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SPACE PROFESSIONAL DEVELOPMENT

INSIDE:

Forward to the Future: A Roadmap for Air Force Space (Part II)

In Search of a Space Culture

People—The Essential Ingredient in Mission Success

Report Documentation Page

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HIGH FRONTIER

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Contents

Next Issue: ***Space and the Joint Fight***

Introduction

Maj Gen Thomas F. Deppe
Vice Commander, Air Force Space Command

The United States was not built by those who waited and rested and wished to look behind them. This country was conquered by those who moved forward, and so will space.
~ President John F. Kennedy, 1962

Forty five years ago, President John F. Kennedy energized the United States into action when he challenged his countrymen to go to the moon and embark on humankind's most "hazardous, dangerous, and greatest adventure." Our country fulfilled that early promise, and has since transformed space into a domain upon which we heavily rely for our national security and economic wellbeing. Such tremendous accomplishments could not have happened without the leadership and professional expertise of our people. This recipe for success continues today where our space professionals carry on the proud legacy of our space pioneers.

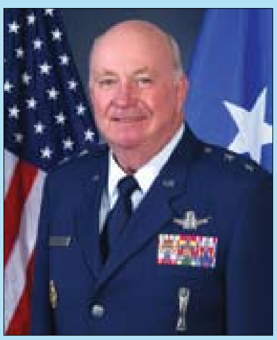
This edition of *High Frontier* acknowledges space professionals are the primary source of success in our efforts to develop, field, and operate dominant space capabilities. Leading off this issue are articles from Air Force and Army general officers who are committed to the growth of our joint space forces. Avowing that our nation's space professionals are joint, LTG Kevin Campbell illustrates how an Army space cadre is keeping pace on the battlefield by shifting from space-supported to space-enabled joint warfighting. Focusing on the foundational education of Air Force space professionals, Maj Gen Michael Gould, 2nd Air Force commander, outlines the evolution of the Space 100 curricula, the Air Force's keystone technical training course for space and missile operators and acquirers. Maj Gen Anthony Przybyslawski, Air Force Personnel Center commander, explains how a Space Professional Development Program is a subset of a larger Air Force-level force development and education program. The National Security Space Institute Chancellor, Maj Gen Erika Steuterman, highlights the NSSI's first three years of excellence and describes educational opportunities for military and civilian space professionals. Finally, Maj Gen Dick Webber from HQ AFSPC analyzes our space culture, relates it to professional development, and provides keen insight on its evolution.

In our "Industry Perspective" section, Dr. William Ballhaus, president and CEO of The Aerospace Corporation, affirms that people are the essential ingredient in mission success and identifies workforce recommendations for successful space systems development. Once a system is developed and fielded, operational mission success requires us to "train like we fight." Mr. Dale Bennett, president of Lockheed Martin's Simulation, Training, and Support, provides a way ahead to meet AFSPC's mission of "delivering trained and ready Airmen with unrivaled space capabilities to defend America."

In the main section of this edition, space and missile experts depict the finer nuances of space professional development ranging from specialized education opportunities to management tools. Ms. Patricia Robey asserts how a deliberate space development plan is paramount, especially in an era of increasing space reliance. Colonels Kevin McLaughlin and Chris Crawford present their second article in a two-part series on the future of the Air Force in the space domain. They discuss how to better enable space thinking, culture, organization and professional development. Col Rex Kiziah and his colleagues at the US Air Force Academy (USAFA) outline how the USAFA Physics Department is arming our future Airmen with the technical skills necessary to meet challenges in the space domain. CDRs (ret) Mark Rhoades and William Joseph Welch describe how the Naval Postgraduate School is forging strong bonds with national security space partners and is poised to meet the educational needs of thousands of our nation's space cadre. As we further develop space professionals with a warrior focus, a select group will have the opportunity to receive the world's most advanced training in weapons and tactics at the US Air Force Weapons School (USAFWS). Maj Chris Putman takes the reader inside this school and describes in detail the USAFWS' Space Weapons Instructor Course curriculum, associated training activities, and expected performance standards.

Highlighting that missile operators and maintainers play a key role in our space professional workforce, Lt Col Andrew Kovich and Maj Lance Adkins express the continued need to develop those who guarantee the safety and security of our nation's strongest strategic deterrent, our ICBM force. Furthermore, expanding our space intelligence capabilities is necessary to meet future challenges in a contested medium. Lt Col Dana Flood states the need to develop intelligence professionals to lead-turn those challenges. To finish the section, Maj Theresa Malasavage gives the reader insight into the Space Professional Functional Authority Advisory Council and its role in shaping space career development, and Mr. Douglas Anding and Mr. David Boyer dissect the Space Professional Development Database System and its use as a career management tool.

