

ACQUISITION LEADERS  
FOR  
RAPID TECHNOLOGY INSERTION PROGRAMS

Christopher M. Coombs, Lt Col, USAF  
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## **Abstract**

In order for the United States to maintain its position as a hegemon, to increase its technological superiority to counter any enemy and to meet the requirement to fight "any enemy, anywhere, anytime,"<sup>1</sup> the Department of Defense (DoD) must revamp the policies and procedures currently in place. DoD must ensure that it has the right mix of scientific and engineering personnel to manage the acquisition system, must invest in basic technologies, must use modern management practices to mitigate financial risk and be willing to embark on projects which may not succeed. If DoD does not do these things, then there is risk that as technology developments continue to increase in speed, that a potential adversary will get inside the U.S.'s OODA (observe, orient, decide, act) loop and present the U.S. with strategic level surprise.

## Chapter 1

# Introduction

From the time of the caveman to today's modern warrior, the individual who can quickly identify a weakness in an opponent and identify a way to capitalize on this weakness will win in battle. Colonel John Boyd, USAF (Ret.) pinpointed a circular process or loop in four parts known as observation, orientation, decision, and action, (OODA) to review the capabilities of an adversary, identify the adversary's weakness(es) and develop a way to target the shortfall(s). The individual or military power which executes this OODA loop the fastest has the advantage over an adversary.

Today, rapid advancements in technology result in the ability to complete the OODA loop faster, and those who complete the OODA loop fastest have a distinct advantage. "Combat has become mainly a race to reach the end of one's decision cycle first. Whoever wins that race gets to take the first shot. And because modern weapons are so precise and deadly, whoever wins the opportunity to take that first shot wins, period."<sup>2</sup> Fielding the technologies ability to complete the OODA loop the fastest requires not just doing the scientific research, but also proper management of the technology transition process and the acquisition system. "The mistaken belief that technological breakthroughs can win wars fails to recognize the importance of doctrine and organization in translating technology into advantage."<sup>3</sup> It is through the adaptation of new doctrine and the transitioning of advanced technologies to the operator that gives the warfighter the edge.

Today's acquisition processes limit the U.S.'s ability to quickly respond to the rapid changes on the battlefield. The current delivery time for new capabilities into the field is typically 15-20 years from an initial concept to full operational capability. This length of time provides a vast amount of time for an adversary to look at the USAF and observe, orient, decide, and to take action with a capability that will overcome our warfighting advantage. Norm Augustine, then CEO for Martin Marietta, commented on the systems used during the Gulf War as "largely representing the technology of the 1960s, the development of the 1970s, and the production of the 1980s – all utilized by the people of the 1990s."<sup>4</sup> Today, commanders and military members are adapting old technology with new procedures and some new minor add-on technology to quickly react to events in the field. While this may satisfy some short-term requirements, this process does not take advantage of the advancements in technology and materials to ensure the warfighter has the upper hand against an agile, adaptive adversary.

Increasingly, states find themselves contending with non-state actors that function as networks rather than bureaucracies. They have shown themselves to be clever, adaptive and able to access the same civilian designed, commercially available, globally distributed technologies that modern militaries, heavily reliant on commercial-off-the-shelf (COTS) have available, and they do so in shorter time frames than states.

In order for the USAF to respond to meet the challenges of these technological savvyed adversaries across the wide range of opponents, new ways to quickly identify, develop and deliver new capability to the field need to be constructed to maximize the advantage to warfighters. Technological advancements continue to change at such a pace that waiting 15-20 years for the delivery of a capability will result in systems that are already four to five generations behind the technology. For example, computer technology is currently doubling computer processing and speed every 12-18 months. This doubling effect, known as Moore's law, reflects not only the rapid advancement in computer speed, but also a reduction in the costs to produce these transistors. At times, Moore's Law has been exceeded. On 14 February 2007, IBM announced that it had "devised a way to triple the amount of memory stored on computer chips and double the performance of data-hungry processors by replacing a problematic type of memory with a variety that uses much less space on the slice of silicon."<sup>5</sup> Similar advances are

occurring in the areas of nanotechnology, biotechnology and the materials sciences. Rapid technology advances have rendered our current acquisition and technology transition processes obsolete. DoD needs to develop processes and develop well-trained personnel to enable quick insertion of new technological advancements to deliver best capability to our warfighters. Among the key questions for the future is will the USAF be able to adapt to technological change faster than our adversaries?

The 27 April 2001 “Transformation Study Report” defined transformation as “changes in the concepts, organization, processes, technology application and equipment through which significant gains in operational effectiveness, operating efficiencies and/or cost reductions are achieved.”<sup>6</sup> This definition of transformation reflected DoD’s focus not only on the changes resulting from the scientific advancements but also the need to change the policies, procedures and organizational structures to adapt the technological advancements. In order to adapt faster to the ever changing environment faced by the rapid advancement in technology, the services must train, organize and equip a workforce that is well educated, adapts quickly and thinks outside the box to complete the OODA loop faster than an adversary.

The whirlwind projected from these technological advancements requires the USAF to identify alternative ways to change and adapt while still meeting warfighters needs. Adapting quickly and knowing which technological advancements to pursue will not be easy. It requires a high-tempo, risk-oriented environment.<sup>7</sup> While DoD has conducted numerous reforms, and while these reforms have reduced cycle time, cost and schedule overruns, the current acquisition system is still inadequate and will not develop the rapid adaptability required for the USAF to meet future challenges presented by rapid advancements in technology.<sup>8</sup> Changes to the way the USAF is organized and trained must be incorporated. Robust leadership that is also technically savvy to identify the appropriate technologies in which to invest scarce Defense dollars are both necessities. To make the case for these changes, this paper will first look at this problem from a historical perspective. It will then look at some possibilities for the future, and then examine the service’s Title X responsibilities. Within this examination, it will discuss the organizational, personnel, and leadership issues associated with creating a more adaptive acquisition process.

## Chapter 2

# Historical Perspective

*Don't ever expect Air Force people to just let change happen. We get ahead of change, shape change, make change work for us.*

Gen Merrill A. McPeak

For almost forty years, the DoD has organized, reorganized and analyzed the acquisition processes to improve the cost, schedule and performance of the weapon and computer systems purchased for the warfighter. In 1969, the military acquisition reform initiatives began with a report from the Packard Initiatives with a focus on increasing costs, duplicate initiatives across the services, and a lack of trained acquisition professionals in the military workforce. “There have been frequent major acquisition reform initiatives responding to concerns that acquisition costs are too high, that the Department is buying the wrong things, or that the organization’s process is too slow.”<sup>9</sup>

In the last twenty years, these efforts at reform have grown more intense. Faced with inter-service rivalries and a need to streamline the military chain of command, in 1986 Senator Barry Goldwater and Representative William Nichols submitted a bill, now referred to as the Goldwater-Nichols Act to overcome these issues. With regard to the acquisition process, the Goldwater-Nichols Act required greater coordination and a look at solutions to satisfy joint requirements. Previously, each service worked their requirements and funding in isolation thus causing duplication of effort and the delivery of systems which were often not interoperable. The Goldwater-Nichols Act provided the services the ability to capitalize on unity of effort and to capitalize quickly on technological advancements identified through acquisition efforts of each of the services. In 1986, the Packard Commission delivered a report entitled “The Quest for Excellence.” This report was followed, in 1989, by then Secretary of Defense, Dick Cheney’s “Defense Management: A Report to the President.” “Each of these efforts attempted to deal with ballooning costs, duplicative programs across services, and the authority line for determining acquisition priorities, budgets, and program evaluations but often also added layers of reporting and bureaucracy.”<sup>10</sup> In 1993, Vice President Al Gore placed his mark on government reformation with his report: “Creating a Government that Works Better and Costs Less: The Gore Report on Reinventing Government.” This report called for changes to simplify procurement processes, eliminate regulatory burden and to rely more on the commercial practices and marketplace.

