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ASSESSING AIR FORCE INVESTMENT AND

OPPORTUNITIES IN INFORMATION SUPERIORITY

BY

Major James R. Marrs

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About The Author

Major James R. Marrs was commissioned in 1987 upon graduation from the United States Air Force Academy. Awarded a Kennedy Fellowship, he attended the John F. Kennedy School of Government at Harvard University. After graduating from intelligence officer training in 1990, he was assigned to the Air Force Electronic Warfare Center at Kelly AFB where he held a variety of positions in the areas of aircraft signature and air defense analysis, system integration, and command and control warfare target selection. He then served as a member of the Air Intelligence Agency Commander's Action Group. In 1994, he was assigned to Falcon AFB as operations officer for the 18th Intelligence Squadron. A distinguished graduate of the Air Force Academy, Intelligence Technical Training, Squadron Officer School, and Air Command and Staff College, Major Marrs holds the degrees of BS (honors) in International Affairs (USAFA) and Master in Public Policy (Harvard). Upon graduation from the School of Advanced Airpower Studies, Maxwell AFB, Alabama, he will be assigned to Headquarters, Air Force, Plans and Programs.

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Abstract

Even though the Air Force lists information superiority as a core competency, this study contends the Air Force does not appreciate the extent of its involvement in those activities. The first half of the paper is an analysis of mental and physical Air Force investment in information superiority. After examining doctrinal, platform, organizational, personnel, and budgetary aspects of this investment, the paper determines that Air Force involvement is significant. The second half of the study explores the organizational implications of such findings for an information age Air Force. Before discussing what the Air Force should do, the paper examines relevant theory from the areas of organizational behavior, business and information technology, and military and technological innovation. The study concludes by recommending a series of major Air Force changes involving organization, information superiority transfer mechanisms, and career fields. It also addresses barriers to implementation.

Chapter 1

Introduction

We are one Air Force and we must speak in one common voice about the pivotal contributions aerospace power can bring to any crisis, battle or war.

—General Michael E. Ryan

In this age of information, military and defense policy journals abound with articles discussing the significance of information technologies on the conduct of war. The overused but illustrative term "revolution in military affairs," or RMA, is used to describe the plethora of new opportunities and vulnerabilities facing strategists through the combination of emerging information technologies with new organizational concepts and procedures.

How the information technologies will play out on future battlefields is far from certain. Information optimists see a future in which American forces enjoy information dominance through a global web of sensors, shooters, and command nodes. They envision a major portion of tomorrow's battles being fought in cyberspace, as friendly troops seek to degrade or destroy an adversary's ability to electronically see and influence the battlespace.[1] Information pessimists focus on the vulnerabilities of our

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[1] Joseph S. Nye, Jr. and William A. Owens, "America's Information Edge," *Foreign Affairs* 75, no. 2 (March/April 1996): 25-28, and Martin C. Libicki, "The Small and the Many," *in In Athena's Camp:*

reliance on advanced technology—from the same global grid, to tanks, ships and aircraft that depend on sophisticated internal computers to function. Pessimists also highlight the disconnect between large information-based forces designed to operate on an armor-heavy modern battlefield, and the growing reality that most conflicts involve less sophisticated enemies whose methods may be far less vulnerable to information-hungry weapons.[2]

The leadership of the United States Air Force is wrestling the nature of the this new information battlefield and what it means in terms of building a relevant aerospace force for the future. Its dilemma is the same as the one facing the military as a whole—how to harness the best and avoid the worst of what the information age offers. This study contends that the Air Force should better organize around the concept of information superiority, because it is highly involved in information-related activities without fully appreciating the extent of such operations. To support such an assertion, this paper first shows that the Air Force does dedicate a significant portion of its resources to information superiority activities. Second, this study recommends the Air Force make significant changes to its organizational practices in order to better carry out its information superiority obligations.

Preparing for Conflict in the Information Age, ed. John Arquilla and David Ronfeldt (Santa Monica, CA: RAND Corporation, 1997), 191-216.
    [2] Williamson Murray, "Clausewitz Out, Computer In: Military Culture and Technological Hubris*,"* *The National Interest* 48, (Summer 1997): 62-63. and A.J. Bacevich, "Morality and High Technology," *The National Interest* 45 (Fall 1996): 44-45. For a well balanced view of the RMA, see Lawrence Freedman, "The Revolution in Strategic Affairs, " Adelphi Paper 318 (London: International Institute for Strategic Studies, 1998), 9-76.

Relevance

There is substantial benefit to understanding investment in information superiority simply because of the fact that ideas have consequences.[3] If the Air Force considers information superiority a core competency, as is stated in basic doctrine, Air Force Doctrine Document (AFDD) 1, what does such a statement mean?[4] If the idea of information superiority is meant to get Air Force members and organizations to act in certain ways that make overall mission success more likely, what is the vision for how such a concept is implemented? Analyzing the Air Force in terms of investment in information superiority is an important first step to answering such questions. Though this study's measurement of Air Force involvement in information superiority is meant to produce value in terms of improved understanding and better organizational practices, there are other reasons why the topic is a timely one.

Within the joint community, discussions are taking place that may change in a significant way who owns joint-level responsibility for information-related missions pertaining to communications, intelligence, and other associated areas.[5] The soon to be released Unified Command Plan (UCP) 21 includes the creation of a space and information command.[6] Successful implementation of the new UCP depends in part on how well each service comprehends both the joint guidance and its own functions.

Air Force leaders, due in part to the proposed UCP changes, have created a significant senior-level review of Air Force information-related missions to determine if

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[3] George F. Will, *Statecraft as Soulcraft: What Government Does* (New York: Simon & Schuster, 1983), 17, cited in Barry B. Hughes, *Continuity and Change in World Politics: The Clash of Perspectives* 2nd ed. (Englewood Cliffs, NJ: Prentice-Hall, 1994), 58.
[4] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 31.
[5] Col Pete Worden, Hq. USAF/XORB, interviewed by author, 10 February, 1999.

organizational changes are in order. This was a major item of discussion during the February 1999 Corona Conference and is slated to receive similar priority for the upcoming June 1999 Corona.[7]

This study is also timely due to the Air Force's increased emphasis on the closer pairing of its air and space communities.[8] Information superiority may be one valuable concept around which the Air Force can organize to offer true "aerospace" capabilities for combat operations.

Finally, as the joint community and the Air Force seek to understand how best to organize and operate in the information age, doctrine will remain an important issue. Already, differences are appearing in information-related doctrine.[9] Certainly, such disconnects are unavoidable when creating concepts pertaining to information technology. Things simply are moving too fast for everyone to stay in step.[10] That said, the Air Force must first have a comprehensive information superiority framework based on experience that it can then articulate to the joint world in order to take an active role in shaping joint doctrine evolution.

All of these events argue for Air Force members to have a solid grasp of a conceptual framework for thinking about information age issues and the Air Force's future. This paper argues the Air Force has already laid the foundation for such a

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[6] Statement of General Henry H. Shelton, Chairman of the Joint Chiefs of Staff, in Air Force Space Command Legislative Liaison, *Legislative Update*, 3 February 1999, 1.

[7] Col Jim Engle, Hq. USAF/XPXC, interviewed by author, 26 February1999.

[8] "Aerospace Integration Plan Task Force Charter," n.d., n.p., on-line, Internet, 5 May 1999, available from http://www.xp.hq.af.mil/xpx/aitf/m-ai_charter.htm.

[9] Currently, Air Force and Joint doctrine differ over the definition of information operations. This is discussed in more detail in chapter 5. See Air Force Doctrine Document (AFDD) 2*, Organization and Employment of Aerospace Power*, 28 September 1998, 129, and Joint Publication 3-13, *Joint Doctrine for Information Operations*, 9 October 1998, I-9.

[10] Capt Frederick L. Baier, Chief, IO and ISR Doctrine Development Branch, Air Force Doctrine Center, telephone interview by author, 7 May 1999.

framework with its idea of information superiority. All that is needed in many cases is to draw some explicit links between information superiority and some related ideas, like information operations and command and control, already being developed throughout the organization.

Scope

Before examining this study's approach in more detail, it is important to spend a moment discussing what it is not. First, this paper does not attempt to fully characterize or recommend the best way to solve Joint information-related issues. As already mentioned, discussions are currently taking place at the Joint Chiefs of Staff level regarding the proper placement of information technology responsibilities. This study's inward look at Air Force involvement in information operations seeks to gather insight to the nature of Air Force information superiority efforts. In addition to recommending ways the Air Force might internally optimize its activities, these insights may prove beneficial for reconciling upcoming joint guidance with operational Air Force realities.

Second, this study does not advocate that information technology be viewed as such a revolutionary force that it promises to change the nature of conflict. Warfare is a domain still dominated by the Clausewitzian trinity of violence, chance, and reason.[11] Information technology promises distinct advantages to those who use it wisely and certain chaos for those who use it with arrogance.

Third, though this paper does examine Air Force investment in concepts and physical resources, it does not evaluate the Air Force's training or acquisition programs with

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[11] Carl von Clausewitz, On War, ed. and trans. Michael Howard and Peter Paret (Princeton, N.J.: Princeton University Press, 1976), 89.

respect to information superiority. It does, however, raise some implications at the end of this study for these two areas, based on the study's overall observations.

Finally, since this is an unclassified product, some information superiority assets are not addressed. Though this short changes the comprehensiveness of the paper, inclusion of classified information would only strengthen the findings. If necessary, the methodology could be duplicated at higher classification levels.

Approach

This is a two-part study. Chapters two and three look at the investment aspects. Chapter two explores the conceptual investment, such as the inclusion of information superiority in Air Force vision documents and doctrine, as well as the internal consistency of those materials. It ends by offering detailed categories of information superiority to serve as a solid base for Air Force activities in this area and for measurement of those activities in the following chapters. Chapter three evaluates the physical investment in information superiority, including organizations, platforms, personnel, and budget. Physical investments are considered significant in this study if they exceed ten percent of the Air Force's total investment.

The second half of the study examines the implications of these findings for an Air Force dependent on information superiority. Chapter four sets the stage for such a discussion, looking at military and non-military examples of theories related to information technologies and innovation. This information is then combined with insights from the first half of the paper to create a series of issue groups in chapter five, addressing 1) organization, 2) critical linkages through which information superiority is applied to combat operations, 3) personnel, and 4) keys to successful implementation.

These issue groups are intended to serve roughly as an information superiority strategic plan for the Air Force.

Chapter 2

Mental Investment

Information in warfare, like information in less lethal aspects of life, resists easy characterization. From a decision making perspective, information can be viewed as a message, process, or physical entity.[12] From a systemic standpoint, information exhibits a communal as well as competitive nature.[13] This chapter examines Air Force attempts to create useful information-related operational concepts in such a multifaceted environment. To do so, it sets the stage by briefly tracing the origins of information superiority within the Air Force. The paper next surveys primary Air Force strategy and doctrine publications to determine the depth and internal consistency of Air Force thinking on warfare in the information age. Finally, it proposes a set of information superiority subcategories to facilitate measurement throughout the remainder of the paper.

History of Information Superiority

In a service as technology-intensive as the Air Force, it's difficult to trace the precise origins of the information superiority concept. Certainly the desire to gain an information

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[12] John Arquilla and David Ronfeldt, *In Athena's Camp: Preparing for Conflict in the Information Age*, ed. John Arquilla and David Ronfeldt (Santa Monica, CA: RAND Corporation, 1997), 145-149, 439-445.

[13] Robert O. Keohane and Joseph S. Nye, Jr., "Power and Interdependence in the Information Age," *Foreign Affairs* 77 (September/October 1998): 84-85.

edge in combat is as old as the recorded history of warfare.[14] From the twin perspectives

of airpower and technology, the quest for information superiority is also much larger than

the U.S. Air Force's short history, as examples from the two world wars quickly

demonstrate. In World War I, aviation's first role was to provide information on enemy

ground forces. Moreover, as aviation's role in warfare grew over the course of the war,

so did the technological quest for information superiority. "One-way communication

from the aircraft to the ground evolved into multi-frequency radio transmissions and

reception leading to both embryonic ground control of formation attacks and the jamming

of channels by the opposition."[15] In World War II, British radar provided vital minutes of

warning to Fighter Command interceptors during the Battle of Britain.[16] In a separate

arena, Allied intercepts of German and Japanese high level communications traffic gave

operational and strategic insight to air planners (and other components) important enough

to shorten the war.[17]

For the U.S. Air Force, Vietnam probably best underscored the need for an

information edge against increasingly dangerous air defense systems. Airborne

surveillance platforms like the EC-121 gave early warning of MiG takeoffs from

sanctuaries inside North Vietnam. Meanwhile, dedicated jamming platforms sought to

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[14] Sun Tzu offered advice with the intent of gaining information advantage. "If I an able to determine the enemy's dispositions while at the same time I conceal my own then I can concentrate and he must divide." Also, "What is called 'foreknowledge' cannot be elicited from spirits, nor from gods, nor by analogy with past events, nor from calculations. It must be obtained from men who know the enemy situation." Sun Tzu, *The Art of War*, ed. and trans. Samuel B. Griffith (Oxford: Oxford University Press, 1963), 98, 145.

[15] Air Vice Marshal Tony Mason, *Air Power: A Centennial Appraisal* (London: Brassey's, 1994), 18-19.

[16] Ibid., 53, and Robin Higham, "The Royal Air Force and the Battle of Britain," in Case Studies in the Achievement of Air Superiority, ed. Benjamin Franklin Cooling (Washington, DC: United States Air Force, Center for Air Force History, 1994), 130-132, 154-158.

