons, but the issue is mission capability and not aircraft type.**
- **The fact remains that “antique” B-52s and B-1s based in Diego Garcia flew 10% of the strike missions, but delivered 11,500 of the 17,500 weapons dropped – 65% of all weapons dropped and 89% of all weapons dropped by the USAF.**
- **During the first three weeks of OEF, one-fifth of the combat sorties were flown by bomber aircraft, but bombers delivered over three-fourths of the ordnance (considered by weight).⁶**
- **Those figures can be attributed to the facts that as bombers they possess a large payload capacity and have the ability to loiter for long periods of time in the skies over and near combat zones and when fitted with highly accurate GPS-guided JDAM bombs, the B-1s and B-52s were able to efficiently provide close air support.**
- **Air Force Chief of Staff, General John Jumper, has described the effective use of bomber aircraft in this close air support role as being transformational.⁷**
- **Ten B-52s delivered most of the ordnance. The majority of the bombs delivered by B-52s, however, consisted of unguided bombs. The typical bomb load for the B-52 included twelve 2,000-pound JDAMs and 27 Mk 82 unguided bombs.⁸**
- **BUT, NEGLIGIBLE AIR DEFENSES, STRATEGIC BOMBING NOT NEEDED. AND “EFFECTS-BASED” CONCEPTS NOT TESTED.**

Cheap Cruise Missiles and Naval Strike Power

- **While no precise unclassified data are yet available, it seems clear that GPS-guided cruise missiles were far more reliable and accurate than the TERCOM-radar mapping versions used in the Gulf War,**
- **They were also much easier and more flexible to target, and had much less predictable flight paths.**
- **At the same time, the Afghan War again raises questions about the sheer cost of the cruise missile, and the best way to arm the kind of “arsenal ship” represented by the DDX.**
- **It is one of the ironies of the cruise missile that the Navy needs more and more long-range strike assets, but that only a relatively few targets merit strike systems that cost nearly \$1 million a round.**
- **The Navy seems to have a very high regional priority for cost-engineering some form of cruise missile that comes closer to the cost level of \$200,000, or less than \$1 million or more.**

Post Gulf War Shifts in Airpower: “Effects Based” Bombing

- **In Desert Storm, only one manned plane could penetrate downtown Baghdad in the first days — the F-117 stealth bomber with its limited arsenal of two laser-guided bombs. The B-2 can carry 16 2,000-pound bombs.**
- **In all, more than 80 percent of all air-to-ground munitions can be precision-guided, compared with 10 percent in Desert Storm. The ability to hit more targets, using fewer missions, is one reason the number of American troops being sent to the region is half the 550,000 deployed in 1991.**
- **"When you roll it all together, I say we're 10 times more powerful," said retired Air Force Lt. Gen. Thomas McInerney. "And [Saddam] is about 30 percent what he was before. So you can see how we can achieve rapid dominance using 'effects-based' operations."**
- **"Effects based" is an Air Force approach to bombing campaigns. Critical parts of the target are destroyed, not the entire complex or network. For example, planners target electrical nodes instead of the much larger generation plant to get the same effect — no military electrical power.**

BUT, Is Air Power Really Any Wiser in Executing Strategic/Interdiction Bombing

- **Doctrine has never tracked with reality and has created massive misuses of resources and collateral damage.**
- **WWII, Korea, and Vietnam saw many unvalidated claims.**
- **Desert Storm, Desert Fox, and Kosovo did nothing to establish the credibility of air planners or strategic bombing doctrine, and strategic/interdiction bombing was not notably effective in Afghanistan..**
- **Target characterization, intelligence, and battle damage assessment still present major problems at every level.**
- **Do we understand what we want to “effect” and how to do it?**
 - **Leadership targets?**
 - **Industrial Base?**
 - **Infrastructure and Electric Power?**
 - **POL: Petroleum, Oil, and Lubricants?**
 - **Lines of Communication?**
 - **Information Warfare?**
 - **Command, Control, and Communications?**
 - **Air Base Attack?**
 - **SEADs: Suppression of Enemy Air Defenses?**
- **Do Terms like strategic bombing and interdiction even make sense in non-existential air wars?**

Key Air Munitions and the Role of Precision⁹

The Role of Precision¹⁰

- **Roughly 57% of the weapons dropped during the key period of October 7 to December 23, 2001 were smart weapons.**
- **Roughly 18,000 weapons were dropped by early February. Of that number, roughly 10,000 were precision weapons, or 56% of the total. This compares with 35% of the 24,000 weapons dropped during the Kosovo campaign in 1999.¹¹**
- **This compares with 35% of the 24,000 weapons dropped during the Kosovo campaign in 1999.¹²**
- **As of June 2002, the percentage of precision-guided weapons used increased to roughly 60% of total munitions, and military officials estimated their accuracy to be roughly 90%.¹³**
- **As of June 2002, the percentage of precision-guided weapons used increased to roughly 60%, and military officials estimated their accuracy to be roughly 90%.**
- **As of May 2002, the Navy claimed that out of all sorties flown, combat aircraft had successfully hit at least one target 84% of the time.**
- **Additionally, the Navy estimated that roughly 90% of the munitions it has dropped were advanced or precision weapons.¹⁴**
- **It is also worth noting that the ability to correct the dispersal of unguided submunitions for wind and greatly improved navigation and targeting capabilities also made the delivery of unguided weapons far more precise than it had been in the past.**
- **According to General Tommy Franks, the US had flown an average of 200 sorties per day in Afghanistan by early February 2002, which is significantly less than the sortie rate in Operation Desert Storm of 3,000 per day. In Afghanistan, the US was, however, able to hit roughly the same number of targets per day as in Desert Storm.¹⁵**
- **General Franks stated the US needed an average of ten aircraft to take out a target in Desert Storm, but a single aircraft could often take out two targets during the fighting in Afghanistan.**
- **Unofficial estimates claimed that Navy aircraft experienced a 70-80% success rate in hitting designated targets.¹⁶**
- **There also was much greater surge capability to use precision weapons against a major array of targets. In one case, the US dropped roughly 100 JDAMs in a twenty-minute period.¹⁷**

- **These estimates almost certainly exaggerated US performance. Both the Assistant Secretary of Defense for Public Affairs and the preliminary findings of the Department of Defense's Task Force Enduring Look – the US military team examining the lessons of the war -- have cautioned that this is the case.¹⁸**

The JDAM: Cutting the Cost of Precision Strikes

- **The JDAM – a guidance kit for conventional 1,000- and 2,000-pound bombs –regularly achieved accuracies of six to ten meters, and came to dominate the delivery of guided weapons.**
- **The \$14,000 JDAM was used at a peak rate of roughly 3,000 per month. It achieved combat CEPS of six to ten meters, and had a standoff range of up to fifteen miles.**
- **This sharply lowered the cost of precision-guided and standoff missions.**
- **It indicates that the US can develop a future “high-low” munitions mix that emphasizes high and low cost precision-guided weapons, rather than high cost precision weapons and cheap dumb bombs.¹⁹**
- **The JDAM solves the “all-weather” problem within limits.**
- **It allows bombers like the B-2 to strike multiple targets.**
- **It simplifies the “package” needed for secure penetration, reduces time over target relative to laser illumination, and eases in-flight retargeting problems.**
- **Cost to defeat a target with precision becomes highly affordable vs. missiles and even EO-guided bombs.**
- **Effectiveness, however, is heavily dependent on the quality of ISR links at every level from satellite to ground.**
- **The challenge of a more effective air defense environment, particularly SA-300 to SA-400 remains.**
- **The GPS system is a potential vulnerability.**

UAVs, Gunships, and Other Key Air Systems

The Shifting Role of UAVS

- **Key Systems are CIA/USAF Predator and Global Hawk, and US Army Shadow.**
- **Remote-controlled drones can loiter aloft for long periods of time, sending back video images. Commanders can use the "real-time" intelligence to direct air strikes or reposition ground forces.**
- **"We did not have that kind of 'real-time' reconnaissance capability in the Gulf war," Col. Warden said. "If we had a handful of Predators in the Gulf war, we probably would have found and killed Saddam Hussein. He was always moving enough that we stayed one step behind."**
- **Col. Warden based his assessment on the fact that in the early hours of the war in Afghanistan, an armed Predator saw Taliban leader Mullah Mohammed Omar escaping Kandahar. Permission to fire the Predator's Hellfire missile was delayed at U.S. Central Command. The reclusive Mullah Omar escaped.**
- **Since then, the Predator's missiles, triggered and guided by CIA operators at Central Command in Tampa, Fla., have killed Taliban and al Qaeda members in Afghanistan and Yemen.**
- **The Predator's performance is one reason top Army officials are so optimistic about the Shadow 200 RQ-7A. The 300-pound spy plane is slated to be assigned to the Army's Stryker Brigade Combat Teams — the mobile ground units of the future — and the 4th Infantry Division at Fort Hood, Texas.**
- **The Army's Mr. Bolton said the future is now for the Shadow if there is a war against Iraq. "They are your eyes and ears," he said. "They can loiter for a long time."**

The Role of Predator UCAVs

- **The Predator can be modified to enable it to carry two Hellfire missiles and has a laser designator to illuminate targets. Predator has been the first real UCAV to enter US service.²⁰**
- **Those Predator UCAVs have deployed ordinance against targets in Afghanistan on at least four occasions, including the strike in which Muhammed Atef was killed, and was also used by the CIA in Yemen in an attack which killed Qaed Salim Sinan al-Harethi (Abu Ali), Al Qaeda's top operative there.²¹**
- **The Predator's operational limits have also led to plans to equip it with much more lethal weapons that have stand-off range (like LOCAAS) and give it a self-protection capability with Stinger missiles.**
- **A Stinger-equipped Predator was shot down by the Iraqis on December 23, 2001 while attempting a Stinger firing.**
- **The US is developing a Predator B to replace the existing Predator RQ-1.**
- **The B would increase range well over the present 740 kilometers; increase speed from 138 to 253 miles per hour; increase payload from 450 to 750 pounds; increase maximum altitude from 25,000 to 45,000 feet; and increase wingspan from 48.7 to 64 feet and length from 27 to 34 feet.²² The US is also seeking to develop an export version for NATO allies.²³**

Transformation and UAV/UCAVs

- **Spend \$1 billion on the procurement and research of unmanned aerial vehicles.**
- **DoD wants to spend \$154.1 million to buy and arm 22 Air Force Predator UAVs in the 2003 fiscal year.**
- **The Air Force has also allocated \$170.8 million for three Global Hawk UAVs. There is another \$100.7 million set aside to buy twelve Army Shadow UAVs.**
- **Purchase 70 more Global Hawks and associated equipment for the USAF (at a price of \$1.55 billion) and 28 for the USN, which will deploy it in seven systems, each with four aircraft and support elements.²⁴**
- **Accelerate funding of Global Hawk research and the Navy's Fire Scout UAV.**
- **The request also accelerates research in unmanned combat aerial vehicles. "These UCAVs are not just UAVs with weapons added...They are combat airplanes built from the ground up, just without pilots."**
- **The request also increased funding for unmanned underwater vehicles as well as the DARPA future UCAV program, with a deployment goal for the latter of 2015.**

AC-130 Gunship

- **Although the AC-130H Specter and AC-130U Spooky gunships present during the fighting did not deliver high numbers of bombs and missiles, they were able to provide extensive combat support with 105mm guns and 40mm cannon.**
- **They have an unrefueled range of some 2,200 miles and, while they are vulnerable to air defenses, they have extensive countermeasures, infrared and radar warning, and flare and chaff dispensing systems (a key reason that the gunship costs as much as \$190 million versus \$30 million for a C-130H II).**
- **The USAF found the aircraft's performance to be so effective that it is seeking to upgrade its existing aircraft and convert four more C-130Hs by 2005.**
- **The USAF currently has eight AC-130Hs and thirteen AC-130Us, and plans to improve their air defense, fire control, cameras and sensors, and add ammunition racks.**
- **It will acquire all-weather combat capability and ISR links to allow it to be fully integrated into the US net of other combat platforms and intelligence assets.²⁵**
- **The challenge of a more effective air defense environment, particularly SA-300 to SA-400, remains.**
- **Next generation or modified EO light surface-to-air weapons will be a problem.**
- **Targeting and BDA remain serious issues for urban warfare, and entrenched/sheltered forces,**

