# The Airfield as a System

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US Air Force airfields are partners in airpower with aircraft, but they are also centers of gravity that cannot maneuver at tempo, making them a potential weakness for adversaries to exploit. If the Air Force is to prevail in great power competition, it needs to rethink airfield organization. Systems thinking can help the Air Force reorganize its airfields into maneuverable rhizomatic teams, mitigating the shortfalls of traditionally organized airfields. This study aims to help Air Force decisionmakers guide the development of airfield systems whose potential has remained relatively unexplored.

When one is asked to visualize American airpower, airfields rarely come to mind. Instead, one would likely conjure the image of a flight of F-100s menacing the skies over North Vietnam, unending streams of C-54 Skytrains breaking Stalin's blockade of West Berlin, or perhaps B-29s lifting off from Tinian to usher in the atomic age of history. Few would consider the outnumbered airfield defenders of Tan Son Nhut airfield repelling waves of North Vietnamese sappers during the Tet Offensive; the constant guiding hand of Tempelhof approach controllers bringing in the endless airflow of the Berlin Airlift; or the resourceful Seabee combat engineers on Tinian island blasting coral to build B-29-capable runways.[1] Airfields are perhaps a less sleek and more subtle reminder of American airpower, but airfields and the service members who defend them, operate them, and build them have always been partners in airpower right alongside aircraft.

Former Chief of Staff of the Air Force General Charles Q. Brown's *Accelerate Change or Lose* action orders are now over three years old.[2] In that time, airfields played critical roles in the Afghanistan retrograde of 2021, Russia's aggression against Ukraine in 2022,

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1. Scott Wakefield, "A Look Back at the 377th Security Police Squadron's Defense of Tan Son Nhut," Air Force Global Strike Command – AFSTRAT AIR, September 22, 2022, https://www.afgsc.af.mil/; "MISSIONS: Tinian," 6th Bomb Group, accessed August 20, 2023, https://6thbombgroup.com/; and Stewart M. Powell, "The Berlin Airlift," *Air & Space Forces Magazine*, June 1, 1998, https://www.airandspaceforces.com/.

2. Charles Q. Brown Jr., *Accelerate Change or Lose* (Washington, DC: United States Air Force [USAF], August 2020).

and the People's Republic of China (PRC) expansionism in the South China Sea in 2023.[3] Yet, airfields are still not organized to best maximize agile combat employment (ACE), as they remain siloed and parochial.

The US Air Force needs to operate and maneuver airfields at tempo to execute ACE successfully, but the service is finding that often it cannot do so fast enough to execute the hub-and-spoke schemes of maneuver. As a result, airfields are putting ACE at risk, and in turn, the nation's ability to prevail in great power competition.

This article argues for a change to this status quo: airfields must be reframed, redefined, and reorganized. First, Air Force leaders must reframe the airfield by acknowledging it is a center of gravity (CoG)—a strategic focal point—with inherent strengths and weaknesses. Secondly, leaders must use a system-of-systems framework to redefine airfields and shape them into systems that mitigate the weakness inherent in CoGs. Finally, the Air Force must reorganize airfields into smaller, rhizomatic weapon systems equipped with a pioneering, mission-driven ethos agile enough to keep pace in great power competition.

## Centers of Gravity

Many people think of the airfield as infrastructure that supports operations—a miniature city bustling with the activities of combat airpower generation. Yet consider the distant floating relative of the airfield, the aircraft carrier. Despite its benign name, the aircraft carrier is instantly recognized around the world as a symbol of American naval power. When aircraft carriers sail somewhere, it can be a reassuring gesture for Allies and a not-so-subtle threat to would-be adversaries.

When the Air Force maneuvers an airfield into place, it is an equivalent gesture. Like aircraft carriers, airfields represent a gateway through which forces many time zones away suddenly appear in the local environment, shifting the regional balance of power with little warning. This maneuver and concentration of forces gives air component commanders enormous power and makes the airfield into a natural focal point of airpower. This concentration phenomenon makes an airfield a center of gravity.

Air forces around the world have long understood airfields as CoGs. Early airpower theorist Italian General Giulio Douhet wrote in 1927 about both the unparalleled offensive potential of aircraft as well as the relative vulnerability of aircraft when they returned

3. Clayton Thomas et al., *U.S. Military Withdrawal and Taliban Takeover in Afghanistan: Frequently Asked Questions*, R46879 (Washington, DC: Congressional Research Services, updated September 17, 2021), https://crsreports.congress.gov/; Bradley Martin, D. Sean Barnett, and Devin McCarthy, *Russian Logistics and Sustainment Failures in the Ukraine Conflict* (Santa Monica, CA: RAND Corporation, 2023), https://doi.org/; Liam Collins, Michael Kofman, and John Spencer, "The Battle of Hostomel Airport: A Key Moment in Russia's Defeat in Kyiv," *War on the Rocks*, August 10, 2023, https://warontherocks.com/; and "China Appears to Be Building an Airstrip on a Disputed South China Sea Island," AP, August 17, 2023, https://apnews.com/.

to land at the "nest."[4] Though the vulnerability of airfields has been implicitly understood for decades, a deeper discussion on what explicitly makes airfields a center of gravity is warranted, because there is little contemporary literature or Air Force doctrine that explains why. Reframing airfields as CoGs sets the stage for redefining airfields as systems-of-systems before reorganizing them into something more rhizomatic and pioneering.