[17] Bruce Lee, *Marching Orders: The Untold Story of World War II* (New York: Crown Publishers, 1995), 17.

degrade or deny North Vietnamese radar capabilities necessary for coordinated air defense operations and surface to air missile shots.[18]

By the early 1990s, the Air Force was articulating its emphasis on specialized information platforms at the highest level. Secretary Donald Rice, in his white paper, *The Air Force and U.S. National Security: Global Reach—Global Power*, included, "CONTROL OF THE HIGH GROUND—Space and [Command, Control, Communications and Intelligence] Systems," as one of five major Air Force objectives.[19] This objective was a curious blend of the present day Air Force concepts of space superiority (to ensure access) and information superiority (to gain information advantage). It included functions such as communications, navigation, and surveillance. Though heavy in space orientation, it mentioned the existence of airborne assets to "complement" space capabilities.[20]

The Persian Gulf War provided the catalyst for the rapid evolution of information age concepts applied to warfare. The post-Gulf War revision of Secretary Rice's white paper placed heavy emphasis on both air and space systems' roles in the war's success. "The Air Force's space sentinels and our U-2s, RC-135s, JSTARS [Joint Surveillance Target Attack Radar System], and AWACS [Airborne Warning and Control System] aircraft provide the United States with the real-time information necessary to anticipate and monitor a crisis and act, when necessary, with a decisive information advantage over our adversaries."[21]

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[18] Cooling, 537.

[19] Air Force White Paper, *The Air Force and U.S. National Security: Global Reach—Global Power* (Washington, D.C.: United States Air Force, June 1990) 5.

[20] Ibid., 12-13.

[21] Global Reach, Global Power: The Evolving Air Force Contribution to National Security (Washington, D.C.: Department of the Air Force, December 1992), 8.

The war also gave rise to the concept of information dominance—a term very similar in intent to today's idea of information superiority. Within the Air Force, Chief of Staff General Merrill McPeak described the term during one of his speeches:

> I think, that our fabulous combination of spaceborne sensors and command and control capabilities produced a lopsided win in the contest for what some are now calling information dominance. Information dominance is a relatively new concept. . . . It means the ability to observe the whole theater, to rapidly assess threats and opportunities, to identify targets, and to navigate precisely to those targets.[22]

Still, the Air Force struggled with how to describe in a useful and structured way what things like information dominance meant to its members. In 1995, Secretary of the Air Force, Sheila E. Widnall, and Air Force Chief of Staff, General Ronald R. Fogleman, published *Cornerstones of Information Warfare* to establish some stable information age terms within the Air Force.[23] Concepts like information warfare and information operations were defined (though even some of these definitions were to undergo significant change in a fairly short time).[24] Of equal note, neither information dominance nor information superiority were mentioned at all in this taxonomy of information warfare terms. However, the first page of the document is quick to mention that, "the commander with the advantage in observing the battlespace, analyzing events, and distributing information possesses a powerful, if not decisive, lever over the adversary."[25]

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[22] Merrill A. McPeak, *Selected Works: 1990-1994* (Maxwell Air Force Base, AL: Air University Press, August 1995), 207. Also see page 224 for additional use of the term.

[23] *Cornerstones of Information Warfare* (Washington, D.C.: United States Air Force, 1995) n.p. ; on-line, Internet, 19 October 1998, available from http://www.af.mil/lib/corner.html.

[24] For example, information operations was defined as, "Any action involving the acquisition, transmission, storage, or transformation of information that enhances the employment of military forces." (Cornerstones, 11). Just two years later, AFDD 1 defined information operations as, "Those actions taken to affect adversary information and information systems while defending one's own information and information systems." Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 81. This definition was to also change (discussed later in chapter).

[25] Cornerstones, 1.

This author was able to find no doctrinal mention of information superiority before 1996.[26] However, during 1996, the joint community placed information superiority on center stage with the release of *Joint Vision 2010*. It described information superiority as, "the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."[27] For the joint community, "enhanced command and control, and much improved intelligence, along with other applications of new technology. . . . transform[ed] the traditional functions of maneuver, strike, protection, and logistics."[28]

Air Force use of the term "information superiority" followed soon after *JV 2010* in the Air Force's own strategic vision, *Global Engagement: A Vision for the 21st Century Air Force*. The Air Force, drawing on the historical connections between aerospace capabilities and information technologies, placed information superiority on an even higher pedestal by establishing it as one of six Air Force core competencies.[29] Significant as this step was, information superiority was never actually defined. Rather, over the course of four paragraphs, *Global Engagement* touched on a number of ideas relating to information superiority. It recognized that, "the ability of the future Joint Team to achieve dominant battlefield awareness will depend heavily on the ability of the Air Force's air- and space-based assets to provide global awareness, intelligence, communications, weather and navigation support."[30] Within the scope of information

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[26] Joint Pub 3-13.1, Joint Doctrine for Command and Control Warfare (C2W), 6 February 1996, GL-8.

[27] *Joint Vision 2010* (Washington, D.C.: The Joint Staff, 1996), 10.

[28] Ibid., 13.

[29] *Global Engagement: A Vision for the 21st Century Air Force* (Washington, D.C.: United States Air Force, 1997), 8-9.

[30] Ibid., 14.

superiority lay programs as diverse as Battle Management/Command and Control systems and Unmanned Aerial Vehicles. [31]

Much of the ambiguity surrounding information superiority within the Air Force was eliminated with the 1997 release of AFDD1, *Air Force Basic Doctrine*. It described information superiority as, "the ability to collect, control, exploit, and defend information while denying an adversary the ability to do the same and, like air and space superiority, includes gaining control over the information realm and fully exploiting military functions."[32] The term helped emphasize the Air Force as a global organization that operated in the air, space, and information environments. In the information battle space, the concept of information superiority recognized, "whoever has the best ability to gather, understand, control, and use information has a substantial strategic advantage."[33]

The current Air Force definition of information superiority first appeared in AFDD 2. It is, "that degree of dominance in the information domain that allows friendly forces the ability to collect, control, exploit, and defend information without effective opposition."[34] Though the Air Force definition does not mirror word for word the joint definition, both embody the idea of competition and the quest for advantage in the information domain.

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[31] Ibid., 14. It appears in this early document that information operations and information warfare were considered two separate entities, though the document makes no explicit mention either way.

[32] AFDD 1, 31. Even AFDD 1 lacked consistency in this area. In the definition section at the back of the publication (page 81), information superiority was defined by the Air Force as, "The capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."

[33] AFDD 1, 31-32.

[34] Air Force Doctrine Document (AFDD) 2, *Organization and Employment of Aerospace Power*, 28 September 1998, 130.

Related Air Force Concepts

Information superiority, like its cousins air and space superiority, describes the struggle for freedom of operation within a medium. There are also significant cross media effects. Losing air superiority places far more than air operations at risk. Similarly, loss of information superiority can threaten operations in other media. Such discussions portray essentially a goal-based view of information superiority. As part of military operations, it is an objective to be gained and maintained. One major difference is that cyberspace, or the infosphere, is not occupied physically. Verifying the existence of air superiority, for instance, is easier due to physical operation in the medium.[35] At least the "virtual presence" dilemma is not new. Space has presented similar challenges to aerospace strategists over the years.

This paper argues there is a larger potential for information superiority to serve as a foundation for thinking about Air Force functions in the information age. Just as air superiority can be used as a modifier to describe resources and plans (an F-15C is a air superiority platform, while most wartime plans contain concepts for achieving air superiority), so can information superiority serve similar utility. This section argues that two Air Force concepts should be explicitly tied to information superiority—command and control (currently is not) and information operations (currently is). After making the case, the final section proposes subcategories related to command and control and information operations to help measure Air Force investment in information superiority.

Command and Control

AFDD 1 defines Command and Control as:

> The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. [36]

Command and control, then, describes command relationships, processes, and resources. It is especially the modern tools of command and control that make it an information age concept.

Though command and control is not mentioned in the current Air Force definition of information superiority, there exists a fair amount of support for its inclusion. The value of the information superiority concept is that it captures the role of information technology as an enabler for other missions. Command and control is just another (albeit vital) information technology-laden enabler. To support this assertion, one only has to review the history portion of this chapter. *JV 2010* and *Global Engagement* both contained mention of command and control systems as elements of information superiority. AFDD 1 adds more evidence by stating that one information superiority objective in war is, "achieving faster and more effective command and control of assigned forces than the adversary." Finally, at the Air Staff level, command and control programs are already tracked as part of the Information Superiority Defense Program Projection.[37]

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[35] Col Jim Engle, Hq. USAF/XPXC, interviewed by author, 26 February1999
[36] AFDD 1, 80 (Joint Pub 1-02 definition).
[37] Briefing, Headquarters USAF/XP, *Air Force Defense Program Projection Submission Corporate Review*, 19 February 1999, 16. (FOUO)

Information Operations

Currently, information superiority has only one primary element—information operations. AFDD 2 defines information operations as, "those actions taken to gain, exploit, defend or attack information and information systems. This includes both information in warfare (IIW) and information warfare (IW)."[38] AFDD 2-5 fleshes out the full concept of information operations and codifies the underlying structure of information operations (see figure 1 for full construct). Most significant for this paper are the two elements directly subordinate to information operations. Information-in-warfare (IIW), "involves the Air Force's extensive capabilities to provide global awareness throughout the range of military operations based on integrated intelligence, surveillance and reconnaissance (ISR) assets; its information collection/dissemination activities; and its global navigation and positioning, weather, and communications capabilities."[39] IIW can be best thought of as a support function for many other Air Force activities. The second element, information warfare (IW), is defined as, "information operations conducted to defend one's own information and information systems, or to attack and affect an adversary's information and information systems."[40] This concept describes a variety of traditional and modern methods to deny an enemy effective command and control while at the same time protecting one's own ability to effectively command and control friendly forces.

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[38] AFDD 2, 129.
[39] Air Force Doctrine Document (AFDD) 2-5, *Information Operations*, 5 August 1998, 41.
[40] Ibid., 42.
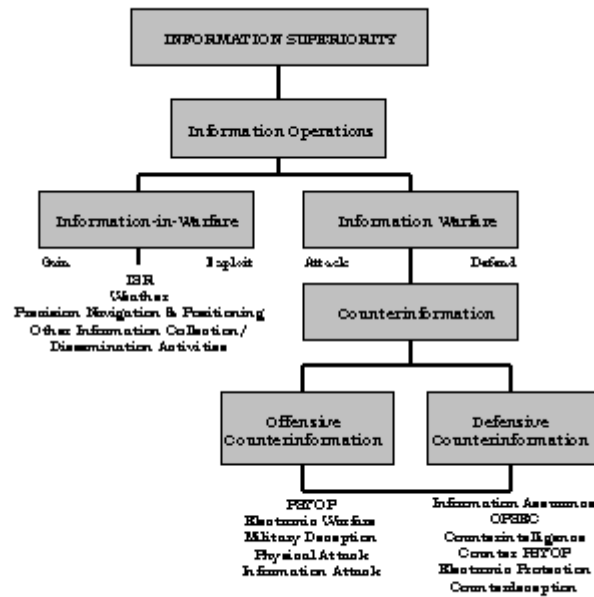
Source: Air Force Doctrine Document (AFDD) 2-5, *Information Operations*, 5 August 1998, 3.

Figure 1. Air Force Information Superiority Construct

Information Superiority Categories

In order to measure investment in information superiority, one needs a categorization scheme that is both comprehensive (capturing all of information superiority) and discrete (minimizing overlap between measurement categories). The preceding discussion of command and control and information operations is a useful starting point. However, some information operations functions require greater resolution. The resulting approach for this study is six measurement categories consisting of 1) command and control, 2) communications and computers, 3) information warfare, 4) intelligence, surveillance, and reconnaissance, 5) precision navigation and positioning, and 6) weather services (see figure 2). Each is described in more detail.
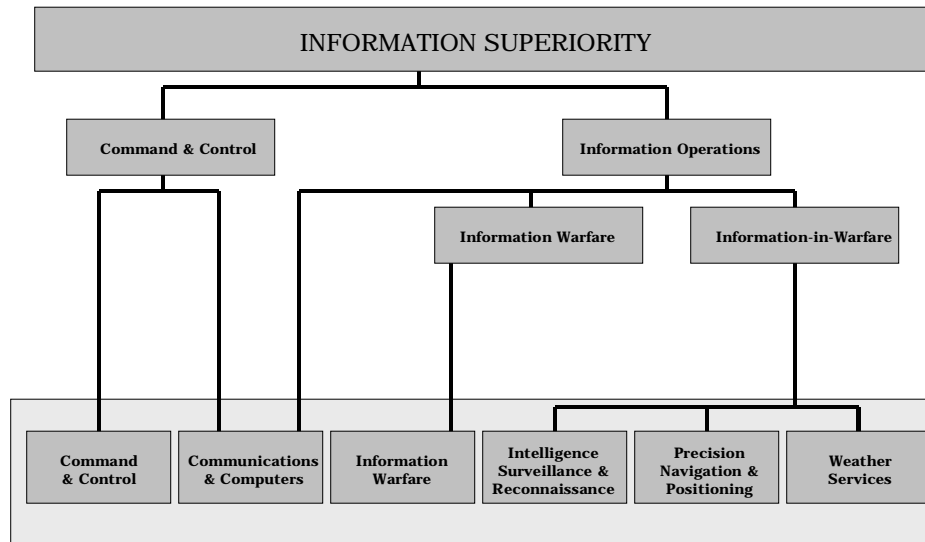
Figure 2: Information Superiority Categories

Figure 2. Information Superiority Categories

The justification for command and control's inclusion was already argued in the previous section. Two points are worth emphasizing. First, the act of command is very much a fundamental, timeless, and non technical element of war that somehow seems inappropriate to lump under the information age concept of information superiority. Second, given this reality, the Air Force as an organization still describes much of its behavior in terms of specialized, technology-intensive, functions pertaining to the operation of command and control systems. This study's interpretation of command and control is based more on the systemic attributes of command and control and less on its purpose. The two never really can be separated completely.

Communications (or what this study calls communications and computers) are claimed by both command and control and information operations as sub-elements. Command and control's reference is an explicit one (see the earlier definition), while

information operation's is less overt (the IO definition in the previous section refers to "information collection/dissemination activities." Still, page two of AFDD 2-5 does state in bold print that communications capabilities are part of IO.[41] Though mention of communication and computer technology would have been helpful in the larger IO definition, this in no way hampers this paper's measurement efforts. Communications and computers are clearly an element of information superiority, since they serve as the information technology infrastructure without which the entire concept of information superiority ceases to exist.

