Strategic Events and Technological Developments of Air Power that Changed the Accuracy of Warfare
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The United States National Security Strategy seeks to guarantee the sovereignty and independence of the nation. According to the Air Force Doctrine Document 1, dated 17 November 2003, “it provides the context that underpins U.S. plans and actions by describing the security environment and threats and describing in general terms the nature and style of U.S. response.” As such, it has evolved over time according to the international environment. During the Cold War, facing the Soviet Union as our primary competitor, a policy of containment dominated U.S. strategy. During the 1990s, when the threat to the Nation was more uncertain, a new strategy evolved centered on engagement. More recently, faced with a worldwide terrorist threat, our strategy has evolved accordingly, to include an emphasis on homeland security and a deliberate shift toward preemption as a viable consideration. These changes in overall strategy drive changes to military capabilities, worldwide posture, and functional and the geographic focus of the U.S. Armed Forces, to include the use of air power.

Technological developments, coupled with greater information availability, have allowed airpower to become the dominant force in most circumstances of war. Ever since World War II, it has provided the United States and allied ground forces with the freedom to operate undisturbed from above. The past decade has seen many air power systems evolve from advanced development to operational use. These systems have combined mainly in the areas of stealth, precision standoff attack, and enhanced information availability. These capabilities were brought together for the first time in combat in the 1991 Persian Gulf War. In an unprecedented convergence of technology, doctrine, concepts of operations, and leadership, the coalition promptly reached an unquestioned control of the air. Today, new aerospace technologies either in hand or on the horizon promise to generate even more dramatic changes, further widening the gap between states that possess them and those that do not.

Advanced platforms of fighter aircraft, such as the F-22 fighter has made the United States the world leader in advanced aircraft. The F-22 “Raptor” is a fifth generation stealth fighter aircraft. It was originally envisioned as an air superiority fighter for use against the Soviet Air Force, but is equipped for ground attack, electronic warfare and signals intelligence roles as well. Successor generations of combat aircraft are likely to be quite different.

Over the past decade, remotely piloted aircraft and unmanned aerial vehicles have proven their worth in operations around the world. The U.S. Air Force and the Department of Defense are working to increase the capabilities of existing unmanned systems and to develop new systems with improved capabilities. First, technological advances provide significant leverage. New sensor and weapon payloads are smaller, lighter, and more capable, providing great capability per unit of weight. New data links can provide high-bandwidth connectivity for vehicle command and control, payload command and control, and data transfer. Advances in microprocessor technology, software development, inertial navigation, and global positioning systems enable robust independent flight control systems and onboard processing of sensor data. New composite materials and improved propulsion systems result in lighter, smaller, and more stealthy airframes, with the resulting fuel efficiency leading to levels of endurance that exceed human tolerance. Leading the pack may be what the United States Air Force Scientific Advisory Board's "New World Vistas" study called uninhabited combat aerial vehicles. Still in the concept stage, these would feature pilots who sit in an execution center in the U.S. and fly the aircraft as far as half a globe away through high-speed fiber-optic and satellite links. They promise levels of

performance unattainable from manned aircraft because they won't have to operate within limits of human tolerance. The uninhabited combat aerial vehicles with plus-or-minus twenty-G capability will be able to defeat nearly all opposing antiaircraft missiles. Vehicles can be made smaller by eliminating displays, ejection seats, controls, life-support gear, and other aspects of manned aircraft, increasing stealth. They can extend aerodynamic performance to hypersonic range, permitting a direct attack of high-value targets from U.S. soil anywhere in the world in less than an hour.