## *Classical Application to Airfields*

The term center of gravity translates from the German *ein Zentrum der Kraft und Bewegung*.[5] The term was borrowed from physics by Carl von Clausewitz in the early-nineteenth century and describes a point of cohesion in an enemy where a striking blow would prove most effective. The intent of the Newtonian metaphor was to echo the effect of a physical blow against an object's literal center of gravity.[6] Clausewitz's center-of-gravity metaphor has endured from the Napoleonic era and still finds use among military theorists and practitioners today. It remains a central concept in Joint warfighting doctrine.[7]

Using this classic notion as discussed by Clausewitz reveals four reasons why airfields are centers of gravity: (1) airfields contain the mass of Air Force forces and act as a hub, (2) airfields are central to the maneuver of Air Force forces and ground forces, (3) the geographical location of airfields determines how air campaigns are waged, and (4) airfields can exert economic and political influence during peacetime as well as wartime.

**Mass.** Tactically and operationally speaking, airfields contain the mass of Air Force forces and serve as a hub of activity. Aerial ports, air traffic control towers, aircraft maintenance hangars, fuel farms, runways, taxiways, aprons, navigational aid facilities, and the airfield's airspace maintain the highest concentration of forces at the point at which aircraft and personnel are at their most vulnerable for the longest period of time—sitting ducks, in other words.[8]

**Maneuver.** In terms of logistics, airfields can send and receive inter- and intra-theater logistics airflow. The ability to maneuver forces from one part of the world to another at the speed of airlift is what gives the US military a global versus regional influence. Joint forceable entry operations such as airfield seizures have been used throughout the history

4. Giulio Douhet, *The Command of the Air,* trans. Dino Ferrari (Maxwell AFB, AL: Air University Press [AUP], 2019), https://www.airuniversity.af.edu/.

5. Joseph L. Strange and Richard Iron, "Center of Gravity: What Clausewitz Really Meant," *Joint Force Quarterly* 35 (2004).

6. Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1989).

7. *Joint Planning*, Joint Publication (JP) 5-0 (Washington DC: Chairman of the Joint Chiefs of Staff, December 1, 2020).

8. Alan J. Vick, *Snakes in the Eagle's Nest: A History of Ground Attacks on Air Bases* (Santa Monica, CA: RAND Corporation, January 1, 1995), https://doi.org/.

of airpower.[9] Some examples include Russia's attempted seizure of Hostomel Airport in the opening days of its invasion of Ukraine (2022), the US seizure of Rio Hato Airfield during its invasion of Panama (1989), and the Nazi Airborne jump operations on Maleme airfield in Malta during World War II (1941).[10]

**Geography.** The Air Force needs an airfield, airspace, aircraft, and many other systems to project airpower. Airfields are the keystone support system that make airpower work. The location of the airfield changes how airpower is employed. Airfields that are close to the adversary pose different risks to mission and force than airfields that are distant. Each has its own advantages and disadvantages. During World War II, Soviets favored airfields close to the front lines of their advance because proximity gave their air forces the agility they required to execute combined arms against the Germans.[11] During Operation Odyssey Dawn, however, the US Air Force used B-1Bs from Ellsworth Air Force Base, South Dakota, to strike targets in Libya by flying sorties from the continental United States to North Africa.[12]

**Influence**. Airfields exert economic and political influence, and they can do so outside of war. Unlike fighters and bombers which can only kill enemies, practice killing enemies, or fly near adversaries to remind them that they can kill enemies, airfields controlled or operated by the military can also be used for a range of operations that are below the continuum of armed conflict. Examples include humanitarian assistance airlift operations following the 2005 earthquake in Pakistan, which tangibly and positively affected the state's short-term opinion of the United States, and China's construction of a ring of airfields in the South China Sea to exert greater control over territorial claims.[13]

## *Contemporary Application to Airfields*

Contemporary center-of-gravity theory focuses on thinking of CoGs as systems that can be broken down into subsystems, analyzed for weaknesses and then targeted. The Air Force associates systems-based CoG thinking with Colonel John Warden, who applied his five-rings targeting methodology while planning air campaigns against Iraq. After the

9. R. F. M. Williams, "The Development of Airfield Seizure Operations in the United States Army," *Military Review*, November 2021, https://www.armyupress.army.mil/.

10. Collins, Kofman, and Spencer, "Hostomel Airport."

11. Martin van Creveld, Steven L. Canby, and Kenneth S. Brower, *Air Power and Maneuver Warfare* (North Charleston, SC: CreateSpace Independent Publishing Platform, 2012).

12. Steven J. Merrill, "Ellsworth Airmen Recall Historic Mission 10 Years Later," Ellsworth Air Force Base, March 27, 2021, https://www.ellsworth.af.mil/.