The remaining categories are drawn directly from information operations doctrine. Information warfare is the category still broadest in scope. It is comprised of all Air Force offensive and defensive counterinformation activities. These include psychological operations, electronic warfare, military deception, physical attack, information attack, and defensive measures to counter adversary capabilities in all these areas.[42] IW also encompasses public affairs.[43] Though sometimes members of the IW team, public affairs has an even larger information age responsibility to help Air Force leaders communicate the value of Air Force capabilities to the nation.

The final three categories are more straightforward. First, intelligence, surveillance and reconnaissance (ISR) capabilities belong to the IIW portion of information operations. Intelligence refers to the process-based and analytical aspects of ISR, while surveillance and reconnaissance apply to Air Force capabilities to sense enemy ability, action, and intent.[44] Second, precision navigation and positioning (PNP) provide, "the

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[41] Ibid., 2.
[42] Ibid., 10.
[43] Ibid., 18 and 31.
[44] Ibid., 21-23.

capability to attack targets in sensitive areas," and, "greatly reduces the number of aircraft and sorties required to neutralize or destroy a target."[45] Finally, weather services, "supply timely and accurate environmental information, including both space and atmospheric weather."[46]

Summary

Air Force doctrine covering the information domain has laid the conceptual foundation for involvement in this growing medium of warfare. Information, as a reality of modern warfare to be understood and harnessed, remains resistant to easy definition. Still, information superiority is integral to ensuring freedom of action for all information age combat forces. Command and control and information operations serve as the core concepts within information superiority. Its detailed elements (command and control, communications and computers, IW, ISR, PNP, and weather services) allow the Air Force to, first, obtain superior knowledge of the battlespace and, then, protect that knowledge while denying the adversary any similar capability. As a detailed concept, information superiority also serves as a yardstick for measuring organizational involvement. The extent of that involvement within the Air Force is the subject of the next chapter.

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[45] Ibid., 23.
[46] Ibid., 24.

Chapter 3

Physical Investment

The previous chapter established that the Air Force, from a conceptual perspective, considers information to be a fundamental component of its activities. Does physical evidence exist to support such an assertion? After outlining the basic methodology used to measure information superiority investment, the bulk of this chapter quantifies Air Force information superiority involvement from four perspectives: platforms, organizations, personnel, and budget. To keep the measurement process manageable, only Regular Air Force resources are considered. The chapter concludes by summarizing the data across all measurement perspectives and discussing some interesting observations raised by the comparison of the major categories.

Though chapter one stated that findings within any major category of more than ten percent are considered significant, such a measurement is too broad for the purpose of this chapter. Based on Air Force information superiority doctrine, how much of the Air Force is doing information superiority-related work? Does the answer vary depending on the broad categories being measured? Are there unanticipated characteristics which might cause one to look at Air Force involvement in information superiority differently?

Method

This chapter examines each of the measurement perspectives through a three part process covering focus, scope, and results and discussion.

Focus: This section discusses why specific units of measure were selected. If necessary, information superiority measurement categories are also clarified within this section. As defined in the previous chapter, this study uses the following information superiority subcategories: 1) command and control (C2); 2) communications and computers (C4); 3) information warfare (IW); 4) intelligence, surveillance, and reconnaissance (ISR); 5) precision navigation and positioning (PNP); 6) weather services (WX).

Scope: This section characterizes what was and was not measured. It also discusses the major sources for the data.

Results and Discussion: Within this section, the data are summarized and significant findings and observations are noted.

Measurement

Platforms

Focus: Operational Air Force platforms are the first measurement perspective, because platforms serve as the basic currency of day to day Air Force operations.

Scope: This study examines both air- and space-based platforms. Only non-trainer Regular Air Force assets are considered.[47] In order to be coded as an information

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[47] Primary trainer aircraft are not counted, though operational aircraft serving in a training capacity but having the ability to still perform their operational mission are counted.

superiority platform, this study requires the asset to perform one of the six information superiority categories as its primary function (Table 1).

Table 1. Air Force Information Superiority Platforms Included in Study

Category	Platforms
C2	EC-130E, EC-135, E-3, E-4
C4	DSCS, MILSTAR, UHF Follow-On
ISR[48]	EC-18, E-8, RC-135, RQ-001, TU-002, U002
IW	EC-130H
PNP	GPS
WX	WC-135, DMSP

Source: Airborne platforms taken from, Department of the Air Force, *United States Air Force Statistical Digest: Fiscal Year 1997* (Washington, D.C.: SAF/FMC, 1998), 95-97. Space platforms taken from (and airborne platforms cross checked against), Susan H. H. Young, "Gallery of USAF Weapons*," Air Force Magazine* 81, no. 5 (May 1998): 160-162. Categories are described in chapter one of this study.

Results and Discussion: Based on a non-information superiority platform total of 3038 and an information superiority platform total of 184, five percent all Regular Air Force platforms perform information superiority functions (table 2).   ISR platforms account for 34 percent and command and control platforms account for another 31 percent of the information superiority total.

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[48] Again, ISR space based assets like DSP are excluded. Not enough unclassified data exists to analyze these systems at the same fidelity as the platforms included in this study.

Table 2. Air Force Platforms

Category	Air	Space	Total
C2	58	0[49]	58
C4	0	20	20
ISR	64	0[50]	64
IW	14	0	14
PNP	0	24	24
WX	2	2	4
Total IS Platforms	**138**	**46**	**184**
Non IS Platforms	3038	0	3038
Grand Total	3176	46	3222
IS as a Percent of Grand Total	**4%**	**100%**	**5%**

Source: Airborne platforms taken from, *United States Air Force Statistical Digest: Fiscal Year 1997*, 95-97. Space platforms taken from, Young, 160-162. Platforms contained in each category described in Table 1.

The largest individual contributors to the information superiority total are a mix of air- and space-based platforms (figure 3). Looking at figure one more closely reveals the "low density" nature of information superiority assets—a variety of platform types perform information superiority functions, but there are not many of any one type.

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[49] Communications satellites included in C4 (see table 1).
[50] ISR numbers, as others, based on unclassified sources (see table 1).

Air Force Information Superiority Platforms
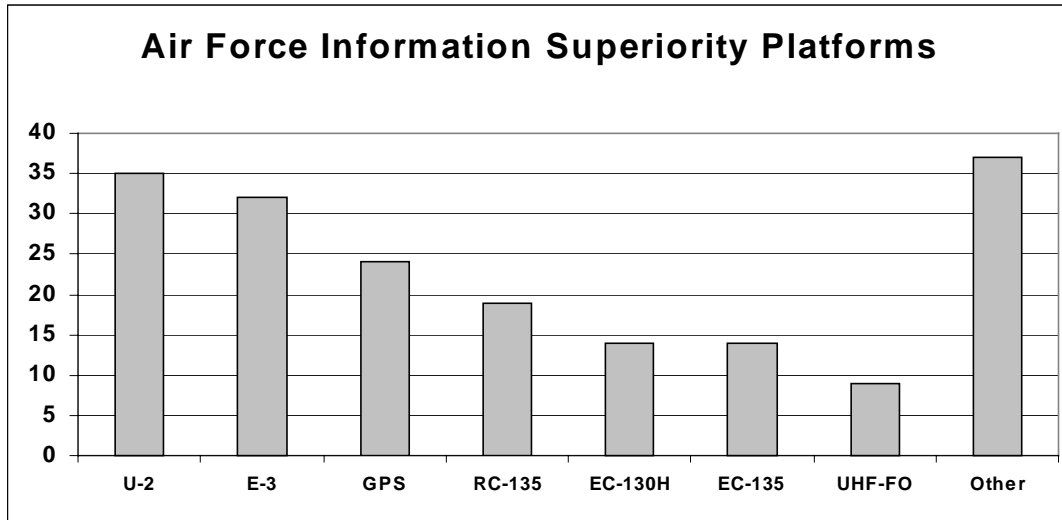
Source: Author's calculations based on table 2 sources.

Figure 3

Figure 3. Air Force Information Superiority Platforms

Organizations

Focus: Determining how to measure organizational investment in information superiority is a bit more complex. Unlike platforms, which have a fairly singular nature, organizations have numerous levels and, consequently, can be cut many different ways. This study looks at two levels of Air Force organization, squadron and center. The squadron was selected as a unit of measure because it normally serves as a least common denominator within Air Force organizational discussions. This analysis seeks to determine the extent Air Force squadrons perform information superiority-related primary missions. As a secondary measure, Air Force centers are also examined. Due to the often specialized and technical nature of these organizations, one might expect to see information superiority as a fairly common theme among centers.

Scope: As in the previous section, this portion of the study only examines Regular Air Force organizations. Its operational focus excludes training, acquisition, and medical units.[51] In some cases, the task of deciding which units to code as information superiority related was straightforward—intelligence squadrons for example (table 3). Other squadrons, such as space operations squadrons, required more research.[52]

Three kinds of organizations deserve specific discussion. First, this paper counts broadcast and combat camera squadrons as information warfare organizations.[53] As noted in chapter two, part of information superiority includes public affairs. Therefore, the organizations within the Air Force that communicate information to Air Force members and the general public need to be considered. Though their numbers do not influence the overall results in any major way, their inclusion underscores the broad nature of information superiority in warfare.

The second category of organizations needing clarification are operations support squadrons (OSS) and mission support squadrons (MSS). Their mission mirrors the mission of the larger wing-level organization they support. For the purpose of this study, however, no OSS's or MSS's were counted as information superiority organizations. In the end, such a conservative counting rule might reduce the overall information superiority numbers slightly (within AIA and AFSPC especially).

Finally, training squadrons were not counted primarily to ease the data gathering portion of the study. This paper assumes that the distribution of training squadrons from

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[51] No AETC or AFMC organizations were counted at the squadron level (due to operational focus), though centers were counted Air Force-wide.

[52] Source: AF fact sheets (see bibliography).

[53] Based on chapter two justification for including public affairs under IW.

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a functional standpoint more or less mirrors the distribution of operational squadrons within the Air Force.

Table 3. Air Force Information Superiority Organizations Included in Study

Category	Platforms
Squadrons	
C2	Command and Control
C4	Communications, Computer, Space Operations
ISR	Intelligence, Information Operations, Space Surveillance, Space Warning, Reconnaissance
IW	Broadcasting, Combat Camera, Electronic Combat, Information Warfare
Multiple IS	Space Operations
PNP	Space Operations
WX	Space Operations, Weather
Centers	
C2	AF Command and Control Training and Innovation Center
C4	AF Communications and Information Center
ISR	National Air Intelligence Center
IW	AF Information Warfare Center
Multiple IS	Aerospace C2ISR Center, AF Technical Applications Center, Space Warfare Center
PNP	
WX	AF Climatology Center, AF Combat Weather Center

Sources: Author's compilation from H. J. Weaver, *List of Active United States Air Force Organizations: Through 31 December 1998* (Maxwell, AFB, AL: Hq. Air Force Historical Research Agency, 15 January 1999). (FOUO). Categories described in chapter one of this study. Space Operations Squadrons and some centers categorized based on Air Force Fact sheets (see bibliography).

Results and Discussion: From an organizational perspective, Air Force involvement in information superiority is significant. Of the 1534 Air Force squadrons considered in this study, 223 (**14 percent**) are information superiority organizations (table 4).   In addition, 25 percent of all Air Force centers perform information superiority-heavy functions.

Table 4. Air Force Organizations

Category	Squadron	Center
C2	31	1
C4	102	1
ISR	67	1
IW	7	1
Multiple IS Functions	3	3
PNP	1	0
WX	12	2
Total IS Organizations	**223**	**9**
Non IS Organizations	1311	27
Grand Total	1534	36
IS as a Percent of Grand Total	**14%**	**25%**

Sources: Author's compilation from Weaver, 1-103.   Organizations contained in each category described in Table 3.

Looking at the various types of squadrons, communications organizations led the group with 40 percent of the information superiority squadrons (see figure 4). [54] As in the

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[54] In figure 4, "S&W" represents Space Surveillance and Space Warning Squadrons.

platform section, there is a high degree of variety of types of information superiority organizations. Centers, on the other hand, are fairly evenly distributed across the various information superiority categories (table 4).

Air Force Information Superiority Squadrons
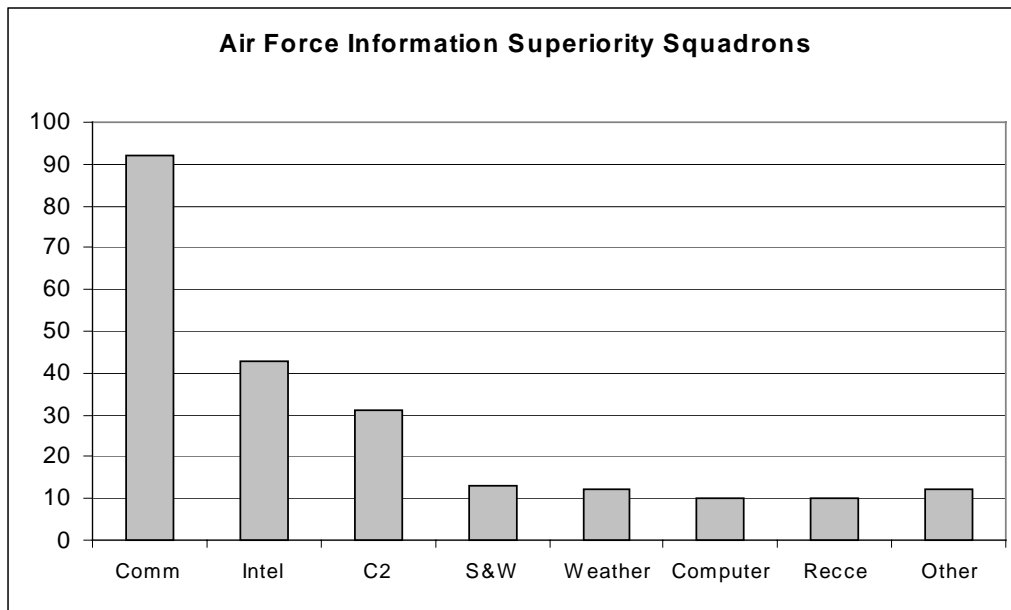
Source: Author's calculations based on table 4 sources.