This edition of *High Frontier* is designed to help you better understand how we develop space professionals and arm them with the expertise necessary to meet the challenges of the future. I hope you enjoy it and find it useful in your own professional growth.



Maj Gen Thomas F. Deppe (BA, Management, Tarkio College, St Louis, Missouri; MS, Systems Management, University of Southern California) is vice commander, Air Force Space Command (AFSPC), Peterson AFB, Colorado. He assists the commander in the development, acquisition and operation of the Air Forces space and missile systems. The command oversees a global network of satellite command and control, communications, missile warning, and launch facilities, and ensures the combat readiness of America's ICBM force. The command comprises more than 39,700 space professionals who provide combat forces and capabilities to North American Aerospace Defense Command and US Strategic Command (USSTRATCOM). General Deppe also directs and coordinates the activities of the headquarters staff.

General Deppe was commissioned in 1977 through Officer Training School. He has commanded a ground-launched cruise missile flight in NATO and a Minuteman II maintenance squadron in Air Combat Command. He also commanded a Minuteman III missile wing, an ICBM logistics group and was vice commander of a space launch wing in AFSPC. The general served as deputy director for operations at the National Military Command Center. He was director, logistics, and communications, chief information officer and chief sustainment officer, Headquarters AFSPC. He is a master missileer in both operations and maintenance. Prior to assuming his current position, General Deppe was commander, 20th Air Force, AFSPC, and commander, Task Force 214, USSTRATCOM. General Deppe is a graduate of Squadron Officer School, Armed Forces Staff College, and Air War College.

The Army's Space Cadre

LTG Kevin T. Campbell
Commanding General, SMDC/ARSTRAT
Commander, JFCC-IMD
Huntsville, Alabama

Some readers of *High Frontier* may be surprised to see an article discussing the Army's vision and mission for space and how the Army has aggressively moved to establish and train a cadre of space experts to implement this vision. These same readers may also not know that the United States Army has a long and proud history of supporting America's space programs. This history dates back to October 1948 when the Army Chief of Ordnance designated Redstone Arsenal the center for ordnance rocket research and development. Since then, the Army has played a critical role in many of America's historical successes in space.

America's First Space Milestone

America's first satellite, Explorer I, was placed in orbit on 31 January 1958 using a modified Army Redstone rocket designated the Jupiter-C because of its use in the Jupiter development program. When CDR Alan B. Shepard's Mercury 3 capsule made its historical flight on 5 May 1961, the launcher sending the first American into space was also a modified Army Redstone rocket designated Mercury-Redstone 3.[1]

Space Force Enhancement

While the Army's long space history is certainly interesting, the Army's use of space force enhancements (SFEs) to successfully maneuver, engage, and defeat the enemy is of far greater importance. Army Field Manual 3-14 states that "space force enhancement functions are similar to combat support operations in that they improve the effectiveness of forces across the full spectrum of operations by providing operational assistance to combat elements."[2]

FM 3-14 identifies five SFE areas:

- Communications;
- Position, velocity, and timing;
- Environmental monitoring (space and terrestrial weather);
- Intelligence, surveillance, and reconnaissance (ISR); and
- Theater missile warning.

US Army Space and Missile Defense Command/US Army Forces Strategic Command (SMDC/ARSTRAT) is responsible for assuring all Army forces have access to these SFE capabilities in order to enhance their assigned missions. We do this by developing the Army's Space Vision and assuring the Army's ability to execute its Space Mission. Army's Space Vision is "to provide dominate space and missile defense capabilities for the Army and to plan and integrate Army capabilities in support of United States Strategic Command (USSTRATCOM) missions." This vision is implemented under Army's Space Mission: "SMDC/ARSTRAT conducts space and missile defense operations and provides planning, integration, control, and coordination of Army forces and capabilities in support of USSTRATCOM missions; serves as a proponent for space and ground-based midcourse defense; is the Army operational integrator for global missile defense; conducts mission-related research, development, and acquisition in support of Army Title 10 responsibilities; and serves as the focal point for desired characteristics and capabilities in support of USSTRATCOM missions."

The Army's Space Cadre

In 1998, the Army recognized the need for a cadre of space professionals who were specifically trained in and knowledgeable of space-based capabilities and their employment in support of the ground warfighter. This was actually several years ahead of the 2001 tasking by former Secretary of Defense Donald H. Rumsfeld to develop and maintain a cadre of space-qualified professionals. The Army established the space operations functional area designated FA40

US Army Forces Strategic Command

Space Force Enhancement.