Weapons and Technology: Other Advances

- Accelerate the development of sea-based wide area missile defenses, and the selection of a suitable replacement to the E-6B electronic warfare aircraft as part of a joint airborne electronics attack program.
- Develop and/or buy small diameter bombs, cockpit selectable fusing options, cockpit selectable “yield” for conventional weapons, and putting dual mode seekers (e.g. GPS and laser).
- Reexamine the value of weapons like the BLU-82 15,000-pound GSX-jellied slurry bomb in terms of hard target kill and psychological impact, and/or re-weaponize fuel-air explosive weapons like the BLU-72.
- Replenish stocks of the GPS-guided Joint Direct Attack Munition (JDAM) – the \$18,000 kit used to convert regular bombs into smart weapons. Approximately 4,6000 JDAMs were used out of a total inventory of 10,000 by December 2001. This is roughly 38% of the 12,000 weapons used as of that date.²⁶
- Enhance use of the wind corrected munitions system (WMCD) which was used in the Afghan War to dispense combined effects munitions like the CBU-130 (a weapon with some 202 BLU-97/B cluster bombs) more accurately.
- Complete development of the sensor fused submunition (SFW), with a smart IR-homing capability for anti-armor and vehicle use, and develop improved submunitions with a fail safe option to prevent them from remaining live for extended periods.²⁷
- Begin development of an advanced, next-generation manned or unmanned bomber, capable of surviving extremely advanced developmental surface-to-air defenses like the Russian S-400 Triumf (SA-20).
- Modify existing CH-47D Chinook helicopters, adding refueling probes, additional weapons, and radar sensors, allowing them be used by SOF.²⁸
- Streamline Navy helicopter fleet from six to two types of helicopters, increasing efficiency and decreasing maintenance costs.²⁹

Finding Adequate Electronic Warfare Assets

- **The continued delays in replacing the EA-6B, and what may be serious engine life problems, also illustrate the need to rethink carrier strike operations in terms of the ability to deliver Afghan-like persistence over target with suitable electronic warfare protection.**
- **The problems with a limited force of EA-6Bs also raise general questions about the combined capability of the US Navy, USAF, and US Marine Corps to deploy enough electronic warfare assets.**
- **This already was a problem in Kosovo, and it is far from clear that current programs will succeed to the point where they ensure future survivability in an air environment where nations like Iraq have dense surface-to-air missile assets in some areas, and other threats like Iran may acquire systems like the SA-400.**
- **The kind of permissive environment that allowed aircraft, like the AC-130, near freedom of operations over Afghanistan, may not exist in future contingencies in the Middle East.**

The New Challenges of Asymmetric Warfare: Dispersed Warfare and Weapons of Mass Destruction

US Strategy Regarding Terrorism, Asymmetric Warfare, Force Transformation, and the Role of NATO

- **The attacks of September 11 were also an attack on NATO, as NATO itself recognized when it invoked its Article V self-defense clause for the first time. NATO's core mission—collective defense of the transatlantic alliance of democracies —remains, but NATO must develop new structures and capabilities to carry out that mission under new circumstances. NATO must build a capability to field, at short notice, highly mobile, specially trained forces whenever they are needed to respond to a threat against any member of the alliance.**
- **The alliance must be able to act wherever our interests are threatened, creating coalitions under NATO's own mandate, as well as contributing to mission-based coalitions. To achieve this, we must:**
 - **expand NATO's membership to those democratic nations willing and able to share the burden of defending and advancing our common interests;**
 - **ensure that the military forces of NATO nations have appropriate combat contributions to make in coalition warfare;**
 - **develop planning processes to enable those contributions to become effective multinational fighting forces;**
 - **take advantage of the technological opportunities and economies of scale in our defense spending to transform NATO military forces so that they dominate potential aggressors and diminish our vulnerabilities;**
 - **streamline and increase the flexibility of command structures to meet new operational demands and the associated requirements of training, integrating, and experimenting with new force configurations; and**
 - **maintain the ability to work and fight together as allies even as we take the necessary steps to transform and modernize our forces.**
- **If NATO succeeds in enacting these changes, the rewards will be a partnership as central to the security and interests of its member states as was the case during the Cold War. We will sustain a common perspective on the threats to our societies and improve our ability to take common action in defense of our nations and their interests. At the same time, we welcome our European allies' efforts to forge a greater foreign policy and defense identity with the EU, and commit ourselves to close consultations to ensure that these developments work with NATO. We cannot afford to lose this opportunity to better prepare the family of transatlantic democracies for the challenges to come.**

The Problem of Distributed Warfare: What Does the Enemy Learn from Partial Defeat?

- It has been clear ever since the battle of Tora Bora in December 2001 that even major military successes in Afghanistan may not bring victory in any traditional sense of the term.
- Tora Bora was the first major demonstration after the fall of Kabul that an enemy can disperse in ways that US intelligence and ISR systems cannot detect, characterize, and target.³⁰
- Nothing that US and allied forces did in Operation Anaconda, or in independent search and destroy missions, has shown that the US and its Western allies have a solution to the problems associated with combating an enemy whose forces are dispersed, fluid, and not seeking a conventional fight.
- Al Qaeda has shown that in spite of the best efforts of US, British, and Australian special operations forces, it can disperse seemingly without a trace, utilize caves and other hiding places to keep arms and ammunition hidden in spite of massive search efforts, move into neighboring countries, and disperse into countries outside the immediate area of combat operations.³¹
- In particular, enemy forces have been conducting cross-border guerilla warfare from tribal areas of Pakistan that are near the Afghan border and over which the Pakistani national government is able to exert only limited control. US forces are not permitted to cross into Pakistan to hunt down those guerilla fighters.
- The US and its allies have had limited success in killing or capturing the top leadership of Al Qaeda and the Taliban, though they have made it very difficult for those individuals to exercise leadership of their respective groups.
- Moreover, Afghanistan is only one country and its neighbors are only one place that Al Qaeda can operate in and disperse to.
- US military planners and counterterrorism experts speculate that one key lesson for future terrorist and asymmetric opponents will be to create far looser and more broadly distributed networks and groups of cells that have a high degree of individual independence and survivability, and which do not have a rigid hierarchy, and headquarters and physical facilities that can be located and attacked.
- US military planners also argue that some key lessons from the conflict in Afghanistan for such enemies will be the realization that they need more anonymity, more emphasis on establishing cover organizations and proxies, and to create a campaign plan of sequential or multiple attacks from isolated cells and elements so that no US victory in any one area can halt the overall campaign.

- **The classic case of Lenin's brother is a warning of what may come. The Czarist secret police found and killed Lenin's brother and destroyed the organization of which he was a part. In practice, however, they may have done a great deal in the process to shape Lenin's attitudes and behavior, causing him to become a far more serious threat.³²**

The Chinese Case and More Sophisticated Approaches

- **It is also worth noting in this regard that a sophisticated military power like China fully recognizes the advantages of many aspects of the US approach to warfare, and is aggressively modernizing many aspects of its forces.**
- **At the same time, China has developed plans and doctrine to counter US technological advantages and the “revolution in military affairs.”**
- **China has paid close attention to Serbian tactics, as well as those of Iraq in dealing with US air and cruise missile strikes since the Gulf War. It feels that high technology sensors, weapons, and nets can be countered through counter-reconnaissance measures such as camouflage and concealment, decoy, dispersion, and frequent force movements.**
- **It too has emphasized the use of underground facilities, landline communications, and concealed supply depots. It has developed an air defense training team called “Three Attacks, Three Defenses,” that concentrates on attacking stealth aircraft, cruise missiles, and helicopters while defending against precision strike, electronic warfare, and enemy reconnaissance.**
- **It also emphasizes speed, asymmetric methods, and preemption or surprise attack as ways of trying to bypass superior conventional forces.³³**
- **Ultimately, the Afghan war may give rise to a new cliché about asymmetric warfare: Short of a political and grand strategic end to a conflict, any given defeat of a terrorist or asymmetric opponent simply forces the opponent to adapt.**

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President George W. Bush, The National Strategy of the United States, September 17, 2002

The Worst Case Asymmetric War: CBRN Weapons

Counter-proliferation and Preemption

- **The discovery of a large-scale Al Qaeda effort to develop CBRN weapons – as well as ongoing proliferation in nations like Iran, Iraq, and North Korea – illustrates the steadily growing importance of offensive counter-proliferation capabilities, and preemption or immediate, time-urgent attack the moment combat begins.**
- **Preemption and large-scale initial destruction is not something that can be advocating carelessly, or lead to the use of weapons without concern for political sensitivities, civilian casualties, or collateral damage.**
- **Proliferation and CBRN threats do, however, fundamentally change the risks and values of war. Proliferators give their enemies the right to preemption and first strikes simply by proliferating, and the axiom that the only way to go to war with the US is with the possession of nuclear weapons is one the US must aggressively counter, regardless of whether a nation or terrorist movement is involved.**
- **Waiting for enemy assets to be dispersed can also create an impossible tactical burden. It is worth noting in this regard, that the US flew some 2,400 sorties searching for and trying to strike at dispersed Iraqi Scud missiles during the Gulf War,**
- **On some 42 occasions, US aircraft spotted a launch plume and made eight actual attacks. Nevertheless, neither Coalition airpower nor special operations forces damaged a single Scud, and Iraq was able to fire some 88 Scuds against Israel and Saudi Arabia.³⁴**
- **The threat of biological warfare is particularly serious, and the US and its allies needs to rethink internal security planning, public health response, and defense efforts to deal with the broad range of CBRN threats.**
- **The treatment of hoof and mouth disease and “mad cow” disease is almost a model of how not to deal with such cooperation, and a warning of how much more effort is needed to deal with both time urgent tactical and the broad spectrum of global threats.**
- **That said, it is one thing to have a doctrine and plans, and quite another to have a capability. Any form of attack on CBRN and their delivery system assets must involve meaningful targeting capability, the proper weapons and destructive means, and careful consideration of civilian and could not carry out a successful attack on Iraq’s CBRN assets at either the time of the Gulf War or Desert Fox. It had no idea of what to target at the beginning of the Afghan conflict.**
- **Moreover, the very prospect of such attacks pushes other countries to create launch-on-warning (LOW) and launch-under-attack (LUA) capabilities in a “use or lose” environment as well as organize and preposition assets for terrorist and unconventional attacks.**

CBRN Weapons: Response and Counter Response

- **At least one Indian general drew the lesson from the Gulf War that, “No one should go to war with the US without nuclear weapons.”**
- **Al Qaeda had a major effort underway to examine chemical and biological weapons, and was examining nuclear terrorism in terms of attacks on power plants, radiological weapons, and crude nuclear devices.**
- **Many nations are likely to note the willingness of the US to fight Iraq before it has nuclear weapons and its restraint in dealing with North Korea**
- **Preemption is a two-edged sword and encourages a race to preempt, arming proxies, launch on warning, and launch under attack/.**
- **It is possible that terrorists will draw the lesson that if they can only launch one major series of attacks, they should not do so without CBRN weapons.**
- **States, on the other hand, may learn both lessons. They may see the value of giving proxies aid in developing CBRN weapons, and they may see acquiring CBRN weapons as a key deterrent to US action in asymmetric wars.**
- **They may also make the judgment that having the ability to launch on warning or launch under attack against the US and/or US interests will either deter the US or force it to limit its range of attacks and goals in war.³⁵**
- **The US still has not resolved the source of the anthrax attacks that followed the attacks on the World Trade Center and the Pentagon. This raises the prospect that states or other terrorists may piggyback on a conflict in unpredictable ways and that future opponents may see a counterterrorism campaign or asymmetric war as a window of opportunity in terms of US vulnerability and confusion rather than as a deterrent.**
- **This raises major new questions about the future of arms control and the value of existing arms control agreements.**
- **It also raises questions about the ability of states and terrorist groups to conduct anonymous attacks with highly lethal or costly CBRN weapons, particularly those of the biological variety. This not only raises the specter that one lesson of Afghanistan is that future opponents should use smallpox (or its equivalent),**
- **It also raises the specter of how the US would deal with anonymous attacks on its economy equivalent to the hoof-and-mouth outbreak in Britain or the swine fever outbreak in Taiwan.**

