Aerospace Power Capabilities

Aerospace power grows out of the ability to use a platform operating in or passing through the aerospace environment for military purposes. The advantages of operating in the third dimension create many important military capabilities and make aerospace power the most versatile component of military power.

Advantages in the Vertical Dimension

Elevation is the unique quality that distinguishes aerospace forces from surface forces. Elevation provides four important relative advantages. From their elevated positions, aerospace platforms have a broader perspective and, with freedom from surface constraints, they can travel faster, go farther, and move through a broader variety of motions than surface forces.

Perspective

Elevation provides a broader field of view than can be had by observers on the surface. This advantage is one of the reasons early aerospace systems were used to observe enemy operations and to spot for artillery fire.[1] As elevation increases, more of the earth's surface is visible, but the increased distance from the surface also decreases the detail that can be detected unless an optical or electronic aid is used.[2]

Speed

Being elevated above the surface gives aerospace platforms the potential to move very rapidly because they are not constrained by surface frictions or impeded by terrain obstacles. However, it is the mission and design of a particular platform that determines just how rapidly it can move.[3] Some missions require slow speeds or stationary positioning while other missions require very fast speeds. The salient point is that the aerospace medium allows platforms to travel at the speed needed to perform the missions for which they are designed.[4]

Range

Elevation also gives aerospace platforms greater potential range or, more correctly, greater potential access to the earth's surface. Aerospace forces can cross over the boundary between land and sea without difficulty, and they can surmount all other surface obstacles. Thus, elevation provides aerospace forces the capability to travel to a point above any spot on the earth.[5]

Maneuverability

While surface forces can move only on the earth's surface and are dependent on its features for any vertical movement, elevation gives aerospace platforms three-dimensional maneuverability.[6] The mission an aerospace platform is designed to perform determines the degree of maneuverability it must have. Some platforms, such as air-to-air fighters, must have exceptional agility to perform their missions. At the other extreme, a geostationary satellite needs only enough maneuverability to maintain position over a spot on the earth's surface. In either case, the environment permits the platform to accomplish its mission by allowing movement in all three axes.

Capabilities

Aerospace power's advantages in perspective, speed, range, and maneuverability result in greater mobility and responsiveness than is possible for surface forces. This combination of factors produces the unique flexibility and versatility of aerospace power.

Mobility

As used here, mobility refers to the ability of military forces to move from one place to another quickly enough for the movement to be of military value.[7] Mobility is, in its simplest form, a combination of range and speed. A force which increases its range or speed (or both) increases its mobility. Land, sea, and aerospace forces can all be mobile. However, aerospace platforms with their advantages in speed and range have an attendant advantage in mobility.

Surface forces compatible with airlift platforms can increase their mobility by using the range and speed of airlift aircraft.[8] Spacelift forces provide similar mobility to satellites between surface bases and operating orbits.[9]

Some aerospace platforms, such as helicopters and short takeoff, vertical landing aircraft, are more tactically mobile than others because they can move to and operate from a variety of relatively unprepared locations.[10] More "conventional" platforms are tied to large, highly developed, and generally vulnerable bases. Currently, satellites are difficult to maneuver from one orbit to another and therefore have little tactical mobility. However, as technology advances, satellites may gain the ability to maneuver significantly, and tactical mobility in space may become a practical and useful reality.[11]

Responsiveness

Responsiveness is the ability to accomplish an assigned task quickly. Responsiveness is not just the ability to react to enemy actions, it also includes the ability to act offensively in a timely fashion to accomplish campaign objectives. Increased mobility—derived from range and speed—combined with broader perspective and three-dimensional maneuverability, makes aerospace forces highly responsive.

It has always been an advantage in battle to be able to act more quickly than the enemy. The cycle of military operations includes obtaining information about the enemy, deciding what to do based on the information, and performing the action. The cycle then begins again by obtaining information about the enemy's new condition, deciding what follow-on actions to take, and so on. If a military force can complete this cycle quickly enough, it can disrupt the enemy's cycle of operations by obviating the enemy's chosen course of action or by destroying his capability to perform that action.[12] Highly responsive forces, such as aerospace systems, are essential to disruption of the enemy's decision-action cycle.