In 1994, Secretary of Defense William Perry focused his reformation on the delivering capability to the field vice processes with his memo titled, “A Mandate for Change.” In 1994, a new office, titled the Deputy Undersecretary for Defense (Acquisition Reform) was created to address issues associated with a decreasing industrial base, while attempting to improve the cost, schedule and performance of military systems in the acquisition process. Colleen Preston, the first Deputy Undersecretary of Defense for Acquisition Reform, implemented the use of Process Action Teams (PAT), Integrated Product Teams (IPT), and initiated efforts to capture lessons learned from current acquisition processes.<sup>11</sup> In 1999, the document called “The Road Ahead: Accelerating the Transformation of Department of Defense Acquisition and Logistics Processes and Practices” was released with three main goals: (1) reduce the acquisition cycle time; (2) lower total ownership costs in program costs and logistics support; and (3) lower overhead costs of acquisition and logistics. This document also initiated the construction of another new office to oversee acquisition reform, specifically, the Office of Acquisition Initiatives under the direction of the Deputy Undersecretary of Defense for Acquisition, Technology and Logistics (AT&L). Near the end of 2002, the Deputy Secretary of Defense, Paul Wolfowitz canceled the DoD 5000 series of acquisition policy documents.<sup>12</sup> On 7 June 2005, Gordon England, then Acting Deputy Secretary of Defense, directed the Air Force to lead an in-depth study of the

Department of Defense's acquisition processes. Lieutenant General Ronald Kadish, USAF (Ret) was selected to chair this panel, which released a preliminary report in 2005 and a full report in January 2006.

This report, the Defense Acquisition Performance Assessment Project report, identified that there had been 128 prior studies to address problems with the military acquisition process. "In fact, historically, the panel observed that cost and schedule instability has been a problem in all system acquisitions since the Civil War. Some of the issues that the Packard Commission saw 20 years ago are still problems today."<sup>13</sup> Some of the reviews occurring twenty years after Goldwater-Nichols have determined that the "current requirements process remains Military Service-centric and does not easily accommodate emerging Combatant Commander (COCOM) needs in a timely manner."<sup>14</sup> Couple the problem of the military service-centric requirements development process with the perception by senior leaders within Congress and the Department of Defense of the military's inability to accurately predict the cost and timeline for weapon procurement and one clearly sees why the United States Air Force and the other military services receive a tremendous amount of oversight of the acquisition processes. Some of the perceptions of the services' inability to predict cost and to act as good stewards of taxpayer money have been highlighted in television and printed news media on the "fleecing of America." Recently, in the February edition of Reader's Digest, numerous government acquisitions were highlighted for their exorbitant costs. The most famous acquisition "running amuck" stories of the \$7K coffee pot, the \$400 hammer and the \$600 toilet seat have been heard by many but now new procurement items can be added to the list—items such as the \$20 plastic ice-cube tray (a 99-cent item at the Dollar Store) and the \$22,800 34-inch refrigerator that appears to cost under \$100 at Lowe's.<sup>15</sup> While neither of these latest examples are advanced technology items, they are examples of why oversight committees lose confidence in the military acquisition system.

One of the more notorious acquisition programs that reflect the incorporation of advanced technology and the loss of confidence in the acquisition system was the Navy A-12 program. McDonnell-Douglas' A-12 Avenger program was designed to replace the A-6 Intruder as the U.S. Navy's Advanced Tactical Aircraft. On 7 January 1991, then Secretary of Defense Richard Cheney cancelled the Navy's highest-priority aircraft program due to increased cost and schedule.<sup>16</sup> McDonnell-Douglas was originally contracted in 1988 but by 1991 the program was already \$1 billion over budget, 19 months behind schedule, 10 percent overweight and neither the contractor nor the Navy could estimate the final program costs and schedule.<sup>17</sup>

It is imperative that DoD's procurement processes be able to quickly adapt to the accelerating advancements in technological capability. Looking forward into the future, some predict that the technological advancements are on a very steep, upward progressing slope. One such theory was presented by Ray Kurzweil in March 2001. Kurzweil's theory of *The Law of Accelerating Returns* states that "An analysis of the history of technology shows that technological change is exponential, contrary to the common-sense "intuitive linear" view. So we won't experience 100 years of progress in the 21<sup>st</sup> century—it will be more like 20,000 years of progress (at today's rate)."<sup>18</sup> Regardless of whether one accepts Kurzweil's assessment, a review of the last ten years clearly shows rapid advancements in technology, computing power, and communications. The military must be prepared to adapt to these rapid changes and ensure the procurement processes developed are not complex. "Complex acquisition processes do not promote program success – they increase costs, add to schedule and obfuscate accountability."<sup>19</sup>

As changes to the military procurement process are made to better adapt to technological advancements, a review of the best practices of the commercial industrial base must be included. However, caution must apply since there are major differences between the commercial and military industry. The military often has a different number of configurations than commercial industry. This is due to the lengthy time it takes to field systems and the requirements creep based on warfighter needs.



If the requirements creep is not contained and the needed capability defined quickly, the net result is an increase to the overall program cost and delivery schedule. This issue is also a direct result of the limited dollars the military has available to develop weapon systems. With such few dollars, the warfighter attempts to get the weapon system to fulfill the maximum number of requirements while the budgeteers cut program funding to meet current year funding shortfalls.

## Chapter 3

# Future Challenges

*“Only a constant inquisitive attitude toward science and a ceaseless and swift adaptation to new developments can maintain the security of this nation.”*

Dr. Theodore von Karman  
Founder of the Scientific Advisory Group (SAG),  
the forerunner to the Scientific Advisory Board (SAB)

### **ACQUISITION INNOVATION**

“Since its inception the USAF has depended on advanced technologies to maintain an edge over its actual and potential enemies. Continuous innovation became a way of life and AF leaders learned quickly to foster productive relationships among their service and the scientists, engineers and industry leaders who built the aircraft, missiles, computers, radar systems and other technologies on which the AF depends.”<sup>20</sup> To continue this legacy into the future, the military acquisition community must improve today’s processes, organizational structure, training of personnel, and identify and promote the right leaders to accommodate technological advances, and expedite delivery of weapons systems to the warfighter. “[The military] must have the flexibility and agility to respond to more dynamic security environments and rapidly changing needs.”<sup>21</sup> To be successful, these procurement processes must instill confidence in the senior leadership to enable minimum oversight.