CBRN Weapons: The Problem of Targeting and Agent Destruction

- **You cannot deter or attack an attacker you cannot identify or locate, or deter an attacker willing to commit suicide.**
- **Improve intelligence and targeting is only a partial answer, but an important one.**
- **For well over a decade, the US has been developing sensors and targeting aids designed to “look” inside buildings and suspect facilities. It is unclear that any such UAVs or unattended sensors are operational or that they are effective.**
- **UAVs can cover traffic going into and out of fixed and hardened facilities, but not activities inside them. CBRN weapons and activities can be dispersed into relatively small facilities, as can many delivery systems and munitions.**
- **In many cases, it is impossible to distinguish CBRN weapons and facilities from ordinary weapons and military facilities, and it is equally difficult to distinguish military/CBRN facilities from civilian facilities.**
- **The physical destruction of CBRN weapons and facilities is problematic. Even when CBRN weapons and/or related facilities are located and thus can be targeted, there is the risk that an attack on them will result in unintentional dissemination of CBRN agents.**
- **Thus, the top priority in attacking such targets would be to limit the risk of such dissemination rather than to limit collateral damage in the immediate area.**
- **The US is attempting to develop munitions that would produce burning effects intense enough to significantly mitigate against that problem. The US is also attempting to develop a less destructive means of containing CBRN materials in the form of sealing foams that would create hardened cases around their targets.**
- **At present, however, the possibility that unintentional dissemination of CBRN materials would occur in an attack remains a problem, and had Al**

Qaeda been known to possess those materials the air war in Afghanistan would have been seriously complicated.

The Conditions Under Which the US Will Preempt

- **The United States has long maintained the option of preemptive actions to counter a sufficient threat to our national security. The greater the threat, the greater is the risk of inaction— and the more compelling the case for taking anticipatory action to defend ourselves, even if uncertainty remains as to the time and place of the enemy’s attack. To forestall or prevent such hostile acts by our adversaries, the United States will, if necessary, act preemptively.**
- **The United States will not use force in all cases to preempt emerging threats, nor should nations use preemption as a pretext for aggression. Yet in an age where the enemies of civilization openly and actively seek the world’s most destructive technologies, the United States cannot remain idle while dangers gather. We will always proceed deliberately, weighing the consequences of our actions. To support preemptive options, we will:**
 - **build better, more integrated intelligence capabilities to provide timely, accurate information on threats, wherever they may emerge;**
 - **coordinate closely with allies to form a common assessment of the most dangerous threats; and**
 - **continue to transform our military forces to ensure our ability to conduct rapid and precise operations to achieve decisive results.**
- **The purpose of our actions will always be to eliminate a specific threat to the United States or our allies and friends. The reasons for our actions will be clear, the force measured, and the cause just.**

President George W. Bush, The National Strategy of the United States, September 17, 2002

Collateral Damage and Civilian Casualties: The New “Rules of War”

Civilian Cover, Human Shields, and Human Rights as Weapons of War

- **Use of civilian cover and manipulation of casualties and collateral damage statistics is another lesson of the war.**
- **The Gulf War, the fight against Iraq since that time, Kosovo, and the Afghan War all saw efforts to use civilians and civilian facilities as shields against US and allied attacks. Distributed terrorist networks and state-sponsored asymmetric forces can be expected to make steadily more use of civilians as shields and civilian areas as hiding places.**
- **Extremist groups like Hezbollah and Hamas have long gone further, as have Kurdish terrorist organizations in Turkey. They deliberately blur the line between terrorist and combat elements; religious, educational, humanitarian, and medical elements and functions; and “peaceful” political elements and action.**
- **Both terrorist organizations (like Al Qaeda) and states (like Iraq) have found that well-organized political and media campaigns can blur the lines of responsibility for terrorist and military acts, enabling them to use collateral damage and human suffering as political weapons of war.**
- **Wrapping movements in the cloak of democratic values, exaggerating civilian casualties and suffering, and exploiting human rights and international law are becoming a steadily more sophisticated part of modern terrorism and asymmetric warfare.**
- **So, for that matter, are religion and ethnicity and the ability to exploit the causes and suffering of others.**
- **Al Qaeda and Saddam Hussein have systematically exploited Islam, their identity as Arabs, and the Second Intifada. Milosevic and his elite did something very similar in Bosnia and Kosovo, exploiting Christianity and their Slavic identity with Russia.**
- **The Taliban exploited the Afghan situation by producing grossly exaggerated claims of civilian casualties. While an independent estimate by the Associated Press put the figure at roughly 500-600, the Taliban Ambassador quoted 1,500, Al Jazeera gave estimates as high as 6,000, and one economist at the University of New Hampshire produced estimates of 5,000, and then 3,100-3,800. In some cases, the Taliban is known to have reported civilian casualties when there were no such casualties at all.³⁶**

Collateral Damage: Designing Weapons to Minimize Civilian Casualties and Collateral Damage

- Properly designed weapons, targeting, and ISR systems can now greatly reduce the problem of collateral damage and civilian casualties.
- The US and its allies do, however, have to demonstrate that they have made a good faith effort to minimize collateral damage and civilian casualties. Ever since Vietnam, the history of war has shown that each improvement in military capability is matched by demands for higher standards of performance.
- This already is leading to steady improvements in weapons and targeting accuracy, the use of sensors to prevent attacks with high civilian losses and collateral damage, and new screening methods for target selection and strike authorization.
- The US and British efforts to develop smaller precision-guided weapons, like 250-pound versions of the joint direct attack munition (JDAM), is one example.
- The use of precision-guided, small-diameter bombs (SDBs) offers a way to strike against roughly 70% of the targets that might normally be hit with a 1,000 or 2,000-pound weapon. It offers a way to carry far more munitions per sortie, reduce the number of sorties required, achieve far more lethality per sortie, and still sharply reduce collateral damage. It can also achieve ranges of 60-70 miles when launched at high altitudes.³⁷
- Miniature cruise missiles with multipurpose warheads, like the Low Cost Autonomous Attack System (LOCAAS), are under development for the same reason, as well as to improve the strike capabilities of weapons like the Predator and future UCAVs. So are so-called “spiral” SDB weapons that would have autonomous or optical sensors and could search a wide area until they were homed in on a specific target.³⁸
- Those advances are supported by virtually every advance in ISR capability. That is equally true of the series of major improvements in target selection and review made throughout the air and missile targeting process after the strike on the Chinese Embassy in Belgrade during the air campaign in Kosovo.
- Advances in accuracy offer the military the best of both worlds: more lethality coupled with less collateral damage, and they can apply to the delivery of unguided or “dumb” weapons as well.
- UAVs and other sensors can greatly reduce the need to use artillery to fire into wide areas rather than at specific targets.
- The B-52s that dropped dumb bombs during the Afghan conflict made use of both far better navigation and targeting capabilities than ever before, but also made the first use of the Wind Corrected Munitions Dispenser in combat to deliver weapons like the

CBU-87 Combined Effects Munition (CEM). This is a strap on, \$10,000 tail kit that allows delivery with greater accuracy from higher altitudes and can also be used with weapons like Gator mine and the new Sensor Fused Weapon (SFW). It scarcely eliminates the problems of using unguided area weapons, but it does reduce them.³⁹

Doing More to Minimize Civilian Casualties

- **British experiments with weapons designs that deactivate the warhead when systems malfunction or lose their targeting lock are a case in point.**
- **Another is the need to come to grips with long-standing problems in cluster munitions and dumb bombs that effectively turn them into mines when they do not explode.**
 - **The use of improved release systems, navigation and targeting aids, and wind correction can help up to a point, but the US dropped some 1,150 cluster bombs on 188 locations in Afghanistan as of early February.⁴⁰ They had many of the same defects as the weapons dropped in Vietnam and the Gulf War, and often produced duds that could be lethal if handled or contacted. This is not a problem that should take three decades to solve.⁴¹**
 - **The Afghan conflict was the first time that the new CBU-103 cluster bomb was used. It is equipped with “course-correcting tail fins” that enable it to compensate for the significant drift that can occur when a bomb is dropped at an altitude of more than 15,000 feet.**
 - **A new cluster bomb, which has a smaller quantity but more powerful bomblets, is being developed.**
 - **In an attempt to improve its accuracy, weapons designers have incorporated a heat-seeking device into the new design, which will allow the bomb to more closely track and hit enemy positions.⁴²**
 - **Pentagon officials estimate that roughly 5% of cluster bombs do not detonate upon impact. The decision to package airdropped food in the same color as cluster bombs further increased the risk that civilian deaths would result from unexploded cluster bombs.⁴³**
- **More generally, the US needs to examine ways in which it can design its ISR sensors and systems, and intelligence and targeting systems, to minimize collateral damage and civilian casualties and to provide some form of near-real time warning and/or imagery to allow rapid confirmation of whether mistakes have occurred.**
- **This does not mean paralyzing operations; it does mean changing design criteria and methods to allow operations to be sustained with both minimal cost to the innocent and minimal political backlash. “Effects-based” air strikes emphasize achieving the tactical or strategic objective versus destructiveness.**
- **One longer-run issue that needs to be addressed is the need for some mix of methodology and technology that can produce meaningful body counts – at least over time. t.**

The Media Part of the Air Battle

- **Regardless of what Western countries do to reduce civilian casualties and collateral damage, they must still fight a media battle in near-real time.**
- **There will be few cases in which enemies cannot exploit civilian casualties and collateral damage with some human rights and anti-war groups. Western air power will always be judged by a dual standard in such cases.**
- **The same will be true of problems with the developing world and often in terms of a clash between ethnic groups (Russia and the Slavs in Serbia), religion (Muslims and the Taliban), or cultural affinity (Iraq and the Arab world).**
- **The use of human shields, deploying forces and equipment in populated areas, critical civilian facilities as shelters, decoys, deception and propaganda will grow steadily more sophisticated with time.**
- **So far, the US and NATO have been slow to react, overcautious, and legalistic – often ceding the field or losing the battle until after-action reporting restores perspective and corrects estimates.**
- **There is little understanding that short, highly intensive air campaigns may actually end wars with far fewer cumulative casualties.**
- **Ironically, the propaganda war tends to treat each day of combat as the same: The same attacks are made regardless of how intense the conflict is.**
- **MODERN WESTERN MILITARY FORCES MUST UNDERSTAND THAT THEY WILL BE IN A MEDIA BATTLE FROM DAY ONE AND JUDGED BY A DUAL STANDARD.**

Deep Shelters and Hard Target Kill

Hard Target Kill Capability

- **Afghanistan had only a few classic shelters and hard target left over from the days of the Soviet occupation and none had serious military meaning.**
- **It did, however, have many caves and a number were improved by Al Qaeda to become highly survivable and well concealed targets.**
- **The US used a wide range of ISR systems to try to find and characterize such caves and shelters and did find many. It could virtually never, however, fully characterize the nature of the target any more than it could “look inside” ordinary buildings and surface facilities. Many were found only by ground troops who could penetrate into caves, and many may have never been discovered or assigned the right priority.⁴⁴**
- **It is unclear that most of these strikes produced any meaningful battle damage either for targeting reasons or because the effects were not serious enough.**
- **In at least some cases, the US seems to have fired such weapons against caves to inhibit their use and struck at their cave entrances more to intimidate those inside than to try to actually damage or kill the target.**
- **It is unclear whether any such attacks have had any real success in terms of major damage. It is clear that caves with rock overhangs or other shielding terrain features at their entrances were difficult for the US to target and attack.**
- **In short, the US may be developing effective intelligence, targeting, and kill capabilities. It did little more in Afghanistan, however, than bang away at hardened targets with unknown psychological and deterrent effects.**