13. *Competition Continuum*, Joint Doctrine Note 1-19 (Washington, DC: CJCS, June 3, 2019); Kali Gradishar, "CRE Airmen in Pakistan Relate 2005 Earthquake to 2010 Flood Operations," Air Mobility Command, October 12, 2010, https://www.amc.af.mil/; and Jennifer D. P. Moroney, *Lessons from Department of Defense Disaster Relief Efforts in the Asia-Pacific Region* (Santa Monica, CA: RAND Corporation, 2013).

success of Operation Desert Storm, contemporary thinking about CoGs grew conceptually from culminating battles against focal points to include systems-based warfare.[14]

Another scholar highlights seven common but not universal systems around which contemporary CoG literature tends to coalesce: fielded military, leadership, industry, infrastructure, population, public opinion, and ideology.[15] The Air Force and Western military thinkers understand the weaknesses of CoGs—as do potential adversaries. The PRC has grown a systems-based framework of warfare directly in response to the Western use of systems-based targeting frameworks such as Warden's rings or other contemporary CoG analyses.[16] Essentially, centers of gravity like the airfield can be broken down into subsystems, analyzed for weaknesses, targeted, and neutralized.[17]

On a practical level, Air Force planners understand the threat adversaries pose. They know that wrestling for air superiority often requires maneuvering their aircraft and ground forces against an adversary. Allies in World War II, notably the American Air Forces of the South Pacific, maneuvered in conjunction with Australian ground forces from airbase to airbase, fighting against Imperial Japanese forces setting up decisive engagements like the Battle of the Bismarck Sea.[18] Ample Gain, a Cold War series of Allied aircraft cross-servicing events and forerunner of agile combat employment, used the robust network of NATO airbases to maneuver combat aircraft around what would be recognized today as a base cluster.[19] Ample Gain worked because of robust airfield infrastructure, a large network of NATO bases, and interoperable combat support functions.

The Air Force's current strategy of agile combat employment, "a proactive and reactive operational scheme of maneuver executed within threat timelines to increase survivability while generating combat power," relies on the dispersion of airpower from a main operating base into basing clusters to complicate enemy targeting.[20] Unlike Ample Gain, ACE maneuvers both aircraft and airfields to complicate targeting while generating opportunity.

In terms of airfields and CoGs, the Air Force uses ACE to hedge against the inherent vulnerabilities of large, static airfields by relying on the speed and surprise of maneuverable airfields. ACE requires both Air Force aircraft and ground forces to simultaneously

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14. Jeffrey Engstrom, *Systems Confrontation and System Destruction Warfare: How the Chinese People's Liberation Army Seeks to Wage Modern Warfare* (Santa Monica, CA: RAND Corporation, 2018), https://doi.org/.

15. Miha Šlebir, "Re-Examining the Center of Gravity: Theoretical and Structural Analysis of the Concept," *Revista Científica General José María Córdova* 20, no. 40 (December 2022), https://doi.org/.

16. Engstrom, *Systems Confrontation*; John Warden, "The Enemy as a System," *Airpower Journal* 9, no. 1 (1995); Joe Strange, *Centers of Gravity & Critical Vulnerabilities: Building on the Clausewitzian Foundation So That We Can All Speak the Same Language*, 2nd ed. (Darby, PA: Diane Publishing, 1996); and JP 5-0.

17. Warden; and Strange.

18. Thomas E. Griffith Jr., *MacArthur's Airman: General George C. Kenney and the War in the Southwest Pacific*, 1st ed. (Lawrence: University Press of Kansas, 1998).

19. *Joint Air Power following the 2016 Warsaw Summit: Urgent Priorities* (Kalkar, Germany: Joint Air Power Competence Centre, October 27, 2017), 98, https://www.japcc.org/.

20. *Agile Combat Employment*, Air Force Doctrine Note 1-21 (Washington, DC: Department of the Air Force [DAF], August 23, 2022), 1, https://www.doctrine.af.mil/.

maneuver in response to emergent threats. Maneuver of aircraft via flush—a type of launch-for-survival—is a skillset that aircraft had before ACE and one that aircraft still practice. Yet, Air Force ground forces cannot keep pace because rapid reactive or proactive maneuver of ground forces in response to emergent threats is still not a cultural norm in the Air Force.

Reframing airfields as CoGs in the classical sense and in the contemporary sense provides two key insights. First, in the classical sense, airfields have a cohesive identity as a system that military commanders can employ to achieve effects. Second, in the contemporary sense, airfields can be dissected into subsystems and targeted by adversaries. The Air Force understands this and actively tries to mitigate this via schemes of maneuver such as ACE.

## Systems-of-Systems

Contemporary Wardian CoG analysis hints at the systems-based thinking paradigm used to define many of society's and nature's complex systems. The Air Force needs to think of airfields as systems so the service can reorganize them into systems that mitigate their historical vulnerability. The system-of-systems framework breaks down complex systems such as airfields, allowing the Air Force to understand and reshape them.

Airfield systems possess five characteristics appropriate for the system-of-systems designation: operational independence, managerial independence, geographic distribution, emergent behavior, and evolutionary development.[21]

### *Operational Independence*

This characteristic is straightforward when looking at airfields. A system is made of separate component systems that are capable of independent operation. Military airfields are meta systems with component systems, and they themselves are component systems in a larger system. As meta systems, they contain component systems such as radar systems, air traffic control facilities, pavement systems, and lighting systems. Each of these provides use independent of the others.[22] Airfields are also component systems of larger systems like the National Airspace System (NAS), within which an airfield operates independently of the others.[23]

### *Managerial Independence*

Component systems are acquired and integrated into a meta system to achieve a specific purpose. At first glance, military airfields can seem like integrated monolithic entities

21. Andrew Sage and Christopher Cuppan, "On the System Engineering and Management of Systems of Systems and Federations of Systems," *Information-Knowledge Systems Management* 2 (December 1, 2001).

