AIR WAR COLLEGE

AIR UNIVERSITY

THE AIR STAFF OF TOMORROW:

SMARTER, FASTER, BETTER

by

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Biography

Lieutenant Colonel Don C. Fuller III entered the Air Force in 1990 as a distinguished graduate of the US Air Force Academy. He earned a Master of Science Degree in Engineering from Purdue University in 1991. He then attended Undergraduate Pilot Training at Williams Air Force Base, Arizona. Following pilot training, he served as F-16 flight test engineer in Tucson, Arizona. He then served as an F-16 pilot at Hill Air Force Base, Kunsan Air Base, and Luke Air Force Base. Lt Col Fuller was assigned as a Joint Staff Officer, completing two deployments to Iraq in support of Operation IRAQI FREEDOM. Afterwards he attended the US Maine Corps Command and Staff College next returning to Hill Air Force Base and serving as the 388th Fighter Wing Chief of Plans and Programs and as Director of Operations, 388th Operations Support Squadron. His last operational assignment was as the Commander, 8th Operations Support Squadron, Kunsan Air Base, Republic of Korea. He is currently a student at Air War College.

Chapter 1: INTRODUCTION

The fundamental organization of the Headquarters Air Force (HAF) must adapt in order to meet the rapid rates of strategic and tactical changes that will be occurring in the 2035 time-frame. These adaptations will need to encompass both new and emerging technologies as well as a generation of Airmen who have grown up in a technological and flattened world. By choosing, or alternatively allowing, a new organizational construct, the Air Force can best leverage its people to meet the strategic challenges of the future. The organizational structure of the Headquarters Air Force (HAF) directly impacts the ability of the HAF to provide essential support to the Chief of Staff of the Air Force, the Congress, and fielded operational forces. These decisions can have far-reaching consequences that impact the Air Force, the nation and other countries. How this Air Staff handles any future environment will depend upon the nature of the future and the organizational structure of the staff.

The cognitive organization, as defined in this paper, will meet the needs of the Air Staff of 2035 to meet the rapid rates of change while retaining the appropriate levels of accountability. A cognitive organization is an organization combining the mechanistic and organic forms of organization by using an existing military hierarchy, which maintains control over a limited number of high risk processes, and decentralizing all other functions across a networked, self-adjusting system. It makes use of decentralization of authority, appropriate control measures, and the use of teams to solve problems. The cognitive organization can be described as a loose confederation of teams, both ad hoc and standing, working toward the common goals of the organization. Proper leadership of the cognitive organization requires the articulation of a clear vision along with oversight of those processes that can have catastrophic outcomes.

Chapter 2 outlines the issues that can be expected to face the Air Force in 2035. Along with these future issues, the Air Force will also have access to both technological and human resources. The world of 2035 will most likely be driven by the development and fielding of disruptive technologies by a wider range of actors, while the United States will find itself resource constrained. Additionally, technology will be advancing at rates that increase exponentially. Rapid technological change will provide adversaries advantages they do not currently enjoy while complicating the decison-making process of any organization. But the same technology can provide tools, such as artificial intelligence, that an established organization, like the Air Force, can use to its advantage. Furthermore, the future will have extraordinary people who have grown up in a world of networked connectivity and problem solving. The future provides the Air Force probable risk and possible reward.

The following chapter begins a discussion of the two fundamental types of organization in management literature. Both the advantages and disadvantages of mechanistic and organic type of organizations are outlined to provide the basis for building a new organization for the HAF. Mechanistic organizations provide stability and reliability in decision-making, but tend to be slow and resistant to change. On the other hand, organic organizations are swift in decision-making, but, due to the nature of decentralization, do not provide the appropriate level of accountability for dealing with high-risk decisions. Chapter 4 describes the cognitive organization that combines the speed of an organic organization with the requirements of an organization that deals with potentially catastrophic outcomes emanating from the decisions that are made. I argue that the cognitive organization can deliver both if the leadership allows risk, provides clear vision, and empowers networked people at the edges of the organization.

Chapter 5 begins with a vignette that presents a realistic problem for two organizational types to confront. The vignette includes technological and intelligence difficulties and forces information across stove-pipes, but with the Air Force and the interagency environment. Maj Smith, the notional action officer in both scenarios, first handles the problem within a cognitive HAF. He then repeats the exercise within a HAF that mirrors today's organization and processes.[1] In both cases, Maj Smith must assemble teams and transfer information. However, in the cognitive organization, he is given much more latitude in his decision-making authority and he has the ability to directly liaison with elements across the entire United States government. This level of authority becomes a critical factor in the speed at which the cognitive organization works and allows the cognitive HAF to outpace the more deliberate processes of today's HAF.

Finally, Chapter 6 concludes with an analysis of the results of the thought experiment posed in Chapter 5. In order to build a cognitive HAF, three things are necessary. The Air Force must arm its decision-makers with the appropriate network and technological tools. Additionally, the right people must be identified and recruited to provide the type of skills needed to succeed at the edges of a decentralized organization. The "edge" of an organization is "where the organization interacts with its operating environment to have an impact or effect on that environment."[2] These people need to be both intelligent and not adverse to risk. Furthermore, Air Force leadership must develop itself to allow risk and decentralize control of processes that do not result in decisions that may have catastrophic results. By implementing plans that incorporate these three elements, the Air Force can develop its HAF via evolutionary change that will deliver the required results without a wholesale disruption of current processes and operations.

The HAF must change to meet the future. No one can say, beyond generalities, what the future will hold. However, with a few generalities, the future environment can be broadly understood and, hence, we can prepare for it. The best preparation for an uncertain future is an organization that can quickly assess changes, react to those changes, and guide the Air Force through those changes. A cognitive organization can meet this challenge and, by implementing evolutionary changes, can change itself to best deal with any future environment imaginable.

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1. The current HAF is primarily a hierarchical entity that incorporates elements of organic structures and processes.
2. David S. Alberts and Richard E. Hayes, *Power to the Edge: Command...Control...In the Information Age* (Washington, D.C.: DoD CCRP, 2005), 5.

Chapter 2: A FUTURE

Defining the future is always a problematic endeavor, however, some key assumptions can be made that will provide a degree a certainty regarding possible future environments. The year 2035 will most likely be strikingly different from the world of today. Technology has been changing and will continue to change at an exponential rate that will have profound societal impacts.[3] This continuing rapid change in technology, along with the associated societal upheavals, can be expected to lead to more disruptive technologies being made available to more entities, even individuals.[4] Ironically, the United States military will most likely have fewer resources to address these increasing threats.[5] Against this backdrop, the Air Force will have tools available to counter these threats. Artificial intelligence and/or advanced computing capabilities will be readily available and already be in use throughout the Air Force and society. Additionally, the networking being used today will continue to improve and proliferate through every niche of the military and society. Furthermore, the Airmen of tomorrow's Air Force will have grown-up in a world of avatars[6], networks[7], and informality.[8] Although limited in nature, these few assumptions can paint a general picture of tomorrow's environment.

The 2008 Blue Horizons Future Studies produced four alternate futures that the Air Force should be capable of confronting in 2030. From this study, two common themes emerge that should be applicable to 2035. The future will be disruptive, characterized by rapid changes; and resource limited, at least for the United States.[9] The disruptive and resource limited nature of the future will have profound impacts on military organizations, processes, and equipment. As technology advances, more disruptive capabilities will be available to a wider range of actors. State and non-state actors that are now only able to affect regional neighbors will be capable of reaching international targets. While the threats increase, the United States' ability to meet those

threats through increased spending will be greatly hampered by fiscal constraints. How the Air Force meets these challenges will rely upon sound, timely decision-making and execution.

A current example of an enemy using various technical means available to thwart US interests is Al-Qaeda. Its use of the internet to organize and train its members is only the tip of the iceberg.[10] In the future, organizations such as Al-Qaeda will be greatly enabled by advances in off-the-shelf technologies. These technologies can be expected to enable more disruptive outcomes. For example, imagine a terrorist group marrying biotechnology[11] with nanotechnology to produce a precisely targeted weapon that can freely pass through nation-state borders and strike at the time and place of the terrorists' choosing.[12] The US's asymmetric advantage of precision strike could be lost to a handful of individuals with a bit of imagination and technical expertise. Furthermore, just about the time the US can understand the new threat and develop countermeasures and defenses, the threat will have already changed. This is due to the fact that technology is rapidly advancing and will continue to increase in its rate of change. Kurzweil, in his book *The Singularity*, describes these rapid changes and postulates a time in the near future where it will be impossible to plan for the future simply because it will be so fundamentally different than anything that has gone before.[13] He claims that it will be impossible for the current human to keep up with the changes that technology will bring. Human organizations and thought processes will be too slow to react to an environment that is being created by technology that humans will no longer control.[14] Although extreme in the outcome, Kurzweil's fundamental premise of increasing change is sound and this rapid change will most likely be an integral part of any possible future.