The ongoing cooperation between the Army and Air Force continues to be essential to the long-term growth of the Army's space professional cadre.

"Space Operations" in order to identify and manage its space professionals; career specialists whose principal duties include planning, developing, resourcing, acquiring, integrating, or operating space forces, concepts, applications, or capabilities in accordance with Department of Defense Directive 3100.1 and Joint Publication 3-14. These space operations officers/FA40 officers form the core of the Army space cadre. This relatively small (less than 200 officers) but significant population is focused on integrating SFE into Army-wide operational and strategic planning.

In 2005, the Army Space Council approved the formation of the Space Cadre Office and definitions for use in identifying space professionals as well as space-enablers; those personnel assigned to positions whose primary career field is not space, but perform unique tasks or functions or may require skills to apply space capabilities. Armed with cadre definitions, the Army used FORMAL, a capstone Army Force Management Analysis tool, to look both horizontally and vertically across the Army in order to identify the Army's space enablers. The Army identified more than 1,700 space enabler positions that are being filled with civilians, non-FA40 officers, warrant officers, and enlisted Soldiers. In January 2006, the vice chief of staff of the Army agreed with the Army Space Council way ahead and directed SMDC to "continue to manage the program."

Army space operations officers have been serving in joint space locations since inauguration of the functional area in 1998. The initial authorized structure listed 50-plus joint positions within which was then the US Space Command, North American Aerospace Defense Command, and the National Security Space Architect Office. This number has grown with the evolution of these organizations into the US Strategic Command and National Security Space Office.

A concentrated effort began in 2006 to identify Army and Joint locations still lacking Army space expertise and to determine the best way to expand the presence of FA40s in these key command locations. As a direct result, Army space operations officers have been placed in the Air Force Space and Missile Systems Center, the Joint Functional Component Command for Space, and Space and Naval Warfare Systems Center. The Army has also placed space operations officers with the Office of the Secretary of Defense, Defense Information Systems Agency, National Reconnaissance Office Army Coordination Team, Defense Advanced Research Projects Agency, and numerous combatant commands. Future Army efforts will focus on expanding the presence of Army cadre (both space professionals and space enablers) at these locations and throughout the national security space community.

The ongoing cooperation between the Army and Air Force continues to be essential to the long-term growth of the Army's space professional cadre. As General Kevin P. Chilton, former commander of Air Force Space Command (AFSPC) said recently, the challenge [for future space professionals] is ensuring there is an adequate supply of smart people to run all the high-tech gear Space Command owns. "We have to look at our seed corn." General Chilton said, "How are we inspiring them to choose those areas of study. I want people to understand the direct application of what they are studying in the classroom to real life."[3]

To assure standardized training of space professionals, the Army uses portions of the Air Force space curriculum in the 11-week long Army Space Operations Officer Qualification Course (SOOQC) managed by SMDC's Future Warfare Center. AFSPC's National Security Space Institute (NSSI) Space 200 course focusing on the concepts of orbital mechanics, acquisition, space law, policy and doctrine, and the integration of space effects into the joint fight constitutes the first four weeks of the Army's SOOQC. Recently, Army space operations officers (mainly combat veterans) were added to the NSSI instructor staff. The result is a stronger joint perspective on space education which benefits all services who attend the NSSI. In concert with the Air Force's Institute of Technology, an effort is currently underway to establish a graduate degree program and to assign an Army space operations officer to its staff.

The Army's effort to assure standardized training of Army space professionals transcends its close relationship with Air Force space professionals. Army space operations officers have graduated from the Naval Postgraduate School (NPS) since 1999 and keep providing timely and relevant input to the NPS's space curriculum. The Army's effort to assure standard training of the Army space cadre resulted in AFSPC recently authorizing award of the Air Force space badge to qualified Army personnel.

Space Support to the Warfighter

The Army is leveraging space expertise in support of the joint warfighter in many ways, including the use of other space professions and experts in addition to space operations officers. Examples include the Army Space Support Teams (ARSSTs) who rapidly deploy worldwide to deliver space capabilities, services, and expertise in support of ground forces to include numbered Armies, Corps, Special Forces, Marine Expeditionary Forces, and Joint Task Forces during exercises and contingency operations. Team members serve as space subject-matter experts across the supported unit's staff. Their mission focus is space force enhancement operations. At present, there are six active duty and four Army Reserve teams activated under the 1st Space Battalion, 2nd Space Company with an additional 11 teams forming under the Colorado National Guard. The end-state for the ARSST force structure is 27 teams across the active, Reserve, and National Guard structures.