Hard Target Kill versus Dispersal, Civilian Cover, and Deception

- **Hard target sheltering is the most expensive challenge to precision air power, and creates a fixed, high cost asset that tends to offer high value to air attackers.**
- **Semi-hardening and dispersal will often be more cost effective.**
- **Developing countries are building more and more “semi-hard” shelters as part of urban development.**
- **Closing the roof, using civilian buildings, going deep in underground parking garages off additional ways of defeating air power.**
- **The use of human shields, deploying forces and equipment in populated areas, critical civilian facilities as shelters, decoys, deception and propaganda will grow steadily more sophisticated with time.**
- **Miniaturization, dispersal, cell-like structure, mobile C4I/BM/ISR assets all offer additional tools to the defender. Iraq’s mobile BW laboratories are a case in point.**
- **Even when physical damage is possible, target characterization, BDA, and “effects-based” analysis may be difficult or impossible.**
- **Microwave weapons, unattended sensors, interdiction or destruction of associated systems, special forces raids, inspection, and penetrators are in a duel with hardening.**
- **HARDENING IS ONE PART OF AN INTERACTIVE DEVELOPMENT OF NEW FORMS OF PASSIVE DEFENSE THAT CAN LIMIT THE VALUE OF PRECISION AND IMPROVED ISR CAPABILITY.**

Power Projection

Power Projection and Force Transformation

- The Afghan War has again demonstrated the need to be able to rapidly project land and air power at very long distances. It demonstrated the value of strategic airlift and long-range strike capability, and the ability to operate with limited forward basing. At the same time, it has confirmed the value of light and special operations forces in counterterrorism efforts and some forms of asymmetric warfare.
- Additionally, the conflict in Afghanistan has demonstrated that major regional contingencies/wars in which the US must fight against heavy armor and heavily defended airspace are only one type of possible scenario in a changing spectrum of potential conflicts.
- An Air Force study anticipates an increase in the need for strategic airlift capabilities and call for the purchase of 60 new C-17 cargo planes. The USAF estimates that of 5,500 missions in Afghanistan, the C-17 was involved in 2,872. Additionally, it claims that C-17s have transported roughly 44,000 personnel, 100,000 tons of cargo, 636 medical patients, and 565 Al Qaeda and Taliban detainees.⁴⁵
- During the fighting in Afghanistan, the US has relied heavily on strategic airlift capabilities to transport forces and equipment to the battlefield and forward staging areas. The heavy reliance on airlift capabilities, however, has revealed several shortcomings in US airlift capability.
- The Marine's fleet of roughly 50 KC-130's is aging and in need of serious maintenance and upgrades. As of January, a majority of the KC-130s in Afghanistan were not equipped with night-vision equipment and the advanced radar systems used in combat aircraft. Because the aircraft are vulnerable to attacks from shoulder-launched missiles - a popular weapon among Al Qaeda and Taliban fighters - they have been forced to fly only at night, making night navigation capabilities essential. A lack of night-vision and terrain avoidance radar was cited by the DoD as a major factor leading to a January 9 accident in which a KC-130 crashed into the side of a mountain in Afghanistan. The KC-130J, the next generation of the aircraft, is equipped with the necessary night navigation equipment. The lack of such equipment on current aircraft, however, suggests that the military must focus additional funding on improving operational effectiveness.⁴⁶
- While Afghanistan did not stress the total pool of US airlift assets, it did indicate how critical having adequate total lift capacity can be in larger wars. It is important to note in this regard, that various war games show that the US is ten to fifteen million ton miles short of a requirement for total strategic lift capacity, which is 54.5 million ton miles.
- The US is now buying C-17s at the rate of one a month to fill this gap, and the C-17 showed in Afghanistan that its ability to use relatively unimproved airfields does give it a practical advantage. The US has an inventory of roughly 120 C-17s and plans to buy

60-120 more. It is also replacing the engines and updating the avionics on its 23 aging C-5s, and seeking to buy 150 more C-130J tactical airlift aircraft.⁴⁷

- **US airlift would still, however, be under severe strain to support one major regional contingency through at least 2019.⁴⁸**

Power Projection: The Value of Strike Range

- **Aircraft range is of limited importance when forward bases are available, but the US could not initially deploy combat aircraft into bases in Central Asia and Pakistan, and had no bases available in Pakistan.**
- **The US did acquire such capabilities over time, and was able to build up major facilities in the forward area at Bagram Air Base in Afghanistan, “Ganci” Air Base near the Manas Airport in Kyrgyzstan, and in Pakistan.⁴⁹**
- **This lack of forward basing initially limited US attack helicopter operations and meant that shorter-range aircraft like the A-10 and AV-8 were only committed after the fall of Kabul.**
- **It was a key factor that forced F-18s, F-14s, and other fighters to fly extremely long missions from carriers in the Indian Ocean and a heavy reliance on refueling as well as long-range bombers.**
- **The fact that the US could deploy so many fighters at such long distances early in the war and refuel and maintain them over time is a considerable achievement.**
- **It is not, however, a substitute for aircraft range, and the conditions in Afghanistan showed that the ability to loiter over a target area can be equally important.**
- **The range of many US fighters and strike fighters is, marginal for such missions. It could also be a problem in other areas where access to adequate basing is uncertain, like the Persian Gulf. In some ways, US air power is still too divided into fighters, which are best suited for European and littoral operations, and long-range bombers.**
- **Afghanistan is a warning that the range and endurance of the US strike fighter fleet may be inadequate, and that the US may have left a “range gap” between strike fighter and bomber.**

Power Projection: Mid-Air Refueling

- **The conflict in Afghanistan also provided another lesson in the vital importance of mid-air refueling operations and US tanker forces.**
- **However, of the USAF's fleet of 545 KC-135 refueling aircraft, 130 were grounded as of April 2002 due to structural problems and other maintenance issues. This has led to a debate over the need to replace the aircraft even though most should still have substantial flying life.**
- **The USAF is currently examining the possibility of leasing up to 100 modified Boeing 767 aircraft to decrease the demands on refueling tankers, however, a long-term solution that reduces overall dependence on USAF refueling assets has yet to be developed. Such a solution will be necessary to ensure future US power projection capabilities, especially in conflicts where the battlefield is located far from US aircraft bases.⁵⁰**
- **While the stealth characteristics of the B-2 only had marginal value in this war, Afghanistan is also a warning that long-range stealth capabilities may be far more critical in the future. Enemies with advanced air defense systems are not going to let conventional fighters loiter over the battlefield or refuel.**
- **In order to refuel, F/A-18s and F-14s were forced to descend to 17,000 feet. After refueling and returning to their previous altitude, however, the aircraft had utilized almost as much fuel as had just been added to their tanks.**
- **The US may also find that not all countries will be as cooperative as Pakistan and the nations of Central Asia have been and that long-range stealth capability may be necessary to allow US air power to "intrude" through the air space of third party countries.⁵¹**

Power Projection: The Weightlifting Contest in Transforming Ground Forces

- Under the current Army transformation plans, some of the equipment problems that US troops encountered may be resolved as early as 2008. The Army is currently developing the Objective Force Warrior with the goal of decreasing by half the weight of the equipment that soldiers carry.
- Like many elements of the Army's future Objective Force, the Objective Force Warrior is highly dependent on the development of new technologies, including a uniform equipped with a micro-climate conditioning system which will allow soldiers to operate comfortably in both hot and cold environments similar to the environmental extremes encountered by soldiers during Operation Anaconda. In addition to protecting soldiers from weather conditions, the uniform would be designed to protect troops from the effects of chemical or biological weapons.⁵²
- During Operation Anaconda, ground forces often became overburdened by the weight and amount of weaponry that they were carrying. Soldiers report that in order to move more quickly they were forced to discard some of their equipment. In one instance, several Special Forces troops scaling the side of a mountain were forced to discard their body armor because it significantly inhibited their ability to ascend the steep mountainside.
- Based on these common experiences and difficulties, it will be essential for the Army to re-examine basic equipment and weapon characteristics. Ground forces in fighting situations like Anaconda face several challenges and require an effective means of defending themselves and attacking the enemy. Their equipment should not become an impediment to their survival or achievement of the main objectives of the mission.
- As part of the development of the Objective Force Warrior, weapons made out of ultra-light materials would replace the M-16A2 rifle, M-4 carbine, and M-249 Squad Automatic Weapon. The new generation of weapons, while having similar capabilities, is being designed to weigh roughly 35% less than the current set of weapons.
- Also being developed as part of the Objective Force Warrior are alternative energy technologies, such as light-weight fuel cells, that will power high-tech sensors and replace heavy batteries which currently weigh down soldiers. The new sensors will monitor the battlefield environment as well as the physical health of the troops in the field, allowing medics outside of the battlefield to provide advice regarding troop readiness and injuries. A final component of the new uniform is development of a camouflage technology that can adapt to the environment in which the troops are operating so as to maximize their concealment.⁵³
- A major additional component of the Objective Future Warrior program is the development of a robotic ATV that will follow troops and carry roughly 500 pounds of

equipment. While this may be practical in a more traditional battlefield setting, it is questionable whether such a vehicle would be of use to ground forces engaging an enemy in mountainous terrain which is difficult for humans, let alone robotic vehicles, to manage.⁵⁴

Joint Warfare, Coalition Warfare, and Interoperability

Joint Warfare: Its Changing Nature and the Combined Arms Mix

- **Virtually every major recent war has shown the growing value of joint operations and of integrating land-air-sea operations in ways adapted to the needs of a given conflict.**
- **Like Kosovo, however, the Afghan conflict has shown that a combination of precision air and missile strike capability, coupled with greatly improved intelligence and targeting systems, can, in some contingencies, provide much of the heavy firepower that previously had to be provided by artillery and armor.**
- **It is dangerous to over-generalize, since much depended in both wars on near air supremacy and the ability to engage enemy ground forces in ways that allowed them to make only limited or no use of their armor or artillery against US and allied forces – aside from targeting local allies and proxies.**
- **The nature of the air-land battle seems to have evolved significantly, even in terms of the standards of a comparatively recent conflict like Kosovo.⁵⁵ Yet, if the opponent had had more serious military capabilities, US and British land forces might have had to spend several weeks winning air superiority and carrying out the suppression of enemy air defense (SEAD) mission.**
- **They could also have added more attack helicopters and gunships to the battle, and possibly lighter and more mobile artillery and armor – although this presented equipment, lift, and mobility problems for both the Army and Marine Corps. (The Army lacks sufficient light armored vehicles (LAVs) and even all terrain vehicles (ATVs) for its special operations forces, and Marine Corps light mechanized forces are still too tied to amphibious operations and need better ability to project force via airlift.).**
- **The US and Britain could also have added more highly trained special operations forces, forward air controllers, and experts with local language and cultural skills. Such forces obviously cannot substitute for heavy ground forces in many contingencies, but it is important to note that the Afghan war, per se, is not an argument for lighter tanks and artillery, nor for lighter and more projectable mechanized ground forces. This poses an obvious challenge in restructuring the Marine Corps for operations in the Middle East, and possibly challenges the relative roles of the Marine Corps and the Army.**
- **Key to any joint operation is an advanced communication network, capable of transmitting data between unmanned and manned sensor aircraft, ground forces, combat aircraft, and commanders.**
- **The fighting in Afghanistan marks a step forward in the development of such a seamless communications system. However, it is important to note that the enemy in**

Afghanistan did not have the technological capabilities to interfere with and disable that system. Indeed, while the fighting in Afghanistan shows us that a communications network that integrates information from many different forces is feasible in a non-hostile environment, it has not proven whether such a communications network can withstand an electronic or physical assault from a more advanced foe.⁵⁶

Jointness: The “New” Air-Ground Linkage

- **Working versions of the J-8 JSTARS**
- **Full integration of GPS**
- **Advanced laser illuminators**
- **Shadow surveillance drone**
- **New communication network called "Force 21 Battle Command, Brigade and Below"**
- **Tactical intelligence readouts and down-uplinks at many levels**
- **Improved Apache tank-killing helicopter.**