Finally, the United States will not have the same resources relative to the rest of the world that it now enjoys. The Air Force can be expected to have a smaller budget. Programs,

such as Social Security and Medicare will consume more of the budget leaving less for discretionary departments, such as the Department of Defense. Fewer funds will limit material solutions available to tackle critical problems quickly and effectively. These trends sketch a future that is full of uncertainty and risk. But the future also holds the keys to success.

The world of 2035 will be an amazing place that has as many opportunities as it does problems. One can expect advanced computing to be prevalent throughout society. Furthermore, one can imagine artificial intelligence helping humans analyze the environment, calculate risk, and propose solutions.[15] Computers will become more integrated with humans, possibly to the point of increasingly complex bio-tech interfaces.[16] This enormous resource will allow a single person to do the work of an entire staff of experts. Knowledge will be at an action officer's fingertips for immediate use for formulating courses of action, analyzing potential outcomes, and choosing or recommending optimal solutions. When the action officer encounters difficulties dealing with the complexities of the environment, a computer will be able to run advanced simulations to assist formulating, analyzing, and choosing solutions to perplexing problems.[17] Humans will become more capable as individuals.

Networking, enabled by increased computing capacity, will add another layer of complexity and power to the future organization. People will be able to connect, share, and create knowledge in new ways. This knowledge will be available to a wide audience for immediate use and further distribution. Networking is already a reality, but it will become even more prevalent in the future. As humans become more capable as individuals, networking will allow them to become super-powered as groups, teams, and associates. Finally, people will have changed by 2035. Societal trends show that young people are already fundamentally comfortable with technology and change. This trend will most likely continue with individuals

relying even more on technology in both everyday and professional life.[18] The Airmen of the future will be comfortable with building ad hoc teams over a distributed network in order to solve problems or take advantage of opportunities because they are already using those skills in virtual gaming worlds.[19] An Airman of this type can be developed to be decisive and entrepreneurial. By developing these traits, along with the proclivity to use technology and to be comfortable with change, the Airman of the future will be the Air Force's greatest asset, as has always been the case. The Air Force must decide how to best organize both the people and the technology to leverage both against the uncertain strategic environment of the future.

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3. Ray Kurzweil, *The Singularity is Near: When Humans Transcend Biology* (New York: Penguin Books, 2005), 10-11. Kurzweil outlines his fundamental premise by describing the exponential trend in technological progress and the impacts to society at large.
4. Quoting Bill Joy, "Most dangerously, for the first time, these accidents and abuses are widely within the reach of individuals or small groups." Joel Garreau, *Radical Evolution: The Promise and Peril of Enhancing Our Minds, Our Bodies--and What It Means to Be Human* (New York: Broadway Books, 2005), 139.
5. "A Unified Security Budget for the United States, FY 2008", *Foreign Policy in Focus of the Institute for Policy Studies*, April 2007, http://www.fpif.org/pdf/reports/0704unifiedsecuritybudget.pdf (accessed 19 Jan 09). Provides an example of arguments concerning contemporary debates for a reduced defense budget. As social security and other entitlement programs continue to grow, the situation will only become more problematic in the future.
6. Kurzweil, *The Singularity Is Near*, 314-315. Description of virtual reality "personalities" and their interactions. Avatar describes the created version of oneself used to interact with a networked environment.
7. Alvin Toffler, *The Third Wave* (New York: Bantam Books, 1980). See page 281 for the "network" characteristics of a future organization.
8. Art Fritzson, Lloyd W. Howell Jr., and Dov S. Zakheim, "Military of Millennials," *Resilience Report* at Strategy+Business, a Booz Allen Hamilton Publication, 10 March 2008, http://www.strategy-business.com/resiliencereport/resilience/rr00056?pg=all.
9. Blue Horizons 2008 Study. This study was accomplished by the Center for Strategy and Technology, an Air University Center of Excellence located at Maxwell Air Force Base. The Center uses Air War College students to analyze technological trends and anticipate possible strategic implications to the Air Force.
10. "Al Qaeda Claims Its Space On The Web," CBS News, 17 January 2008, http://www.cbsnews.com/stories/2008/01/17/eveningnews/main3725693.shtml (accessed 25 January 2009).
11. "'Biotechnology' means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use." From *The Convention on Biological Diversity, Article 2*, United Nations, 1992, http://www.cbd.int/convention/articles.shtml?a=cbd-02 (accessed 28 January 2009).
12. 'Science has now advanced to the point that those on the cutting edge of research work with individual atoms and molecules. This is the defining characteristic of the new metafield of nanotechnology...at this level--roughly 100 nanometers...and smaller--the applicable laws of physics shift as Newtonian yields to quantum." From Lynn E. Foster, *Nanotechnology: Science, Innovation, and Opportunity* (New york: Prentice Hall, 2006), xiii.
13. Kurzweil, *The Singularity is Near*, 7.
14. Kurzweil, *The Singularity is Near*, 25-30. In these pages, Kurzweil articulates the principles of the Singularity. These include the concepts of artificial intelligence, the necessity of human adaptation through biotechnology, the rapid onslaught of technological change, etc.
15. Kurzweil, *The Singularity is Near*, 8-9.

16. Humanity has already passed the threshold of bio-tech interfaces. Cochlear implants allow some deaf people to hear (from author's personal experience). Additionally, brain impulses from a monkey are able to control machines 600 miles away. This research is funded by the Defense Advanced Research Projects Agency and described in Joel Garreau, *Radical Evolution*, 17-20.

17. Development of this technology is already a recommendation from the Air Force Scientific Advisory Board 2003 Summer Study, *Predictive Battlespace Awareness*, done by Ray Johnson and Lt Gen (USA, Ret) Malcolm O'Neil.

18. Thomas L. Friedman, *The World is Flat: A Brief History of the Twenty-First Century* (New York: Farrar, Straus, and Giroux, 2005), Chapter 3. By living through Friedman's triple convergence, society will be changed in these ways.

19. "World of Warcraft," WoW, is an on-line virtual reality game created by Blizzard, Inc. In the game, players interact with the environment and each other through avatars. By creating teams, players leverage the traits of different avatar types to achieve objective goals. These interactions can be ad hoc in nature or may be longer lasting through the establishment of permanent guilds. Leadership in these teams is based on the perceived abilities of the player claiming leadership to lead effectively vs any established rules, i.e. age or total time as a WoW player.

Chapter 3: "MECHANISTIC VS ORGANIC"

Organizational structures, for the purpose of this analysis, can theoretically be divided into two primary types, "mechanistic" and "organic."[20] These two organizational, or management, types are intrinsically different from one another, but are not necessarily mutually exclusive. In a mechanistic organization "the problems and tasks facing the concern as a whole are broken down into specialisms. Each individual pursues his task as something distinct from the real tasks of the concern as a whole, as if it were the subject of a sub-contract....Interaction within management tends to be vertical... (and) Operations and working behaviour [*sic*] are governed by instructions and decisions issued by superiors."[21] The mechanistic style is best expressed through the hierarchical form of organization. Alternatively, the organic form is much more decentralized and less familiar to most military officers. In it "Individuals have to perform their special tasks in the light of their knowledge of the tasks of the firm as a whole....Interaction runs laterally as much as vertically... (and) Communication between people of different ranks tends to resemble lateral consultation rather than vertical command."[22] Each type of management structure has distinct advantages and disadvantages given the strategic environment and the various decisions that must be made and implemented. In reality, organizations exhibit traits of both styles to greater or lesser degrees. An understanding of these two basic types and how they combine to create a modern organization is key to the development of an organization prepared to meet the challenges of the future.

A strict hierarchical organization is the best example of a "mechanistic" model. This model was developed during the Age of Industrialization and is perfectly adapted to mass production.[23] In this environment, a quick time cycle is subordinate to the need to make the right decisions in order to maximize productivity or effectiveness while minimizing risk to the

institution. The primary attribute of a hierarchy is that it is governed by rules and direction from superiors within the organization.[24] The hierarchy is typically depicted by a wire-diagram that strictly outlines the chain of authority with decision-making processes clearly outlined through formal policy or regulatory documentation. Decision-making authority is normally reserved for higher levels within the organization with the most important decisions made by the person occupying the most senior position. Furthermore, a hierarchy is intentionally designed to operate independently of individuals occupying positions within the system by promoting people according to their perceived ability to operate at the next higher level in the organization. In other words, people are interchangeable and expendable in a robust hierarchical system since someone with equal potential, not necessarily experience, is normally ready to replace someone who departs the organization. Because of this interchangeability, hierarchies require standard operating procedures when dealing with the environment exterior to the organization. Finally, hierarchies are functionally organized with expertise within each function of the system. In essence, hierarchical organizations can best be described as:

1) Utilizing a long time span between start and completion of a task.
2) Requiring large investment of capital to start and maintain.
3) Normally inflexible with regard to fixed resource investment.
4) Characterized by work force specialization.
5) Tending to be highly bureaucratic.
6) Requiring long-range planning to implement change.[25]

All of these characteristics favor a system designed to operate within a stable external environment with few variables and with adequate time for reasoning and decision-making by the most experienced and trusted agents within the system. As with any organization or system, advantages and disadvantages are present.