The Joint Tactical Ground Station (JTAGS) is the Army's element to USSTRATCOM's Theater Event System (TES). TES provides an integrated, in-theater, 24-hour overhead non-imaging infrared detection capability for processing and disseminating missile early warning, alerting, and cueing information data to combatant commanders and missile defense assets through the use of stereo processing of the Defense Support Program (DSP) satellite data. The TES is composed of three ground elements: the Space-Based Infrared System (SBIRS) Mission Control Station, the JTAGS, and the Tactical Detection and Reporting system. By processing DSP direct down-linked infrared data, the JTAGS provides timely notification of missile launches to theater forces. The JTAGS in-theater capability will be enhanced significantly as its hardware and software are upgraded to interface with the future SBIRS High and Space Tracking and Surveillance System satellite constellations.

As the combatant commander's action officers for space support, Commercial Exploitation Teams (CETs) provide receipt, exploitation, and dissemination of commercial satellite imagery products to space elements, warfighters, and coalition elements. CETs work in collaboration with National Geospatial-Intelligence Agency support teams, the topographic community, and collection managers—and bring the "warfighter" perspective. Currently the Central Command theater CET provides invaluable support by obtaining timely imagery from commercial vendors in support of those who can make a difference. These commercial images are key to sharing information with the Iraqi government, enabling it to assume a greater role in Iraq's security, and to support the thousands of others working to stabilize the country and build its infrastructure.

Space-based capabilities provide or facilitate the exchange of vital information required to support and sustain multi-national and coalition operations. These complementary and reinforcing effects minimize relative vulnerabilities and enable the delivery of combat power greater than the sum of individual parts. Army space forces contribute significantly to these efforts.

The Army's Space Master Plan

Space-based capabilities, leveraged by Army space professionals, provide enhanced information superiority and situational awareness, permitting high-tempo, noncontiguous, simultaneous distributed operations. When integrated with complementary airborne and terrestrial-based systems, space-based systems provide the joint warfighter and operational commanders with unprecedented options that enable strategic responsiveness.

The Army has developed a comprehensive Army Space Master Plan outlining how to best guide the development of space capabilities and to incorporate those capabilities, as key enablers, into its current and future forces. There are three core Army space objectives guiding the assessment and prioritization of these capabilities. These objectives are to:

- Influence development and design of future space systems and their operational concepts to support the full range of joint ground force operations;
- Improve the ability to exploit space systems by the current and future force; and
- Facilitate delivery of space capabilities that address Army requirements.

Achieving these objectives requires an Army combat developer community that can understand, substantiate, articulate, and defend space requirements supporting the ground maneuver force. The Army must continue to influence the development, design, and deployment of national assets to incorporate responsive, assured, and timely support to maneuver commanders from the initial design phases. To fully exploit these future and current space-based assets, a complementary mix of highly trained Army space cadre and other space professionals is needed, particularly within the areas of satellite communications (SATCOM) and ISR platforms.

There are however, issues the Army must address to ensure future force mission success. Military SATCOM (MILSATCOM) programs, for example, must stay on schedule and meet performance level criteria to serve as the primary means of transmitting mission-critical joint command and control, Joint Blue Force Situational Awareness, combat identification, theater early missile warning, and Blue Force tracking activities-related information and data. The Army Space Master Plan recommends the Army seek innovative solutions, including partnering with commercial providers, to overcome MILSATCOM shortfalls in capacity, user access, and delays in capability improvements.

US Army Forces Strategic Command

Deployed Joint Tactical Ground Stations (JTAGS).

Providing Space Technology for the Army—Operationally Responsive Space

The SMDC/ARSTRAT's Technical Center is actively supporting in the joint service Operationally Responsive Space (ORS) Office whose goal is to provide tactically responsive, operationally relevant space capabilities to the joint warfighter. The Army is providing an ORS deputy director and other key positions in the ORS Office. ORS will use the most expeditious requirements, resource allocation and acquisition processes available to meet the urgent needs of the joint warfighter. Responsiveness is the most desired attribute across the ORS range of activities.

One major element contributing to ORS is the Tactical Satellite (TacSat) Demonstration Program. TacSat's objective is to build smaller, cheaper, simpler satellites to provide relevant space capabilities, and demonstrate military utility through operational experimentation. This will enable the capability to build, store, and launch on demand a class of small, inexpensive satellites with plug-and-fight payloads tailored to meet the existing and emerging needs of the tactical warfighter. Payload concepts addressing communications on the move and persistent battlefield surveillance/characterization are currently being worked in a joint, collaborative environment with the other services and combatant commanders. SMDC/ARSTRAT's Technical Center is the Army's executive for TacSat project planning, development, and execution.