Figure 4

Figure 4. Air Force Information Superiority Squadrons

Personnel

   Focus: Platform and organizational investment captured Air Force information superiority activities at a macro level. This section takes more of micro approach by examining which individual Air Force members are involved in information superiority. Specifically, Air Force Specialty Codes (AFSC) and personnel statistics are used to estimate information superiority investment from a personnel perspective.

Scope: Only active duty officers and enlisted are examined. For officers, the data is filtered one additional step to include only line officers. In most cases, AFSC families fit well into various information superiority categories (table 5). A few families proved more difficult to characterize. Pilots (11X), Navigators (12X), and Space, Missile, and Command and Control (13X) had to be analyzed one level deeper for information superiority relevance on the officer side. Aircrew operations (1A) required similar efforts for the enlisted numbers.

Four issues related to personnel measurement require clarification. First, in this perspective more than the others, there exists a fairly loose connection between AFSCs and specific information superiority categories. For example, it is fairly safe to say that all communications AFSCs deserve to be counted as relevant to information superiority. However, given the level of data used in this study, it is not possible to determine how many of those communications AFSC's are involved in information warfare. This situation does not endanger the results as long as those data are used to show overall Air Force involvement in information superiority. One should not assume that each information superiority subcategory fully characterizes Air Force personnel involvement in that aspect of information superiority (table 5).

Second, similar to what was done in the organizational section, public affairs and visual information are included as information superiority functions within the information warfare category. As was stated earlier, this inclusion does not influence the results in any meaningful way due to the low numbers of personnel performing these duties--but it remains important to capturing the essence of information superiority as a whole.

Third, due to the operational focus of this paper, engineering and analytical AFSCs (which are developmentally focused) are not included.

Finally, information management is included as a C2 function for the enlisted career fields. Such an assumption does increase the overall information superiority results due to the large size of this career field. Still, information management has evolved from the early days of forms and file cabinets to its modern form of computer-intensive office management. Its existence makes administrative command and control possible throughout the Air Force.

Table 5. Air Force Information Superiority Personnel Included in Study

Category	AFSC Description (and code)
Officer[55]	
C2	Air Battle Management (13B), Air Traffic Control (13M), Combat Control (13D)
C4	Communications-Information Systems (33XX)
ISR	Intelligence (14N)
IW[56]	Public Affairs
Multiple IS	Reconnaissance/Surveillance/Electronic Warfare Pilot (11R) and Navigator (12R), Space and Missile Operations (13S)
PNP[57]	
WX	Weather (15W)
Enlisted	

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[55] Line officers only.

[56] Though other AFSCs are involved in IW, they are captured in other primary categories. For example, a communications officer may be involved in computer network defense, though such an individual would still be counted in this section as C4.

[57] Based on the broad resolution of AFSC data, it is not possible to match an AFSC to PNP.

C2	Command Control Systems Operations (1C)[58], Information Management (3A)
C4	Airborne Comm Systems (1A3XX), Airborne Battle Management Systems (1A4XX), Airborne Mission Systems (1A5XX), Communications-Electronics-Systems (2E), Communications-Computer Systems (3C)
ISR	Intelligence (1N)
IW[59]	Public Affairs (3N0XX), Visual Information (3V0XX)
PNP[60]	
WX	Weather (1W)

Sources: Air Force Visual Aid (AFVA) 36-211, *Officer Classification Structure Chart*, 31 October 1998, and Air Force Visual Aid (AFVA) 36-212, *Airman Classification Structure Chart*, 31 October 1998. Categories defined in chapter two of this study.

Results and Discussion: From a personnel perspective, Air Force involvement in information superiority is very significant. Overall, 23 percent of uniformed Air Force members perform information superiority-related duties (Table 6). The numbers are surprisingly close between officer and enlisted—only one percentage point separates the two.

Table 6. Air Force Personnel

Category	Officer	Enlisted	Total
C2	1519	21251	22770
C4	4254	30444	34698
ISR	2707	11739	14446
IW	390	2396	2786
Multiple IS[61]	2908	0	2908

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[58] Excluding 1C0XX (Airfield Mgt and Ops Resource Mgt)
[59] As in officer case, other AFSCs are involved in IW.
[60] Based on the broad resolution of AFSC data, it is not possible to match an AFSC to PNP.

PNP[62]	0	0	0
WX	683	1983	2666
Total IS Personnel	**12461**	**67813**	**80274**
Non IS Personnel	43007	221108	264115
Grand Total	55468	288921	344389
IS as a Percent of Grand Total	**22%**	**23%**	**23%**

Sources: "Current Active Air Force Officers," *Hq. AFPC*, 31 Jan 1999, n.p.; on-line, Internet, 4 March 1999, available from http://www.afpc.af.mil (cont. next line) /demographics/demograf/DAFSC.html, and "Enlisted Demographic Data," Hq AFPC, 28 February 1999, n.p.; on-line, Internet, 12 March, available from http://www.afpc.af.mil.demographics/demograf/CAFSC.html. AFSCs within each category described in table five.

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[61] Since the space and missile career field merges information superiority, space lift, and missiles, this study makes assumes 50 percent of this AFSC is involved in information superiority tasks. This assumption is based on analysis of the 13S AFSC by MPF (13S tends to cluster in one of three groups based on geographic location). Source: "Active Duty Officer Demographics, HQ AFPC/DPSARA," n.d., n.p; on-line, Internet, 5 May 1999, available from http://www.afpc.randolph.af.mil/vbin/broker.exe.

[62] Resolution of data was not fine enough to account for satellite controllers of specific systems like GPS.
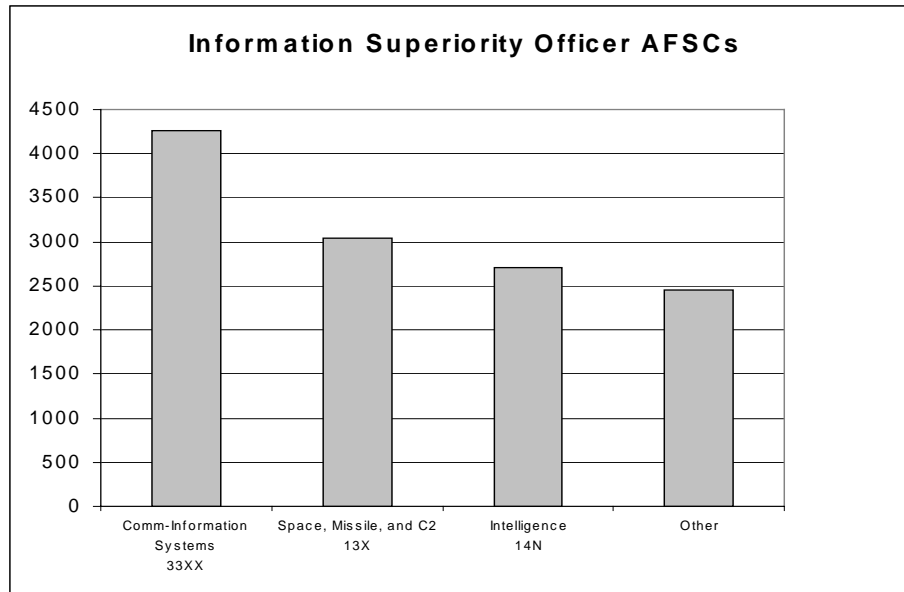
Source: Author's calculations based on table 5 sources.

Figure 5

Figure 5. Information Superiority Officer AFSCs

Within the officer and enlisted ranks, the numbers do fall out somewhat differently in terms of predominant career fields. For officers, the three career fields of 1) communications, 2) space, missile and C2, and 3) intelligence together account for 80 percent of the information superiority total (figure 5).

Information Superiority Enlisted AFSCs

Category	
Comm 2E	15000
Computer 3C	13500
Info Mgmt 3A	12000
Intelligence 1N	11800
C2 System Ops 1C	9200
Other	6300
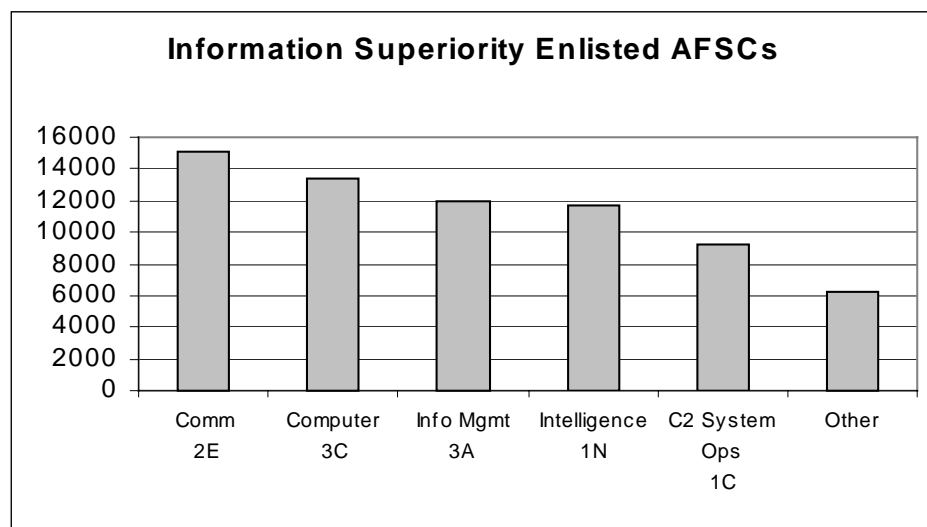
Source: Author's calculations based on table 5 sources.

Figure 6

Figure 6. Information Superiority Enlisted AFSCs

Though there appears to be a larger number of career fields sharing a majority of the information superiority total, the communications and computer career fields, when combined, account for 42 percent (figure 6). The top five career fields comprise 91 percent of all enlisted information superiority AFSCs.

Budget

Focus: This final perspective looks at projected Air Force monetary investment in information superiority. Specifically, this section examines Defense Program Projection (DPP) submissions. The DPP covers the Air Force's top 200 modernization programs and includes acquisition, operations, and sustainment costs in its projections. Since the DPP is organized by Air Force core competencies, this study uses the information superiority figures.

Scope: Two limitations deserve note before the results are examined.   Most importantly, the DPP does not capture the entire Air Force budget. For FY 00, a DPP of approximately $21 billion accounts for about one third of all projected Air Force outlays.[63] As a measure of the largest modernization programs, however, the DPP is a useful indicator of Air Force attention.

Second, the DPP figures used in this section are only estimates based primarily on charts provided by AF/XPPI. Again, they are more than sufficient to provide information on relative investment between core competencies.

Results and Discussion: Air Force projected DPP investment in information superiority (based on the information superiority core competency) is significant—accounting for 19 percent of the total Air Force DPP (table 7). Projected spending in this area will continue to grow relative to the total budget—the FY08 column from table 7 is one example.

Table 7. Air Force DPP Budget (in CY 99 Millions)

Category	FY 00	FY 08
Information Superiority	**4000**	**6000**
Other Core Competencies	17000	20000
Grand Total	21000	26000
Information Superiority as a Percent of Grand Total	**19%**	**23%**

Source: Briefing, Headquarters USAF/XP, *Air Force Defense Program Projection Submission Corporate Review*, 19 February 1999, 7. (FOUO) Estimate only, based on visual interpretation of graphs.

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[63] Briefing, Headquarters USAF/XP, *Air Force Defense Program Projection Submission Corporate Review*, 19 February 1999, 7 and 21. (FOUO)
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Summary and Observations

Air Force physical investment in information superiority is significant. Of the four major perspectives measured, three easily passed the ten percent threshold established at the beginning of this study (figure 7).

**Air Force Physical Investment in
Information Superiority (percent)**
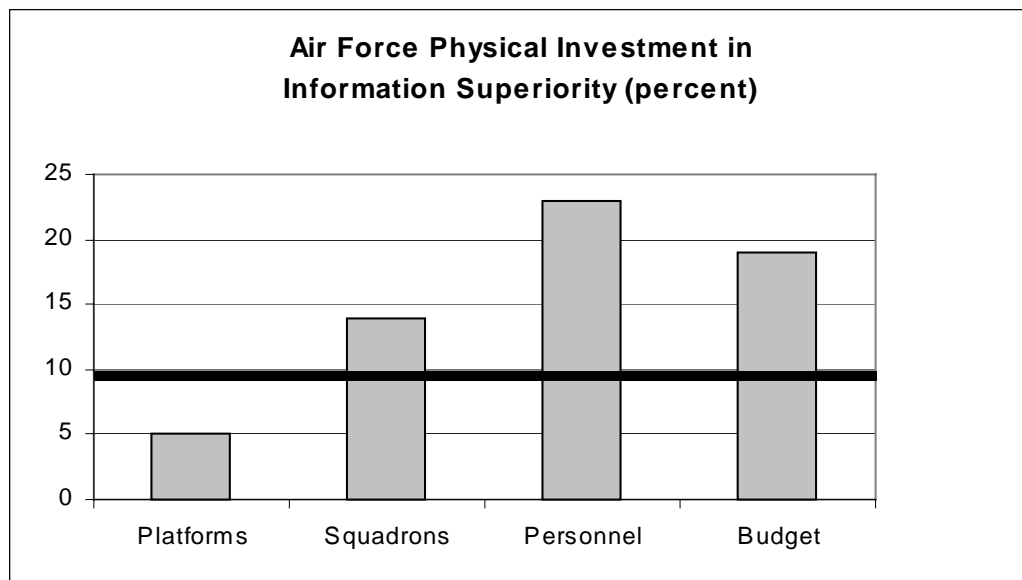
Figure 7

Figure 7. Air Force Physical Investment in Information Superiority (percent)

It is worth considering the apparent discrepancy between platforms (still a respectable five percent) and the other measures. The relatively low number of platforms may indicate that a mindset change is in order. Information superiority may be a significant function for the Air Force, but it is not as reliant on platforms (in a numeric sense) as other functions. For an organization that tends to place a rather large emphasis

on platforms in its day to day thinking, such an observation may improve awareness of information superiority's presence within the Air Force.