Joint Warfare: Operation Anaconda: Bomber and Attack Helicopter Lessons

- **The next phase of Operation Anaconda was largely air based, with B-52 heavy bombers dropping 2,000- and 500-pound bombs on Al Qaeda targets in the valley and along the mountains. Additionally, the US successfully utilized two new 2,000-pound thermobaric bombs, which, when fired into a cave, expel the oxygen and suffocate any hidden fighters. Following this stage of the battle, US ground forces were able to operate effectively, and over the next two weeks successfully located and destroyed enemy positions in the valley.⁵⁷**
- **Though the use of airpower during the initial days of the operation was essential, some observers argue that the need for intense air support revealed serious shortcomings in the capabilities of light ground forces. A recent report analyzing the Army's performance in Afghanistan cites a lack of artillery as a major shortcoming of the operations in Afghanistan.**
- **During Operation Anaconda, ground forces did not have the option of using artillery to target and destroy entrenched enemy positions. Army troops had to rely on their own mortars, as well as air support from AH-64 Apache helicopters and combat aircraft, to eliminate the enemy threat. In many cases, it took a direct hit from a 2,000-pound bomb to take out an enemy position.⁵⁸**
- **Unlike aircraft flying at higher altitudes, the Apache's were easily targeted and hit by small arms fire and rocket propelled grenades from Al Qaeda and Taliban fighters. Nevertheless, the Apache helicopters were more effective than fixed-winged aircraft at destroying enemy positions. Following Operation Anaconda, A-10 aircraft were dispatched to the region to further support Apache operations.⁵⁹**
- **Five AH-64 Apache gunships were called in to suppress enemy gunfire, but several quickly became damaged and were forced to withdraw. While additional helicopters, including the US Marine Corps Super Cobra, were deployed to provide support and cover for the ground forces, they did not operate at optimal levels due to the extreme elevations at which the battle was occurring. Limitations on the helicopters' abilities to loiter over the combat area and the inability of the helicopters to hover in relatively stationary positions negatively affected their targeting ability, thereby decreasing the accuracy of the helicopters' fire.⁶⁰**
- **Adaptations had to be made to the Apache helicopters. Originally designed to attack Soviet armor at night, the weapons systems were modified to increase their effectiveness at hitting entrenched ground forces. The high altitude of the operation, however, forced Apache pilots to engage in maneuvers that decreased their ability to accurately target ground positions.**

Joint Warfare: “Asset Integration” and New Approaches to Land Warfare

- It is clear that far more can be done to improve the integration of US sensors, battle management systems, strike platforms, communications, and the use of precision weapons in the future. Many of the US efforts during the Afghan conflict were improvised, relatively crude, and scarcely set the standard for the level of progress that can be achieved in “closing the loop.”
- A number of analysts have since argued that the advances in battle management/ISR have reached the point where platforms are less important than achieving a broad fusion of battle management/ISR, and that precision strike assets that can be used to strike as effectively as possible in near-real time, regardless of the age of the launch platform.⁶¹
- While much does depend on the sophistication of the opponent’s air forces and air defense assets, stealth, and long-range stand-off munitions; the use of unmanned aerial vehicles (UAVs) and unmanned aerial combat vehicles (UACVs) offers a potential way to use such techniques even against sophisticated opponents. At the same time, land systems, like the High Mobility Artillery Rocket System, Netfires, and precision-guided artillery shells could provide land firepower capabilities with equal precision-fire capability and more mobility and ease of power projection than existing artillery systems.
- Though development of unmanned ground vehicles (UGVs) lags behind that of UAVs, in part because of the difficult nature of ground navigation, UGVs could offer further enhancements to already existing sensor and weapon platforms.⁶²
- During the war in Afghanistan, the United States utilized robots in a combat situation for the first time.⁶³ US soldiers used four robots, called PackBots, to reconnoiter 26 caves, four bunkers, an ammunition cache, and a building complex.⁶⁴ The PackBots can be fitted with as many as twelve video cameras, and can also employ a grenade launcher and a 12-gauge shotgun.⁶⁵ The end result could be what some call “asset integration” and the creation of forces that combine land-air-sea systems into a near-real time mix of capabilities to “target-strike-assess-retarget-and re-strike” with an efficiency that has never been previously achieved.⁶⁶ It would extend joint warfare and combined arms to a new level.
- Senior US Army officers also feel that such systems may be a key to force transformation for the Army. Rather than having to use a substantial number of forces to secure flank areas – forces which need heavy armor and artillery -, the Army could rely on sensors to avoid surprise and counter maneuver before the enemy could react.
- Air and missile power would substitute for heavy forces in many contingencies and air mobility would allow rapid maneuvering to strike at the most critical aspects of enemy

ground force operations. The result could be smaller, faster, and more effective ground units that would also be much easier and faster to deploy and would require much less logistic and service support.

Joint Warfare: Remote Command and Intelligence Lessons

- **A complicated command structure that was dispersed over a wide area with key links back in the US added to communications problems. USCENTCOM did not decide to create a joint task force headquarters until May 2002, when one was created at Bagram.⁶⁷**
- **In fact, a number of reports - including an analysis of the course of the war by the Marine Corps - seem to have concluded that USCENTCOM's headquarters in Tampa, Florida, some 7,000 miles away, was too far away to coordinate operations in Afghanistan.⁶⁸ (In February, the top Marine general commanding operations in Afghanistan had moved closer to the theater, from Hawaii to Bahrain.)⁶⁹**
- **While Operation Anaconda was a joint operation, special operations soldiers from each service were not under joint command. Information relayed from one group of forces to a commander sometimes did not get relayed back out into the field to another group of forces.**
- **Overall, observers believe that the type of mission conducted by forces in Operation Anaconda indicates the need for higher-bandwidth and more closely linked communication systems, which will provide ground forces with up-to-date information on enemy and friendly positions.**
- **Additionally, analysts urge the Army to upgrade its "common operational picture," which currently provides commanders UAV imagery of ongoing operations. The key to using such technology effectively does not lie simply in mainstreaming the collection process, but also in training officers to rapidly analyze it and adapt their mission plans as needed.⁷⁰**
- **In evaluating the intelligence operation that assisted the military in planning and executing Operation Anaconda, US military officers argued that despite some inaccuracies, human intelligence played a pivotal role in the success of the mission.**
- **Lt. Colonel Dave Gray, chief of operations for Operation Anaconda, noted the importance of combining human intelligence with other technical sources. He said that human intelligence was used to confirm observations from surveillance aircraft. Additionally, noting the surprisingly fierce resistance that US forces faced during the first days of Anaconda, Gray argued that limitations in technical intelligence gathering create a continued need for accurate human intelligence, both before and during a battle.⁷¹**

Coalition Warfare: The Value of Coalition Warfare and Mission-Oriented Interoperability

- In the past, the US has paid more attention to seeking technological clones or doing it alone than to using its specialized, high technology strengths in ways which make it easier to operate with less-well-equipped Western and regional allied forces. This may well have been too narrow, if not the wrong, approach to coalition warfare and interoperability in many mission areas.
- Recent wars have repeatedly demonstrated the value of coalition warfare in every aspect of operations from power projection to combat.
- The US and British experience in Afghanistan may indicate that the US and NATO have overstressed the high technology and high investment aspects of coalition warfare and interoperability, and paid too little attention to the value of being able to draw on a pool of highly trained, lighter forces, like the SAS, or their Australian, Canadian, German, and other equivalents.
- Light, highly trained allied forces, like the SAS, could be highly effective without expensive high technology equipment, standardization, and interoperability. Similarly, relatively primitive allied local ground forces could be very effective substitutes for US ground forces when given the support of US Special Forces and advisors and effective air and missile strike capability. This is a lesson that emerged in a different way from the role that the KLA and other Kosovar forces played in Kosovo.
- The same may be true of the value of using limited numbers of highly trained advisors, forward air controllers, and targeteers on the ground, along with rapid transfers of low and medium technology arms to strengthen local forces.
- There were significant initial problems in deploying allied forces. The basing, transportation, and support systems available at the start of the campaign limited US ability to accept allied forces.
- So did the lack of language training, command and control assets, cross-training in the use of US ISR equipment and battle management techniques, and problems in combat rescue and force protection capabilities. Most allied forces lacked strategic mobility and sustainability and the US was not organized to use many of the assets other countries offered.
- The lack of a clear US nation-building plan, and prior allied planning for such a mission, also meant that the US was relatively slow to recognize the importance of nation-building and peace keeping support.
- The situation changed radically as time went on, however, and the value of allied forces became clear.

- **By June 2002, twenty nations had deployed more than 16,000 troops to the U.S. Central Command's region of responsibility. In Afghanistan alone, coalition partners contributed more than 7,000 troops to Operation Enduring Freedom and to the International Security Assistance Force in Kabul – making up more than half of the 14,000 non-Afghan forces in Afghanistan.**

Coalition Warfare: Possible Lessons for Lower-Cost Interoperability

- **NATO has always had a de facto high-low force structure and mission-orientation.**
- **Advances in electronics and lower-cost precision systems like the JDAM can change the cost of integrating allied forces into to US war plan and ISR network.**
- **The “low side” of coalition warfare could mean:**
 - **Not buying advanced ISR capabilities.**
 - **Not attempting to carry out the SEAD mission or to buy forces that can survive in an intact S-300/S-400 air defense environment.**
 - **Retaining existing platforms longer, avoiding “stealth-like” platforms, and concentrating on ISR, munitions, and readiness.**
 - **Looking for lower cost UAVs.**
 - **Reducing power projection problems by concentrating on precision strike, minimizing F-22 air-to-air combat missions.**
 - **Focusing on missions near the FEBA, rather than deep penetration.**
 - **Creating a NATO series of “standards” for such missions.**
 - **Matching light ground components to such missions.**
- **The “high side” could mean plug in and play interoperability in a US/NATO/EU force mix for advanced combat or special mission aircraft avoiding the costs and force structure impact of sovereign air forces and freeing resources to buy advanced modern systems.**

Targeting, Intelligence, and Battle Damage Assessment

Key Evolving Issues in Targeting, Intelligence, and Battle Damage Assessment

- **During the Gulf War, Desert Fox, and again in Afghanistan, the US faced several major problems in using its strike power effectively that will not be solved with better sensors and command, control, communications, and information (C⁴I) systems.**
- **US ability to locate some kinds of targets is far better than its ability to characterize them, judge their importance, or assess the level of damage it did to their functional capabilities once it strikes them. These include:**
 - **Hard targets.**
 - **Urban/MOBA buildings.**
 - **Vehicles/weapons not directly involved in combat and “dead” or inactive vehicles/weapons in combat.**
 - **Infantry targets of all kinds, especially dispersed and entrenched.**
 - **Concealable high value targets like CBRN weapons and delivery systems: LOW/LUA forces.**
 - **Many kinds of terrorist and asymmetric warfare forces and elements.**
 - **Cheap, low value facilities.**
 - **Military forces intermingled with civilians.**
- **The US did not demonstrate during the Gulf War, Desert Fox, or in Afghanistan that it had a valid doctrine for striking at leadership, infrastructure, and civilian C³I, LOC, and other rear area strategic targets. It essentially guessed at their importance and bombed for effect. It is unclear that “effects-based” planning really solves the problem.**

The Myth of Target Characterization

- **US ability to characterize sheltered and closed-in targets remains weak, as does its ability to assess and strike at hardened targets.**
- **This remains a major problem in the case of nations that make extensive use of such facilities, like Iraq and Iran, but it is important to note that US sensors and teams on the ground never succeeded in characterizing many much simpler Taliban and Al Qaeda facilities, such as caves.**
 - **For example, the Navy SEAL team that explored the cave complex at Zhawar Kili in February had no idea that it would turn out to be the largest complex yet uncovered and had to physically enter the area to determine that the US air strikes on the facility had little or no effect and left large stocks of supplies intact.⁷²**
- **The US has better ability to assess physical damage to surface buildings, but limited ability to assess damage to their contents. Its ability to assess functional damage to complex systems, like land-based air defense systems, and the resulting degree of degradation in their operational capabilities, is also generally weak.**
- **The US had major problems in these areas in the Gulf War, Kosovo, and in ten years of strikes against the Iraqi air defense system. The US had – and still has -- major problems in locating key targets, like the leadership of hostile powers or the facilities and forces related to weapons of mass destruction.**