“When Defense and Congressional leaders are surprised by unanticipated cost overruns, failure to meet expected schedule and system performance, they lose confidence in a system that is expected to provide promised capabilities. Leaders and staffs at all levels react by becoming more involved, applying more oversight and often making budget, schedule or requirements adjustments that significantly lengthen development and production cycles, and add costs.”<sup>22</sup>

Thus, when confidence in the senior leadership is lost, a vicious cycle develops. Unanticipated cost overruns or a failure to meet schedule or system performance triggers budgets cuts, extended schedules and additional oversight. This additional oversight typically requires more briefings and coordination of program decisions which, in turn, results in program overruns and schedule delays.

### **NEW TECHNOLOGIES**

The rapid advancement of technology requires the services to take additional risks on some technologies that may never come to fruition. Significant advances in several areas are likely over the next 20 years. The Center for Strategy and Technology examined four such areas in 2007: biotechnology, nanotechnology, cyber technology and directed energy. Potential future advances in each of these advanced technologies were addressed in the *Horizons 21* study research papers. The following are brief summaries of only a few of these papers.

In the area of cyber technology, Lieutenant Colonel Mark Mattison, USAF, addresses in his paper, titled “Achieving Decision Making Superiority: USAF Cyber Weapons School,” the rapid response and application of Warden’s OODA loop to defend against enemy attacks on our intelligence and command and control centers. The warriors at the forefront of cyber technology must be trained and equipped to “detect computer attacks, analyze the code used to launch the attack, quarantine the affected networks and, if allowed, counter-attack in microseconds.”<sup>23</sup> Colonel Mattison concludes his research paper by stating that “the USAF will need to educate bright young minds in cyber warfare and in tactical military planning.”<sup>24</sup> It is through the

education of these young minds that the USAF will accelerate the changing pace of cyber technology and its military applications. In order to accomplish these advancements, special, focused education and up-to-date equipment must be provided to these cyber warriors.

Colonel Phil Samples, USAF, identifies the advancements in the life science arena with the Human Genome Project. These advancements are made possible due to simultaneous advancements in other rapidly growing technology areas like nanotechnology and cyber technology. His paper titled, "DNA Possibilities and Military Implications," outlines the potential benefits and military applications that arise from the genome project and advancements in DNA technology. He argues that while biotechnology is fueled mainly from civilian applications, it is pertinent to the military as well. The ability for an adversary to unleash a bioterrorism agent is a threat not only to the civilian population but to the military and its ability to defend the United States and to operate freely in an Area of Responsibility (AOR). To increase the future effectiveness of military applications of biotechnology, Colonel Samples recommends "developing specific individuals along the science and technology (S&T) career path specifically focused on life sciences and the future applications for the USAF."<sup>25</sup>

In the field of Directed Energy, Lieutenant Colonel Kelly Noler, USAF, looks at the impact of Laser Radar (LADAR) in his paper, titled "The Laser Radar (LADAR) in the Battlespace of the Future." The development of the LADAR has allowed the USAF to adapt to the now common, unconventional urban warfare. The use of LADAR in the battlespace exponentially enhances weapon delivery capability and accuracy thus allowing the USAF to apply the right amount of force precisely on a target; even those camouflaged, and limit collateral damage.

In the nanotechnology arena, Lieutenant Colonel Steven Garland, USAF, addresses the rapid advancements in application of nanotechnology. While it is very difficult to predict the pace of growth in this arena, "the advantage will go to the adversary who can predict changes in quantum effects and quickly nanomanufacture materials in sufficient quantity and quality to generate those effects across the operational environment."<sup>26</sup> The ability for an adversary to be the first to develop an application in this area, keep it a secret, and apply either offensively or defensively will have a distinct advantage. "Countries which cultivate their idea base through education of the populace stand to gain the most rewards as new ideas beget new capabilities."<sup>27</sup>

### ***THE CHALLENGE***

These changes are bringing about a lighter fighting force that will be heavily dependent upon advancement in technology. These technologies come in the form of space-based communication systems, smarter weapons, and advanced materials that can be energy sources or sensors. These changes are coming at a time where the United States is preeminent, and when no enemy can compete against the military might of our armed forces. It is during this time that a review of our capabilities should be conducted and risks are best taken to provide a quantum leap in the capability of the United States Air Force.

## Chapter 4

# Title 10 Responsibilities: Organize and Train

*“Uncertainty and upheaval always accompany change, but so does opportunity.”*

General Bruce Carlson

Commander, Air Force Materiel Command  
AFMC Almanac 2006-07: Commander’s Focus

The United States Code or U.S.C. is the codification of all the federal laws of the United States and are organized into 50 separate chapters or titles for easier reference.<sup>28</sup> Title 10 refers to the laws and guidance of the Armed Forces of the United States and directs the roles, missions and organization of each of the services. In addition, U.S.C. Title 10 directs the services with the mission to organize train and equip a military force. In order to organize, train and equip a robust military force that is well prepared to deter, detect, deceive, disrupt, defend, deny and defeat U.S. adversaries, the services must analyze the organizational structure, the education and training requirements of the acquisition workforce and accept additional risk. Decreasing the level of risk aversion within the USAF requires top down direction and leadership.

Major General I.B. Holley, Jr., USAFR, in his study of *Ideas and Weapons*, outlined Holley’s Law of Technological Innovation in the Military”: “The adoption of new technology within a military service requires that the service develop a doctrine for the successful use of this technology in war, and neither the doctrine nor the technology will be developed unless that military service has an organization whose members understand technology and can make binding decisions about its support and application.”<sup>29</sup>

To achieve this end, “scientific research spending must be considered part of the national security budget.”<sup>30</sup> “The threat of failure in math and science education programs in America is the second greatest threat to American national security.”<sup>31</sup> “America must lead the world in math and science education and attract foreign students and researchers to the United States while American scientists participate in worldwide forums.”<sup>32</sup> To shape a workforce that understands the rapid progress of technology requires a change in USAF accession requirements, manpower and personnel policies, and an increased focus on the importance of technical degrees. To ensure individuals with the right credentials and leadership capabilities are promoted within the acquisition community, a change to the organizational structure was needed.

### **ORGANIZATION (STRUCTURE)**

Air Force Materiel Command (AFMC) and the acquisition community is the poorly understood “backbone of the flying, fighting Air Force.”<sup>33</sup> As recently as 2005, job titles, duty descriptions, leadership responsibilities, accomplishments and impact on the mission, were difficult to translate for non-acquisition personnel to understand. The recent, 2005 reorganization of AFMC and other acquisition organizations to match the Air Force’s structure of wings, groups, and squadrons has helped alleviate some of the mysticism of the acquisition community.<sup>34</sup> It also consolidated organizations focused on delivering similar capabilities, and improved efficiency throughout the command.