Many aerospace forces are responsive in another way—they can quickly change from one mission to another. Most military aircraft can respond to rapidly changing circumstances during a single sortie as well as on successive sorties. This ability includes the tactical responsiveness to change targets rapidly or to recall or divert while en route.[13] Even some satellites have been reprogrammed to accomplish different tasks in orbit.

It is important to recognize that there are limits to aerospace power's responsiveness. For example, an in-place artillery battery may be able to respond to an infantry unit's request for supporting fire faster than an aircraft can launch from its base and fly to the point of needed support. However, if no artillery is within range, the aircraft probably can respond faster than artillery can be moved into position.[14]

Flexibility

Aerospace power's relative advantages in mobility and responsiveness combine to produce a unique flexibility that is the foundation of the employment concepts of aerospace power. Both aerospace and surface forces are versatile in that they can be used in differing ways under various conditions to produce diverse results.[15] Aerospace forces also have a type of flexibility that differs from that of surface forces in two ways: the ability to concentrate anywhere rapidly and to attack any type of target.

Due to their mobility, aerospace platforms can quickly concentrate power from widely dispersed locations to achieve an objective and then rapidly disperse again.[16] This capability was demonstrated in the massed Allied bomber raids of World War II, when more than 1,000 bombers launched from dispersed airfields in England, concentrated their striking power over targets on the continent, and then returned to their separate bases.[17] Should directed-energy weapons be deployed in space, even satellites, which are difficult to move from one orbit to another, could concentrate their power against specific targets through the use of reflector satellites. [18]

The second aspect of aerospace power's unique flexibility is an outgrowth of the first. Due to their mobility and responsiveness, aerospace assets can directly attack an enemy's political, military, economic, and social structure. Once they have gained control of the aerospace environment, they can strike at any facet of an enemy's power.[19] These two aspects of aerospace flexibility allow commanders to choose a course of action or develop a campaign plan from an expanded number of alternatives that would not otherwise be available.

Versatility

The versatility of aerospace power is derived from its inherent speed, range, and flexibility.[20] Because of these characteristics, a number of authors have contended that aerospace power is the dominant factor in modern warfare.[21] While this point of view has been and continues to be controversial, the ability to employ aerospace power rapidly against any level objective makes it the most versatile component of military power. Indeed, the validity of the pervasiveness of aerospace power in all aspects of modern warfare is no longer in question.[22]

From nuclear deterrence to directly supporting the land forces' scheme of maneuver, aerospace power's versatility provides a wide range of options and opportunities. For example, both our World War II and Operation Desert Storm experiences vividly demonstrate the ability of aerospace forces to independently (or in conjunction with surface forces) attack strategic, operational, and tactical objectives, simultaneously or separately. At the strategic level, using aerospace power to carry out persistent, coordinated strategic attacks against an enemy's centers of gravity will affect his capability and may affect his will to wage war. At the operational level, interdiction of enemy lines of communications can prevent or delay resupply or reinforcement and thereby disrupt the enemy's timing and tempo. At the tactical level, close air support can be critical to ensuring the immediate success or survival of surface forces.

Centralized control of aerospace forces is critical to the effective exploitation of aerospace power's versatility. As Gen Bernard L. Montgomery, commander of the British Eighth Army, observed in January 1943, "Nothing could be more fatal to successful results than to dissipate the air resources into small packets placed under command of army formation commanders, with each packet working on its own plan."[23]

Conclusion

The advantages of the vertical dimension together with the capabilities of aerospace power produce a wide variety of options and opportunities for accomplishing national objectives. The combination of aerospace power's outstanding attributes provides the foundation for its employment concepts. Aerospace forces must be employed to exploit these attributes if we are to realize their full potential and contribution to national defense.

Notes

1. M. J. B. Davy, *Interpretive History of Flight* (London: His Majesty's Stationery Office, 1948), 132.

2. For a method of calculating the percentage of the earth's surface visible to satellites at various heights, see Lt Col David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, Ala.: Air University Press, June 1988), 29 (note 5).

3. For a discussion of early (1914–1918) developments in aircraft design related to increasing speed and how it affected employment, see I. B. Holley, *Ideas and Weapons* (new imprint, Washington, D.C.: Office of Air Force History, 1983) and Davy, 130–39.