The hierarchical form of organization is optimized to focus the energy and drive of numerous individuals towards an objective or set of objectives determined by the hierarchy's leadership. This style of organization is well suited for organizations that deal with decisions that may have ruinous and far reaching consequences operating in stable environments.[26] By having the most trusted and experienced office holders make critical decisions, the organization limits the chance that a decision will be catastrophically wrong. Although bureaucratic decisions may be slow, they seldom produce decisions that may lead to the ruin of the system as long as the organization is operating within a stable external environment. Additionally, hierarchies provide a level of accountability to individuals within the organization that enables the organization to focus efforts in line with the needs of the organization. As one moves from the lower levels of a hierarchy to the highest echelons of control, execution of standard operating procedures slowly transition to decision-making functions. By controlling the rules governing standard operating procedures and levels of decision-making authority, the hierarchy's leadership is able to maintain responsibility for the organization's actions and accountability for the results. Ultimately, the functional nature of hierarchies ensures that the trusted agents of the system are functional experts. Most leaders within a hierarchy have climbed the proverbial ladder within the functional stovepipes of the organizations. This reliance on the experts ensures any decision made is consistent with prior experience and is likely to produce a known result, namely one consistent with the objectives set by the organization's leaders. While this organization is well suited for stable external environments, there are significant limitations once a variable external environment is introduced.

Although widely utilized, hierarchical structures have distinct disadvantages. Hierarchical organizations are typically unable to reach quick decisions due to the formal

processes that are normally involved. Jill Janov, in her book *The Inventive Organization*, observes, "When power is highly centralized, it is quite possible that many organizational boundaries are not only meaningless but also barriers to fast and efficient operations."[27] Boundaries within an organization delineate those places or processes where information must pass from one entity or function to another in order to be acted upon or passed to another entity or function. Effectively, these boundaries may be meaningless with regard to the actual objective to be achieved while slowing or even preventing the required information from reaching the ultimate actor or operator. Hierarchies, by their very nature, introduce boundaries between people, offices, and functions that limit and slow the flow of information required for timely, useful decisions. Because information flows are typically impeded and people operate primarily within their functional stovepipes, the organization tends to be resistant to change. This is "organizational inertia which always pushes for continuing what we are already doing."[28]

Since a swiftly changing environment is expected in the future, a hierarchy is at a distinct disadvantage due to its inherent inertia. To be successful in a changing environment requires an organization able to adapt to those changes. Resisting change is not the solution to a changing world and will lead to an organization that is left behind and no longer relevant given new situations and problems. Finally, as the hierarchy is introduced to more variation within the external environment, uncertainty increases and standard operating procedures begin to break down. More decisions need to be made by fewer authorized people. Jay R. Galbraith noted, "As uncertainty increases, we encounter the overloaded hierarchy."[29] As the hierarchy is overloaded, standard operating procedures are no longer able to effectively control either the flow of information within the organization or the interaction with the outside environment. As can be seen, the disadvantages of hierarchies are slow decision-making, resistance to required change

and difficulty responding to uncertain environments. Management theorists have observed another style of organization that seeks to overcome these disadvantages.

The organic form of organization more closely resembles a living organism, as opposed to a machine. The organic organization is not described by a wire-diagram. It is formed through lateral communications, empowerment of individuals, limited definition of roles and jobs, and continuously redefined formal and informal interactions.[30] The decentralized nature of the organization encourages decisions to be made at the lowest levels of the organization. Only when people require help do issues rise to authorities within the system. A key enabler of an organic organization is a network through which individuals can pass information, coordinate actions, communicate objectives, and share power. "Networks offer what bureaucracies can never deliver--the horizontal link."[31] David S. Albert and Richard E. Hayes explore the nature of organic organizations in their work *Power to the Edge*. Their "edge organization," arguably a form of organic organization, is characterized by greater peer communication, leadership at the edge of the organization, and "unbundled" command and control.[32] The organic organization also tends to be task oriented versus functionally organized. The organization responds to the external environment by forming either ad hoc or planned teams to gather required data, make decisions, and implement actions. These teams cut across functions and have the necessary authority and expertise to accomplish all three of the above tasks quickly and efficiently. In fact, different teams will reach differing decisions and implement different actions based on the same external conditions. This experimentation is key to the growth and survival of an organic organization. As opposed to hierarchies, organic systems are characterized by swift decision-making by empowered individual and teams, adaptability to change, and ability to thrive in an uncertain environment.

The advantage of organic systems flow from their essential characteristics. Primarily, organic systems are adaptable to change, seek change, and thrive in change. Agility is a key component of organic strength. In a 2000 study, Mankin and Chakrabarti finds that agile companies perform better in volatile environments and that agility outperforms specialized optimization.[33] Volatile environments produce innumerable variables and challenges to any organization. Organic organizations respond with experimentation that ultimately leads to adaptation to the new environmental conditions. By pushing decision-making to the edge of the organization, the central "authority" lets experimentation determine the outcome of new variations. Successful decisions will "survive" contact with the environment; failed decisions will not. The organization will respond by rewarding the successful decisions and encouraging similar processes throughout the system. Lessons learned from both successful and failed outcomes will be immediately available to the rest of the organization allowing the decision-makers at the lowest levels to adjust to the successes and failures of others. Thomas Peters and Robert Waterman, Jr. note, "Adaptation is also too complex to manage by rules in a big enterprise. Alacrity and sheer numbers of experiments are critical ingredients to success through experimentation.[34] An organic organization ensures experimentation will occur and that, as the system responds to success and failure, the outcome to most challenges will ultimately be positive. Organic organizations exhibit their strengths in a volatile environment where experimentation is the rule and mistakes are allowed and even encouraged. But, experimentation comes with its own risks.

The nature of decentralization in an organic system can pose problems for an organization as it reacts to its external environment. Decentralized decision-making always risks an incorrect decision being made by someone who may not have the appropriate functional

expertise or organizational oversight. Janov states, "...in a highly decentralized organizations, boundaries may serve a single functional unit and preclude service to the entire system."[35] In other words, the person or persons making a decision may not see the whole picture in the same way that a traditional "corporate executive" would. Additionally, the decision may be functionally wrong as well because there is no guarantee that the most experienced expert in a particular field will have the opportunity to review or comment on a pending decision. Experimentation itself can also cause problems to an organization. The premise of organic structures is that mistakes will be made, but the preponderance of decisions will be correct due to the robust ability of the system to respond to both successes and failures as they occur. This runs the risk of incorrect decisions being made that could have catastrophic results for the organization and, in some cases, the external environment. An example of an organization that would not operate well with an organic structure is the nuclear enterprise of the United States military. Decision-making authority must rest with the President of the United States and ought not be delegated down to the "lowest level." Organic structures have distinct advantages in a complex environment, but the gains are purchased with the expectation of wrong decisions at the edge of the organization with varying levels of impact.

No organization is purely hierarchical or organic. Any organization includes elements of both in order to deal with everyday standard interactions, as well as, unique challenges posed by an external environment. Currently, Headquarters Air Force (HAF) is organized formally as a hierarchy with functional directorates. Both vertical and lateral communications across functional directorates occur through formal staff functions, such as Staff Summary Sheets, and informal communication between staff officers. Teams are formed to deal with specific items of interest to the most senior leaders of the service. Although lateral communication exists,

decision-making is not pushed to the lowest level. Offices within the hierarchy have varying degrees of responsibility and authority. Staff officers serve to provide the appropriate decision-makers the data needed to make informed decisions. HAF exhibits most of the characteristics of a classic hierarchy along with the strengths and weaknesses outlined above. However this structure will prove to be unable to cope with the challenges of the future and a new organization must either evolve or be actively created.