This is not to meant to underplay the importance of platforms within information superiority. The term 'low density high demand', as it applies to Air Force platforms required for deployed operations, refers in large part to information superiority assets. Their low numbers are due partially to their specialized and expensive nature.

The platform category also underestimates the hardware investment the Air Force has in dedicated information superiority systems. This study did not include fairly major systems such as those used by the surveillance and warning community (telescopes and radar are two examples). The organizational perspective helps mitigate this shortfall by providing an upper boundary based on squadrons performing specialized information superiority tasks. In this case, surveillance and warning missions are captured by such a measure.

Ultimately, the Air Force is heavily invested in information superiority. The results of this chapter's physical assessment support the Air Force's doctrinal assertions examined in chapter two. Given the large investment, how should the Air Force organize its operations to get the most leverage out of its information assets? The next chapter explores two concepts (innovation in war and the role of information technology in modern organizations) to create a conceptual foundation. The final chapter of this study then uses this foundation to build a series of issue groups to make recommendations and to guide Air Force strategic planning in the information age.

Chapter 4

Thinking About Information and Organization

Air Force doctrine makes a compelling case for the importance of information to modern warfare and Air Force operations. The Air Force investment in information operations is significant. To set the stage for this paper's final series of organizational recommendations, this chapter takes more of an academic approach and provides a theoretical overview of possible ways to think about organizing with information technology in mind. It does so by first examining the idea of innovation as a fundamental characteristic of modern warfare. Next, the chapter explores from three different perspectives how information-based organizations innovate. Organizational theory, modern business practices, and military-specific theories all add a measure of insight and complexity to the range of options facing the Air Force. The chapter concludes by offering a generic framework to guide Air Force organizational thinking in the final portion of this study.

Innovation

Innovation is one of the most powerful ideas in warfare. Whereas strategy provides a framework for relating resources and methods to a desired end, innovation is a leading

dynamic in the Clausewitzian clash of wills that epitomizes war.[64] Innovation is about problem solving. As a strategy suffers inevitable setbacks in execution, successful innovation allows the commander to make use of the resources at hand in new ways. Given a longer time frame, new capabilities might also be brought to bear on the problem.

Though certainly not a new concept, modern information technology has propelled the concept of innovation to new heights both in peace and war by allowing rapid sharing of and more in-depth access to information. Innovation, central to understanding the inner workings of the modern economy, has been called, "the only source of sustainable growth."[65] Innovation and information technology in the private sector are harnessed through agility, "a comprehensive response to the challenges posed by a business environment dominated by change and uncertainty."[66] To succeed, companies must recognize and capitalize on rapidly changing customer needs, while individuals must show their ability to contribute to the company, even as internal resources and jobs are transformed.[67]

Innovation in military matters is a product of similar dynamics. John Boyd best captures this reality in his theory of the nature of modern conflict. He envisioned warfare as a series of competing decision cycles. In such a world, agility is the hallmark of

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[64] Carl von Clausewitz, On War, ed. and trans. Michael Howard and Peter Paret (Princeton, N.J.: Princeton University Press, 1976), 77.

[65] John Browning and Spencer Reiss, "Encyclopedia of the New Economy, Part II," *Wired*, April 1998, 97.

[66] Steven L. Goldman, Roger N. Nagel, and Kenneth Preiss, *Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer* (New York: Van Nostrand Reinhold, 1995), 3.

[67] Ibid., 3.

effective warriors and warfighting organizations. The side who can observe, orient, decide, and act first across a series of events will win.[68]

Important as innovation is to modern military success, harnessing it is no simple task. After searching for theoretical support to explain and predict innovation successes, Stephen Peter Rosen complained that, "much of the problem with social scientific studies of bureaucratic innovation has been that as one study found a factor that seemed to be associated with innovation, another would find evidence of innovation when that factor was absent, or even when the opposite of that factor was present."[69] Rosen echoed that sentiment when looking at innovation from an organizational learning perspective.[70]

This study proposes no easy solution to the question of how best to organize for innovation in the information age. Instead, it examines three perspectives on the topic of innovation as a way of drawing useful connections between theory and this paper's effort to build a general approach to address the specific situation in which the Air Force finds itself today. These connections are made in the next chapter.

Perspectives on Organizing in the Information Age

Organizational Behavior Theories

The following paragraphs develop two metaphors that are used describe representative information age organizational frameworks conducive to innovation—"the organization as a brain" and the "garbage can model". The brain metaphor seeks to answer the question, "is it possible to design organizations so that they have the capacity

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[68] David S. Fadok, *John Boyd and John Warden: Air Power's Quest for Strategic Paralysis* (Maxwell AFB, AL: Air University Press, February 1995), 14-18.
[69] Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca: Cornell University Press, 1991), 3.

to be as flexible, resilient, and inventive as the functioning of the brain?"[71] Gareth

Morgan, in *Images of Organization*, believes there are and supports his assertion by first

examining the organization as an information-processing brain and then as a holographic

system.[72]

The information-processing approach views organizations as being unable to make

value maximizing decisions. Based on the work of Herbert Simon, James March, and

later Jay Galbraith, organizations are like individuals in the sense that they are capable

only of "bounded rationality." Evidence for this theory stems from the argument:

> That people (a) usually have to act on the basis of incomplete information about
> possible courses of action and their consequences, (b) are able to explore only a
> limited number of alternatives relating to any given decision, and (c) are unable
> to attach accurate values to outcomes.[73]

Consequently, organizations act as, "kinds of institutionalized brains that fragment,

routinize, and bound the decision-making process in order to make it manageable."[74] In

order to decrease uncertainty in the operating environment, organizations will either

create excess capacity in the system (slack) and focus on self-contained tasks (reducing

the need for information), or increase information processing capabilities by, "investing

in sophisticated information systems and improving lateral relations through the use of

coordinator roles, task forces, and matrix designs."[75] Cybernetics adds a more recent idea

to the information processing concept by introducing the idea of double-loop learning.

Not only must an organization be able to determine whether or not it has met its goals, it

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[70] Ibid., 4.
[71] Gareth Morgan, *Images of Organization* (Newbury Park, CA: SAGE Publications, 1986), 78.
[72] Ibid., 77-109.
[73] Ibid., 81.
[74] Ibid., 81
[75] Ibid., 83.

must also be able and willing to question whether it is doing (and measuring) the right thing.[76]

The holographic system approach views the organization as a brain with hologram-like characteristics (each portion of the hologram also contains the whole). In this case, the brain's component parts (neurons) are capable of both specialization (able to store large amounts of information) and generalization (through connectivity to other neurons). Though portions of the brain specialize in certain functions, a great deal of excess capacity exists to accommodate a changing environment or to act as substitutes (in the case of brain damage, other areas of the brain have been shown to replace lost functions).[77] Recognizing that it is impossible for most organizations to create superworkers able to carry out any task, Morgan introduces the concept of "requisite variety," a term describing the idea that, "any control system must be as varied and complex as the environment being controlled."[78] According to its proponents, variety, a type of redundancy, "should always be built into a system where it is *directly* needed, rather than at a distance."[79] If each individual cannot posses the variety of required skills, multifunctioned teams can, "collectively possess the requisite skills and abilities and, where each individual member is as generalized as possible, [create] a pattern of overlapping skills and knowledge bases in the team overall."[80]

Though the brain metaphor offers some powerful concepts pertaining to innovation and an organization's ability to learn, it is limited by another organizational metaphor, "the organization as a political system." Anytime an organization attempts internal

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[76] Ibid., 84-95.
[77] Ibid., 95-105.
[78] Ibid., 100.
[79] Ibid., 100.

change, power-relationships are altered causing resistance to change. This hurdle to innovation is discussed later in the business section.

While the brain metaphor emphasizes an organization's ability to learn, the garbage can model provides interesting insight into how organizations solve problems. If innovation really is, as this paper claims, an act of problem solving, such a model has important consequences. The garbage can model is based on the idea that, "In an environment characterized by complex interactions among actors, solution, problems, and choice opportunities, the simplest source of order is that of time."[81] The most important idea behind the model is the notion of temporal sorting. Connections are made between problems and solutions when decision makers take part in a choice opportunity. Each choice opportunity (a meeting, for example) presents the decision maker with a mix of problems and solutions. Since the decision maker has limited time (attention) not all problems are always paired with solutions.[82]

The garbage can model raises an interesting question for military decision makers in an information technology rich environment. Is it possible to use information technologies to present the decision maker with a wider array of problems and solutions at a given choice opportunity? Pessimists who tend to avoid or eliminate elements of temporal sorting in favor of objective or vision-based decision making would probably disagree. Optimists who view the garbage can model as a kind of decision marketplace of problems and solutions might find merit in such an approach.[83]

[80] Ibid., 101.
[81] James G. March, *A Primer on Decision Making: How Decisions Happen (*New York: The Free Press, 1994), 198.
[82] Ibid., 198-201.
[83] Ibid., 205-206.

Thoughts from the Business World

The value of observing non-military organizations for information age clues stems from the fact that military organizations get to experience a combat environment only on an infrequent basis. The business world provides some credible lessons, because, "competition is at the core of the success or failure of firms."[84] Still, major differences exist between these two fields of conflict that remind one to use care when drawing parallels. In addition to the lethal consequences of warfare is the less dangerous but still significant distinction that the Air Force is a regulated monopoly on a fairly fixed budget. The profit motive rules the business world. Within the military services life not so simple. Even a "profitable" idea in terms of military utility has to compete with other programs within the same service. Such qualifications aside, the modern economy speaks volumes about organizational change in the information age. This section explores three primary facets of information-based business, including 1) the focus of firms when it comes to information, 2) primary organizing concepts, and 3) obstacles to obtaining the information advantage.

Focus: When it comes to explaining the role of information in the modern firm, the literature takes a mix of two approaches. The first focuses on information technology (IT). A common view of IT, "refers to the technologies of computers and telecommunications (including data, voice, graphics, and full motion video)."[85] They act as "fundamental enablers" for organizations to compete in the information age.[86]

The second approach to information in business focuses on the concept of knowledge:

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[84] Michael E. Porter, Competitive Advantage: Creating and Sustaining Superior Performance (New York: The Free Press, 1985), 1.

[85] Lynda M. Applegate, F. Warren McFarlan, and James L. McKenney, *Corporate Information Systems Management: The Issues Facing Senior Executives*, 4th ed. (Chicago: Irwin, 1996), 1.

> Every company depends increasingly on knowledge—patents, processes, management skills, technologies, information about customer and suppliers, and old-fashioned experience. Added together, this knowledge is intellectual capital. . . In other words, it's the sum of everything everybody in your company knows that gives you a competitive edge in the marketplace.[87]

The results of this new environment are startling:

> Microsoft has annual sales of US$11 billion, and most of its assets walk in and out of the doors wearing T-shirts. Yet the stock market values the company at well over $150 billion—far more than either IBM. . . or General Motors. . . . Why? Because the rules of competition are changing to favor companies like Microsoft over paragons of the industrial age.[88]

Central to this knowledge-based economy is the individual. These "knowledge workers," or "symbolic analysts," who, "solve, identify and broker problems by manipulating symbols," are the foundation of a transformed economic system.[89]

Most writings take a fairly balanced approach between IT and the individual—and for good reason. It's the interplay between the two that is most significant. Michael L. Dertouzos says, "we begin to reap the value of information when we have created an infrastructure that leverages our work."[90] Recent examples of such leverage include the development of search engines that increase the "intelligence density" of information

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[86] Vasant Dhar and Roger Stein, *Intelligent Decision Support Methods: The Science of Knowledge Work* (Upper Saddle River, NJ: Prentice Hall, 1997), viii.

[87] T.A. Stewart, "Brainpower," *Fortune*, 3 June 1991, 42-43, cited in Blaise Cronin, "Intelligence Management Systems for Intelligent Corporations," *in Managing Information for the Competitive Edge*, ed. Ethel Auster and Chun Wei Choo (New York, Neal-Schuman, 1996), 281.

[88] John Browning and Spencer Reiss, "Encyclopedia of the New Economy, Part I," *Wired*, March 1998, 106.

[89] Drucker prefers the term knowledge worker. Robert Reich coined the term, "symbolic analyst." Paul Strassman uses the term "information worker." Peter F. Drucker, "The Age of Social Transformation," *The Atlantic Monthly* 274, No. 5 (November, 1994), 76, cited in John Arquilla and David Ronfeldt, "Information, Power, and Grand Strategy: In Athena's Camp—Section 2*," In Athena's Camp: Preparing for Conflict in the Information Age*, ed. John Arquilla and David Ronfeldt (Santa Monica, CA: RAND Corporation, 1997), 437. In his book, Robert Reich says, "The tools (of the symbolic analyst) may be mathematical algorithms, legal arguments, financial gimmicks, scientific principles, psychological insights about how to persuade or to amuse, systems of induction or deduction, or any other set of techniques for doing conceptual puzzles." Robert B. Reich, *The Work of Nations: Preparing Ourselves for 21st Century Capitalism* (New York: Alfred A. Knopf, 1991), 177-179. Paul A. Strassmann*, Information Payoff: The Transformation of Work in the Electronic Age* (New York: The Free Press, 1985), 4.

[90] Michael L. Dertouzos, "Communications, Computers and Networks," *Scientific American* 265, No. 3 (September 1991): 65.

available to decision makers.[91] At a higher level, "Leverage is derived from the effective management of information assets (e.g. information technology and systems; information worker; locally created and bought-in information goods and services; intellectual capital)."[92]

Organizing Concepts: The ideas of competitive advantage and centralization versus decentralization play important roles for businesses considering how best to organize with information-based innovation in mind.