The Myth of Battle Damage Assessment

- **To be blunt, the US military services and intelligence community simply do not have a credible battle damage assessment capability.**
- **They use an ever-changing set of rules that transform vague and inadequate damage indicators into detailed estimates by category and type.**
- **Their rules and methods have only crude analytic controls and cannot survive simple review methods, like blind testing.**
- **They rely heavily on imagery that cannot look inside buildings and shelters, which often cannot tell whether a weapon was inactive or had already been damaged by other kinds of fire, and which is essentially worthless in estimating infantry and human casualties.**
- **No evidence solved problem of major weapon BDA and kill exposed in Kosovo.**

**Intelligence and Strategic Reconnaissance
(ISR), and C4I/BM:
Closing the Loop and the Limits of
Capability**

ISR: “Closing the Sensor to Shooter Loop” to Near-Real Time: Improved Intelligence, Targeting, Precision Strike, Assessment and Re-strike Capabilities⁷³

- The US ability to use ISR data to conduct precision strikes with both precision-guided weapons and area ordnance, and then, at least partially, assess damage as well as retarget and re-strike almost immediately, did involve a wide range of advances in tactics and technology. The US was able to “close the loop” in conducting air and missile strikes in near-real time.
- It was a further development of techniques that owe their origins to the use of spotter aircraft and kill boxes in the Gulf War, and which were significantly further developed in Kosovo.⁷⁴
- A number of the tactical encounters between US and Al Qaeda forces have shown that it is now possible for air power to be far more effective and responsive in the close support of missions and for precision weapons to act as a partial substitute for artillery under conditions in which the enemy does not have high quality, short-range air defenses or large numbers of heavy weapons.
- A combination of fixed- and rotary-wing aircraft performed such missions well during the fighting at Tora Bora. In the current of phase of the fighting, however, US military officials concede that airpower is of limited use in locating and destroying small, dispersed pockets of Al Qaeda and Taliban fighters. Indeed, rapid “surgical” strikes by ground troops remain a more effective option for combating a dispersed enemy.⁷⁵

ISR: Dealing with Mobile Targets

- Senior defense officials believe that the fighting in Afghanistan shows that, since the Gulf War, the US has made significant advances in addressing the problem of identifying and destroying mobile targets.
- During the Gulf War, the USAF and Navy unsuccessfully targeted Iraq's Scud missiles, flying 1,460 sorties that failed to destroy a single missile battery. In contrast, during the fighting in Afghanistan, the US Navy attacked 2,500 mobile targets and has claimed to have achieved a 65% hit rate.
- As of June 2002, the Navy claimed that aircraft had struck 2,000 mobile targets.⁷⁶ Experts attribute this significant achievement to the use of improved precision munitions and communications technology, as well as the use of UAVs to gather target information. Air Force officials also cite the presence of special operations personnel, who could more readily identify mobile targets from the ground, as crucial to the success of the air missions over Afghanistan.
- The use of satellite-guided smart bombs, which are accurate regardless of weather conditions, along with reliance on the Joint Surveillance Target Attack Radar System (JSTARS), which can track several mobile targets simultaneously, contributed to the increased level of success in hitting mobile targets. Based on the successful integration of ground and air forces in pursuit of mobile targets, it is likely that "Scud hunting" may be a key feature of any future conflict with Iraq.⁷⁷
- In Afghanistan, targeting data from JSTARS was fed directly to F-15E pilots, allowing them to respond quickly and strike targets before their locations changed. Though UAVs, such as the Global Hawk, were able to provide imagery of mobile targets, a means to transmit such information directly to USAF and Navy pilots has yet to be developed.
- Currently, UAV information is transmitted to the CAOC in Saudi Arabia where analysts determine potential targets and relay specific target coordinates to the battlefield. Military officials describe the CAOC as an essential component that has greatly enhanced US efforts in Afghanistan. As a hub of communications between unmanned and manned aircraft, it provided commanders with a complete, up-to-date picture of the battlefield.⁷⁸
- If the USAF and Navy are to further increase the percent of successful hits to mobile targets, it will be necessary to reduce the "sensor-to-shooter" time between UAVs and fighters by developing direct lines of communication between the unmanned and manned aircraft. Some steps have been taken to address this issue, as evidenced by the USAF's linking of Predator imagery directly to the cockpit of AC-130 gunships.

- **This, in turn, has allowed the gunship crews to determine the location of targets and the features of the surrounding areas before actually arriving at the target areas. Much work, however, remains to be done.⁷⁹**

ISR: The Decision Time Problem

- Some analysts feel that the Afghan conflict shows that reducing decision time is now a critical issue.
- They feel that changes to the sensor-to-shooter cycle suggest that the Find-Fix-Track-Target-Attack-Assess (FFTAA) parts of the sensor-to-shooter cycle have improved so much since Desert Storm and Kosovo that US forces now have the ability to find, classify and put ordinance on targets before those targets can get away.
- For instance, while in Desert Storm it took, in a particular instance, 80 minutes to complete the sensor-to-shooter cycle when identifying and targeting an SA-2 site, in Afghanistan sensor-to-shooter times decreased, on average, to just twenty minutes.⁸⁰
- Indeed, in Afghanistan it was not these problems that caused US aircraft to miss opportunities to destroy targets. Rather, it was the “decision time” necessary to get authorization to act which cost opportunities to engage legitimate targets because of the time it took to make the decision to attack.
- They feel that examination of the data and lessons learned during the war will show that decision time has become the “long pole in the tent.” Shortening the decision segment of the cycle would have a major effect on our future ability to strike time-sensitive targets and, therefore, improve future combat effectiveness.⁸¹
- This issue is rooted in the problem of command authority and the rules of engagement (ROE) as promulgated, interpreted and acted upon – more specifically the extent to which the decision authority should be delegated to subordinate components and/or operational/tactical levels of command.
- Afghanistan (like every other conflict) has unique political aspects: the extent and perceptions of collateral damage were very important in the broader context of how the international Muslim community (and others) would react to US operations against a terrorist network that happened to be associated with Muslims.
- As a result, rules of engagement (ROE) were applied that had a significant impact on the length of the decision process and drove the time length of the decision segment far more than any other element (like weapon accuracy) in this part of the cycle.
- The less precise the guidance provided to the warfighter or the more restrictive the ROE, the longer it takes to complete the decision segment of the cycle. One possible reason for this is that technical components of the FFTAA steps in the cycle have received primary attention and resources over the last ten years and are more optimized from the standpoint of putting ordinance on target.

- **Today's technology, systems, and procedures do not do as well when it comes to acquiring and disseminating the types of information the person in the loop needs to determine if the rules of engagement permit attacking the target.**

Mission Effectiveness versus Mission Intensity: The Duel Between Offense and Defense Continues

- **“Closing the loop” in near real time intelligence, targeting, precision strike, assessment and re-strike operations, may significantly improve mission effectiveness in ways that reduce the need for sheer force numbers and mission intensity. Not only did airpower substitute in many ways for heavy ground forces, armor, and artillery, precision air power and far better targeting almost certainly substituted for air power numbers. This indicates that deploying even more effective real-time intelligence, targeting, and damage assessment systems can either make a given force steadily more effective in battle, or allow a reduction in force numbers and mission intensity.⁸²**
- **There are potential countermeasures to such advances, and ones that are all too familiar to most military forces in the Middle East. They include:**
 - **A shift to more distributed forms of warfare, where terrorists and other opponents seek to present smaller and smaller targets.**
 - **Hide or shield operations by more and more use of collocation with civilians.**
 - **The constant relocation of operations makes it harder to target by function. Under such conditions, no advances in technical platforms will be able to compensate for a lack of reliable human intelligence and/or enhanced presence on the ground.**
 - **Disperse assets before or during a conflict without any normal indicators of combat operations -- just as Iraq dispersed chemical weapons near unmanned air facilities during the Gulf War.**
 - **Deploying distributed mixes of highly advance surface-to-air missiles, like the SA-10 or SA-11, shorter-range systems, sensors, and command and control links, to deny effective long-range air strike capabilities.**
 - **Creating retaliatory forces with weapons of mass destruction that can be launched on warning or when under attack.**
- **At the same time, there are limits to the adaptations that enemy forces can make in response to such US capabilities. Large masses of armor, artillery, and combat air assets can scarcely be distributed. Indeed, moving them may simply make them targets. Distributed forces are weaker forces, and hiding among civilians is a two edged sword that may alienate those you hide among. Buying very expensive and highly sophisticated air defense systems can also be countered with new targeting and strike technologies. Relying on CBRN weapons as a deterrent is only credible if they cannot be a target, and if it is clear that they will be used.**

Intelligence and Strategic Reconnaissance (ISR), and C4I/BM:

Bandwidth, Technology, and Hardware Issues

ISR: Communications, Bandwidth, and Satellite Capacity Lessons

- **Soldiers could not rely on line-of-sight communications equipment and had to turn to more expensive and less available military and commercial satellite communications.**
- **At the same time, this battle and other experiences in Afghanistan showed that critical aspects of the US national security communications system – such as the Defense Satellite Communications System (DSCS), Milstar, UHF follow-ons, NRO relays, and the NASA TDRSS spacecraft -- are still “stovepiped and lack proper integration. This seems to be true of the designs for the new Advanced EHF and Wideband Gapfiller programs.”⁸³**
- **This has led to a coordinated effort under the National Security Space Architecture Office by seven teams from each of the key agencies, including the NRO and NSA. Improving this aspect of force transformation has been given high priority and new programs could start being funded in 2003.**
- **The program will be evolutionary and emphasize field use and access across a wide range of channels, as well as the integration of the transmission of secure data from NASA, NRO, NSA, and the Defense Department. At present, US forces often have to use two to four different terminals to talk to two to four different satellites in a situation in which a single laptop could do the same job.**
- **Also, key new technologies like Lasercom are also just coming into service and there are no UAV links to the DSCS and Milstar systems. Milstar II is coming into service and will ease some problems, but will scarcely be a substitute for an integrated systems architecture. Current systems are also particularly weak in rapidly transmitting encrypted imagery.”⁸⁴**
- **The situation was made worse by a much broader problem in satellite bandwidth capacity. The US military had anticipated a far faster growth in commercial satellite capacity than that which ended up taking place (some 275 satellite launches actually occurred instead of the 675 the military had planned on).**
- **As a result, the Afghan conflict became the first practical case where a lack of bandwidth began to inhibit US communications and ISR capabilities. The US military calculates a future need for a total of some sixteen gigabits per second in a major theater war by 2010 – some 208,000 simultaneous phone calls. Actual military capacity could be little more than half that, thus resulting in much higher reliance on commercial communications satellite capacity that may not be available.”⁸⁵**

ISR: The New Family of US Assets

- **Major improvements in US combat performance over that in past wars - improvements made possible by a number of factors, including added reliance on precision-guided weapons and the new abilities of US forces to draw on greatly enhanced ISR capabilities.⁸⁶**
- **The US was able to link its air and ground forces to power ISR assets. It could provide real-time imagery (PHOTINT) and electronic intelligence (ELINT) data on the movements of enemy and friendly forces.**
- **It could cover and characterize fixed targets and cover and target mobile enemy forces with high precision in real time even as they were engaged by Afghan ground forces, from imagery satellites, U-2s, E-8 JSTARS, RC-135 Rivet Joints, E-3A AWACS, E-2s, P-3s, and UAVs, like the Global Hawk and Predator. Signals intelligence (SIGINT) also played a role, however, it was not automated in a form that allowed the same degree of instant reporting and communication.**
- **Advances in US sensors, moving target radars, and synthetic aperture radars also reduced problems associated with weather and cloud cover.**
- **The US had the technical capability to communicate this data, which included targeting data for US bombers and strike fighters, special operations soldiers and other ground troops, and sea-launched cruise missile platforms. This allowed aircraft like the F-16, F-15, AC-130, F-18, B-1, and B-52 to not only operate with near-real time intelligence, but to retarget in flight and in some cases re-strike after damage assessment from forces on the ground.⁸⁷**
- **At the same time, a family of new, light ground systems like the Joint Tactical Terminal used by US Special Forces and other ground forces, the components of the Integrated Broadcast Service, new laser illuminators, GPS systems, and satellite uplinks transformed tactical ISR operations in the field.⁸⁸**