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20. Tom Burns and G.M. Stalker, *The Management of Innovation* (Chicago: Quadrangle Books, 1961), 5.
21. Burns and Stalker, *The Management of Innovation*, 5.
22. Burns and Stalker, *The Management of Innovation*, 5-6.
23. John Kenneth Galbraith, *The New Industrial State, 4th ed*. (Boston: Houghton Miffin Co., 1985), 13-17.
24. Burns and Stalker, *The Management of Innovation*, 119-120.
25. Adapted from Galbraith's model as described by William Scott, Terence Mitchell, and Philip Birnbaum, *Organization Theory, 4th ed*.(Homewood, IL: Richard D. Irwin, 1981),188. See also John Kenneth Galbraith, *The New Industrial State, 4th ed*., 13-17. Galbraith's assertion is technology has required organizations, particularly manufacturing companies, to organize specifically for long-range planning. "Technology means the systematic application of scientific or other organized knowledge to practical tasks." Galbraith, J.K., p 12.
26. Burns and Stalker, *The Management of Innovation*, 28. Burns and Stalker contend that the "mechanistic" form of organization is well suited for stable external environments.
27. Janov, *The Inventive Organization*, 143.
28. Drucker, *The Age of Discontinuity* (New York: Harper and Row Publishers, 1968), 193.
29. Jay R. Galbraith, *Organization Design* (Reading: Addison-Wesley publishing Company, 1977), 47.
30. Burns and Stalker, *The Management of Innovation*, 5-6 and 121.
31. John Naisbitt, *Megatrends* (New York: Warner Books, 1982), 196.
32. David S. Alberts and Richard E. Hayes, *Power to the Edge*, 5.
33. Eric Mankin and Prabal Chakrabarti. "Valuing Adaptability: Markers for Managing Financial Volatility." *Perspectives on Business Innovation*. Issue 9. Cambridge, MA: Center for Business Innovation. Spring 2003. <<http://leader-values.com/Downloads/CBI/Journals_Issue_9.pdf>>. Accessed 26 January 2009. p 21. Idea to apply more generally to organizational performance vice strictly financial stability came from Albert and Hayes, *Power to the Edge.*
34. Thomas Peters and Robert Waterman, Jr., *In Search of Excellence* (New York: Harper and Row Publishers, 1982), 106 and 141.
35. Janov, *The Inventive Organization*, 144.

Chapter 4: THE COGNITIVE ORGANIZATION

Social adaptation theory convincingly argues that organizations undergo radical transformation when the old organizational model no longer enables a company to cope with the demands of a dramatically different environment.

- Charles Hecksher and Anne Donnellon [36]

A new organizational concept, the cognitive organization, is needed for the Headquarters Air Force to meet the challenges of a future strategic environment that will be chaotic, ever-changing, and uncertain. A cognitive organization is an organization combining the mechanistic and organic forms of organization by using an existing military hierarchy, which maintains control over a limited number of high risk processes, and decentralizing all other functions across a networked, self-adjusting system. Many of the concepts of the cognitive organization are based on the ideas of a learning organization[37] from Peter M. Senge and an inventive organization[38] from Jill Janov. This organization is specifically designed to allow the system to adapt to and take advantage of a rapidly changing external environment while safeguarding both the integrity of the institution and the security of the nation. To do this, the leadership of the cognitive organization, in this case the HAF, must clearly define those decisions that *must* rise to higher levels of the organization. As the number of decisions requiring higher authority increases, the cognitive organization takes on more characteristics of a mechanical system. To strike the right balance is the fundamental requirement of the cognitive organization. The term *cognitive* is chosen since it encompasses the idea of a *thinking* system meant to efficiently and effectively communicate, manipulate, and use *knowledge* for the accomplishment of the organization's mission.

The cognitive organization has many characteristics of an organic system with elements of a hierarchy to maintain control where appropriate. It makes use of decentralization of

authority, appropriate control measures, and the use of teams to solve problems. The concept of network consensus[39] is key to the efficacy of the cognitive organization. Furthermore, the cognitive organization is built on lateral communications, personal relationships, and creativity. The amount of oversight by higher levels of authority is defined by the level of risk that can be accepted by the organization. This cognitive organization provides a starting point for analysis and discussion of a future HAF capable of meeting the challenges of a new strategic environment.

The cognitive organization differs the most from the current HAF organization by increased decentralization of authority that can be most easily described as flattening the organization, but not allowing *all* decisions to be made at the edge of the organization. Airmen and civilian personnel on the edges of the staff must have both the infrastructure and authority to enable decision-making appropriate to the risks accepted by the organization. No decisions should be raised to a higher level in the organization unless absolutely necessary. This means that an action officer should be capable and be allowed to pull in vast knowledge-based resources, analyze the data, communicate with other parties as required, make a decision, and execute that decision. The action officer will be guiding networked consensus toward a goal that is best for the organization and its mission. Networked consensus is key to the cognitive organization as it uses all the knowledge-based resources of the system germane to the issue, as well as the judgment of experts, in order to arrive at an optimum solution.

Cognitive computing, nano-technology, and advanced networking are only some of the tools that will be available to enable an action officer to accomplish all of these elements quickly and effectively.[40] He will have the capacity to explore the second- and third -order effects of his decisions. In fact, given advanced computing capabilities, he will be able to run simulations on

the potential decisions and determine probable outcomes. Higher-level authorities must be willing to trust in both the resources available and the creative force of the people using those resources. Additionally, technology will allow the direct link to the appropriate level of authority from the external environment. Even simple artificial intelligence and computer algorithms will be able to route enquiries, problems, and new information to the right person at the right time. Cognitive reapportionment is one way to describe the movement of knowledge and decision-making authority in a learning organization. This idea is articulated by Benn R. Konsynski and John J. Sviokla, "In cognitive reapportionment we suggest the idea that the organization is conceived as bundles of decisions and that these bundles can be allocated across humans, systems, or combinations of humans and systems" and that these "can be dynamic."[41] Ultimately, the cognitive organization should become what Hecksher describes, "...when people throughout an organization are equipped with knowledge, skills, and authority to cooperate on the fly as needed, they can move much more quickly than if decisions must move up a fixed chain of command."[42] By decentralizing vast numbers of decisions within the cognitive organization, the system seeks speed and efficiency when interacting with the external environment. The cognitive organization, through decentralization, seeks to operate at the very limits of chaos restricted only by concern for safety of people, legal constraints, and organizational survival. As noted in *Future Leadership, Old Issues, New Methods*, "The organization should function as closely as possible to the edge of chaos. This is where life has enough stability to maintain itself and enough creativity to be called life..."[43] However, decentralization without appropriate control measures may have unintended and possibly disastrous consequences.

A cognitive organization must also provide adequate controls that will minimize the risk of catastrophic outcomes due to incorrect system decisions and clear vision to empower and guide all members of the organization. Control of a cognitive system has less to do about making decisions than it has to do with designing and modifying the processes by which decisions are made in order to maximize speed and efficiency while minimizing unacceptable consequences. The regulatory processes in a cognitive organization define those decisions that cannot or should not be resolved at lower levels within the organization. Ideally, these processes, as promulgated by formal regulations such as Air Force Instructions, ought to only exist for legal requirements, human safety, and catastrophe prevention.[44] Future lessons learned, best practices, and administrative activities will adapt and change too quickly to be addressed in formal regulations. Instead, these processes should be informal and networked across the organization and throughout the external environment where possible. In order for this to work, leadership must take a central role by setting and enforcing a vision that all members of the organization can understand and to which they can contribute. Peters and Waterman contend that organizations should be sailed rather than driven.[45] The cognitive organization sails on an ocean of change toward a determined goal or at least in a way that prevents sinking of the system.

In a cognitive system, typical authority figures will take on new roles and functions in order to maximize decentralization of decision-making while minimizing catastrophic results. Instead of limiting authority of subordinates and restraining communication within and outside the organization, superiors will encourage independent thought, networked consensus, and swift authoritative action. Control will be provided by a vision set by the head of the organization, oversight of processes and outcomes, and mentorship of those actively making decisions.

Although superiors will be able to have full visibility into the activities and communications of subordinates through advanced network and computing technologies, they should not desire to affect decisions unless it appears the decisions will infringe on the regulatory requirements of the organization. In this way, leaders can intercede when required by circumstances while providing the most flexibility to subordinates. On the other hand, if a leader interferes too much, the organization will tend to revert to a hierarchical model and the speed and accuracy of networked consensus will be lost. Additionally, superiors should be willing and able to contribute to the process as an equal voice when appropriate. Finally, the most important control feature of a cognitive system is the ability to self-regulate. Jill Janov contends that when given a goal and limited constraints on freedom of action, teams of people are capable of self-regulating their behavior to suit both the needs of the organization and the best interests of the individuals.[46] Many of the controls that are currently in place deal largely with regulating individual and group behaviors. By reducing the time and energy expended managing these controls, the leaders can better husband limited resources to the fundamental, core responsibilities of the organization. Control is a fundamental requirement of an organization. A cognitive organization attempts to eliminate many control functions performed by regulations and superiors; and replace them with clear vision from the "top" to the "bottom" of the organization. By shifting control of less important issues to the decision-makers at the edge of the system, the leaders are given more freedom to engage only when and where it is necessary.