22. Sage and Cuppan.

23. "National Airspace System," Federal Aviation Administration (FAA), last updated April 20, 2023, https://www.faa.gov/.

under the control of a commander; however, airfields are managerially independent of the systems they are administratively grouped with. An apt example comes from comparing Chicago O'Hare International Airport to Travis Air Force Base (AFB). The more federated civil airfield of O'Hare has a diverse and loosely affiliated ecosystem of agencies that interact for the common goal of generating economic activity.

O'Hare's airfield, aircraft, logistics operations, housing communities, and security functions are all distinct component systems required for the airport to function. As noted, the airfield's systems are run by a loose, federated mix of government, commercial, and private organizations. Geographically, some of these systems are not run or located out of Illinois, much less O'Hare itself, but they all collaborate to produce safe, efficient airflow and economic activity that benefits the region.[24]

O'Hare's comparatively more federated organization contrasts with the 60th Air Mobility Wing at Travis AFB. Travis is geographically concentrated and under the management of a wing commander. The wing at Travis AFB has aircraft, an aerial port, security forces, and basing facilities—including gyms, restaurants, and housing—all within approximately a mile of the airfield. At first glance, the military airfield appears completely integrated with the rest of the installation under the command of the wing commander.

Yet upon closer inspection, the airfield and its airspace are unique from the other parts of Travis AFB. The airfield is part of the NAS, which provides regulatory oversight over portions of airfield operations. The airfield has its own specialty fire-fighting equipment and crews, distinct engineering regulations, and specific force protection requirements. Although the wing commander at Travis has command of its airfield, the authorities, resourcing, and systems used to run the airfield are not interchangeable with those used to run the basing. Thus, it can be said that the airfield at Travis AFB can operate independently of the attached base.

## *Geographical Distribution*

The system is often geographically spread out and connected via information exchange. Airfield operations stretch from the surface to the top of an airfield's airspace. They extend from an airfield's center point to the edges of approach airspace. Yet component systems that support the airfield system may be located several feet underground, such as the airfield lighting system, to several hundred miles above the airfield, such as position, navigation, and timing satellites. Other typical examples of geographically distributed component systems include radar towers placed on nearby hills serving airfields in their proximity, or command-and-control centers located thousands of miles away.

24. Matt O'Shea, "Ald. Matt O'Shea: O'Hare's Facilities Are Aging. Terminal Expansion Plans Are Crucial to Move Chicago Forward," *Chicago Tribune*, January 11, 2024, https://www.chicagotribune.com; and "Great Lakes Region," FAA (website), last updated March 11, 2024, https://www.faa.gov/.

## *Emergent Behavior*

The system has capabilities that do not reside within the component systems. The career fields and component systems of air traffic control; radar, airfield, and weather systems maintenance (RAWS); and airfield management cannot run an airfield by themselves. When they are combined into a flight and unified under the control of an airfield operations officer, however, they produce the emergent property of airfield operations.[25] The Air Force did not mastermind the creation of the airfield operations flight, but rather, air traffic control was combined with airfield management and RAWS over a series of years to meet the emergent demands of running an increasingly complex airfield system. Over time, the chief air traffic control officer came to run the airfield management and RAWS sections and slowly evolved into the airfield operations officer known today.

Understanding the airfield system and airfield operations as emergent might help explain why the Air Force does not have a stand-alone body doctrine that describes airfield operations. There are unique behaviors and properties of airfield systems which might be considered universal to airfield systems:

a. They function as adaptable, evolving weapon systems that project tactical-, operational-, and strategic-level airpower effects.

b. They perform the function of "anchoring" military air operations to a local terminal node that concentrates and projects forces into the air and land domains, and potentially space.

c. They are configurable to meet mission, community, and stakeholder needs.

d. They are portals between the land, air, and even space domains, just as the airfield's floating cousin, the aircraft carrier, is a portal between the maritime and air domains.[26] Airpower effects and commerce pass through the airfield and influence the ground space, airspace, and political space around them.

e. They contain infrastructure component systems, but they are not solely infrastructure.

## *Evolutionary Development*

The system grows and evolves over time, never fully forming. Airfields evolve by adding or specializing their component systems. They change in response to their stakeholders,

25. Sage and Cuppan, "System Engineering."

26. Sandra Erwin, "SpaceX Wins $102 Million Air Force Contract to Demonstrate Technologies for Point-to-Point Space Transportation," *SpaceNews*, January 19, 2022, https://spacenews.com; Jane Edwards, "SpaceX Awarded $102M AFRL Rocket Cargo Contract," GOVCONWIRE, January 20, 2022, https://www.govconwire.com; and Mike Wall, "US Military's X-37B Space Plane Lands, Ending Record-Breaking Mystery Mission," Space.com, November 12, 2022, https://www.space.com.

nearby communities, and both natural and humanmade threats. An example is Afghanistan's Kandahar Airfield, an airfield built for piston engine aircraft in the 1960s. Kandahar expanded and changed under Soviet use in the 1980s to accommodate higher performance aircraft.[27] It expanded again under American use in 2001, and Kandahar continues to change after the American withdrawal from Afghanistan.