According to Michael Porter, "Competitive advantage grows fundamentally out of value a firm is able to create for its buyers that exceeds the firms cost of creating it."[93] Businesses create value by competing in terms of price or superior quality at a premium price.[94] Though virtually all businesses rely on information technology to a degree, some companies depend on it for strategic success.[95] Such an information dependency can also be viewed as a core competency.[96]

No magic formula exists to determine whether information technologies or knowledge workers automatically constitute a core competency, but the following tests provide a general sense of information's strategic nature to the firm. First, what is the nature of the business? The banking and insurance industries as a whole are information-

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[91] Intelligence density can be thought of, "as the amount of useful 'decision support information' that a decision maker gets from using the output from some analytic system for a certain amount of time. . . . Thus, if a decision maker can consistently make the *same quality* decisions and come to the same conclusions after examining Source A for 3 minutes as he or she could after examining Source B for 30 minutes, Source A can be said to have 10 times the intelligence density of Source B. Dhar, viii and 9.
[92] Cronin, 285.
[93] Porter, 3.
[94] Ibid., 3.
[95] Applegate, 3.
[96] Robert Klepper and Wendell O. Jones, *Outsourcing Information Technology, Systems, and Services* (Upper Saddle River, NJ: Prentice Hall, 1998), 82.

intensive, while manufacturing tends to be less reliant on information.[97] Second, "Does this function contribute substantially to what customers see as [the] organization's most important product or service attributes?"[98] Finally, "Does the [current or future] provision of this information systems capability involve skills or combinations of skills and other assets that are unique to [the] organization?"[99] If the answers to a majority of these questions are yes, information is a strategic source of competitive advantage and should be given high priority by the firm's leadership. If the answers tend toward no, most current writers on the subject suggest at least considering outsourcing information services to outside vendors so the company can focus on its core competencies.[100]

One additional concept related to the idea of competitive advantage is that of competitive scope—which refers, "to a broader conception of the scope of a firm's activities, encompassing industry segment coverage, integration, geographic markets served, and coordinated competition in related industries."[101] Of most importance to this paper are segment and vertical scope. Essentially, a highly segmented scope refers to a tailored process that focuses on a relatively small portion of the market. Vertical scope refers to how much of the process (or value chain) is owned by the company as opposed to outside suppliers. A company with multiple segments may have common activities in

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[97] Ian Owens and Tom Wilson with Angela Abell, Information and Business Performance: A Study of Information Systems and Services in High Performing Companies (London: Bowker Saur, 1996), 7.

[98] Klepper, 83.

[99] Ibid., 83.

[100] Even companies rich in information-related core competencies (Xerox, Kodak, General Dynamics, and British Aerospace) have outsourced significant portions of their information technology requirements. In the Xerox case, it appears that the operation of the information technology infrastructure, not the development of new information technologies, was the object of transfer. For the others, there may have been a similar element, though Applegate et al also cites the "acceptance of strategic alliances" as a driving factor. "Alliances allow a firm to leverage a key part of the value chain by bringing in a strong partner that complements its skills." Applegate, 246-247, and Lynda M. Applegate, F. Warren McFarlan, and James L. McKenney, *Corporate Information Systems Management: Text and Cases*, 4th ed. (Chicago: Irwin, 1996), 574.

[101] Porter, 53.

those segments that can be shared. A company with a highly vertical scope has more flexibility in modifying its operations. In both cases, competitive advantage is enhanced.[102]

The idea of centralization and decentralization also plays an important role in how a company organizes around information. Information systems experts have speculated for quite some time over whether information technologies would cause organizations to become more centralized or decentralized.[103] With respect to how information technology is or is not centrally managed within a firm, Michael J. Earl et. al. states:

> Centralization of the IS [information systems] function is necessary to reap economies of scale, ensure the ability to integrate applications or share data, and optimize the use of scarce resources. Conversely, decentralization of the IS function is necessary to ensure that IS responds to real business needs, to encourage managers to get involved with IS, and often to add control of IS resources to the autonomy that local units possess. [104]

Recent studies show a federated model to be the most prevalent form of IT organization within companies. "In the ideal federal form the IS function is co-ordinated from the centre, but IS activities are divided between central and distributed units."[105] Earl thinks such a model is popular, because:

> It can be adapted to align well with most forms of complex, multi-divisional organization. It perhaps represents a design space in which compromises can be accommodated, balances evolve over time, different types of IS resource get distributed differently, and multiple dimensions of most organization structure be serviced. [106]

Obstacles: This section discusses two barriers to creating and implementing technology-related organizational change: organizational dynamics and cost.

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[102] Ibid., 53-61.

[103] For survey, see Pat-Anthoney Federico, Kim E. Brun, and Douglas B. McCalla, *Management Information Systems and Organizational Behavior* (New York: Praeger, 1980),85-96.

[104] Michael J. Earl, Brian Edwards, and David F. Feeny, "Configuring the IS Function in Complex Organizations," in *Information Management*, ed. Michael J. Earl (Oxford: Oxford University Press, 1996), 201.

[105] For the Federal form, "IS is a distributed function, with each business unit containing and largely controlling its own IS capability. However, there is in addition a central IS unit reporting to corporate management which has responsibility for defined aspects of policy and architecture across the organization, and which may deliver some common or shared services. It may or may not be coincident with the IS unit for corporate HQ." Earl, 211.

[106] Ibid., 212.

This paper views organizational dynamics as primarily a function of organizational culture and political forces.[107] Though the academic literature differentiates between the two, simple awareness of the results of these elements of an organization's dynamics are what matters to this study. At the heart of the matter is the fact that:

> Since information is often at the heart of power, arguments about the control of information processing can seem critical in the politics of organizational design. Indeed, nowadays information systems are something everybody has a concern about and thus can be guaranteed to stimulate a debate—at least in complex organizations.[108]

In addition to the combined forces of culture and power that impede change, specialization and stress are emerging as significant forces in the organizational dynamics equation.

Specialization is a duel-edged sword of the information age. While, "specialization is required to develop expertise and competence within a given discipline," it also results in jargon and thought processes that are not understood by an organization's members who serve more as generalists.[109] This necessary dilemma will be one with which an organization's leadership will have to grapple on a continuing basis. Specialization is necessary for information-based organizations to remain successful.[110] However, as specialties grow, a firm must again evaluate which of those specialties are to be cultivated as core competencies and which are to be outsourced.[111]

Stress on a company's employees is one result of increasing specialization and the growing agility of organizations. "Successful implementation of a technology often

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[107] In the case of culture, "Organization is now seen to reside in the ideas, values, norms, rituals, and beliefs that sustain organizations as socially constructed realities." The political metaphor, "Focus(es) on the different sets of interests, conflicts, and power plays that shape organizational activities." Morgan, 14-15, and 111-198.
[108] Earl, 201.
[109] Applegate, 5-6.
[110] Owens, 12.

requires that individuals learn radically new ways of performing intellectual tasks, causing changes in information flows as well as individual roles."[112] Unfortunately, as individuals have worked to cultivate a certain kind of expertise or, what Dorthy Leonard-Barton refers to as signature skills, they resist change to the extent it makes that skill obsolete.[113] Barton suggests that to mitigate the negative effects of change, "a task critical to organizational well-being and the integration of knowledge bases is managing across and among these enclaves of talent and signature skills."[114]

Having discussed some of the peculiarities of organizational dynamics and change in the information age, it is important to focus on a counter to those obstacles emphasized quite strongly in business-oriented writing: having active senior leadership involvement in the change process. Ian McLoughlin and Martin Harris assert, "if change is essentially a political process requiring the capacity to mobilize power resources, it would seem to have specific and important consequences for the kinds of expertise required by change management."[115] Owens et al state that case study evaluations of their information and business model show, "those companies which have successfully implemented change and created an information ethos have done so with the backing and leadership of senior managers and the CEO in particular."[116] Martin Lockett agrees that most important single factor to successful IT innovation is the existence of a project champion or sponsor. The role of these individuals is to provide core business focus to the project as

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[111] Applegate, 6.

[112] Ibid., 32.

[113] Dorothy Leonard-Barton, *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation* (Boston: Harvard Business School Press, 1995), 62.

[114] Ibid., 63.

[115] Ian McLoughlin and Martin Harris, *Innovation, Organizational Change and Technology* (London: International Thomson Business Press, 1997),.11.

[116] Owens, 52.

well as high level review.[117] Leadership involvement will undoubtedly remain important to the success of large innovation efforts within organizations, based on the views again of McLoughlin and Harris. "If new technologies are designed and used to serve particular interests, and if organizations are seen, not as arenas of consensus, but rather the locus of conflict, then disagreement over particular technical changes may be seen as an inevitable and legitimate feature of organizational life."[118]

Information age innovation suffers from another source of friction—cost visibility. Businesses must wrestle over whether to eat the cost of IT for the entire organization (unallocated cost center), charge individuals for IT services (allocated cost center), or establish IT as a business. Problems exist for all. Unallocated cost centers, while simple, invite overuse of IT services, since they appear free to the user. Allocated cost centers, while reducing overconsumption, are forced to be somewhat arbitrary in how costs are assessed to individual users. Finally, IT profit centers, though economically most efficient, sometimes find themselves in a difficult positions of having to make a profit off of only internal users (or selling services outside of the company which may dilute IT's focus on its internal customers).[119]   There are no easy answers to the cost question. "Each alternative generates quite different behavior and motivation, and each decision is fundamental one; once made, it is not lightly changed."[120]

The Military Perspective

Having looked at the organizational theory and business perspectives on organizing for innovation in the information age, it is now important to discuss the same topic with the military in mind. This section reviews relevant portions of Stephen Peter Rosen's, *Winning the Next War*,

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[117] Martin Lockett, "Innovating with Information Technology," in Earl, 124-125.
[118] McLoughlin, 7.
[119] Applegate, 217-225.

that focus on peacetime and wartime innovation. His thoughts on technological innovation are not reviewed, since they gravitate toward acquisition issues beyond the scope of this study.

Peacetime Innovation: Rosen's distinction between peacetime and wartime begins at the organizational level. During times of peace, military organizations behave, "as complex political communities in which the central concerns are those of any political community: who should rule, and how the 'citizens' should live."[121] The ramifications of such a view are significant:

> Because the service is a political community, innovation does not simply involve the transfer of resources from one group to another. It requires an 'ideological' struggle that redefines the values that legitimate the activities of the citizens. Because the service is a military organization, and because it is victory in war that ultimately legitimates any military organization, this ideological struggle will revolve around a new theory of victory, an explanation of what the next war will look like and how officers must fight if it is to be won. [122]

Such a theory must be converted into concrete "critical tasks" against which officers can be evaluated.[123]

Such a view, tested against a number of cases, results in two major requirements for peacetime innovation. First is recognition, "of change in the structure of the international security environment."[124] In this case, simulations were more important than intelligence to recognizing changes to the environment. Intelligence often proved too volatile to trigger changes over large spans of time.[125] The second critical element of innovation is the heavy involvement of senior leaders in implementation—especially the creation of, "a new set of operational tasks relevant to the new military capability and a new promotion pathway for young officers to follow as they developed those new skills."[126]

Wartime Innovation: During periods of war, military organizations behave more like rational bureaucracies than political communities. Conventional wisdom says war is

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[120] Ibid., 217-218.
[121] Rosen, 19.
[122] Ibid., 19-20.
[123] Ibid., 20.
[124] Ibid., 57,
[125] Ibid., 57, 58, 69.

the mother of invention. Yet, Rosen argues that significant innovation is literally "unprecedented." "Even if that innovation takes place in wartime, there will not have been much relevant previous experience. The lack of precedent makes wartime innovation risky, and with the risk often comes a justified aversion."[127]

As in the peacetime case, two primary findings result. First, innovation is most likely if proper measures of strategic effectiveness are used. Essentially, if current actions are making the strategic situation worse, massive innovation is in order. However, as one innovates it appears that, often, previous measures of success were incorrect. In other words, the wrong battle was being fought.[128] Second, and more important to this study is the observation that centralized organizations fared better than decentralized ones when it came to innovating in war. Rosen thinks this is due to the fact that, "a tightly controlled organization in which intelligence is collected and concepts of operation are enforced from the center may be able to act more quickly."[129]

A Framework for Discussing Air Force Issues

The preceding pages provide insight and justification for the following issue groups that will serve as a framework in the final chapter for recommending a comprehensive operationally focused strategy for information superiority. The four primary issues are: 1) organization, 2) critical linkages, 3) personnel, and 4) keys to successful implementation. Each is discussed briefly.

Organization: If information superiority is a core competency and source of competitive advantage, the Air Force must organize with that reality in mind. This issue group focuses how

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[126] Ibid., 58.
[127] Ibid., 22-25.
[128] Ibid., 22-39.

information superiority organizations should be grouped within the Air Force's peacetime organization. Support for such an approach stems from Porter's idea of competitive scope. Information superiority capabilities are vital to the success of other Air Force core competencies (or segments). Consequently, it makes sense to centrally manage information superiority capabilities that are common to all. Likewise, the Air Force owns a large portion of the information superiority assets upon which it relies for combat effectiveness (vertical scope)—which again makes a case for organizing around information superiority to gain flexibility in the use of those resources. The federated model highlighted by Earl guides the approach to this section through the question, "what should, and should not, be centralized?"

Critical Linkages: Information superiority capabilities are useless if they cannot be translated into effective combat power. This issue group focuses on the key linkages to wartime users. Emphasis in this case is on the Joint Force Air Component Commander (JFACC), the Joint Force Commander (JFC), and individual platforms. Horizontal strategies must exist for all three.[130] Central to appreciating these discussions are organizational theories highlighting innovation (brain and garbage can approaches), as well as Rosen's conclusion that innovation in wartime operations favors more tightly controlled structures—both discussed earlier.