ISR: Upgrades and Older Platforms

- **The US and Britain have drawn the lesson from Afghanistan that permissive air environments, new sensor and targeting systems, and long-range precision strike systems allow older, long-range slow fliers, like the P-3 and British Nimrod, to be armed and used as delivery platforms, and could even allow tankers and transport aircraft to be reconfigured for use in strike roles.**
- **Older aircraft can also be modified to assist in ISR activities, as has been evidenced by the US Navy's use of P-3 Orion maritime patrol aircraft in support of Special Operations Forces on the ground in Afghanistan.**
- **The P-3, for example, was designed for maritime surveillance and anti-submarine warfare missions, but was used as a land-based observation plane by the SEALs. The P-3 possessed data links to the Predator and E-8 and provided real time reconnaissance during Operation Anaconda and the fighting in the Shah-i-Kot Valley.⁸⁹**
- **Taking advantage of the upgrades in communications, radar, and sensor capabilities made to aircraft as part of the P-3 Anti-Surface Warfare Improvement Program (AIP), the Navy used P-3s to gather ISR information, which was then transmitted directly to the Special Operations Forces on the ground. Not only could SEAL teams download information from the P-3, but they could also upload target information and coordinates to the P-3, which in turn would transmit the information to strike aircraft.⁹⁰**
- **The USAF modified existing aircraft to enhance ISR by placing communications pallets onboard KC-135 tanker aircraft. These modified aircraft communicated with the CAOC in Saudi Arabia and relayed battlefield information to F-15 aircraft.**
- **According to Air Force Secretary, Dr. James G. Roche, the "smart tanker" worked incredibly well; consequently, the USAF plans on modifying 40 of its current KC-135s so that they can enhance battlefield communications further.⁹¹**

ISR: The Problem of Asset Density

- **Afghanistan may have been a small war, but it consumed a very large number percentage of total US ISR assets.**
- **The US had to have at least four photo reconnaissance-class satellites and two radar-imaging satellites in operation, however, experts estimate that Afghanistan and the surrounding area can be photographed roughly every two hours.⁹²**
- **CIA director George Tenet instructed the military and intelligence community to rely on high-resolution imagery from private satellite networks to complete more basic tasks, such as assembling aerial maps of Afghanistan.**
- **The campaign in Afghanistan has been the first time ever in which private satellite data was relied on by the US military. This move preserves the use of the limited but more sophisticated and higher resolution government satellites for specific tasks, such as determining precise military targets and assessing the damage from a US or coalition strike against a target.⁹³**
- **There were equal limitations in ISR resources at the tactical level. The number of Special Forces teams that could be deployed to provide on-the-ground intelligence and targeting designation was very limited, and probably only a fraction of the number that will be found useful in the future.⁹⁴**
- **Many of the on-the-ground data links, targeting systems, and communications systems provided to special operations forces and rear area intelligence/targeting analysts lacked the desired range and reliability and can still be greatly improved.⁹⁵**
- **Other such improvements include the provision of lighter and longer-range laser designators and light all-terrain vehicles and trucks that offer higher mobility and less detectability than systems like the High Mobility Multipurpose Wheeled Vehicle (HMMWV).⁹⁶**

ISR: “Friendly Fire”

- While the media has focused largely on collateral damage, putting an end to tragic friendly fire incidents like the US air strike that killed four Canadian soldiers in May 2002 are also very important.⁹⁷
- The incident mentioned above was due more to pilot error and command decisions than any fault in the ISR system. An F-16 pilot misinterpreted a night firing exercise and, believing he was being attacked (even though his altitude was 28,000 feet), dropped a laser-guided, 500-pound GBU-12 bomb on the Canadian troops who were conducting that exercise.⁹⁸
- A more integrated ISR system might have told him that he was flying over friendly forces. Similarly, an earlier incident in December 2001, when a B-52 dropped a 2,000 pound JDAM that killed three US soldiers and wounded twenty others might have been avoided.⁹⁹
- There were also many ambiguous cases involving Afghan civilians who may or may not have been taking part in hostile action or may have been near or mixed with persons who were.
- The July 1, 2002 incident in which 40 afghans attending a wedding party died when an AC-130 fired in response to what it said was hostile fire, but where no confirming evidence was readily available when an after action ground investigation took place, is only one of the many cases where there was not clear dividing line between the problem of “friendly fire” and collateral damage.¹⁰⁰
- It is not clear that minimizing friendly fire has, as yet, been given the proper priority in US ISR designs and procedures. Certainly, technology may be approaching the point at which the US may be able to create some form of personal identification of friend or foe (IFF) system might be both affordable and technologically feasible.

Conflict Termination, Nation Building, Grand Strategy, and the Aftermath of Military Victory

Conflict Termination and Non-Existential Threats

- It has become clear that it may be much harder to win the peace than the actual war, particularly in terms of Afghan nation building and in ensuring that some Taliban-like movement does not arise in the future.
 - There already have been an attempted assassination of President Karzai, the successful assassination of Afghan Vice President and Minister for Public Works Haji Abdul Qadir, serious clashes between warlords, the murder or assassination of Afghan tourism minister Abdul Rahman, and cases where Afghan factions have tried to use the US and British militaries to achieve their own tactical and political ends.
 - Neighboring powers, like Iran and Pakistan, are starting again to play the “Afghan Great Game,” and any effort to create even a federal or cantonal Afghan state faces major political, ethnic, and economic challenges.
- As the Gulf War, Lebanon, Somalia, Kosovo, and Bosnia have shown, even the most impressive tactical or strategic military victory can lose much or all of its meaning if it is followed by a diplomatic and political power vacuum or failure to achieve grand strategic goals.¹⁰¹
- It unclear at this point how the US will come to grips with this aspect of the war, if at all. It is clear that the Department of Defense does not want to keep US forces engaged or provide massive support to an allied peacemaking force. The preferred goal seems to be to try to create an Afghan national army and police force. On this front, however, the US faces numerous challenges.
- The fact remains that grand strategy always requires more than military victory and any commander or policymaker who cannot recognize this fact indulges in strategic infantilism at the cost of becoming a strategic jackass.
- Conflict termination cannot always end in successful nation building. Transforming cultures, political systems, and economies is far harder than most advocates of nation building would like to admit, and is often impossible or too costly to attempt. Nevertheless, victory is only victory when the use of force is tied to a satisfactory political and economic outcome and a satisfactory level of post-conflict stability.¹⁰²
- It is becoming clear that for that to occur the United States will need to become more involved in what some refer to as “nation building.”
- It should also be stressed that even if the Afghan problem were solved, it would still not be a grand strategic victory. If the US must mix force with diplomacy and allied support in some 68 countries, it must have a broader definition of victory and be able to both communicate that definition and progress towards meeting it. As of this writing, US efforts at this are episodic at best, and the overall grand strategy and conflict

termination aspects of the US battle against Al Qaeda are as unclear as its goals regarding the defeat of “global terrorism.”

Winning Battles Merely Defeats the Enemy: The Challenge of Grand Strategy

- **The US government and Defense Department seem to have been only marginally more concerned with planning for conflict termination and grand strategic outcomes in Afghanistan, than they were during the Gulf War and the war in Kosovo.**
- **This failure to give conflict termination the same priority as military operations, and grand strategy the same priority as strategy, is particularly striking because many senior officials in the present Bush Administration have been so deeply involved in trying to come to grips with the end result of a similar failure in the Gulf War and the survival of Saddam Hussein.**
- **There is a similar irony in the fact that their legitimate criticism of the vacuous moral posturing of the Clinton Administration and the s optimism and false promises surrounding the Dayton Accords and conflict aftermath in Kosovo has tended to be replaced by an equally vacuous effort to avoid being deeply involved in the aftermath of Afghanistan.**
- **Afghanistan is yet another warning that American war planners must plan for true victory, and not simply the defeat of enemy military forces.**
- **The time – if it ever existed -- in which military planners could only plan for war is long over. In fact, it seems fair to say that war plans that do not include peace plans have always been signs of gross military incompetence. The fact that most post-conflict peace involves some form of prolonged occupation, peace keeping, and nation building may be unpopular, but that does not change the fact that military action cannot have satisfactorily positive lasting benefits unless the military (and their political leaders) are willing to pay the necessary price.**
- **In war, more than any other human activity, no one should begin what they are not prepared to finish, and few modern wars will have outcomes where desirable governments, economies, societies, and patterns of alliance magically occur simply because the fighting ends.**
- **The officer who cannot adjust to this reality is unfit to wear his or her uniform. The political leader unwilling to face this reality is, at best, a recipe for military futility and, at worst, a recipe for disaster.**

¹ Defense Daily, April 10, 2002, p. 7.

² In many cases, "pilot error" may have been the result of inadequate avionics for mountain flying or having to carry out missions in very marginal flying conditions. An example is the KC-130 crash in June 2002. San Diego Union Tribune, June 20, 2002, p. 1.

³ The USAF reported a normal figure of 12,600 "shooter sorties." See Anthony H. Cordesman, The Lessons and Non-Lessons of the Air and Missile Campaign in Kosovo, Westport, Praeger, 2001, pp. 42-44.

⁴ See William M. Arkin, "Old-Timers Proved Invaluable in Afghanistan Air Campaign," Los Angeles Times, February 10, 2002.

⁵ Dr. Rebecca Grant, "The Afghan Air War," Air Force Assoc. web site, Sept. 2002.

⁶ Paul Lewis, "Aging Aircraft Prove Their Worth: Operational Success in Afghanistan May Lead to a Significant Boost in Funding," Flight International, Nov. 26, 2002.

⁷ Dr. Rebecca Grant, "The Afghan Air War," Air Force Assoc. web site, Sept. 2002.

⁸ Hunter Keeter, "Communications, Weapons-Carrying Improvements Key to Bomber Force," Defense Daily, Nov. 4, 2002.

⁹ See William M. Arkin, "Old-Timers Proved Invaluable in Afghanistan Air Campaign," Los Angeles Times, February 10, 2002.

¹⁰ See William M. Arkin, "Old-Timers Proved Invaluable in Afghanistan Air Campaign," Los Angeles Times, February 10, 2002.

¹¹ Bryan Bender, Kim Burger, and Andrew Koch, Afghanistan: First Lessons, Jane's Defense Weekly, December 19, 2001, p. 20; New York Times, February 8, 2002, p. A-14, and Philadelphia Inquirer, February 12, 2002, p. 1.

¹² General Tommy Franks testimony to the Senate Armed Services on February 5, 2002. <http://www.centcom.mil/news/transcripts/General%20Franks%20Testimony%205Feb02.htm>; Bryan Bender, Kim Burger, and Andrew Koch, Afghanistan: First Lessons, Jane's Defense Weekly, December 19, 2001, p. 20; New York Times, February 8, 2002, p. A-14, and Philadelphia Inquirer, February 12, 2002, p. 1.

¹³ The New York Times, June 25, 2002.

¹⁴ The New York Times, June 25, 2002; Aviation and Space Technology, April 28, 2002, p. 55.

¹⁵ Aerospace Daily, February 20, 2002; General Tommy Franks testimony to the Senate Armed Services on February 5, 2002. <http://www.centcom.mil/news/transcripts/General%20Franks%20Testimony%205Feb02.htm>.