The cognitive organization can be described as a loose confederation of teams, both ad hoc and standing, working toward the common goals of the organization. A current military example of standing teams exists within United States Southern Command where the staff is organized, not according to function, but according to role and mission.[47] This is a great way to

break down traditional stovepipes, but can lead to new ones as the organization becomes more fixed in its wire-diagram. Another team-forming model is an ad hoc team that is specifically formed by leaders within an organization to solve a specific problem.[48] Tiger teams are currently put together to solve problems that cut across functional boundaries and rise to a level of concern to the leaders of the organization. The cognitive organization also uses both of these team types where appropriate, but adds a third element. Self-forming, task-centered teams are a fundamental element of a cognitive system. Individuals will recognize problems or opportunities, share information across a network, and form into teams to tackle the issue at hand. The team will form informally, solve the problem, and then dissolve. All of this will happen without the leader's express consent. In this model there is no need for a middle-management echelon of control to exist. The teams are the fundamental building block of organizational decision-making and these teams will be in a continual state of change as they deal with new problems. All that is needed from the organization's leadership is a clear vision of the goals and core capabilities of the organization. Teams will then be able to use networked consensus to get the best solution. The substance of these teams will be both human and computer-based.

The cognitive organization is not only based on people, but relies heavily on technology and organizational structures to bridge the gaps between teams and individuals, enable swift computations and simulations, and maintain the organizational memory required for long-term viability and success. Technology is already bridging the gaps between people, organizations, and cultures. E-mail provided the first steps in this direction, but social networks such as Facebook[49] and MySpace[50] are continuing the trend of networked connectivity of vast numbers of individuals. Taken a step further, on-line games involving vast numbers of players are

increasingly popular and prove the concept that teams can form for a common purpose and then disband. Through this networking technology, distance is becoming less of a factor to an organization. A cognitive staff organization will be able to pull expertise from the world-wide Air Force where it is appropriate to do so. No longer will every function have to be physically represented "at" the organizational headquarters. Teams, through networking, will be world-wide and interdisciplinary in nature. Technology is the catalyst for this fundamental change and this trend toward networked teams will continue as long as technology continues to advance. As computing capabilities continue to advance, computational and simulation functions reserved previously for only the most sensitive projects will be readily available to the decision-makers of an organization. The cognitive organization takes full advantage of this by enabling the decision-makers and team members to run simulations and perform complex calculations in order to better understand potential outcomes of various decisions. There will be less "guesswork" and when potential outcomes pass certain thresholds, upper-level leadership can be automatically informed. Even more radically, machines will most likely act as full members of the team and contribute not only vast computing resources, but ideas and corporate memory.

Machines will bridge the gap not just between individuals and groups, but time as well. Currently, formal corporate knowledge resides within regulations, policies, and technical guides. In the cognitive organization, regulations will only be used for legal, safety, and catastrophe prevention. Policy will exist only to provide the leadership's vision and general direction to the organization. Technical guides will exist but will be fully digitized and responsive to changes in training, materials, and processes. All the other functions of regulation will be done through computer/machine corporate memory. A current example of this capability is Wikipedia. Already a self-regulating network of individuals contribute, edit, and self-regulate a website

dedicated to an exchange of knowledge.[51] While only in its infancy, the potential power of Wiki-type processes to capture corporate memory and lessons learned is enormous. Most standard corporate processes now controlled by regulations and standard procedures could be handled by a Wikipedia-type system. Lessons learned and best practices would be immediately available to the entire organization and the system will learn, over time, who makes the best inputs to the network. The network will learn and enable even more cognitive capabilities within the organization. But technology is only half of the equation in a cognitive organization.

A cognitive organization seeks to find and develop creative people comfortable with change, at ease with responsibility, and capable of self-regulation. A cognitive organization must have risk-takers as decision-makers in order to thrive in a dynamic environment. Creative risk-taking is a fundamental requirement of experimentation. As previously noted, experimentation is necessary for quick adaption to a rapidly changing environment. The cognitive organization cannot simply reward success, but must actively reward those people who are willing and able to make decisions and take risk. In other words, the cognitive organization must have entrepreneur-minded people throughout the system, particularly on the edges. Failures will occur and must occur for the cognitive organization to ultimately succeed. Peters and Waterman note that one attribute of a successful innovative company is "autonomy and entrepreneurship."[52] Jill Janov adds an inventive organizational culture evolves when it "rewards learning--risk-takers--and not just success."[53] An entrepreneurial risk-taker is not normally sought after in a hierarchical organization and is infrequently rewarded and promoted. Finding, recruiting, and rewarding this type of person becomes a critical enabler of the cognitive organization. Risk-taking, coupled with creativity, provides the foundation for a successful cognitive organization.

Without capable decision-makers on the edges of the organization, decision-making will inevitably fall upon the leaders of the organization, causing possible paralysis when faced with rapid and chaotic change. Decentralization of decision-making, networked teams, and appropriate levels of control are all required to make a cognitive organization function. In this way the cognitive organization begins to exhibit the characteristics of Janov's inventive organization:

1) Everyone sees the big picture--knows how they contribute to the final product or service and understands the whole of the enterprise as well as its parts.
2) Everyone enhance efficiencies and corrects errors without asking permission.
3) Everyone acts in ways that provide service and support to the whole system.
4) Organizational boundaries--namely those that define job roles and functions--exist only to enhance organizational learning, the development of core competencies, and long-term viability.[54]

The goal of the cognitive organization is to match people and resources to a rapidly changing environment in order to effectively and efficiently achieve the objectives of the organization without risking those processes that could destroy the organization or the object it is created to serve.

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36. Charles Hecksher and Anne Donnellon, eds., *The Post Bureaucratic Organization* (Thousand Oaks, CA: SAGE Publications, 1994), 4.
37. Peter M. Senge, *The Fifth Discipline: The Art & Practice of the Learning Organization, revised ed* (New York: Doubleday, 2006). One of Senge's major themes is the need for an organization to deal with "dynamic complexity" by taking a holistic, non-functional view of problems. (p 71-73) He also details using feedback to adjust the system to the external environment. (p 79-88)
38. Janov, *The Inventive Organization.* Janov's assertion is that organizational change is more than cosmetic changes. "It is a change in what we assume and how we think about work and, more importantly, the relationships needed to get the work done." xii-xiii.
39. Cheryl Boudreau, Mathew D. McCubbins, Daniel B. Rodriguez, and Nicholar Weller, "Opting in or Opting Out: The Conditions for Creating Network Consensus" (September 7, 2008). Available at SSRN: http://ssrn.com/abstract=1264626. Abstract provides the idea of networked consensus by utilizing political consensus theory within the context of networked decision-making. "Political decisions reflect a remarkable degree of consensus. This outcome does not simply occur by luck or nature; one of the key features that facilitates consensus is a network of connections between individuals." The abstract identifies the difficulty of achieving networked consensus.
40. Kurzweil, *The Singularity*. Kurzweil describes the use of nano-technology to enable advanced computing. p 112-122. He further concludes that by 2030 computing power will be equal, if not exceed, human capacity. p 135. Furthermore, by 2030, Kurweil further postulates a fundamental increase in the intellectual capacity of mankind through technology. p 339-340.

41. Benn R. Konsynski and John J. Sviokla, "Cognitive Reapportionment," in *The Post Bureaucratic Organization,* 91.
42. Hecksher, "Defining the Post-Bureaucratic Type," in *The Post Bureaucratic Organization*, 48.
43. Glenn W. Mitchell, "The New Math for Leaders: Useful Ideas From Chaos Theory," in *Future Leadership, Old Issues, New Methods*, ed. Douglas V Johnson (Carlisle, PA: Strategic Studies Institute, 2000), 72.
44. These three are provided by the author based on personal experience with Air Force Instructions, Inspections, and executing daily operations.
45. Peters and Waterman, *In Search of Excellence* 106-107.
46. Janov, *The Inventive Organization*. See theme in Chapter 7: Self-Regulation: Control and Support for Everyone, 158-191.
47. United States Southern Command Public Website, http://southcom.mil/AppsSC/pages/leadershipStaff.php (accessed 28 January 2009).
48. Alvin Toffler, *Future Shock* (New York: Random House, 1970). Chapter 7, "Organization: The Coming Ad-hocracy."
49. "Facebook gives people the power to share and makes the world more open and connected. Millions of people use Facebook everyday to keep up with friends, upload an unlimited number of photos, share links and videos, and learn more about the people they meet." From Facebook website, http://www.facebook.com/facebook (accessed 28 January 2009).
50. "MySpace is an online community that lets you meet your friends' friends." From MySpace website, http://www.myspace.com/index.cfm?fuseaction=misc.aboutus (accessed 28 January 2009).
51. "Wikipedia is written collaboratively by volunteers from all around the world; anyone can edit it. Since its creation in 2001, Wikipedia has grown rapidly into one of the largest reference Web sites, attracting at least 684 million visitors yearly by 2008. There are more than 75,000 active contributors working on more than 10,000,000 articles in more than 260 languages. As of today, there are 2,717,978 articles in English." From Wikipedia website http://en.wikipedia.org/wiki/Wikipedia:About (accessed 28 January 2009).
52. Peters and Waterman, *In Search of Excellence*, 13-16.
53. Janov, *The Inventive Organization*, 53.
54. Janov, *The Inventive Organization*, 53.