Understanding the airfield as a system of systems helps explain airfield system behavior. The system-of-systems framework also delineates the basic component systems (table 1). An understanding of these basic building-block categories enables the reorganization of airfield systems as CoGs to overcome their inherent weaknesses.

**Table 1. Typical airfield component systems**

| Categories of Systems | Examples | Narratives |
|---|---|---|
| operational surface systems | helipad, runway, launch pad, grass strip | operational surface that launches and recovers air/spacecraft |
| air traffic control, landing guidance, and weather systems | tactical air navigation (TACAN), RADARs, terminal instrument procedures/(non) precision approaches, GPS | family of systems that guides, senses, and detects aircraft or weather conditions in the terminal environment; provides command and control of aircraft |
| command, control, communication systems | tactical operations center | leads, manages airfield system, conducts C4ISR, early warning, personnel reporting |
| emergency service system | airfield rescue and firefighting, basic medical care, crashed, damaged, or disabled aircraft recovery (CDDAR), explosive ordnance disposal (EOD), rapid airfield damage recovery (RADR) | systems that provide emergency response, basic medical, triage, and recovery services necessary to resume normal airfield operations |

Two things are apparent in table 1. First, some systems on the airfield necessary to airpower do not support airfield operations—for example, aerial port facilities. Second, some systems and capabilities necessary to airfield operations are outside the typical airfield operations organization—for example, civil engineering pavements and airfield lighting technicians.[28] Of note, the component systems in table 1 correspond with the role of the "Senior Airfield Authority." Additionally, there are some civil engineering functions such as airfield rescue fire fighting required to perform airfield operations that fall under the Senior Airfield Authority's counterpart, the Base Operations Support Integrator. The current organizational hierarchy used to run airfields is thus coordination intensive and complex.

27. Monica Whitlock, "Helmand's Golden Age," BBC, August 7, 2014, https://www.bbc.co.uk/; and National Photographic Interpretation Center, "Imagery Analysis Report: Disposition of Soviet Air Forces in Afghanistan and in the USSR along the Afghanistan Border Area as of [redacted]," Z-20056/80, IAR-0173/80, declassified report (Washington, DC: Central Intelligence Agency, August 1980), https://www.cia.gov/.

28. *Contingency Basing*, JP 4-04 (Washington, DC: CJCS, January 4, 2019).

## Reorganizing Airfields

The system-of-systems framework clarifies what an airfield is, what it does, and what component systems make up the airfield. The next step is reorganizing those airfield component system building blocks to mitigate CoG-related critical weaknesses. Military structures are typically organized into a hierarchical structure like a chain of command.

One contemporary design scholar refers to such a structure as a root-tree form of organization.[29] Root-tree hierarchies form organizations which tend to develop into CoGs. An alternative hierarchical form to the root-tree form is the rhizome form of organization. A more rhizomatic form will typically "encompass ideas paradoxical to centralized hierarchical forms, such as 'self-organized,' 'decentralized,' 'nonlinear,' 'lacking order,' and 'irregular' or 'asymmetric'—terms often used in complex security challenges."[30] Rhizomatic organizations are more akin to loosely organized structures that break apart, reform, and scale as required to accomplish their goal, before breaking apart again.[31] Changing these hierarchical forms of organization starts with understanding what each excels at.

### *Root-Tree Form*

In the root-tree form, the "trunk" of the tree is a centralized focal point of organization that governs the "branches" growing off the trunk.[32] US military airfield systems currently are organized according to the root-tree system. In fact, root-tree hierarchy is the organizing principle of Air Force bureaucracy. In a typical wing, flights are nested under squadrons, which are nested under groups, which are nested under the wing. The wing commander is the focal point of decision and leadership. The wing commander is represented by the trunk where the branches all grow from. Airmen executing the mission represent the end branches farthest from the trunk. Once Airmen learn the root-tree logic of wing organization, they can walk into any squadron and understand how a squadron in a different wing is organized in a similar way.

Air Force airfields—root-tree organizations—and the rest of the entities operating on the airfield adhere to a standard military hierarchy that values efficiency.[33] Each function-based organization builds its own separate and parallel hierarchy. Each "siloed" hierarchy in these function-based organizations has independent versions of specialized workers, supervision, command posts, and so on.

The airfields' industrial-era Taylor-esque silos organize these systems in a root-tree form. This works well when a typical sequence of aircraft operations occurs: an aircraft

29. Ben Zweibelson, *Beyond the Pale: Designing Military Decision-Making Anew* (Maxwell AFB, AL: AUP, 2023), https://www.airuniversity.af.edu/.

30. Zweibelson, 225.

31. Zweibelson.

32. Zweibelson.

33. Stanley McChrystal et al., *Team of Teams: New Rules of Engagement for a Complex World,* 1st ed. (New York: Portfolio, 2015); and Zweibelson.

coordinates to arrive at the airfield; the aircraft enters the airfield's airspace, lands, and taxis to a predetermined parking spot; the aircraft and crew are regenerated; then the aircraft taxis, takes off, and exits airspace. This sequence is aircraft-centric—that is, processes are organized with reference to the aircraft—and each individual step in the process is supported by a specialized system with its own hierarchy.