4. There are presently speeds which platforms operating in the atmosphere cannot exceed without excessive heating due to atmospheric friction. However, this constraint may prove to be a technological rather than a physical barrier. Solutions may yet be found, just as they were found to allow aircraft to exceed the sound barrier. Currently, there are no obstructions to the speeds at which platforms operating in space can travel, although there may be another barrier to be overcome as we approach the speed of light.

5. Maj Gen William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power—Economic and Military* (Port Washington, N.Y.: Kennikat Press, first published in 1925, reissued in 1971), 3–5.

6. Other than aerospace platforms, the only weapon system type that can maneuver in all three axes is the submarine.

7. Air Marshal Sir Michael Armitage, "Manned and Unmanned Aircraft," in *War in the Third Dimension: Essays in Contemporary Air Power*, ed. Air Vice-Marshal R. A. Mason (London: Brassey's Defence Publishers, 1986), 192. Discussing the operational advantages of aircraft, Armitage noted that the mobility factor

> to a unique degree gives aircraft the ability to focus fire power rapidly at critical times and places, thus making an often decisive contribution to the overriding principle of war—concentration of force at the decisive point. One corollary of this mobility is that it brings with it the potential capability of rapid dispersal in order to avoid the parallel air power initiatives of an opponent. High mobility also brings with it the ability to adopt, if necessary at short notice, an ostentatious alert posture; or to reinforce across very wide geographical areas so as to demonstrate commitment or intent; and once deployed, that mobility also means that a relatively small force can be used to generate a high number of operational sorties in the area of interest.

8. For a discussion of tactical mobility provided to surface forces by airlift aircraft, see Group Captain Timothy Garden, "The Air-Land Battle," in *War in the Third Dimension*, 162–64.

9. Spacelift is such an important function that Congress has held joint hearings to determine the best way to ensure access to space. See House, *Assured Access to Space during the 1990s: Hearings before the Subcommittee on Space Science and Applications of the Committee on Science and Technology and the Subcommittee on Research and Development of the Committee on Armed Services*, 99th Cong., 1st sess., 1985. Concerns over access to space were heightened by the shuttle *Challenger* disaster in January 1986, and additional hearings were held later that year focusing on the role of the shuttle as compared to expendable launch vehicles.

10. Giulio Douhet saw the need for this kind of tactical mobility and suggested:

> Of necessity, the dispersion of aerial units will have to be on improvised airfields during the war, thus avoiding disaster by camouflaging them as much as possible and by being ready to change location as fast as the bases are identified by the enemy. This means the aerial units must be highly mobile and autonomous. Large permanent airfields near the front should be moved back to prevent the destruction of the materials in them.

Giulio Douhet, *The Command of the Air*, trans. Dino Ferrari (New York: Coward-McCann, Inc., 1942), 137.

11. For a discussion of the characteristics of space forces including their current lack of maneuverability and potential future mobility, see Lupton, 17–31.

12. This cycle is essentially the observation-orientation-decision-action (OODA) loop attributed to Col John Boyd from his "asymmetric fast transient" theory of conflict. Colonel Boyd, "Patterns of Conflict," slide briefing given to the Air Command and Staff College, Air University, Maxwell AFB, Ala., 1979. Slide 109 includes the following statement:

> Observe, orient, decide, and act *more inconspicuously, more quickly*, and with more *irregularity* (or fluidity) as basis to keep or gain initiative as well as to repeatedly and unexpectedly focus main effort thru [sic] vulnerabilities and weaknesses exposed by that effort or other effort(s) that tie-up, divert, or drain away adversary attention (and strength) elsewhere [emphasis in original].

Other more available sources that discuss the OODA loop and the asymmetric fast-transient theory are Maj James M. Simpson, "Doing Things the Same or Differently: An Alternative Approach to the Study of Conflict," *Air University Review* 31, no. 4 (May–June 1980): 88–93; and Capt Kevin B. Smith, "Combat Information Flow," *Military Review* 69, no. 4 (April 1989): 42–54.

13. Armitage, 193. Here Armitage uses the term *flexibility* to refer to what we are calling responsiveness, but the concept is the same. We have reserved the term flexibility for another meaning as discussed under that heading in the essay.

14. Garden, 156. Here Garden discusses transit time and the fact that "artillery, infantry weapons, and tanks in contact with the enemy can respond in very short time scales, and at significantly less cost than expensive air assets."