¹⁶ See Erwin, Sandra I., "Naval aviation: lessons from war; Enduring Freedom reinforces need for new targeting pods, radar, data links." National Defense, National Defense Industrial Association, June 1, 2002, p. 16.

¹⁷ Aerospace Daily, February 20, 2002; General Tommy Franks testimony to the Senate Armed Services on February 5, 2002. <http://www.centcom.mil/news/transcripts/General%20Franks%20Testimony%205Feb02.htm>.

¹⁸ ABC News background brief and Defense Daily, April 10, 2002, p. 7.

¹⁹ For further details, see Bill Sweetman, "The Falling Price of Precision," Jane's International Defense Review, April 2002, pp. 46-50. The JDAM had an initial cost of \$40,000 and a CEP specification of 13 meters. The cost is not roughly a third of that and CEPs of less than 5 meters have regularly been achieved on test ranges.

²⁰ Defense News, February 11, 2002, p. 3; USA Today, March 11, 2002, p. 3B.

²¹ Matt Kelley, "Pilotless Aircraft Become a Potent Weapon in War on Terror," The Associated Press, November 5, 2002.

²² Defense News, June 10, 2002, p. 20.

²³ Defense News, May 6, 2002, p. 6..

²⁴ Defense News, February 11-17, p. 3., pp. 3

²⁵ Defense News, January 14, 2002, p. 28, April 29, 2002, p. 6.

²⁶ Bloomberg.com, January 22, 2002; Los Angeles Times, January 21, 2002, p. 1.

²⁷ Los Angeles Times, January 21, 2002, p. 1.

²⁸ Defense News, April 8-14, 2002, p. 4.

²⁹ Norfolk-Virginian Pilot, July 11, 2002.

³⁰ See New York Times, March 4, 2002, p. 1; Washington Post, February 10, 2002, p. A1, March 4, 2002, p. A1, May 8, 2002, p. A16; Christian Science Monitor, March 4, 2002, p. 1.

³¹ New York Times, February 4, 2002, March 27, 2002, May 1, 2002, May 3, 2002, May 6, 2002, p. 1, June 3, 2002; London Times, March 4, 2002; Washington Post, December 23, 2001, p. A10, March 20, 2002, p. A1, May 14, 2002, p. A15, May 16, 2002, p. A1, June 27, 2002, p. A1 and A28; Washington Times, May 15, 2002, p. 3, May 29, 2002, p. 4, June 24, 2002, p. 15, June 27, 2002, p. 16, June 28, 2002, p. 1, June 29, 2002; Newsweek, June 10, 2002; USA Today, June 13, 2002, p. 1, June 18, 2002, p. 7; Los Angeles Times, May 1, 2002, May 14, 2002, June 11, 2002, p. 1, June 28, 2002; Chicago Tribune, May 30, 2002, June 23, 2002, June 30, 2002; Christian Science Monitor, March 22, 2002, p. 1, June 27, 2002, June 28, 2002, p. 1, July 2, 2002, p. 1.; Insight, July 22, 2002; Time, July 1, 2002, p. 26; London Daily Telegraph, March 21, 2002, June 24, 2002; Wall Street Journal, December 12, 2001; Jane's Defense Weekly, October 17, 2001, p. 21, October 31, 2001, p. 3; John G. Roos, "Turning Up the Heat," Armed Forces Journal, February 2002, pp. 36-42..

³² For a short unclassified overview, see "What's become of Al-Qaeda," Time, January 21, 2002, pp. 18-22.

³³ Office of the Secretary of Defense, Annual Report on the Military Power of the People's Republic of China, Report to Congress Pursuant to the FY2000 National Defense Authorization Act, Washington, Department of Defense, July 2002, pp. 11-14.

³⁴ Barry Watts, "Effects and Effectiveness," Gulf War Air Power Survey, Volume II, Washington, GPO, 1993, p. 335; Christopher J. Bowie, "Destroying Mobile Ground Targets in an Anti-Access Environment," Northrop Grumman Analysis Center Paper, Washington, December 2001, p. 3.

³⁵ For typical reporting on Al Qaeda activity see; Washington Post, March 12, 2002, p. 1; Washington Times, April 11, 2002, p. 1; Associated Press, February 1, 2002; Time, June 24, 2002, p. 24; Reuters, December 12, 2002; New York Times, February 26, 2002, p. 1, March 20, 2002; March 23, 2002, p. 1; USA Today, March 26, 2002, p. 10.

³⁶ See Laura Kind, "A Civilian Toll in Afghan War Likely Lower," Philadelphia Inquirer, February 12, 2002, p. 1. The AP estimate of civilian deaths includes 70 in Kabul, 81 in Khandahar, 55 in Jalalabad, 10 in Mazar e-Sharif, 18 in Heart, 25 around Spin Boldak, 55 in Karam, and 167 in the Tora Bora region (155 in Kama, 5 in Agom, and 7 in Pacair). Also see Barry Bearak, "Uncertain Toll in the Fog of War," New York Times, February 10, 2002, p. A-1.

³⁷ James G. Roche, "Transforming the Air force," Joint Forces Quarterly, Autumn/Winter 2001-2002, pp. 9- 12; Bill Sweetman, "The Falling Price of Precision," Jane's International Defense Review, April 2002, pp. 46-50.

³⁸ Bill Sweetman, "The Falling Price of Precision," Jane's International Defense Review, April 2002, pp. 46-50.

³⁹ Aerospace Daily, December 5, 2001.

⁴⁰ Chicago Tribune, February 6, 2002.

⁴¹ See Dallas Morning News, May 31, 2002.

⁴² The Los Angeles Times, January 21, 2002, p. A-1.

⁴³ The Los Angeles Times, January 21, 2002, p. A-1; Chicago Tribune, February 6, 2002.

⁴⁴ For discussion of US wartime technology developments see Los Angeles Times, March 17, 2002, p. 1; Washington Post, March 26, 2002, p. 16.

⁴⁵ Inside the Air Force, July 12, 2002, p. 1.

⁴⁶ The San Diego Union-Tribune, June 24, 2002.

⁴⁷ Washington Post, June 24, 2002, p. 13

⁴⁸ Defense News, May 6, 2002, p. 34.

⁴⁹ USA Today, April 30, 2002; Jane's Defense Weekly, December 5, 2001, p. 3, Los Angeles Times, December 11, 2001; Time.com, April 27, 2002.

⁵⁰ Defense Daily, March 25, 2002, p. 48, July 3, 2002, p. 1; Wall Street Journal, May 3, 2002.

⁵¹ Defense Daily, July 3, 2002, p. 1; Aviation and Space Technology, April 29, 2002, p. 55.

⁵² Defense News, July 15-21, 2002, p. 40.

⁵³ Defense News, July 15-21, 2002, p. 40.

⁵⁴ Defense News, July 15-21, 2002, p. 40.

⁵⁵ For a more detailed assessment of these points and why the air environment in Afghanistan may not be relevant to fighting against countries like Iran, Iraq, and North Korea, see the presentation of General Hal Hornburg, commander of the Air Combat Command, and General Gregory Martin, commander of USAFE, before the Air Force Association Conference in Orlando Florida, as reported in Bloomberg.com, February 20, 2002.

⁵⁶ Norfolk Virginian-Pilot, July 12, 2002.

⁵⁷ The London Times, March 4, 2002.

⁵⁸ Defense News, July 22-28, 2002, p.38; See also “Emerging Lessons, Insights, and Observations: Operation Enduring Freedom” prepared by the Center for Army Lessons Learned, Fort Leavenworth, Kansas; The Washington Post, April 28, 2002, p. 16.

⁵⁹ Defense News, July 22-28, 2002, p.38; See also “Emerging Lessons, Insights, and Observations: Operation Enduring Freedom” prepared by the Center for Army Lessons Learned, Fort Leavenworth, Kansas; The Washington Post, April 28, 2002, p. 16.

⁶⁰ Asia Pacific Defense Reporter, May 2002, pp.34-36.

⁶¹ For more details, see Defense news, April 22, 2002, p. 28, March 25, 2002, p.8

⁶² Joseph N. Mait and Jon G. Grossman, “Relevance and Risk: The U.S. Army and Future Combat Systems,” Defense Horizons, Center for Technology and National Security Policy, National Defense University, May 2002, p. 4.

⁶³ Defense News, September 16-22, 2002, p. 28.

⁶⁴ Press Release, Exponent, Inc., <http://www.exponent.com/about/news/090502.html>.

⁶⁵ “Robots Risk Their Lives for U.S. Soldiers in Afghanistan,” AP, ChannelOne.com, <http://www.channelonenews.com/articles/2002/07/31/ap.robots/>.

⁶⁶ See Lt. Col. Merrick Krause, “How to Project Power: Asset Integration, Not Platforms, Get Results,” Defense News, June 3, 2002, p. 19.

⁶⁷ Washington Post, May 22, 2002, p. 26.

⁶⁸ Wahsingtonpost.com, June 3, 2002, P. A-1.

⁶⁹ New York Times, February 4, 2002.

⁷⁰ Defense News, July 22-28, 2002, p.38; See also “Emerging Lessons, Insights, and Observations: Operation Enduring Freedom” prepared by the Center for Army Lessons Learned, Fort Leavenworth, Kansas.

⁷¹ Defense Week, April 1, 2002, p. 8.

⁷² Washington Post, February 16, 2002, p. A-27.

⁷³ For a good preliminary analysis of these lessons of war, see Bryan Bender, Kim Burger, and Andrew Koch, “Afghanistan: First Lessons,” Jane’s Defense Weekly, December 19, 2001, pp. 18-21.

⁷⁴ James G. Roche, “Transforming the Air force,” Joint Forces Quarterly, Autumn/Winter 2001-2002, pp. 9- 12; Defense News, January 3, 2002, p. 1.

⁷⁵ The Los Angeles Times, July 15, 2002.

⁷⁶ Defense Daily, July 9, 2002, p. 3.

⁷⁷ The Washington Post, July 5, 2002, p. 14.

⁷⁸ The Washington Post, July 5, 2002, p. 14, Air Force News, May 29, 2002; Aviation Week and Space Technology, March 11, 2002, p. 24.

⁷⁹ The Washington Post, July 5, 2002, p. 14, Air Force News, May 29, 2002.

⁸⁰ Joseph N. Mait and Jon G. Grossman, “Relevance and Risk: The U.S. Army and Future Combat Systems,” Defense Horizons, Center for Technology and National Security Policy, National Defense University, May 2002, p. 4.

⁸¹ For an interesting Israel perspective on these issues, see Avi Kober, Reflections on Battlefield Decision and Low Intensity Conflict, Ramat Gan, Bar-Ilan University, BEA Center for Strategic Studies, May 2002.

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⁸³ For excellent reporting on this issues seem Carig Covault, “US Military Wants Sweeping Satcom Changes,” Aviation Week and Space Technology, January 21, 2002, p. 27.

⁸⁴ For excellent reporting on this issues seem Carig Covault, “US Military Wants Sweeping Satcom Changes,” Aviation Week and Space Technology, January 21, 2002, p. 27.

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⁸⁷ Defense News, January 3, 2002, p. 1.

⁸⁸ Defense News, March 25, 2002, p. 8

⁸⁹ Jane’s Defense Weekly, January 16, 2002, p. 3; Washington Times, April 2, 2002, p. 5.

⁹⁰ Defense Daily, July 9, 2002, p. 3.

⁹¹ Air Force News, May 29, 2002.

⁹² Jane's Defense Weekly, October 17, 2001, p. 6.

⁹³ The New York Times, June 26, 2002.

⁹⁴ Dana Priest, "In War, Mud Huts and Hard Calls," Washington Post, February 20, 2002, pp. A-1 and A-8

⁹⁵ Defense News, February 11-17, 2002, p. 8.

⁹⁶ Defense News, February 11-17, 2002, p. 8.

⁹⁷ See the Ottawa Citizen, June 26, 2002, p. 12.

⁹⁸ New York Times, June 19, 2002; Washington Post, June 19, 2002, p. 22.

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