Now the next step is needed. A career development plan for acquisition officers similar to that used for pilots and navigators is needed. As with pilots, this plan would have a series of “gates” and “training requirements.” Within this system, required experiences, training, education and career broadening should be defined and tracked. In addition, key positions for our Company Grade Officers like the rated world’s flight commanders and shop chiefs need to be identified to groom officers for more challenging positions.

## ***ORGANIZATION (PERSONNEL)***

This “out of the box” thinking is not easy while faced with the current AF force shaping and manpower reduction efforts. “Future personnel drawdowns will leave a smaller acquisition and operator workforce available to support this structure, leaving the acquisition reformed force with little choice but to work harder with less, not unlike the frustrated forces of today.”<sup>35</sup> However, now is the time to prepare to mold the USAF of the future to ensure that the US retains its preeminent position.

The military structure must recognize and accept the increased need for acquisition and technology specialists. Historically, the USAF first determined a warfighting requirement and then found a system to fulfill this requirement. The speed of technology advancement will reverse this process--the military will need to look at new technology and then identify its warfighting applications. To do this requires a workforce that is more technically trained.

The USAF must look at future studies, such as the AF Transformation Plan and identify future force structure requirements and then determine future accession needs. In the past, the USAF accessions have been based on history not forward thinking. This new process will allow a refinement to the USAF accessions which specifies the number of engineers with mechanical, aero, computer, etc. expertise required to meet future requirements. As Lieutenant Colonel Mattison asks in his Professional Studies Paper (PSP), “Where is the cadre of “bright young minds” to be educated? Who will perform analysis and plan for integrated systems that will be required to defend against sophisticated adversaries?”<sup>36</sup> USAF accessions come from the Air Force Academy (AFA), the Reserve Officers’ Training Corps (ROTC) and the Officer Training School (OTS). However, the timelines for changing the accessions from the AFA and ROTC are between four and six years long to bring a new second lieutenant into the AF. We need to identify our future requirements with enough clarity to formulate, calculate, and specify the number of engineers required in each of these specialties, and do so four to six years in advance. Based on the discussions between leading scientists in civilian organizations, military organizations and academia; the changes in the biotechnology, nanotechnology, cyber technology, and directed energy arenas are moving so rapidly that it is difficult to predict where the technology will be in five to ten years. Yet, as General Bruce Carlson, Commander Air Force Materiel Command (AFMC) stated, at the 2006 U.S. Air Force Acquisition Leaders Forum in Charlotte, NC (15-17 February 2007), “In years past, [the U.S.] had a technological advantage over other countries. Today the world is the market for technology. The edge goes to whoever can develop, integrate, package and produce that technology the fastest.”<sup>37</sup> To try to regain this competitive advantage, General Carlson has identified the need to bring more engineers into the acquisition career field. Individuals with sharp minds who can think analytically and rapidly grasp the cutting-edge, complex technologies.

So how can we solve this accession issue? One way is to review the current assignments of engineers and ensure they are assigned to positions within the acquisition and technology arena. In some cases, additional training of acquisition personnel and modifications to acquisition processes and policies will be required. As the USAF precedes through current and future manpower reductions, the boards should target career fields, not just particular year groups. Officers with science and engineering backgrounds should be targeted for retraining and/or reclassification into acquisition duties, with increased emphasis on engineers and technical degrees in key acquisition positions such as Program Manager.

It may also be advisable to combine the acquisition (63A) and engineering (62E) career fields into a single Air Force Specialty Code (AFSC). The combination of these two career fields would create the third largest AFSC behind pilots and navigators.<sup>38</sup> Ensuring a successful career path for our science, engineering, and acquisition career fields is also essential.

To that end, another option is to establish the science and engineering career field as a unique specialty similar to the medical field. Like the medical field, leading scientist and engineers in the civilian arena could be accessed into the military with constructive credit for

“specialty” expertise and not just years of service. These accessions would require additional training and possibly a financial incentive to entice these individuals to transfer from the civilian to the military world, but the precedent is already established with the medical model. This would provide an opportunity for members of industry to participate in government service.

Regardless of which solution is implemented, one is needed quickly. Nearly 50 percent of AFMC’s workforce can retire in the next five years.<sup>39</sup> Coupled with the 2007 Selective Early Retirement Board (SERB) and Company Grade Officer Reduction In Force (RIF) it is clear why the Air Force Science and Technology Board (AFSTB) called this a “near-term crisis.”<sup>40</sup>

To counter the impact of this rapidly approaching retirement crisis and to facilitate the trade of expertise from civilian defense industry and institutions of higher education, the use of more Intergovernmental Personnel Act (IPA) assignments could be used.<sup>41</sup> The IPA program authorizes the assignment of employees to or from state and local governments, institutions of higher education, Indian tribal governments and other eligible organizations to facilitate cooperation between the Federal Government and the non-Federal entity. These assignments must be temporary and of short duration.<sup>42</sup>

Another opportunity may be the use of what President George W. Bush referred to in his January 2007 State of the Union Address as the Civilian Reserve Corps. While President Bush intends the Civilian Reserve Corps to be “much like our military reserve and ease the burden on the Armed Forces by allowing the government to hire civilians with critical skills to serve on missions abroad when America needs them,”<sup>43</sup> the crisis facing the acquisition corps is of critical importance to the success of the military to fight and win its nation’s wars. A Civilian Reserve Corps for the acquisition community would improve relations between the government and civilian institutions providing more insight and a better understanding of the way the military works and the government conducts business. Through the collective efforts of the IPA program and the Civilian Reserve Corps, appropriate “best business practices” can be incorporated into the policies and processes of the acquisition community.

The USAF must recognize the importance of technical degrees in maintaining our competitive edge and the role it plays in national security. “The aging science and engineering workforce and declining numbers of science and engineering graduates willing to enter either industry or government will further enforce the negative impact on the Department’s ability to address these concerns.”<sup>44</sup> Technical degrees and the opportunities within the USAF must be marketed to today’s youth. The current USAF recruitment videos and commercials are beginning to touch on these but more is needed.

Finally, acquisition professionals need operational assignments to bring the war-fighter back into the acquisition organizations. In the past, the operational experience was injected by tours of assignments of pilots and navigators to the acquisition organizations. With the shortage of pilots and navigators to meet current cockpit requirements, these opportunities have been reduced. However, the acquisition corps still needs operational experience. General Carlson stated, “I’d like to develop a pool of young officers who begin their Air Force careers in acquisition assignments. When they become captains, they are given an operational assignment to learn that aspect of the Air Force mission. Then, a few years later, they return to acquisition positions.”<sup>45</sup> This operational tour of duty would give acquisition personnel valuable insights.

## ***RISK TAKING***

In order to properly execute its procurement function in an environment of rapidly changing technology, the Air Force needs to address risk taking. Technical risk, both in developing basic technologies and in ensuring new weapon systems do not overreach is crucial. Properly managing financial risk through cross-functional coordination and proper definition of the acquisition program helps manage financial risk. Lastly, the Air Force needs to encourage risk-taking by individual program managers by institutionalizing the concept that it is acceptable to take risk on a program, and if it does not work, it is also acceptable for a program to fail.