Chapter 5: SOLVING A HYPOTHETICAL PROBLEM

"Vignette"

Item 34 from USAF daily intelligence report (March 25, 2035): Intelligence reports 200+ swarming micro unmanned air vehicles delivered to a terrorist organization from China. These micro UAVs are capable of seeking, identifying, and killing specific individuals based on preprogrammed instructions. They are also capable of networking information to neutralize threats to the swarm as the swarm of micro UAVs accomplishes its planned mission. The swarm data rides on frequencies used for critical commercial networks. The terrorists are currently operating in a region with a large and controversial US military presence.

This problem has multiple layers of complexity for an organization to tackle.[55] There are elements of technological advances, nation-state politics, enabled non-state actors, and non-military impact. UAVs are chosen to create an inherently air-centric problem. Finally, the problem is far enough down the list of intelligence items that it would unlikely attract the immediate attention of senior officers. This problem is designed to land on the desk of an Air Force staff action officer with little to no immediate oversight from higher authority.

The actors in the analysis will remain essentially the same in order to concentrate our efforts to understand how the organization will effect decisions and outcomes. The staff officer is Major James Smith. He is a 15-year officer and a graduate of ROTC from a Midwestern college. He completed UAV-pilot training in 2021 and has served operationally as a UAV pilot and Air Liaison Officer. He is a graduate of Squadron Officer School and Air Command and Staff College. As an A3 staff officer, he has three primary computer networks to utilize on a daily basis. One is a classified network with limited connectivity similar to today's SECRET and TOP SECRET systems. He also has access to the world-wide web, although the level of utility will change based on the organizational model. Finally, both systems are tied into an artificial intelligence software package (called Air Staff Artificial Intelligence, or ASAI) that can

move data across all the networks and can assist in team building and decision-making. Finally, the overall functional structure is the same as today's with A1, A2, A3, etc. Each of the functional directorates is run by a three-star general.[56] The A3, in this case, is Lt Gen Robert Jones. Gen Jones is a former F-22 pilot and has experience as a UAV wing commander. He is a graduate of the US Air Force Academy and has nearly 30 years time in service.

"A Cognitive Solution"

Major Smith arrives at work on 25 March 2035 and is greeted by ASAI. ASAI informs him that the daily intelligence report has an item of interest for the UAV expert on the A3 staff. He is also told that the data has been disseminated to the action officers in the anti-terrorism section of force protection as well as to the experts in base defense. ASAI has an electronic portfolio available for his review and it is available through his hand-held device or via direct download through an inter-cranial bus port.[57] Jim elects to read the report on his hand-held and begins to ponder the potential effects of this new terrorist capability. He elects to put two routine tasks aside in order to organize a response to the threat.

Lt Gen Jones is also beginning his day with ASAI assistance. His staff is largely non-existent since the AI takes care of most routine administrative work. He is also aware of the daily intelligence report, but is primarily concerned with the top ten items on the list. Item #14 piques his interest, but does not demand his immediate attention. ASAI helps him prioritize his efforts for the day. As Maj Smith decides to delay action on two routine tasks, ASAI notes the decision and will inform the General if and when the tasks will impact something outside the division. There is no level of management between the A3[58] and his staff officer. The A3 provides leadership, oversight for those processes that can produce catastrophic outcomes, and experience to teams when required.

As Jim decides to tackle the problem, ASAI assesses the skills of the other staff offices involved and decides that Jim is the most qualified to lead the response. The decision is relayed to the other staff officers and Jim is acknowledged as the team lead, currently a team of three people and an AI. Jim needs to build a team of experts quickly in order to determine a course of action. Once again he enlists the help of ASAI. ASAI reaches across both the classified and unclassified networks to find people within the Air Force, within the rest of the military, within the government, within business, and within academia that may have the ability and inclination to work on a problem of this sort. Jim knows that the intelligence methods used to gain knowledge of the threat is sensitive, he therefore limits the team to members of the government with appropriate clearance levels. Invites are sent to the "experts" identified by ASAI and they can either join or refuse. Each invitee knows that the invitation to participate on a HAF solution team is a great opportunity to affect the Air Force in a direct way. Furthermore, participation on teams of this sort are included in official Air Force records for promotion and job opportunities. Finally, Airmen of 2035 will have grown up in a world of virtual groups solving difficult problems.[59] This networking will be second nature and a common part of socializing and problem-solving. Within minutes, Jim's team begins to form, but it is not static. Individuals can both leave and enter the team. The team consists of personnel from the Air Force, Army, Navy, Marines, State Department, Homeland Security, Department of Defense, Commerce Department, Treasury Department and Congressional Staffers. It has experts from the Combatant Command of the impacted region and tactical advisors from the local air base. Scientists and engineers from DoD research labs are also included. Members can invite others to join that may not have been identified by ASAI, and Jim will either personally approve the invites or delegate that responsibility to ASAI.

Jim's next move is to determine the nature of the problem and its possible impacts. ASAI creates a virtual space to collaborate and share data. Lt Gen Jones has visibility on the team and its processes and he notes that the embassy is not involved. He makes a phone call and another invite is sent to include the local embassy. All team members have full access to the room and can use virtual reality tools to meet and discuss the problem.[60] The team inputs the potential effects of the threat and the ASAI begins to run simulations to determine likely outcomes of an attack and potential countermeasures. Within a few hours, the solution team is made aware by a member of the team from the deployed location that OSI has noted increased activity of a local terrorist cell as well as some limited disruption of the commercial network near the base indicating limited testing of the new weapons by a local terrorist group. Jim queries his team and outlines the need for immediate analysis of the threat. Primarily he needs to know the level of threat capability, the second- and third-order effects of its use, time until it is operational, and what, if any, countermeasures are available to US forces. Within a 24 hour cycle, the team, with ASAI assistance, concludes that:

1) the threat is significant and has the ability to shut down an air base
2) the swarming UAVs will slow the local commercial networks, but not shut them down
3) the threat will be operational within 2 to 4 weeks
4) current countermeasures available to base personnel will completely disrupt the commercial network, requiring several hours or days to restore after the attack

Within 48 to 72 hours, Jim's team has identified and evaluated an operational threat to an air base at a deployed location and the team begins formulating an immediate tactical solution to secure the base and its personnel from potential harm.

Jim ensures his boss is aware of the immediacy of the new threat, the steps taken thus far to understand the nature of the threat, and the team formed to present a solution to the problem. The DoD lab experts have already sent countermeasure tactics and procedures to the field and

the embassy staff is aware of the potential effects. Base officials stand-up anti-UAV teams, trained by the DoD labs via networked means, to counter the immediate threat. The embassy is already engaged with the host nation concerning the limited disruption occurring and is prepared to deal with the diplomatic and informational impact of a complete commercial network disruption. Furthermore, the Departments of the Treasury and Commerce are preparing to provide economic assistance to the host nation's economy if it is severely impacted by USAF defensive operations. Within one week from the identification of a threat, the HAF solution team has provided a short-term tactical solution and senior officers can then begin to formulate a plan to deal with the long-term implications of the threat.

On April 7 2035, the terrorists strike. The UAV swarm is shut down by the local defenders but the commercial network is severely degraded, as expected. The embassy is immediately able to inform the host nation of the threat and response. Furthermore, economic assistance is promised and the host nation economy is stabilized, at least for the short term. The base is defended and the host nation's interests are protected. Jim's team is not surprised by the attack and uses the attack to gain more intelligence; directly from local experts, OSI and intelligence; to feed into the long-term countermeasures that are already being debated and tested throughout the HAF and DoD.

"Today's Solution"

Major Smith arrives at work on 25 March 2035 and is greeted by ASAI. ASAI informs him that the daily intelligence report has an item of interest for the UAV expert on the A3 staff. He is also told that the data has been disseminated to the action officers in the anti-terrorism section of force protection as well as to the experts in base defense. ASAI has an electronic portfolio available for his review and it is available through his hand-held device or via direct

download through an inter-cranial bus port. Jim elects to read the report on his hand-held and begins to ponder the potential effects of this new terrorist capability. Jim is working two routine issues for the A3. He decides this new threat capability requires additional effort and sends a message to his director Col Sands. Until he hears a reply, Jim starts work on the first of the two routine tasks while asking ASAI to put together a list of folks that would be helpful in dealing with the threat.