Personnel: This issue group is concerned with the ultimate weapon—the mind. This section draws from organizational theory, business, and military discussion on innovation. What should be the depth and breadth of airmen involved in information superiority tasks? Is there utility in differentiation between knowledge workers and information technology workers? Finally, based on Rosen's peacetime findings, what career field structure would ensure adequate promotion pathways for information superiority personnel?

Keys to Successful Implementation: This issue group address three additional points important to Air Force change based on information superiority justifications: doctrine, cost, and

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[129] Ibid., 38-39.
[130] Porter, 320-323.

senior leadership commitment. Doctrine, as it reflects sanctioned theory, must be changed to better clarify the elements of information superiority. Cost is a critical issue when information superiority initiatives crowd other Air Force programs within a relatively fixed budget. Finally, senior leadership commitment will remain vital to seeing through any major changes to Air Force organization and practices.

Conclusion

The topics covered in this chapter establish some reference points for beginning to think about organizational change in the information age. Still, those involved in planning for change must not lose sight of the most important fact: understanding why it is the organization exists. The final chapter tries not to lose sight of this imperative. Unfortunately, the difference between knowing what "business" one is in and finding agreement among an organization's members is the source of perpetual conflict. How that conflict is managed remains key.

Chapter 5

Operating with Information Superiority in Mind

This chapter proposes the Air Force change its organization and activities in a number of ways to better leverage its information superiority capabilities. Four issue groups frame the argument. First is organization. The Air Force must centralize more of its information superiority activities—including identification of a major command to assume information superiority responsibilities. The second issue addresses how information superiority is applied to combat operations. Critical mechanisms for this transfer are identified in this section. Third is the issue of personnel. More can be done to identify and leverage information superiority career fields. Finally, change will not be easy. This last issue identifies four areas to facilitate implementation of information superiority-based ideas.

Issue 1: Organization

Recommendation

Emphasize information superiority in the Air Force by placing overall responsibility for information superiority activities in one major command (Aerospace Information Command—or AIC) headquartered at Peterson AFB.

Justification

Numerous points support such a move. First, it shepherds and leverages the heavy investment the Air Force already has in this core competency—as shown in chapters two and three. Second, information superiority is clearly a key source of competitive advantage for both the Air Force and the entire Department of Defense (which relies on many Air Force information superiority capabilities). Rosen's peacetime innovation criterion of recognizing change in the international security environment seems to fit well with the ideas of competitive advantage. The concept of information superiority is one recognition of that change. Third, while creation of AIC recognizes the large role space plays in information superiority, equally important is the fact that information superiority becomes a tangible everyday function that <u>aerospace</u> forces deliver. Fourth, though information superiority would still be much larger than the role assumed by AIC, one command would be responsible to build information superiority plans and a culture that integrate all of the Air Force. Finally, similar logic is driving consolidation of DoD command, control, communications, intelligence, surveillance, reconnaissance, and space responsibilities under the information superiority banner.[131]

Discussion

Setting the stage: Before explaining this paper's recommended structure, it is necessary to discuss the focus and nature of the new command. AIC's focus would be in large part a peacetime one consisting of organizing, training, and equipping Air Force information superiority forces for combat operations. It's innovation focus would be threefold: packaging information superiority capabilities for improved understanding of red and blue forces, linking information superiority capabilities in better ways to other Air Force missions, and providing similar support to sister services.

Regarding the kinds of information superiority platforms and organizations that should reside within AIC, one must determine the nature of each information superiority

task. The most critical distinction is between what this study calls organic and non-organic organizations. Organic organizations are those whose primary output goes to members of the immediate parent organization. An air intelligence squadron at a numbered air force or a communications squadron as part of a support group are two examples. Non-organic organizations support a variety of end users outside their immediate parent organization. For the most part, this study recommends leaving organic organizations where they currently reside. Non-organic information superiority organizations, in most cases, transfer to AIC.

The Reorganization Plan: This plan calls for two numbered air forces within AIC to carry out most information superiority responsibilities. 14AF would remain in name but change its focus to aerospace battle management infrastructure. A second numbered Air Force would be created to focus on aerospace combat information and protection. Though most centers would fall under one of the NAFs, two would work directly for AIC/CC.

14AF: This NAF would deliver battle management expertise and information technology infrastructure to combat forces through two subordinate wings and three centers. Headquartered at Vandenberg AFB, it would also serve as the operational focal point for the command and control portion of information superiority doctrine. The 50th Space Wing would retain most of its current responsibilities for flying space-based systems (all are currently information superiority platforms). A second wing would own all airborne command and control platforms. Finally, three centers would work directly

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[131] Bill Gregory, "Organizing for Information Superiority: The Pentagon's New C3I Office Takes On a Broadened Charter," *Armed Forces Journal International*, December 1998, 18.

for 14AF/CC: the Space Warfare Center, Air Force Command and Control Training and Innovation Center, and the Air Force Communications and Information Center.

The New NAF: This NAF would deliver combat information and protect friendly information systems through three subordinate wings and four centers. Headquartered at Kelly AFB, it would also serve as the operational focal point for the information operations portion of information superiority doctrine. An airborne wing would own all ISR and IW platforms and crews. A space wing would own all space surveillance and warning squadrons. An intelligence wing would own all remaining intelligence organizations. Four centers would also belong to the new NAF: the Air Force Information Warfare Center, the National Air Intelligence Center, the Air Force Climatology Center, and the Air Force Combat Weather Center (the last two would transfer along with and remain subordinate to the Air Force Weather Agency).

Direct Reporting Centers: Two centers would report directly to the AIC/CC. The Aerospace Command and Control & Intelligence, Surveillance and Reconnaissance Center requires direct four star access (just as it currently enjoys in Air Combat Command) given its Air Force-wide information architecture responsibilities. The Air Force Technical Applications Center (AFTAC) would also report directly to the commander.

Current Air Force Efforts

Primary activities in this area include Corona Conference preparations and work being done by the Aerospace Integration Task Force (AITF).

Considerations

This reorganization will precipitate a number of thorny questions. Three significant ones are addressed here. First is the question of command and control. Where is the line drawn between responsibility for development of command and control systems and command of the system? Under this proposal, preparation efforts would focus on the Command and Control, Training, and Innovation Center (within AIC), while operation of actual air operations centers would most likely reside with ACC. Cooperation between commands would be essential. Still, this seems to be the right way to focus energies (one command improves capabilities while the other trains to the highest level possible on current systems). Cross flow between commands will be essential.

Second, what becomes of the non-information superiority portions of Air Force Space Command? The short term answer may be that the Air Force simply cannot manage so much change so fast. Retaining counterspace, strategic attack, and spacelift functions may force AIC's attention to be directed in several directions. Still, even this compromise centralizes responsibility for information superiority. A cleaner (though organizationally more traumatic) option does exist. At the very least, the Air Force needs to consider and debate a future in which a United States Aerospace Force consists of, in addition to AIC, an Aerospace Combat Command (including ICBMs and future counterspace capabilities), and even an Aerospace Mobility Command that includes spacelift capabilities.

Finally, what of the link to United States Space Command (or as Gen Shelton suggests, a United States Space and Information Command)?[132] The compromise position that has AIC retain non-information superiority space responsibilities potentially

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makes for a cleaner connection between United States Space and Information Command and its Air Force Component. The cost, however, may be to internal cohesion in an Air Force (or Aerospace Force) that might find it operationally sound to organize around aerospace tasks such as force application, mobility, and information superiority.

Issue 2: Critical Linkages

Recommendation

Focus AIC on primary mechanisms to deliver information superiority capability to three levels of combat forces: the Joint Force Commander, the Joint Force Air Component Commander, and individual Air Force platforms.

Justification

This issue is concerned with the presentation of information superiority forces to combat commanders. Command and control doctrine, organization, and procedures can be thought of as a horizontal strategy that brings all Air Force core competencies together to achieve wartime objectives. AIC must ensure it understands and can support its role in that command and control system. Complicating matters is the tremendous number of DoD organizations that rely on Air Force information superiority capabilities. Consequently, Air Force information superiority assets are often referred to as national assets—reflecting both their popularity and scarcity. Delivery mechanisms must be created to manage the tension between Air Force and non-Air Force requirements.

Drawing on the somewhat academic examples in chapter four highlights an additional practical benefit. U.S. military forces seek the most effective command and

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[132] Shelton, 1.

control system possible. Such a system allows commanders and front line forces to exchange knowledge. If, as chapter four asserted, warfare is an act of competitive innovation between opposing forces—those forces who learn faster gain a significant source of advantage. The garbage can model raises interesting possibilities for well designed command and control systems to foster better quality decisions by making problems and solutions more visible to problem solvers. The organization as a brain metaphor also offers hope that organizations can learn more quickly. In every case, modern information technology presents significant opportunities to improve command and control in warfare.

Discussion

Dual approach: The Air Force strategy for managing the powerful demand for information in war requires two approaches. The first brokers the demand for information superiority capabilities from organizations inside and outside of the Air Force. The second focuses on making the air component's command and control system as effective as possible.

Approach 1--Primary Delivery Mechanisms: Three kinds of organizations need to support the three levels of information superiority use identified earlier (JTF, JFACC, and individual Air Force platforms). Starting in the middle, the JFACC would receive information superiority support from an information superiority cell within the AOC. Such an organization would contain information infrastructure, ISR, IW, weather, and space system expertise. Preferably, the cell's personnel would belong to the NAF owning the AOC team. The cell would do more than support air component operations in theater. It should also serve as the planning and tasking authority for theater-wide

information superiority requirements.   Given the flexibility and versatility of aerospace forces in general (and the fact that they, more than any other component, must plan with the entire depth of the battlespace in mind), such a mindset makes the information superiority cell well suited to carry out theater tasking based on joint force commander priorities.

At the JTF level, AIC would create an Aerospace Information Superiority Center (AISC).   It's first purpose would be to broker competing requirements for national information superiority assets not assigned to the JFACC.   Second, it would serve a reachback function for leveraging Air Force information superiority expertise.   In this capacity, it could support both AOC forward and AOC rear operations and even serve as a backup command facility.   While this paper envisions the AISC physically located at AIC headquarters, it would also be networked to its two NAFs.

Finally, AIC centers and battle labs would focus on mainly peacetime improvements to combat capabilities (mainly at the platform and unit level). One example of this is the Space Warfare Center's Tactical Exploitation of National Capabilities (TENCAP) Directorate which, "demonstrates leading edge space technologies which show the potential to enhance the combat capabilities of units in the field."[133]   Wartime duties might include development of quick reaction capabilities (systems and procedures) to counter enemy actions.

Approach 2—Command and Control Improvements: Though very much an Air Force-wide concern, AIC responsibility for improving the quality of command and control systems would reside mainly with the Aerospace Command and Control &

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[133] Air Force Space Command Fact Sheet, Space Warfare Center, March 1999, n.p.; on-line, Internet, 27 April 1999, available from http://www.spacecom.af.mil/hqafspc/library/facts/SWC.html.

Intelligence, Surveillance and Reconnaissance Center (AC2ISRC) and a redesigned 14AF.

Current Air Force Efforts

Regarding approach one (primary delivery mechanisms), the Air Force is already creating information operations cells to reside at various NAFs in support of AOC functions.[134] The emphasis is currently on information warfare capabilities (with billets from Air Intelligence Agency and the SC community).[135] An Information Superiority Flight could start with such a concept and add additional expertise especially in the areas of space systems and weather.

Supporting reachback and national level tasking, currently 14AF and AIA have 24 hour command and information facilities.[136] This would provide a starting point for managing information superiority tasking until a formal Aerospace Information Superiority Center could be established.

This study also highlights three current Air Force initiatives benefiting approach two (command and control improvements). First is the ACC-sponsored program to treat command and control as a weapon system. In recognition of the specialized skills and complex coordination required to plan and execute aerospace operations, plans are currently being developed to create three AOC organizations independent from NAFs

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[134] Lt Gen Roger G. DeKok, Deputy Chief of Staff, Plans and Programs, Hq. USAF, memorandum to all MAJCOM/CV, subject: Establishing Organization Structures for Information Operations (IO), 19 February 1999.

[135] Ibid., and ACC/AIA IW Flight CONOP (draft), n.d.

[136] AIA's is the Information Operations Center. See Air Intelligence Agency Fact Sheet, "Information Operations: For the 21st Century," n.d., n.p. 14AF's is the Space Operations Center. Air Force Space Command, "Concept of Operations for the AFSPACE Space Operations Center (SOC), 15 March 1999. (FOUO)

with enough internal manning to avoid augmentation and steep learning curves.[137] Second, the AC2ISRC is developing a concept called "spiral development" intended to rapidly field new information technologies.[138] Finally, the Air Force Science Advisory Board is heavily involved in identifying promising new information technology concepts and capabilities on the horizon.[139]

Considerations

This section identifies two potential problems. The first is one of transparency from above. With a centrally managed information superiority command, might it become too easy for the joint community to tap Air Force expertise at the expense of other Air Force functions needing the same support? The problem here is one of tradeoffs. If Air Force information superiority becomes too successful, it may crowd out other Air Force programs. This concern is addressed more completely under issue four. Still, it seems that if competitive advantage and the international security environment favor information superiority, the Air Force needs to invest heavily in this area. Good or bad, to some degree the political skill of the organization will determine how much credit the Air Force gets for this capability (which may force internal tradeoffs).

The second concern addresses the subject of conflict between JFACC requirements (and the theatre CINC) and requirements from outside the theater. Two models should be

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[137] Briefing Slides, Aerospace Command and Control & Intelligence, Surveillance and Reconnaissance Center, *EAF C2 Baselining*, n.d; on-line, Internet, 14 May 1999. Available from http://151.166.56.51/505OS/FinalEAFBaseXP-Xov5.ppt.

[138] Briefing Slides, Aerospace Command and Control & Intelligence, Surveillance and Reconnaissance Center, *Spiral Development and Testing: A Discussion,* 18 February 1999; on-line, Internet, 16 May 1999. Available from http://wwwmil.acc.af.mil/ac2isrc/briefings/Testing Spiral Development as of 12 Feb at 1529.ppt.