The first area where change is needed is in the willingness of the AF to take risk in funding basic technology research. Commercial industry routinely invests in technologies that may very well never make it out of the initial stages of research and development. Although this may increase the upfront costs of product development, it provides more opportunities to incorporate new technologies which may increase capabilities and/or reduce life-cycle costs...

This is partly what was suggested by the Center for Strategic and International Studies in their review of *Beyond Goldwater-Nichols*, where they wrote “current issues such as more aggressively managing risk at the early stages of the development process in terms of assessing technology maturity more accurately and giving increased weight to getting capabilities into the field faster may prove fruitful in the next few years.”<sup>46</sup> The other piece is accurately managing technology transition from the laboratory into a project. Currently, the Air Force relies on a process, using the National Aeronautics and Space Administration’s (NASA) Technical Readiness Levels (TRLs) as a means of reducing risk. The ten-point TRL’s scale is a subjective rating that laboratory personnel use to measure the maturity of a technology. According to Lt Gen Kadish in his remarks to the Technology Panel: “Tech Trends 2001: Profiting Through Technology Partnerships,” “for program insertion, weapon systems need technology at a level of no less than 6 and preferably 8 or better.” As a GAO report on TRL put it, “Once a technology’s readiness level has been established, the risks of including that technology in a product development can be assessed.”<sup>47</sup> The key to success is accurately assessing the TRL and providing an understanding of the current maturity of the technology. If a technology is incorporated into an acquisition program at too low a TRL program risk increases and typically the cost and schedule of the program increase too. While the author agrees with the methodology of the TRL process, the acquisition community needs to look for ways to decrease the time to reach the TRL 6 to 8 range. Investment in basic technologies through a well-defined process of prioritizing the technologies in which to invest will go a long way toward this end.

Managing financial risk in major programs is also essential. The commercial sector accepts an increase in manufacturing costs due to moving into production faster and reducing the amount of time spent “production-izing” the product. As stated above, speeding production timelines is valuable. Yet, the risk associated with moving faster can be significantly reduced including members from the whole product development process in decision-making. The military has already incorporated this teaming effort in the Integrated Product Team (IPT) with membership from all departments associated with the procurement life-cycle. The success of the IPT is based upon the empowerment of this team to review recommendations for product modifications and to analyze the impact of these changes across all procurement areas. This decentralization of decision making requires a team of people well trained in the procurement process and the leadership to hold this team together.

Another method of reducing financial risk is the commercial practice of keeping technology development outside the acquisition program. “Incremental programs do not have the luxury of developing technology as part of their project.”<sup>48</sup> Incorporating the technology development within the program results in uncertainty and adds risk to the cost and schedule of the development program.

But we should not limit our thoughts on risk taking only to a financial and technical maturity setting. The climate surrounding risk-taking by leadership needs to change within the services. Numerous successful careers have been made by limiting the amount of visible risk. Individuals are awarded bigger, better assignments and promotions for succeeding without failure. In the future, with the rapid advancement of technology, not all projects will succeed. This should not be viewed as a flaw in the program manager’s leadership ability. Instead, acquisition leaders evaluate program management based on what was known at the time, and whether the right decisions made to maximize the possibility of success. In this review, leaders must maintain the purity of the situation as it existed to review the decisions made. It is similar to the legal standard of the “reasonable person” – were the actions taken commensurate with the

actions of a well trained acquisition professional. The future rapid technology growth requires individuals who can step out and take risks, recover when initiatives do not succeed and have leaders who recognize the capabilities and necessary skills required for tomorrow's acquisition leaders.



## **Chapter 5**

# **Conclusion**

The United States Air Force and the Department of Defense still deliver the finest weapon systems the world has ever seen. We have maintained this ability despite the numerous flaws that have been identified by all the reviews of the acquisition system. Despite this success, this trend will unlikely continue in the future when adversaries have the ability to quickly turn technological advancements from their own “garage” in a cycle time that allows them to reduce the time it takes for them to complete the OODA loop and to take action against the United States.

The coming years will see a mass exodus of acquisition personnel due to civilian retirements, military selective early retirement boards and reduction in force efforts. Efforts to increase accessions from the Air Force Academy, Reserved Officer Training Corps, and Officer Training School based on scientific backgrounds and pre-determined needs is necessary to meet tomorrow’s challenges. To meet these challenges, the acquisition workforce needs to be technically savvy, masters of the acquisition processes and policies, military leaders and not risk adverse. The system must identify the most talented officers early and place them in key developmental positions within the acquisition community. These officers must get operational experience during their Company Grade Officer years to apply what is learned in “the field” to the acquisition systems of the future. All of this can be tracked with an Acquisition personnel system with established “gates” for education, training, and experiences to ensure the leaders of tomorrow are ready to incorporate technology growing at a pace between four and seven times today’s rate.

## Bibliography

Acceleration Watch web site, <http://accelerationwatch.com/futuristdef.html>

AFPC Web Site. Interactive Demographic Analysis System (IDEAS).  
[http://www.afpc.randolph.af.mil/vbin/broker8.exe?\\_program=ideas.IDEAS\\_default.sas&\\_service=vpool1&\\_debug=0](http://www.afpc.randolph.af.mil/vbin/broker8.exe?_program=ideas.IDEAS_default.sas&_service=vpool1&_debug=0)

AFPC Web Site. “New Acquisition Officers Assignment Information”.  
[http://ask.afpc.randolph.af.mil/main\\_content.asp](http://ask.afpc.randolph.af.mil/main_content.asp)

AFPC Web Site. “Special Experience Exchange Duty (SPEED) Program”.  
[http://ask.afpc.randolph.af.mil/main\\_content.asp](http://ask.afpc.randolph.af.mil/main_content.asp)

AFPC Web Site. “Talking Paper on Acquisition and Intelligence Experience Exchange Tour (AIEET)”. [http://ask.afpc.randolph.af.mil/main\\_content.asp](http://ask.afpc.randolph.af.mil/main_content.asp)

Air Force Doctrine Document (AFDD) 1-1, Leadership and Force Development, 18 February 2006. <http://www.e-publishing.af.mil/pubfiles/af/dd/afdd1-1/afdd1-1.pdf>

Air Force Materiel Command (AFMC) Intergovernmental Personnel Act (IPA): Information, Guidelines, and Processes. 14 September 2005

Air Force Science and Technology Board (AFSTB), “Effectiveness of Air Force Science and Technology Program Changes”. (Washington, DC: The National Academies Press, 2003), 29, <http://books.nap.edu/books/030908895X/html>

Air University Center for Strategy and Technology. <http://csat.au.af.mil/about>.