By mid-afternoon, Col Sands informs Jim that the routine tasks can be put on hold and his full effort should be applied to the new problem. Jim takes a look at the list of people with expertise and/or interest in the problem. He directs ASAI to author an electronic staff summary product that will request support from the rest of the HAF, all three military departments, the Joint Staff and the Secretary of Defense Staff. He also needs another product for the Combatant Commander's staff for the impacted AOR.[61] Finally, another needs to be created for interagency departments, such as Department of State (DoS). These staff products are reviewed by Col Sands and sent to Lt Gen Jones for his approval. ASAI tracks all the routing so the flow of data is swift, however, the A6 believes that his directorate should have the lead role. ASAI is used to arbitrate and Jim remains the lead staff officer for the response.

The following day, the all required HAF directorates are engaged as well as the rest of the DoD system, including COCOM staffs, the Joint Staff, DoD labratories, etc. The interagency approval process is expected within one or two working days. ASAI is directed to send invites to all DoD and the local base commander has been informed of the threat through the Air Operations Center. Jim and ASAI will both continue to press for formal interagency commitments while Jim works informal contacts with action officers in the DoS. The team

formed is static in nature since any additions to the list of involved personnel will require additional staff actions for approval.

Jim's next move is to determine the nature of the problem and its possible impacts. ASAI creates a virtual space to collaborate and share data. All team members have full access to the room and can use virtual reality tools to meet and discuss the problem. The team inputs the potential effects of the threat and ASAI runs simulations to determine likely outcomes to an attack and countermeasures. Jim needs to know the level of threat capability, the second- and third-order effects of its use, time until it is operational, and what, if any, countermeasures are available to US forces. Within a 24 hour cycle, the team concludes that:

1) the threat has the ability to shut down an air base
2) the swarming UAVs will slow the local commercial networks, but not shut them down
3) current countermeasures available to base personnel will completely disrupt the commercial network, requiring several hours or days to restore after the attack

Within 72 to 96 hours, Jim's team has identified and evaluated a potential threat to an air base at a deployed location. DoS representatives become part of the team at this point. Jim is still waiting for other interagency assistance.

Base officials stand-up anti-UAV teams and the local OSI agent reports localized disruption of the local commercial network has been occurring for the last 4 days. The team is not immediately informed, since the OSI report is flowing through "normal" channels, and continues to work methodically to provide a better tactical solution. Additionally, the embassy staff is informed of the threat, but not of the potential impact to the commercial network.

Jim then informs his boss of the new threat, the steps taken thus far to understand the nature of the threat, and the team formed to present a solution to the problem. Within one week from the identification of a threat, the HAF solution team has begun to formulate a military only

response to the threat. Any thought of long-term solutions has not begun and the team remains focused on the near-term military implications. The DoS is involved, but is playing catch-up to understand the full problem. As of yet there is still no Treasury or Commerce involvement.

On April 7 2035, the terrorists strike. The UAV swarm is shut down by the local defenders but the commercial network is severely degraded, as expected. Embassy response is slow and the host nation's economy begins an immediate downturn. The base is defended, but the host nation's interests have been negatively impacted by a lack of planning and forethought. Jim's team is surprised by the timing of the attack and only then begins searching, in earnest, for a long-term countermeasure that will not impact the commercial network.

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55. The case studies for this analysis include the cognitive organization and the current HAF organization. The analysis does not include a purely mechanistic or organic organization. In reality, no organization is purely mechanistic or organic and the author concentrated his efforts on realistic organizations reacting to realistic problems.
56. Reflects current Headquarters Air Staff functional hierarchy. Each A-Staff is functionally aligned: A1-Personnel, A2-Intelligence, A3-Operations, etc.
57. Although not required for a cognitive organization, the world of 2035 may include direct network to biological connections. In this case, Major Smith has a device implanted in his body which allows information to flow directly from the network into his brain and vice versa.
58. Common military terminology for both the office and individual filling the office.
59. For example, World of Warcraft has the capacity for both ad hoc groups and more formalized groups to challenge dungeons and other teams. WoW is just the infancy of this capability, but one with which Airmen will be very comfortable.
60. Kurzweil, *The Singularity Is Near*, 312-314 and 340.
61. The Combatant Commander's (COCOM) A3 and A2 would be immediately informed via message traffic as well due to the new threat in the AOR. In this case, the COCOM may delegate the response to the Joint Forces Air Component Commander.

Chapter 5: ANALYSIS

At the beginning of this study, initial research suggested that the analysis of a future case study would lead to a fundamental change in the way the HAF should be organized, but the results of this analysis indicate that the HAF, organized as a cognitive organization, will look fundamentally the same while acting in a more networked fashion. Futurist literature tends to sell the case for an organic form of organization to meet the needs of the future environment. Ad hoc teams and fluid power structures predominate the debate. Risk of catastrophic decisions are typically excluded from the discussion. Given the need for the HAF to maintain control and accountability for decisions that can have profound effects for our nation and the world, i.e. nuclear weapons accountability, nation-state diplomacy, etc., it seems clear that the HAF will continue to be hierarchical in nature. However, the nature of the hierarchy must change.

Currently, power for decision-making resides at the highest levels of the organization, but must be devolved to the action officers interacting with the outside environment. One way of expressing this change is to say that centralized control of the bureaucracy needs to be "weakened" to centralized direction. Power in the future will not necessarily reside in the offices of general and flag officers. Individuals in the future will be more empowered in society at large and we can expect the same to be true of the military. Airmen will able and willingly to solve more complex problems and take on responsibility for their actions. The future HAF must harness these changes and not suppress them. Certainly field grade officers entrusted to serve on the Air Staff should be trusted to make decisions that may have far reaching implications with little oversight from superior officers. By enabling them to solve problems with networked teams of experts, the organization can increase the speed and accuracy of the organization's decisions.

As seen in the case study, the cognitive organization could respond with more authority and speed due to the power Maj Smith enjoyed. The autonomy enjoyed by Maj Smith, and action officers like him, ought not be limitless (as in a purely organic organization). Senior leaders must place boundaries and retain some decisions to themselves. How much power a general officer retains will be dictated by law, limited resources, and level of acceptable risk. The more a general officer can push down true decision-making authority, the faster the organization will be in producing solutions to complex problems. But decentralizing power alone is not enough to ensure success in the future.

A robust network, whether AI is included or not, is essential to the success of cognitive organizations. The decentralization of power risks individuals at the edges of the organization making wrong decisions. Some of this risk can be mitigated by networking experts so that the decision-making devolves not to "just" a single action officer, but to a robust team lead by an action officer. Leaders within the organization trust the networked group to work toward a common goal. By robust networking, enabled by the trust of superiors, stove-pipes can more easily be overcome. Senior officers can maintain situational awareness of multiple projects being undertaken by subordinate action officers through the network and intercede only when required or asked. A secure, robust network is the key infrastructure enabler to a cognitive organization. Without the network, the organization will assume the risks of a decentralized system without enjoying the benefits.

To become a cognitive organization, the HAF does not need to reinvent itself in some extraordinary, revolutionary way. It seems clear that the HAF should be coaxed by Air Force leadership to evolve into a more networked organization that has the potential to become cognitive. The right people must be recruited, trained, and, most importantly, educated to

assume the role of strategic decision-maker at a much earlier stage in their careers.[62] Secondly, the Air Force must continue to invest in networking technology. Finally, senior officers must be willing to allow risk within their organization. By concentrating on these three elements, the HAF will be most likely poised for success in the future by growing into a cognitive organization. People are the power of any organization, so it is with people that I will begin to discuss an evolutionary approach to the cognitive HAF.

A successful organization of any type requires motivated, educated people throughout all levels of the system; however, a cognitive organization requires particularly skilled individuals at the edge of the organization that are both capable and willing to make decisions and incur risk. The Air Force must reach out to society and entice individuals with an inherently entrepreneurial spirit, not only for the requirements of the Air Staff, but for the greater good of the Air Force as a whole. To do this, the Air Force must not simply look to recruit high school and college students, but must throw the net wider into industry and business.[63] Thought must be given to allow people to move into and out of the Air Force more freely in order to attract the type of people who want to take risks. The Reserves are a great venue to encourage this type of migration into and out of military service. By refreshing Airmen at all levels of the Air Force, the organization is more likely to include disparate opinions and frameworks which can be very useful to the solution of novel problems. Additionally, the Air Force must encourage serving Airmen to think outside established parameters when encountering both new situations and established processes. Air Force Smart Operations for the 21st Century is a first step to encouraging problem-solving and empowerment at the lowest levels.[64] This trend must continue and spread beyond process improvement into all levels of decision-making. Furthermore, promotion opportunities must not only be based on success, but on well-reasoned risk-taking.