This sequence of operations runs on procedural flow with respect to the aircraft and does not emphasize communications and relationships between systems in the sequence. The result is that each specialized system has its own way of coordinating with the aircraft. For example, during the flight back to an airfield an aircraft might communicate with a military-owned approach control, an air traffic control tower, supervisor of flying, a maintenance operations center, an air terminal operations center, the airfield management desk, and a base's command post.

## *Rhizome Form*

True agility will require the Air Force to change the form of its hierarchies. Root-tree form hierarchies have their virtues and efficiencies, but the structure is not optimal for producing small interdisciplinary teams that can effectively execute agile combat employment. The functional silos resulting from root-tree hierarchies are incentivized and organized to build connections vertically within the silo from the tactical up through the operational and strategic levels of war.

Generating flexible teams capable of ACE in response to a dynamic threat will require the Air Force to integrate an alternate form of organization known as the rhizome type. The rhizome is a horizontal root system capable of producing new shoot-and-root plants aboveground from the same root system underground, such as turmeric or ginger plants.[34] The effect is that one root system grows plant systems distributed across the ground, creating a resilient network.

Rhizome form, compared to the Aristotelian root-tree form, represents a postmodern means of organizational hierarchy. One analysis uses the analogy of the traditional library network versus the hyperlinked nature of the internet to characterize the root-tree-to-rhizome comparison.[35] In deconstructing why the Joint Special Operations Task Force retired Army General Stanley McChrystal commanded from 2003 to 2008 initially failed to decisively counter al-Qaeda in Iraq (AQI), a violent extremist jihadist organization, McChrystal and his coauthors point to the root-tree characteristics of the US military versus the rhizomatic nature of the jihadist network.[36] To match the adaptability and tempo

34. *Encyclopaedia Brittanica Online*, s.v., "Rhizome," last updated March 22, 2024, https://www.britannica.com/.

35. Lyn Robinson and Mike Macguire, "The Rhizome and the Tree: Changing Metaphors for Information Organisation," *Journal of Documentation* 66, no. 4 (2010), https://doi.org/.

36. McChrystal et al., *Team of Teams*.

of the inherently horizontal, rhizomatic, and dispersed al-Qaeda insurgency, McChrystal transformed the task force command structure into a flatter, more horizontal hierarchy. [37]

The vast majority of airfield systems are organized in a root-tree hierarchy and struggle to adapt and maneuver at tempo against adversaries. Yet today there are a select few airfield systems that can maneuver and adapt; these systems are notably rhizomatic. Contingency response is one such organization.

Contingency response forces are what the Air Force calls an "open the base" force, although this is somewhat of a misnomer.[38] They deploy to a location and, as long as the location has a suitable surface to land aircraft on, these forces open an airfield. Generally, once an airbase is opened, strategic and tactical airlifters such as the C-17 and C-130 start landing and flowing personnel and materiel through the airfield, which serves as an aerial port of debarkation.

Of note, contingency response teams only bring enough base operations support equipment to support themselves for approximately 45 to 60 days. The bed down of contingency response personnel is completely dependent on the terrain, the enemy, and the existing structures proximate to the airfield. Generally speaking, however, they will bed down in the immediate vicinity of the airfield they are operating.

Contingency response forces train in garrison to ingress to a potential airfield site, assess the airfield, and then receive fixed-wing mobility aircraft. A contingency response squadron has a cross-section of aircraft maintenance, security forces defenders, aerial port logistics, fuels, airfield operations, communications, civil engineering, command and control Airmen, and other specialized Airmen who provide services such as weather forecasting and defense against chemical, biological, radiological, nuclear threats.

A typical contingency response group is made up of contingency response squadrons and support squadrons. Groups have 36 unique Air Force Specialty Codes (AFSCs) of Airmen and train their Airmen to work in small, functional teams. These teams are not specific hierarchical silos. Rather, contingency-response teams are a cross-section of all the hierarchies by design.

In terms of system classification, contingency response forces are a system-of-systems made up of many diverse component systems. The main component systems used for military airfield operations are an airfield system, a logistics system, an aircraft system, and a force-protection system.

For example, a contingency-response team is a deployable team of Airmen that belongs to a contingency response squadron. The team of roughly 22 to 25 Airmen is typically led by a senior noncommissioned officer. This team can assess and open an airfield, sustain and protect itself at that airfield, perform air traffic or landing zone operations, perform airfield management, perform basic survey and civil engineering functions, exercise

37. Zweibelson, *Beyond the Pale*.

38. *Air Mobility Operations*, Air Force Doctrine Publication 3-36 (Washington, DC: DAF, June 28, 2019), Appendix C: Air Mobility Support and Contingency Response Elements.

command and control of an airfield, and perform continuous aerial port operations, one aircraft at a time for 12 hours.[39]

Because contingency response teams have aerial port logistics built into the structure, they can pack up their footprint and move themselves via airlift. This ability may seem mundane, but it is what makes these teams maneuverable. Most other squadrons in the Air Force—and indeed, across the entire Joint force—do not have this ability because it does not fall into their specialized siloed hierarchy. Most Air Force units do not have the know-how and specialized aerial port personnel and materiel to move themselves, and as a result, they cannot maneuver themselves out of harm or into an advantageous position.