An interview with AAC/XR (Todd Carnahan, Gregory Jenkins and Sam Nelson, conducted on 12 February 2007

An interview with Enrique V. Barrera, Ph.D., Professor of Materials Science and Department Chair, Rice University, conducted 12 September 2006 by Lt Col James E. Fairchild and Lt Col Christopher M. Coombs

An interview with Naomi J. Halas, Ph.D., Stanley C. Moore Professor of Electrical and Computer Engineering and professor of Chemistry, Rice University, conducted 13 September 2006 by Lt Col James E. Fairchild and Lt Col Christopher M. Coombs

An interview with Grant Hammond, Air War College’s Center for Science and Technology faculty, conducted 9 January 2007.

An interview with Patrick Hogan (SAF/AQXD), conducted on 18 January 2007.

Berkowitz, Bruce. *The New Face of War: How War Will Be Fought in the 21<sup>st</sup> Century*. New York, NY: Free Press, 2003.

Berube, David M. *Nano-Hype*. Amherst, NY: Prometheus Books, 2006.

Binnendijk, Hans. *Transforming America's Military*. Washington, D.C.: National Defense University Press, 2002.

Blaker, James R. and Steven J. Nider. Democratic Leadership Council: "Why it's Time to Revolutionize the Military." 7 February 2001.

Booker, Richard, and Earl Boysen. *Nanotechnology for Dummies*. Hoboken, NJ: Wiley Publishing, Inc., 2005.

Bush, George W. State of the Union Address. 23 January 2007.  
<http://www.whitehouse.gov/news/releases/2007/01/print/20070123-2.html>

Center for Strategic and International Studies (CSIS). Beyond Goldwater-Nichols: An Annotated Brief. *Department of Defense Acquisition and Planning, Programming, Budgeting, and Execution System Reform*. Phase III. August 2006.

Cornish, Edward. *Futuring: The Exploration of the Future*. Bethesda, MD: World Future Society, 2004.

Daso, Lieutenant Colonel Dik. "New World Vistas: looking toward the Future, Learning from the Past". <http://www.airpower.maxwell.af.mil/airchronicles/apj/apj99/win99/daso.pdf>

Defense Acquisition University's Publication Program Manager. "Martin Marietta's CEO Speaks to Program Manager", March-April 1995.

Delano, Major Kenneth J. "Critical Success Factors for DoD Program Managers." Research Report no. 99-039. Maxwell AFB, AL: Air Command and Staff College, 1999.

Department of Defense: *Defense Acquisition Performance Assessment*, Executive Summary, December 2005.

Department of Defense: *Defense Acquisition Performance Assessment*, Deputy Secretary of Defense, Assessment Panel of the Defense Acquisition Performance Assessment Project, January 2006.

Department of Defense: Quadrennial Defense Review Report, 30 September 2001.

Department of Defense: Transformation Trends-21 October Issue: New Rules for a New Era, 2002.

de Vries, Willem. Note for ASEAN Seminar: "Priority setting in national statistical programs." December 2002.

Fogleman, General Ronald R. (USAF). Air Power and the American Way of War. Presentation at the Air Force Association Air Warfare Symposium, Orlando, FL. 15 February 1996.  
[http://www.af.mil/news/speech/current/Air\\_Power\\_and\\_the\\_American\\_.html](http://www.af.mil/news/speech/current/Air_Power_and_the_American_.html)

Galway, Lionel A., et al. *Understrength Air Force Officer Career Fields, A Force Management Approach*. RAND Report. Santa Monica, CA: RAND, 2005.  
[http://www.rand.org/pubs/monographs/2005/RAND\\_MG131.pdf](http://www.rand.org/pubs/monographs/2005/RAND_MG131.pdf)

Garamone, Jim. United States Department of Defense: Armed Forces Informational Service's News Articles: *Rumsfeld Attacks Pentagon Bureaucracy, Vows Changes*. 10 September 2001.

Garland, Lieutenant Colonel Steven D., USAF. Air War College's Professional Studies Paper (PSP): Nanotechnology Risk Analysis for a 2025 Air Campaign. AY 2006-07.

Garreau, Joel. *Radical Evolution*. New York, NY: Doubleday & Co., 2004.

General Accounting Office (GAO) report number GAO-04-534SP: 'GAO Strategic Plan 2004-2009', 1 March 2004.

General Accounting Office (GAO) report number GAO/NSIAD-99-162: 'Better Management of Technology Development Can Improve Weapon System Outcomes.' United States General Accounting Office, 30 July 1999.

Gilmartin, Kevin. "Commander discusses top issues, challenges at Leadership Call". The Integrator, 24 August 2006. <http://integrator.hanscom.af.mil/2006/August/08242006/08242006-03.htm>

Hall, J. Storrs. *Nanofuture*. Amherst, NY: Prometheus Books, 2006.

Hiltz, Lieutenant Colonel David, USAF. Air War College's Professional Studies Paper (PSP): Developing Technical Leaders. AY 2006-07.

Johnson, Stephen B. Bernard Schriever and the Scientific Vision. <http://www.space.edu/papers/SchrieverSciVis.doc>

Johnson, Stephen B. The United States Air Force and the Culture of Innovation: 1945-1965. US Government Printing Office: 2002.

Jovene, Lieutenant Colonel Vincent T. Jr., USAF. Air War College's Professional Studies Paper (PSP): Next Generation Assembly Fabrication Methods: A Nanotechnology Trend Forecast. AY 2006-07.

Kadish, Lieutenant General Ronald, USAF. Panel remarks for the Technology Panel. "Tech Trends 2001: Profiting Through Technology Partnerships." Atlantic City. 17 April 2001.

Kurzweil, Ray. *The Singularity is Near*. NY: Penguin Group, 2005.

Leading Edge AFMC Almanac 2006-07. <http://www.afmc.af.mil/shared/media/document/AFD-060920-010.pdf>

Leading Edge Almanac 2005, vol. 47, no. 5, May 2005. [http://www.afmc-pub.wpafb.af.mil/HQ-AFMC/PA/leading\\_edge/index.htm](http://www.afmc-pub.wpafb.af.mil/HQ-AFMC/PA/leading_edge/index.htm)

Lopez, Staff Sergeant C. Todd. Air Force Print News: "SECAF town hall meeting: Every Airman an ambassador." 2 February 2007. [http://www.af.mil/news/story\\_print.asp?storyID=123039733](http://www.af.mil/news/story_print.asp?storyID=123039733)

Matthews, Mark T. Written Statement of Brigadier General Mark T. Matthews, Commandant, Air Force Institute of Technology for Field Hearing on Air Force Institute of Technology: An Intergovernmental Model for Today's Military Education. 29 July 2006.

Mattison, Lieutenant Colonel Mark, USAF. Air War College's Professional Studies Paper (PSP): Achieving Decision Making Superiority: USAF Cyber Weapons School. AY 2006-07.

McCall, Morgan. *High Flyers: Developing the Next Generation of Leaders*. Boston, MA: Harvard Business School Press, 1998.