An increasingly important aspect of the United States air power is precision guided munitions. They largely influenced the outcome of the Gulf War by quickly shutting down Iraq's air defenses. Such munitions already have provided a thousand fold increase in destructive power, compared to unguided bombs. Near-term systems include precision guided munitions upgrades and the Joint Direct Attack Munitions. The next generation sensor-fuzed smart weapons will be able recognize, identify, and sort targets even as their sensors guide them, achieving accuracies measured in centimeters rather than meters. Advances in technology are taking the United States away from primary reliance on putting munitions on a target. U.S. forces also will use disruptive measures, such as energy (lasers and high-power microwave bursts), electrons (directed radio-frequency energy), and deception. Also in development are "information munitions" to attack, destroy, confuse, or fool information systems. These munitions will enter a command's computers and destroy or distort files. Information warfare techniques, for example, could enable a war fighter to sift through an enemy's e-mail, discover locations of his weapons, and scramble his air defense computers. High-power microwave and laser weapons may work in tandem with or replace many traditional explosive weapons. They may, for example, penetrate an enemy fighter cockpit, illuminate the fire warning light, shut down digital engine controls, or make other covert inputs like penetrating flight controls and forcing an unwanted turn.

Situational awareness is a term seen for decades by fighter pilots as the vital difference between winning and losing in combat. It determines combat outcomes more than all other factors combined, including previous combat experience. Now in development are major upgrades for Airborne Warning and Control System and Joint Surveillance and Target Attack Radar System aircraft. The Airborne Warning and Control System (AWACS) will gain a doubled radar range against fighter-sized targets and an improved ability to detect and track cruise missile sized targets. Technology promises high-speed processors exceeding today's capability by a factor of 10,000 for AWACS aircraft. Synthetic aperture radar will be incorporated in sensors on distributed satellite constellations, unmanned aerial vehicles, munitions, and ground stations. Eventually, satellites will be able to locate an emitter with enough accuracy to permit delivery of Global Positioning System guided weapons even if emissions cease. Global awareness will include not only threat-related information but also information on one's own and allied forces--individual aircraft maintenance status, location, availability, mission status, and so on. It may include information from an enemy's databases. In fact, it may be more useful to preserve an enemy's command, control, communications, computer, and intelligence net than to destroy it, because US forces can take advantage of knowing what the enemy knows about his own assets.

One of a commander’s primary tasks is to gain and maintain information superiority, with the objective of achieving an effective command and control of assigned forces that functions faster than that of the adversary. The eventual goal of information superiority is greater than just having more information than an opponent. Information must be accurate, usable, and tailored for the user. Information superiority effects include the ability of commanders to consistently make accurate decisions more rapidly than the enemy. Information processing has greatly improved the accuracy of warfare. The Joint Tactical Information Distribution System, for example, offers an F-15 flight lead an improved view of

his tactical situation. This has greatly driven up kill ratios in peacetime air combat training. It permits real-time data exchange between aircraft and, accordingly, new tactics. It shows the position of all aircraft in a formation or strike package, as well as the location of enemy aircraft, ground forces, and other threats. The Joint Tactical Information Distribution System allows an exchange of digital information on relative positions, weapons availability, and fuel status, among other things, reducing the need for intra-flight voice communications. It indicates when other friendly fighters are being illuminated by radars. Other systems include advanced data-fusion software, interlinked but physically dispersed databases, and high-speed, large-capacity communications nets, all of which enable prompt and precise application of force.

Another benefit from the technological developments of air power is the synergism that has come from the greater efficiencies in joint operations. Military leaders are able to use the right assets in the right place at the right time using assets from other service branches. Technology is permitting movement toward true combined-arms and multinational operations.

Traditional service lines more and more are breaking down under the pressure of the continuing integration of systems and capabilities. In future wars, in which air activity will be a forerunner to any land operation and naval weapons can engage a wider range of land targets, the interests of mission effectiveness will require cross-service communication as a matter of routine. The U.S. is approaching a time when, for example, an Air Force sensor operator and coordinator could assign a Navy platform to launch an Army weapon in support of Marines. The next generation of aircraft will embody significant improvements in reliability, maintainability, and sustainability, making possible even greater leverage from fewer numbers. These advances even now permit the Air Force to maintain air dominance over hostile territory and enforce no-fly and no-drive zones.