15. Armitage, 192–93, calls this versatility *adaptability*, but his point is the same.

16. Early airpower thinkers recognized this quality as the essence of aerospace power's flexibility. For example, Lord Arthur William Tedder noted:

> The flexibility of air [power] is indeed one of its dominant characteristics. From one base area it can strike at a variety of targets over a wide area; conversely, from widely separated bases it can strike at a single target or target system.
>
> Given centralized control of air forces, this flexibility brings with it an immense power of concentration which is unequalled in any other form of warfare. In other words, if properly used, the flexibility of air [power] enables it to be highly economical.

Air Chief Marshal of the Royal Air Force Lord Tedder, *Air Power in War* (London: Hodder and Stoughton, 1948), 89.

17. For example, on D day of the Normandy invasion between the hours of 0155 and 0529, 1,361 B-17s and B-24s launched on missions against coastal batteries and shore defenses. Of those, 1,083 arrived over their targets six squadrons abreast and dropped 2,944 tons of bombs. Wesley F. Craven and James L. Cate, eds., *The Army Air Forces in World War II*, vol. 3, *Europe: ARGUMENT to V-E Day, January 1944 to May 1945* (Chicago: University of Chicago Press, 1951; new imprint, Washington, D.C.: Office of Air Force History, 1983), 190.

18. For a discussion of directed-energy weapon potential, see G. Harry Stine, *Confrontation in Space* (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1981), 99–109.

19. Douhet, 50.

20. Versatility was one of the major themes of a white paper by Secretary of the Air Force Donald B. Rice entitled *The Air Force and U.S. National Security: Global Reach—Global Power* (Washington, D.C.: Department of the Air Force, June 1990). On page 7, Secretary Rice discusses versatility in terms of speed, range, and flexibility and concludes, "This ability to rapidly project power, as well as readily adapt to changing circumstances and environments, will be increasingly important in the future."

21. While this assertion in its most strident form is generally attributed to the early airpower advocates like Douhet, other writers have made similar but more qualified claims. For example, Lord Tedder states,

> I am utterly convinced that the outstanding and vital lesson of this last war is that air power is the dominant factor in this modern world and that, though the methods of exercising it will change, it will remain the dominant factor so long as power determines the fate of nations. I believe that sea power is still vital to our very existence, and I am sure that sea power, properly exercised, can still be one of the keys to our security and not merely a commitment.

Tedder, 123. More recently, Indian Air Commodore Jasjit Singh observed,

> This history of warfare in the 20th century emphasises [sic] the increasingly dominant role of air power, which is now reaching nearly pervasive dimensions. . . . However, one fundamental fact must not be allowed to cloud the acceptance of air power as the dominant factor in war: *air power is an integral part of warfare*, therefore, it must be seen in its correct perspective in relation to land and sea power. Historically, air power has indeed substituted for land and sea power: not completely and absolutely or indefinitely, but to a certain extent [emphasis in original].

Air Commodore Jasjit Singh, *Air Power in Modern Warfare* (New Delhi: Lancer International, 1985), xvii–xviii.

22. Mason identified two reasons for this change in attitude.

> First, the unique qualities of air power are now beyond dispute: the ability to deliver many different kinds of weapons on an unlimited variety of target arrays with a speed and destructive capacity over distances beyond the dreams of all but the most optimistic of visionaries; to extend the reach of ground forces by intercontinental airlift or by placing special forces deep behind enemy lines; to provide reconnaissance or early warning of attack many hundreds of miles behind the point of encounter on land or at sea.
>
> Second, it can be argued that airmen themselves have come to a much more mature appreciation of both the potential and limitations of air power. The unique features are rightly emphasized, but others, inherited from centuries of warfare on sea and land are given their due consideration.

Air Vice-Marshal R. A. Mason, "War in the Third Dimension: Continuity, Innovation and Convergence," in *War in the Third Dimension*, 4, 6.

23. Quoted in Robert Frank Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force*, vol. 1, *1907–1960* (Maxwell AFB, Ala.: Air University Press, December 1989), 137. In the same paragraph, Futrell quotes a March 1943 letter from Maj Gen Carl Spaatz (after he had organized the Northwest Africa Allied Air Force) to Gen Henry H. ("Hap") Arnold which emphasized that

> the air battle must be won first. . . . Air units must be centralized and cannot be divided into small packets among several armies or corps. . . . When the battle situation requires it, all units, including medium and heavy bombardment must support ground operations.