Morgan, James. "Take note of these names: they're shaping your future." *The Herald*. 30 August 2006, 5. <http://www.theherald.co.uk/features/69043.html>

National Science Board. "Science and Engineering Indicators 2002". <http://www.nsf.gov/statistics/seind02/c2/fig02-29.htm>

National Science Board. "Science and Engineering Indicators 2006". <http://www.nsf.gov/statistics/seind06/c0/fig00-07.htm>

Noler, Lieutenant Colonel Kelly G., USAF. Air War College's Professional Studies Paper (PSP): The Laser Radar (LADAR) in the Battlespace of the Future. AY 2006-07.

Olson, Lieutenant Colonel Craig, USAF. "From Cradle to Save: Revolutionary Acquisition Force Structure Alternatives for the 21<sup>st</sup> Century." *Acquisition Review Quarterly*—Spring 2000.

Petersante-Gioia, Martha, 1<sup>st</sup> Lt., "General Carlson, visits base, discusses hot topics". *Hansconian*, 5 December 2006. <http://integrator.hanscom.af.mil/2006/March/03232006/03232006-02.htm>

Pierce, Terry C. *Warfighting and Disruptive Technologies: Disguising Innovation*. NY: Frank Cass, 2004.

Reynolds, Lieutenant General Dick, "Junior Force Study & AF Climate Survey", PowerPoint briefing, June 2004.

Rogers, Edward W. *Defense AR Journal: A ten-year review of the vision for transforming the defense acquisition system*. January-April 2004.

Samples, Colonel Phil L., USAF. Air War College's Professional Studies Paper (PSP): DNA Possibilities and Military Applications. AY 2006-07.

Scaggs, John. "Acquisition career track may be redirected". *AF Print News Today*, Air Force Materiel Command Public Affairs, 27 February 2006. <http://www.af.mil/news/story.asp?storyID=123016660>

Smith, Preston G. and Donald G. Reinertsen. *Developing Products in Half the Time*. New York, NY: John Wiley & Sons, Inc. 1998.

Stem, David E., Michael Boito, Obaid Younossi. "Systems engineering and program management: trends and costs for aircraft and guided weapons program" Project Air Force. Santa Monica, CA: RAND, 2006.

Stevenson, James P. *The \$5 Billion Misunderstanding: The Collapse of the Navy's A-12 Stealth Bomber Program*. Annapolis, MD: Naval Institute Press, 2001.

Taylor, Lieutenant Colonel Russell E., USAF. Air War College's Professional Studies Paper (PSP): Potential Impact of Nanotechnology-Enabled Micro Air Vehicles on USAF Missions, CONOPS, and Force Structure. AY 2006-07.

Wilkinson Francis. "The Discover Interview: Newt Gingrich".  
<http://www.discover.com/issues/oct-06/features/discover-interview-newt-gingrich/>

Wolborsky, Colonel Stephen L.. *Swords Into Stiletos: The Battle Between Hedgers and Transformers for the Soul of DoD*. Harvard University: Weatherhead Center for International Affairs, AY 99-00. 13 July 2000.

[www.aaas.org/spp/yearbook/2002](http://www.aaas.org/spp/yearbook/2002). American Association for the Advancement of Science. 2002.

[http://www.foxnews.com/printer\\_friendly\\_story/0,2566,251921,00.html](http://www.foxnews.com/printer_friendly_story/0,2566,251921,00.html). IBM Announces Major Processor-Memory Advance

[www.kurzweilAI.net](http://www.kurzweilAI.net). Ray Kurzweil. The Law of Accelerating Returns. 2001.

[www.newt.org/collaborate/version.asp?di=10000033](http://www.newt.org/collaborate/version.asp?di=10000033). "Science and Math Technology as the Key to 21<sup>st</sup> Century Success". 7 February 2006.

Zimmerman, Sacha. "Your Money for This?". Reader's Digest: February 2007.

## APPENDIX

The United States Air Force Scientific Advisory Board (SAB), an advisory body to the Secretary of the Air Force and the Chief of Staff of the Air Force, provides a link between the Air Force and the nation's civilian scientific and engineering community. “Over the past twenty years, many acquisition reform recommendations have focused on making incremental improvements to a narrowly defined acquisition process.”<sup>49</sup> The following is a summary of all the major assessments of and attempts at acquisition reform since 1985.

### **Packard Commission – 1985**

- Followed 131 separate investigations of 45 of the Department’s 100 top contractors
- Focused on Defense management issues, evaluated Department’s acquisition system, organization and decision-making as well as Congressional oversight

### **Defense Reorganization Act – 1986**

- Established the Service Acquisition Executive and consolidated acquisition decision-making in the hands of the civilian leadership
- Codified many of the Packard Commission recommendations

### **Section 800 Report – 1993**

- Reviewed existing legislation and recommended repeal or amendments
- Focused on streamlining and simplifying acquisition laws

### **National Performance Review – 1993**

- Vice President Gore initiative in light of the end of the Cold War
- Promoted using commercial standards for more acquisition programs

### **Federal Acquisition Streamlining Act – 1994**

- Consolidated and simplified hundreds of laws into unified procurement code

### **SecDef Perry Memo – 1994**

- Addressed shrinking industrial base
- Commercial technologies are outpacing DoD sponsored efforts

### **Defense Reform Initiative – 1997**

- Consolidation of industry and erosion of core capabilities addressed
- Need to recover interest in DoD requirements by commercial sector

### **The Road Ahead – 1999**

- Addressed the slowness of logistics to meet sustainment needs
- Requirement to integrate civil-military industrial base

### **Rumsfeld’s Challenge – 2001**

- Bureaucratic inertia stopping crucial initiatives, excess infrastructure
- Planning, Programming and Budgeting System outdated
- Technology moving faster than DoD, that is deploying outdated technology