[139] United States Air Force Scientific Advisory Boar*d, Information Management to Support the Warrior*, SAB-TR-98-02, December, 1998 and *A Space Roadmap for the 21st Century Aerospace Force, Volume 1: Summary*. SAB-TR-98-01, November, 1998.

studied: intelligence collection and airlift tasking. Both must contend with strategic and theater assets. Both are forced to make decisions based on the requirements of many organizations. The heart of this specific concern is not whether conflict will occur over limited information superiority assets. What is most critical is identifying a process that manages the conflict as effectively as possible.

Issue 3: Personnel

Recommendation

Create an information superiority AFSC family (in this study, such a recommendation is limited to officer AFSCs only).

Justification

Based on significant Air Force investment in information operations shown in chapter three (including over 20 percent of the line officer corps), combined with the growing significance of information technology to combat operations, the Air Force must create an innovative career framework for information superiority personnel. If done right, such a move could foster information superiority experts who can apply an array of information technology capabilities to combat operations.[140] It would also diversify the mix of senior Air Force leaders—making the organization better equipped to tackle information age issues.[141] Finally, as Rosen pointed out in his study, one of two

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[140] It would also counter the tendency to create specialized technology stovepipes. The tension identified in chapter four is that specialization (to stay competitive) causes specialists to become farther removed from an organization's core culture and mission.

[141] "In today's time of geostrategic change, as reflected by the end of the cold war, institutions that maintain broad, pluralistic, and pragmatic perspectives can better recognize and adjust to the new paradigm [or realities]." Sam C. Sarkesian, The Professional Army Officer in a Changing Society (Chicago: Nelson-Hall, 1975), n.p., cited in Mike Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership, 1945-1982* (Maxwell AFB, AL: Air University Press, March 1998), 238.

significant factors influencing successful peacetime military innovation is establishment of new promotion pathways for officers. If innovation in modern warfare hinges on information technologies, how can the Air Force not rethink its AFSC architecture in light of this reality?

Discussion

   Range of AFSC's: Probably more than the two previous issues, there are scores of solutions that would result in an effective information age career matrix. This particular recommendation considers six core AFSCs for inclusion: airborne weapon systems operators from information superiority platforms, space, battle management, communications and computer, intelligence, and weather. Other AFSCs might prove acceptable if officers received interim technical training (for instance, pilots flying information superiority platforms, engineers, or even public affairs officers). If the reader is tempted to smirk at the mention of public affairs in this context—welcome to information age warfare and the changing nature of traditional jobs.[142]

   Even within the six core AFSCs, important differences emerge. Recall the distinction made in chapter four between information technology and knowledge workers. The information superiority AFSC family contains both. Communications and computer officers tend to be technology experts with a focus on infrastructure and system operations. Battle management, intelligence, and weather officers tend to work more with abstract concepts and ideas—placing them more in the knowledge worker category. Space and airborne IS platform WSOs are a mixes of the two categories in varying

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[142] Military columnist Bill Arkin says the solution to the Air Force's problem with the media requires the involvement of senior leaders, not public affairs. Bill Arkin, interviewed by author, 9 April 1999. This

degrees. What is important, though, is that all are vital elements of the information superiority core competency. Knowing how to leverage the strengths of each may prove to be the key to a successful information superiority plan.

T-Shaped Skill Plan: This plan gets to the heart of one information age dilemma—specialization. As military capabilities become increasingly reliant on information technologies, there is a tendency to create specialists to make the information technology-based capabilities ever more effective.[143] Unfortunately, such specialization may not develop the wider ranging expertise needed to make information superiority an effective part of combat operations (which requires the broadest of expertise). To a certain extent, this tension can never be undone. Cultivating one kind of talent will always be at the expense of the other. Still, the Air Force can do a better job in creating information superiority leaders instead of information superiority stovepipes.

The basis for such a plan rests on the concept of T-shaped skills.[144] I-shaped skills (the vertical portion of the T) are the, "deep functional expertise" normally rewarded by organizations. The horizontal portion of the "T" refers to the ability to apply knowledge "across situations." Some research has shown dramatic performance increases in technology based companies that emphasize T-shaped skills. This approach also seems to support discussion in chapter four of the holographic systems approach (allowing an organization to perhaps function like a brain and exhibit qualities of both generalization

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author only half agrees. Public affairs officers with sufficient training must help create information strategy, just as officers with platform expertise are often called on to create air strategy.

[143] This is a broad tendency and is not based on Air Force statistics. Martin van Crevald makes an interesting observation (though now slightly dated) that the complexity of the 1963 armed forces was four times that of the 1945 armed forces (as a function of number of Military Occupation Specialties and percentage of people in core combat positions). See Martin van Crevald, *Command in War* (Cambridge: Harvard University Press, 1985), 235.

[144] Dorothy Leonard-Barton, *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation* (Boston: Harvard Business School Press, 1995), 76-77.

and specialization). An Air Force heavy in personnel with T-shaped information superiority skills would be well placed for technological innovation necessary to stay competitive.

One of many ways such an approach could be applied to the information superiority AFSC family is to build very focused specialization early in an officer's career and then, at the mid Captain level, return information superiority officers for a core competency qualification course. This course would be an technically intensive look at a survey of information superiority subjects from each career area of expertise. Students would also face a variety of contemporary problems involving the application of information superiority capabilities to combat operations.

Those who successfully completed the course would be designated information superiority officers (ISOs). All Air Force information superiority squadrons (those in AIC and those organic to other commands) would receive commanders through a central board considering only of ISO graduates.[145] Any AFSC within the information superiority family would be considered for any squadron.

Though it is far beyond the scope of this paper to examine how such a requirement would duplicate or draw on current programs, two points are worth mentioning here. First, some technology leveling would probably need to be done at the tech school level for award of an initial AFSC. Second, the program should take into account the nature of each AFSC and tailor the overall course accordingly. In other words, each AFSC should study less of itself and much of other AFSCs. The result might include a general set of

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[145] Other positions might also require the ISO designator (field grade information superiority positions at the AOC level, for instance).

courses plus one or two "minors" students could choose to add knowledge outside their area of traditional expertise.

Current Air Force Efforts

There is a great deal of work taking place to create officer (and enlisted) Air Force members who can excel in information age warfare.[146] However, this issue involves the creation of an entirely new career family. For the scope of this paper, there is limited utility in surveying what each of the current AFSCs are contemplating with respect to information superiority, since this proposal essentially puts all of these AFSCs out of business to some degree.

Considerations

Upheaval is probably a conservative term in this case. Yet, if information superiority is as important as what the Air Force argues it is (a core competency) and what this paper finds (exceeding 20 percent of Air Force investment in some cases), it seems to deserve some rather extraordinary thought regarding how the human side of information superiority might best be applied to warfare. The benefit from this proposal is an information superiority-oriented officer core with improved technical insight across the information technology continuum. It might even retain a certain percentage of highly qualified individuals who are attracted to the prospect of more diversified leadership opportunities that would also be present in such a case.

In some ways, the Air Force has already started down such a path—maybe without understanding all the reasons. For instance, the 13X career field includes space, missile,

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[146] Gen. Lloyd W. Newton, commander, Air Education and Training Command, address to the Air Force Association symposium on information operations, Lackland Air Force Base, Tx., 24 March 1999,

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and command and control.[147] Without a doubt, any large-scale creation of new career skills and progressions would be fraught with speculation and second-guessing. It is with these forces of resistance in mind that the final section takes aim.

Issue 4: Keys to Successful Implementation

Up to this point, this chapter has at best given short consideration to the discussion of just how difficult such a series of changes would be. This section breaks from the format of the previous three. It addresses four areas that will determine more than others how successful the information superiority concept will be in the Air Force's future: cost, hitting the target, continued senior leadership commitment, and doctrine.

Cost

Part of what makes military decision making so different from the business world is that, in the military, valuable new ideas must often compete against established programs on merits other than profitability. At least in degree, a promising new military capability's future might be jeopardized because, even though it might be operationally valuable, its supporters can't convince the organization's leaders that it deserves a slice of a fixed budget at the expense of another operationally effective programs.[148] Air Force information superiority programs could suffer from this dynamic in two ways. The first involves internal tradeoffs. The second involves getting a larger portion of the resource distribution.

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n.p.; on-line, Internet, 9 May 1999, available from http://www.af.mil/news/speech (cont. nxt line) /current/spch04.html.

[147] Air Force Visual Aid (AFVA) 36-211, *Officer Classification Structure Chart*, 31 October 1998.
[148] See discussion in chapter four.

Regarding internal tradeoffs, it seems reasonable that the Air Force will value most strongly those information superiority programs that enhance other Air Force capabilities. However, in the second case (where some Air Force information superiority capabilities are seen as supporting other services), it is most beneficial to the Air Force if it can charge non-Air Force users for its services. Unfortunately, as chapter four highlighted, even in the private sector there are no easy answers when it comes to determining how to charge users for an information technology service. If the Air Force is unable to create a way to assess costs as a means of increasing its portion of the budget, it must at least try to measure each service's use of its capabilities and make a more general argument based on those numbers.

Hitting the Target

Does this study's view of information superiority adequately prepare the Air Force to be relevant in warfare for the coming decades? It does, if the reader accepts a major role for information technology in future warfare. Still, in every plan there exists a vulnerability. In the case of this paper, does a platform, organization, personnel, and budget strategy based on those resources that perform information superiority primary functions miss something? Every aircraft and every airman depends on information technology every day. Based on this view, information superiority involves everyone and everything in the Air Force.

Though such an observation is a powerful one, it needs to be met by the Air Force with a two tiered approach. At the Air Force wide level, the training and acquisition communities must lead the way with plans that incorporate information technology the best way possible into everything the Air Force does. The value of this specific study is

for the second approach. For those operational activities that are very heavy in their information technology orientation, the Air Force must organize with that reality in mind.

Continued Senior Leadership Commitment

Change is a political process. This was emphasized in chapter four during the review of related information age business concepts and during the discussion of Rosen's theory of military peacetime innovation. New theories, no matter how promising they appear, can easily die on the vine. Both Rosen and the business experts agreed on the need for strong senior leadership involvement in the implementation of technology-based change. Air Force information superiority plans must continue to receive such attention as they are executed.

Doctrine

This paper asserted fairly early that there needs to be an explicit connection made between information superiority and what this study contends are its two component parts (command and control, and information operations). If doctrine is intended to harness and influence behavior, there is great merit in ensuring that the various information age concepts in Air Force doctrine are connected wherever practical. The just-released Air Force Instruction covering operational procedures for the aerospace operations center shows that information superiority is central to Air Force operations but some work still remains. Chapter nine, a discussion of specialty functions, actually describes each of the six major categories used in this study.[149] However, in the information operations section, little is said about IIW while a great deal is mentioned about IW. It seems the

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[149] Air Force Instruction 13-1AOC, Volume 3. *Operational Procedures—Aerospace Operations Center*, 1 June 1999, 65-76.

Air Force is comfortable with the component parts of information superiority but not yet clear on how they might fit together.

Finally, Air Force and joint doctrine must maintain close ties. Currently, the doctrinal camps are divided over the definition of information operations. The joint version of information operations is much more like the Air Force definition of information warfare.[150] No joint concept exists to capture the idea of information-in-warfare.

One could argue that, given the relative infancy of the information age's place on the modern battlefield, differences in doctrine are signs of innovation within organizations. Though this might be true, joint doctrine has gone much farther—actually attaching organizational mandates to its doctrine. Within 3-13 are descriptions of information operations cells and officers as part of a Joint Force Commander's staff.[151] Having a staff function at the JFC level responsible for IW-like tasks (Air Force definition) is absolutely necessary. However, differing information operations concepts raises the possibility of misunderstanding between Air Force component commander and the JFC.

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[150] Joint Pub 3-13, Joint Doctrine for Information Operations, 9 October 1998, I-9.
[151] Joint Pub 3-13, IV-1 to IV-9.

Chapter 6

Conclusion

This paper has shown that Air Force is correct to identify information superiority as a core competency. Overall Air Force investment in information superiority is significant.

Doctrinally, the Air Force ideas of information superiority, command and control, and information operations have the potential to serve as a framework for harnessing innovation in modern Aerospace warfare.

Air Force physical investment matches the conceptual assertions. From an organizational, personnel, and budgetary perspective, information superiority encompasses 14 to 24 percent of all Air Force activities. Though platform numbers are lower (only five percent), some of this is explained by the high cost of specialized information superiority systems. Moreover, the relatively low number of platforms highlight an important quality of information superiority—it may depend less on platforms and more on people and organizations.

Understanding the level of one's involvement in any mission is an essential first step to developing strategy for the future. Taking a second step toward an information superiority strategy for the Air Force, this study emphasized the importance of innovation to the nature of information age warfare. Before discussing specific courses of action for

the Air Force, this paper examined relevant theory from the areas of organizational behavior, business and information technology, and military and technological innovation. All shed important light on how an Air Force might better organize for information superiority.

This study has treated investment as a term having far more than monetary connotations. In a similar way, this study's recommendation chapter pushes the idea of architecture past its normal limits. The first recommendation is that the Air Force must reorganize a number of information superiority organizations around an Aerospace Information Command. Though an important starting point, useful architecture goes far beyond the idea of organization. An effective information superiority architecture also involves processes and people. Consequently, this paper recommends the Air Force emphasize three areas where information superiority is to be delivered (Joint Force Commander, the Joint Force Air Component Commander, and individual Air Force platforms.). Last, but perhaps most important, is the need to develop an information superiority personnel architecture. This paper takes a first step in that direction for officer positions and recommends a way to tie together a number of currently isolated specialties into a force for information age leadership in warfare.

Change won't be easy—as the last portion of chapter five warns. Certainly, there are other paths to organizational success in delivering information superiority to the battlespace. What is most important is that the Air Force understand it role in gaining that information superiority. Only then can it build a comprehensive and innovative plan to harness Aerospace power in the information age.

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