Officer and enlisted evaluations will need to account for the level of authority not only granted to the ratee,[65] but to the amount of responsibility the ratee seized when given the opportunity. The people that are successful at seeing and seizing opportunities are the Airmen that we want to promote and encourage. The Airman that simply takes the safe road will not be able to operate as an empowered individual. Finally, our Airmen must not just be trained, but must be educated. Technical proficiency and tactical leadership are only the first elements of a well-trained Airman. The Air Force must seek new ways to broaden and deepen the experiences of Airmen at every level. Virtual education may be one way that Airmen can grow intellectually. Some of this education will be mandatory, based on Air Force needs. There should also be opportunity to allow individuals to explore subjects of interest to them as well. Additionally, as Airmen move in and out of the wider society, new experiences will be able to shape and inform future decision-makers. At the heart of the matter is developing Airmen to the point that they will be able and comfortable making decisions at the ten to fifteen year point in their careers that general officers with twenty-five plus years in service now make.

The crux of this issue then rests with where the appropriate levels of authority must reside. Certainly some decisions that are made by general officers today will continue to be made at that level in the future. As an example, critical decisions concerning the nuclear enterprise of the Air Force are now handled by general officers with a depth and breadth of experience which engenders the trust of the civilian leadership as well as the American people. It can be expected that these types of decisions will be made by general officers in the world of 2035. But other decisions will be able to be made by field grade action officers. Current organizational literature focuses on the requirement of hierarchical organizations to the movement and control of knowledge and information. The requirement to ensure decisions that

may have strategic or catastrophic consequences are made by appropriately authorized personnel is not explicitly explored by current literature. More research in this specific area is required to begin to understand where proper authority should reside with regard to potential outcomes. Once a framework is understood, the appropriate authorities can be pushed to the lowest levels of the cognitive organization while retaining those decisions at higher levels when required. All of these actors, at both high and low levels of the organization, can then be tied together with a robust, efficient network.

The network of a cognitive organization forms its nervous system. The network serves to move information from one point in the organization to another as well as to the outside world, when required. As an information transfer system, the network must link all the required personnel when confronting any problem or opportunity. The network would be best served by an AI, but it is not necessary as long as processes are in place that can ensure the swift movement of key information throughout the network to the decision-maker and his team of experts. In addition to routing information, the network must also serve as a corporate memory of past experiences, both good and bad. These lessons learned should not be enshrined in regulations, but be made available to inform the decisions that are being made.[66] As mentioned before, regulations should exist only for those matters that involve legal requirements, human safety and catastrophe prevention. The Air Force should now begin identifying these essential regulations now and ensuring that they are given primacy in the current Air Force Instruction system. Finally, any network that is fundamentally empowering must be robust and protected. Current efforts in cyberspace defense and offense must continue to be advanced to ensure the network is available when and where it is needed, especially given the global nature of cognitive teams as described in this paper.

Finally, Air Force leaders must change their current concept of control with regard to non-combat decision-making. The success of a cognitive organization rests with the level of authority the senior officials relinquish to subordinates. The Air Force has always contended that centralized control and decentralized execution is the best way to use airpower during conflict. Air Force leaders must now start developing a culture of centralized vision and decentralized execution in order to encourage the evolution of the current bureaucracy into a more cognitive form. To relinquish control involves risk and senior leaders will need to understand when and where they must intervene to control the decision-making process to prevent either catastrophic mistakes or missed opportunities. Air Force leaders already do this, primarily in operational contexts, but this trait must be encouraged in staff environments, as well, in order to ensure future success. Finally, senior leaders must not strengthen stove-pipes. In fact, stove-pipes must be actively weakened to enable the free flow of critical information to all parts of the organization in spite of the risks involved. The best way to describe this trust is to say that direct liaison is an implied authority for all action officers and is not something that has to be explicitly given, as it is today. Air Force leaders will continue to lead, but the manner of leadership must be different in order to be effective.

The future is uncertain and full of both risk and opportunities. A successful Air Force will be one that has an Air Staff that is adaptable to novel situations, yet one that is also stable enough to provide consistent guidance and prevent catastrophic failure. The cognitive organization, as described in this paper, offers a compelling solution to the problem of organizing for the future. The price to be paid for an increase in HAF effectiveness and efficiency will not come from a revolutionary change in the organization. Instead, a successful change will rely upon the evolutionary integration of social and technological change,

decentralization of authority, and acceptance of risk. By combining elements of a hierarchy and an organic organization, the cognitive Air Staff will be poised for success in the future.

62. Art Fritzson, Lloyd W. Howell Jr., and Dov S. Zakheim, "Military of Millennials."
63. Attracting talented people from commercial enterprises may require alternative pay and rank structures. Also, ways may be needed to time share expertise between Air Force and commercial enterprises.
64. Author's personal experience of Air Force Smart Operations for the 21st Century indicates that the potential of this methodology has not been tapped. Thus far it has only succeeded in attempting to use technical means to solve problems. It has not truly empowered lower echelons of command nor has it decentralized decision-making.
65. "Ratee" refers to the individual that is the subject of a formal rating report.
66. Friedman, *The World Is Flat*, 90-91. The Apache programming community is an example of meritocracy based collaboration that networks lessons learned.

BIBLIOGRAPHY

Alberts, David S., and Richard E. Hayes. *Power to the Edge: Command...Control...In the Information Age*. Washington, D.C.: DoD CCRP, 2005.

"Al Qaeda Claims Its Space On The Web." CBS News, 17 January 2008. http://www.cbsnews.com/stories/2008/01/17/eveningnews/main3725693.shtml (accessed 25 January 2009).

Boudreau, Cheryl, McCubbins, Mathew D., Rodriguez, Daniel B. and Weller, Nicholas. "Opting in or Opting Out: The Conditions for Creating Network Consensus." 7 September 2008. Available at SSRN: http://ssrn.com/abstract=1264626 (accessed 28 January 2009).

Burns, Tom, and G.M. Stalker. *The Management of Innovation*. Chicago: Quadrangle Books, 1961.

The Convention on Biological Diversity, Article 2, United Nations, 1992. http://www.cbd.int/convention/articles.shtml?a=cbd-02 (accessed 28 January 2009).

Drucker, Peter F. *The Age of Discontinuity*. New York: Harper and Row Publishers, 1968.

Foster, Lynn E. *Nanotechnology: Science, Innovation, and Opportunity*. New York: Prentice Hall, 2006.

Friedman Thomas L. *The World is Flat: A Brief History of the Twenty-First Century*. New York: Farrar, Straus, and Giroux, 2005.

Fritzson, Art, Lloyd W. Howell Jr., and Dov S. Zakheim. "Military of Millennials," *Resilience Report* at Strategy+Business, a Booz Allen Hamilton Publication,10 March 2008. http://www.strategy-business.com/resiliencereport/resilience/rr00056?pg=all (accessed 28 January 2009).

Galbraith, Jay R. *Organization Design*. Reading: Addison-Wesley Publishing Company, 1977.

Galbraith, John Kenneth. *The New Industrial State, 4th ed*. Boston: Houghton Miffin Co., 1985.

Hecksher, Charles, and Anne Donnellon, ed. *The Post Bureaucratic Organization*. Thousand Oaks: SAGE Publications, 1994.

Janov, Jill. *The Inventive Organization: Hope and Daring at Work*. San Francisco: Jossey-Bass Publishers, 1994.

Johnson, Douglas V. *Future Leadership, Old Issues, New Methods*. Carlisle, PA: Strategic Studies Institute, 2000.

Mankin, Eric and Prabal Chakrabarti. "Valuing Adaptability: Markers for Managing Financial Volatility." *Perspectives on Business Innovation*. Issue 9, Spring 2003. Cambridge, MA: Center for Business Innovation. http://leader-values.com/Downloads/CBI/Journals_Issue_9.pdf (accessed 26 January 2009).

Naisbitt, John. *Megatrends*. New York: Warner Books, 1982.

Peters, Thomas, and Robert Waterman, Jr. *In Search of Excellence*. New York: Harper and Row Publishers, 1982.

Scott, William, Terence Mitchell, and Philip Birnbaum. *Organization Theory, 4th ed*. Homewood, IL: Richard D. Irwin, 1981.

Senge, Peter M. *The Fifth Discipline: The Art & Practice of the Learning Organization, revised ed*. New York: Doubleday, 2006.

Tagliere, Daniel A. *People, Power and Organization*. New York: AMACOM, 1973.

Toffler, Alvin. *The Adaptive Corporation*. New York: McGraw-Hill, 1985.

Toffler, Alvin. *Future Shock*. New York: Random House, 1970.

Toffler, Alvin. *Powershift*. New York: Bantam Books, 1990.

Toffler, Alvin. *The Third Wave*. New York: Bantam Books, 1980.

Trout, Jack with Steve Rivkin. *The Power of Simplicity*. New York: McGraw-Hill, 1999.

"A Unified Security Budget for the United States, FY 2008." *Foreign Policy in Focus of the Institute for Policy Studies*, April 2007. http://www.fpif.org/pdf/reports/0704unifiedsecuritybudget.pdf.

United States Southern Command Public Website. http://southcom.mil/AppsSC/pages/leadershipStaff.php (accessed 28 January 2009).