## ENDNOTES

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- <sup>1</sup> Lopez, Staff Sergeant C. Todd. Air Force Print News: “SECAF town hall meeting: Every Airman an ambassador.” 2 February 2007.  
[http://www.af.mil/news/story\\_print.asp?storyID=123039733](http://www.af.mil/news/story_print.asp?storyID=123039733)
- <sup>2</sup> Berkowitz, Bruce. *The New Face of War: How War Will Be Fought in the 21<sup>st</sup> Century*, 131.
- <sup>3</sup> Pierce, Terry C. *Warfighting and Disruptive Technologies: Disguising Innovation*, xii.
- <sup>4</sup> Defense Acquisition University’s Publication Program Manager. “Martin Marietta’s CEO Speaks to Program Manager”, March-April 1995, 3-4.
- <sup>5</sup> FOX News.com: IBM Announces Major Processor-Memory Advance. February 14, 2007.  
[http://www.foxnews.com/printer\\_friendly\\_story/0,35566,251921,00.html](http://www.foxnews.com/printer_friendly_story/0,35566,251921,00.html)
- <sup>6</sup> Office of the Secretary of Defense, “Transformation Study Report: Transforming Military Operational Capabilities”, chart 5.
- <sup>7</sup> The Discover Interview: Newt Gingrich – science news articles online technology magazine.  
<http://www.discover.com/issues/oct-06/features/discover-interview-newt-gingrich/?page=3>
- <sup>8</sup> Olson, Lieutenant Colonel Craig, USAF. “From Cradle to Save: Revolutionary Acquisition Force Structure Alternatives for the 21st Century.” *Acquisition Review Quarterly*—Spring 2000, 168.
- <sup>9</sup> Department of Defense Acquisition Performance Assessment, Executive Summary, December 2005, 1.
- <sup>10</sup> Rogers, Edward W. *Defense AR Journal: A ten-year review of the vision for transforming the defense acquisition system*. January-April 2004, 2.
- <sup>11</sup> Rogers, Edward W. *Defense AR Journal: A ten-year review of the vision for transforming the defense acquisition system*. January-April 2004, 3
- <sup>12</sup> Rogers, Edward W. *Defense AR Journal: A ten-year review of the vision for transforming the defense acquisition system*. January-April 2004, 1.
- <sup>13</sup> Department of Defense Acquisition Performance Assessment, Executive Summary, December 2005, 2
- <sup>14</sup> Center for Strategic and International Studies. Department of Defense Acquisition and Planning, Programming, Budgeting, and Execution System Reform: *A Beyond Goldwater-Nichols Phase III Annotated Brief*. August 2006, 3.
- <sup>15</sup> Zimmerman, Sacha. “Your Money for This?”. *Reader’s Digest*: February 2007, 148.
- <sup>16</sup> <http://www.globalsecurity.org/military/library/report/1991/GJP.htm>
- <sup>17</sup> <http://www.afa.org/magazine/1991/0491down.asp>
- <sup>18</sup> [www.kurzweilai.net/articles/art0134.html](http://www.kurzweilai.net/articles/art0134.html)



- 
- <sup>19</sup> Department of Defense: Defense Acquisition Performance Assessment, Executive Summary, December 2005, 6.
- <sup>20</sup> Johnson, Stephen B. *The United States Air Force and the Culture of Innovation: 1945-1965*, 221
- <sup>21</sup> Department of Defense: Defense Acquisition Performance Assessment, Executive Summary, December 2005, 14.
- <sup>22</sup> Department of Defense: Defense Acquisition Performance Assessment, Executive Summary, December 2005, 7-8.
- <sup>23</sup> Mattison, Mark. *Achieving Decision Making Superiority: USAF Cyber Weapons School*, 8.
- <sup>24</sup> Mattison, Mark. *Achieving Decision Making Superiority: USAF Cyber Weapons School*, 41.
- <sup>25</sup> Samples, Colonel Phil L. *DNA Possibilities and Military Implications*, 29.
- <sup>26</sup> Garland, Lieutenant Colonel Steven G., USAF. *Nanotechnology Risk Analysis for a 2025 Air Campaign*, 1.
- <sup>27</sup> Garland, Lieutenant Colonel Steven G., USAF. *Nanotechnology Risk Analysis for a 2025 Air Campaign*, 34.
- <sup>28</sup> Wikipedia: Title 10 of the United States Code
- <sup>29</sup> Binnendijk, Hans. *Transforming America's Military*, Washington, DC: National Defense University Press, 2002, 33
- <sup>30</sup> <http://www.newt.org/collaborate/version.asp?di=10000033>. Science and Math Technology as the Key to 21<sup>st</sup> Century Success. 7 February 2006.
- <sup>31</sup> <http://www.newt.org/collaborate/version.asp?di=10000033>. Science and Math Technology as the Key to 21<sup>st</sup> Century Success. 7 February 2006.
- <sup>32</sup> <http://www.newt.org/collaborate/version.asp?di=10000033>. Science and Math Technology as the Key to 21<sup>st</sup> Century Success. 7 February 2006.
- <sup>33</sup> Leading Edge AFMC Almanac 2006-07.  
<http://www.afmc.af.mil/shared/media/document/AFD-060920-010.pdf>
- <sup>34</sup> Gilmartin, Kevin. "Commander discusses top issues, challenges at Leadership Call". *The Integrator*, 24 August 2006.  
<http://integrator.hanscom.af.mil/2006/August/08242006/08242006-03.htm>
- <sup>35</sup> Olson, Lieutenant Colonel Craig, USAF. "From Cradle to Save: Revolutionary Acquisition Force Structure Alternatives for the 21st Century." *Acquisition Review Quarterly—Spring 2000*, 170.
- <sup>36</sup> Mattison, Mark. *Achieving Decision Making Superiority: USAF Cyber Weapons School*, 9.

- 
- <sup>37</sup> Scaggs, John. "Acquisition career track may be redirected". AF Print News Today, Air Force Materiel Command Public Affairs, 27 February 2006.  
<http://www.af.mil/news/story.asp?storyID=123016660>
- <sup>38</sup> AFPC Web Site. "New Acquisition Officers Assignment Information".  
[http://ask.afpc.randolph.af.mil/main\\_content.asp](http://ask.afpc.randolph.af.mil/main_content.asp)
- <sup>39</sup> AFMC Web Site, "Work Force Shaping", fact sheet.  
<http://www.afmc.af.mil/library/factsheets/factsheet.asp?id=200>
- <sup>40</sup> Air Force Science and Technology Board (AFSTB) "Effectiveness of Air Force Science and Technology Program Changes". (Washington, DC: The National Academies Press, 2003), 29, <http://books.nap.edu/books/030908895X/html>
- <sup>41</sup> An interview with AAC/XR (Todd Carnahan, Gregory Jenkins and Sam Nelson, conducted on 12 February 2007
- <sup>42</sup> Air Force Materiel Command (AFMC) Intergovernmental Personnel Act (IPA): Information, Guidelines, and Processes. 14 September 2005
- <sup>43</sup> Bush, George W. State of the Union Address. 23 January 2007.  
<http://www.whitehouse.gov/news/releases/2007/01/print/20070123-2.html>
- <sup>44</sup> Department of Defense: *Defense Acquisition Performance Assessment*, Deputy Secretary of Defense, Assessment Panel of the Defense Acquisition Performance Assessment Project, January 2006.
- <sup>45</sup> Scaggs, John. "Acquisition career track may be redirected". AF Print News Today, Air Force Materiel Command Public Affairs, 27 February 2006.  
<http://www.af.mil/news/story.asp?storyID=123016660>
- <sup>46</sup> Center for Strategic and International Studies. Department of Defense Acquisition and Planning, Programming, Budgeting, and Execution System Reform: *A Beyond Goldwater-Nichols Phase III Annotated Brief*. August 2006, 23.
- <sup>47</sup> General Accounting Office (GAO) report number GAO/NSIAD-99-162: "Better Management of Technology Development Can Improve Weapon System Outcomes." United States General Accounting Office, 30 July 1999, 23.
- <sup>48</sup> Smith, Preston G. and Donald G. Reinertsen. *Developing Products in Half the Time*. New York, NY: John Wiley & Sons, Inc. 1998, 79.
- <sup>49</sup> Department of Defense: *Defense Acquisition Performance Assessment*, Deputy Secretary of Defense, Assessment Panel of the Defense Acquisition Performance Assessment Project, January 2006.