Contingency response teams, like rhizomes, are dynamic. The traditional vertical root-tree airfield hierarchies are largely dissolved and flattened. Teammates share larger amounts of interoperability, allowing them to perform airfield, logistical, maneuver, and combat operations while maintaining a smaller footprint. These teams can combine with each other, and with a few additional personnel added as a coordination overhead, they can scale to form larger elements. For the ACE base cluster use case, the ability of contingency response teams to move themselves via airlift is ideal. They can be thought of as a well-rounded system of systems that open an airfield system to execute logistics and—when it is time to maneuver—as a logistics system that configures itself into self-loading cargo.

Figure 1 compares rhizomatic airfield systems such as contingency response teams to their root-tree form hierarchical counterparts. While not an exhaustive list of component systems that form these teams or air task forces, the figure illustrates the differences between root-tree and rhizomatic system-of-system groupings. The alpha level cannot be broken down further; the delta level represents groupings whose component systems are themselves systems of systems. The levels of system groupings (alpha, beta, etc.) denote the level of complexity, with alpha representing the simplest system level and delta the most complex.[40]

The Air Force needs more airfields that can maneuver themselves in small rhizomatic packages—airfield systems that look a lot like contingency response teams. These airfields would feature component systems from aircraft, logistics, force protection, basing, and other airfield systems to establish a system capable of projecting airpower in the right place and at the right time.

Such rhizomatic maneuverable airfields systems must be produced in large enough quantities that they can form networks of homogenous contingency response teams which can then combine or separate into diffused networks of airfields that maneuver in conjunction with aircraft. This network would support and complement the large, static, and root-tree-form main operating bases. The teams could move along the axis of advance, executing the ground scheme of maneuver in an air campaign.

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39. *Contingency Response*, Air Force Tactics, Techniques, and Procedures 3-4.7 (Washington, DC: Secretary of the Air Force, March 3, 2022), https://static.e-publishing.af.mil/.

40. D. A. DeLaurentis, "A Taxonomy-Based Perspective for Systems of Systems Design Methods," *Proceedings of the 2005 IEEE International Conference on Systems, Man and Cybernetics* 1 (2005), https://doi.org/.