Airpower can now make effective use of the middle and upper air to avoid enemy infrared surface-to-air missiles and antiaircraft artillery. Stealth is another technological development of air power that has changed the accuracy of warfare. The F-117's stealthy capabilities were a key factor in enabling the coalition to achieve air dominance early in Desert Storm. Stealth in the F-22 and Joint Strike Fighter will further change the existing rules of aerial combat. It is already forcing a complete change in tactics, both in air-to-air and in surface attack, for the possessor as well as for the side that lacks it. Stealth will allow airpower to operate virtually at will. The stealthy F-22 can use new radar systems without revealing its location. The active transmitter can be on an off-board platform like AWACS, and the fighter can receive intercept vectors with its radar operating in a standby mode, so as not to emit radiation that would reveal its location. Closely related in importance are the emerging advantages in reach in air-to-air combat and survivability to kill heavily defended ground targets.

Situation control from the outset of fighting has been by the technological development of air power. Thanks to this breakthrough, the initial blow can now achieve strategic goals in the first moments of combat and thus determine the subsequent course and outcome of a war. Before long, the initial attack may even be done without anyone seeing or knowing, for example, into computer systems, to pave the way for the delivery of munitions. As Desert Storm showed, the ability of independently applied airpower to control airspace and shape the battlefield eliminated any urgent need to commit ground forces.

Strategic events have changed and the technological developments of air power have changed the accuracy of warfare and in doing so, have created a new model for warfare. The old two-dimensional model of warfare has a sequential orientation. It assumes that an

enemy's military forces will be deployed to defend his centers of gravity. Thus, the two-dimensional model of warfare suggests that fielded armies and navies must be defeated and driven back, to the extent that an enemy's center of gravity becomes vulnerable. Seizing, controlling, and holding territory become of paramount importance in the old model of warfare. Further, progress is simple to evaluate; one uses a map and watches the orderly advance, or retreat, of the front lines. The new three-dimensional model of warfare is based on a unique capability that defines the new accuracy of air power. That capability is the quick concentration of great power over any spot on the surface of the globe. The result is that an enemy is vulnerable everyplace all the time. Theoretically, every tangible facet of an enemy's power structure can be attacked with equal facility at any time. The air campaign in Desert Storm illustrated the advantages of parallel operations in a three-dimensional model of war. The result was an aerial onslaught that put enormous pressure on the Iraqi strategic, operational, and tactical targets all at once and continuously, offering the enemy no chance to recoup.

The capabilities of modern air power have not only changed the accuracy of warfare but have created a truly three-dimensional war-fighting model and may preclude the need for sequential strategies in many situations. If an enemy is vulnerable everywhere all the time, commanders can choose and then orchestrate the combination of simultaneous or near simultaneous actions that will create the greatest impact upon that enemy's ability to resist. The result should be a rapidly unfolding campaign in which there are no front lines, in which holding territory is often irrelevant, and in which air, land, and sea forces are used to their greatest advantage against the most appropriate and important enemy vulnerabilities anywhere at any time.

Bibliography

Air Force Doctrine Document 1. U.S. Army War College. 17 November 2003. http://www.carlisle.army.mil/usacsl/divisions/pksoi/StaticDocuments/Air%20Force/afdd1.pdf (23 June 2007).

Drew, Dennis M. *Desert Storm as a Symbol: Implications of the Air War in the Desert*. Airpower Journal. Fall 1992. http://www.au.af.mil/au/awc/ns/electives/AirpowerPostGulfWar/Lsn03/drew_DS_symbol.pdf (23 June 2007).

Lambeth, Benjamin S., *Technology and Air War*. Air Force Magazine, November 1996, Vol. 79, No. 11. http://www.afa.org/magazine/nov1996/1196techairwar.asp (23 June 2007).

The U.S. Air Force Remotely Piloted Aircraft and Unmanned Aerial Vehicle Strategic Vision. Air Force Link, Shared Media. The United States Air Force, 2005. http://www.af.mil/shared/media/document/AFD-060322-009.pdf (23 June 2007).