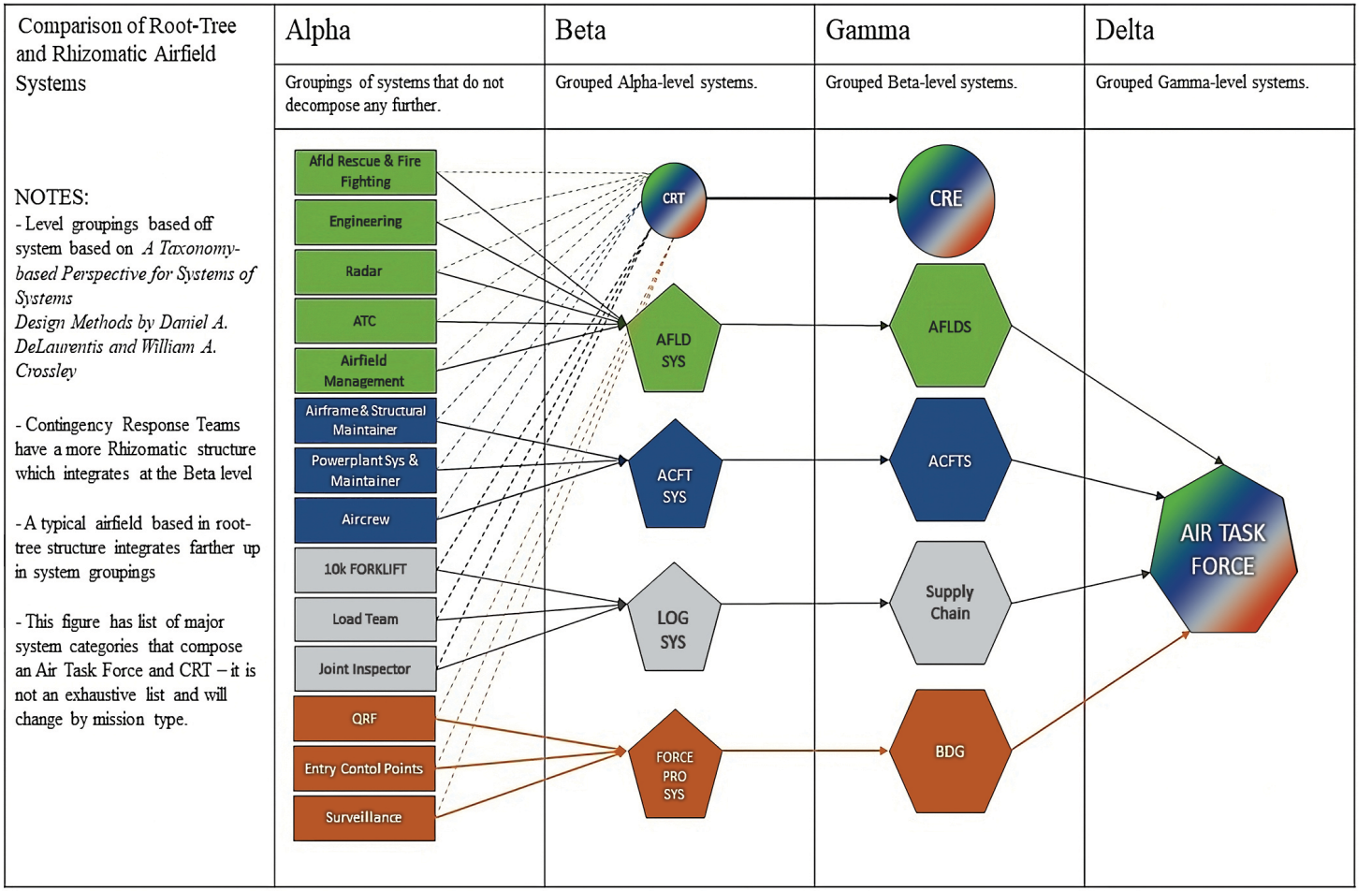


**Figure 1. Rhizomatic and root-tree system-of-systems groupings**

## *Pioneer Culture*

The Air Force must invest in the culture required to operate maneuverable airfields. This starts with creating an organization that supports a pioneering ethos, which is a prerequisite for scaling the number of rhizomatic organizations. Such a shift to a rhizomatic culture calls for teams staffed with strategically aware, high-initiative noncommissioned officers operating alongside company and field grade officers who are technically adept. This flattened rhizomatic organization would comprise self-sufficient, mission-driven problem solvers who get the job done creatively and effectively in a dynamically unfolding environment. These so-called Pioneer teams would be comfortable operating on their own initiative in maneuvering and executing the mission.

Pioneer teams would live on the edges of the known and unknown, providing a maneuverable airfield capability. Pioneer teams are not envisioned as special operational forces (SOF). In the Air Force context, they would be the forces that bridge the gap between SOF and the cultural mainstream of the Air Force. Pioneer team culture should be slightly more discerning than traditional Air Force forces but more scaled and reproducible than SOF. Individual Pioneers would value resiliency, self-sufficiency, technical acumen, and initiative. Pioneer teams would value flat communication, aggressive problem solving, and cross-trained skill redundancy, such that each individual team member would be a jack-of-a-few-trades and the master of one.

Contingency response forces in Air Mobility Command, Pacific Air Forces, US Air Forces in Europe, the Air National Guard, and Air Force Reserve have already started to foster the pioneering spirit by organizing Airmen into diverse squadrons built around the contingency response mission, creating a contingency-response Airmen identity. The Air Force must amplify this effect and supplant its primary AFSC identity with the contingency-response identity. Contingency-response Airmen must become contingency-response Airmen first and foremost via distinctive AFSCs, dress, and organizational values.

Finally, the Air Force should change the promotion system to value pioneer thinking and values while creating viable career paths that recognize Airmen who excel in flat, rhizomatic organizations. The traits that would help Pioneer Airmen excel in dynamic environments are different than those of Airmen who excel in the traditional root-tree hierarchy.[41] Contingency response Airmen would be ideal Pioneer Airmen. A Pioneer corps would accelerate organizational learning and reinforce the ethos required to execute rhizomatic "team-of-teams" hierarchies. Finally, it would allow the Air Force to obtain a higher return on investment when teaching specialized perishable skills in a multicapable Airmen setting—skills such as specialized fueling operations, landing-zone operations, shoot-move-communicate, advanced field craft, or weighing, marking, and joint inspection.

41. Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 2018).

## Recommendations and Conclusion

The Air Force needs to increase the number of contingency-response-team-like rhizomatic airfield systems to complement the Air Force's existing network of static airfields. A Pioneer organization could focus on the organization, train, and equip mission for all contingency response and contingency-response-like maneuverable airfield mission sets within the Air Force. How should the Air Force tailor its systems? How does it expand the contingency-response rhizomatic concept across the Air Force? The recommendations are threefold.

First, the Air Force needs to make the airfield a major weapon system akin to other non-aircraft weapon systems, such as the Guardian Angel Weapon System, used for combat search and rescue and personnel recovery. Although the airfield has long been acknowledged informally as such within the Air Force, the service-wide designation of airfields as weapon systems is a necessary step to accelerate their development. Such a designation is also a step in the right direction toward running the enterprise of airfields that range from the large, static root-tree systems to the small, rhizomatic maneuverable systems.

Secondly, similar to other Air Force nonaircraft weapon systems, contingency-response-team-like maneuverable airfield systems should be associated with organic airlift. Organic airlift allows maneuverable airfield systems to seize the initiative when they sense a window of opportunity or reposition when in imminent danger. This point is only reinforced by challenges in the Indo-Pacific where the tyranny of distance, the possibility of degraded command and control, and the threat of near-peer aggression emphasize the need for the ability to rapidly maneuver.

Lastly, Air Force leaders should capitalize on the effectiveness of maneuverable airfield systems that can perform agile combat employment by integrating airfield systems into Joint all-domain command and control. Airfields are natural platforms for command-and-control-related functions since position, navigation, and timing and two-way communication equipment are required for all-weather airfield operations.

Airfields work hand in hand with aircraft to project airpower. The Air Force needs rhizomatic airfield systems similar to contingency response teams, which are powered by a pioneer ethos to maneuver and project airpower while mitigating the critical weaknesses associated with them as centers of gravity. The Air Force must invest in the unique programs, cultures, and values required to maneuver airfields to succeed in today's great power competition. ✈