Space Superiority—Preserving Space Capabilities

Although the US currently possesses overwhelming space capabilities, its dominance in space is not guaranteed. Our space-based systems, communication links, and ground stations potentially present attractive targets to an adversary seeking to level the battlefield. Preserving and protecting US military space-enabled capabilities requires space situational awareness. Just as situational awareness in the terrestrial sense provides joint warfighters with tactical awareness, space situational awareness enables commanders to understand the factors that could impact their space information superiority. Investments in space situational awareness capability represent the most fundamental step in preserving our space advantage.

Conclusion

The joint combat operating environment has evolved, extending vertically into space. Space-based capabilities enable the joint warfighter to see further, communicate faster, act more quickly, and dominate the battlefield in ways only dreamt about when the US Army helped launch America into space nearly 50 years ago. The linkage between the Army and space will continue to grow.

The Army is proud of the rapid growth and subsequent involvement of its professional space cadre in providing the joint warfighter with capabilities that simply cannot be matched by terrestrially based assets. In a very short period of time, the joint warfighter has moved from being just "supported" by space assets to being truly "space enabled."

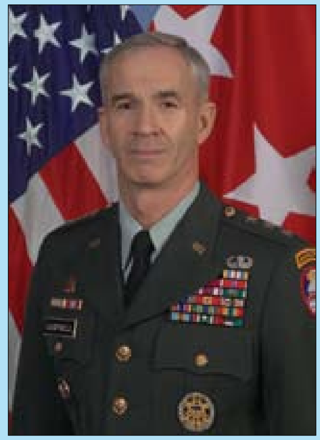
Secure the high ground!

Notes:

[1] You can read about these and many other Army achievements in space by visiting our web page at: http://www.redstone.army.mil/history/arspace/welcome.html.

[2] Army Field Manual (FM) 3-14, *Space Support Operations*, May 2005.

[3] Tom Roeder, "Chilton embraces challenge at Air Force Space Command" *Colorado Springs Gazette*, 22 July 2007.



LTG Kevin T. Campbell (BS, Worcester State College, Worcester, Massachusetts; MS, Personnel Management, University of New Hampshire) is the commander, US Army Space and Missile Defense Command/Army Forces Strategic Command, and serves as the commander for the Integrated Missile Defense Joint Functional Component Command (JFCC-IMD). This component is responsible for meeting USSTRATCOM's (United States Strategic Command) Unified Command Plan responsibilities for planning, integrating, and coordinating global missile defense operations and support. JFCC-IMD conducts the day-to-day operations of assigned forces and coordinates activities with associated combatant commands, other STRATCOM Joint Functional Components and the efforts of the Missile Defense Agency.

General Campbell's previous assignments include: chief of staff, United States Strategic Command, Offutt Air Force Base, Nebraska; director of plans, United States Space Command; deputy commanding general, United States Army Air Defense Artillery Center and Fort Bliss, Texas; commanding general, 32nd Army Air and Missile Defense Command (AAMDC), Fort Bliss, Texas; Assistant Deputy Chief of Staff for Combat Developments, United States Army Training and Doctrine Command, Fort Monroe, Virginia.; commander, 94th Air Defense Artillery Brigade, Darmstadt, Germany; political-military planner (Eastern Europe/Bosnia), J5, the Joint Staff, Washington, DC; G3, 32nd AADCOM, Darmstadt, Germany; commander, 2nd Battalion (PATRIOT), 43rd Air Defense Artillery, Hanau, Germany; executive officer, 3rd Battalion (PATRIOT), 43rd Air Defense Artillery, Fort Bliss, Texas; chief, Unit Training Division, Directorate of Training and Doctrine, Fort Bliss, Texas; ROTC instructor, University of New Hampshire; adjutant, 1st Battalion (HAWK), 2nd Air Defense Artillery, Korea; assistant operations officer, 38th Air Defense Artillery Brigade, Korea; commander, Nike Hercules Battery, Homestead, Florida, and Fort Bliss, Texas; and artillery team commander, Datteln, Germany.

General Campbell's military education includes the Air Defense Artillery Officer Basic and Advanced courses, the Nike-Hercules Officer course, Ranger and Airborne Schools, the Army Command and General Staff College, and the Naval War College.

Space 100—Past, Present, and Future

Maj Gen Michael C. Gould
Commander, 2nd Air Force
Keesler AFB, Mississippi

Today's Air Force finds itself in a dynamic and changing world. The Global War on Terror has illustrated how important air and space power are to combatant commanders. Even more so, it becomes abundantly clear that of all the Air Force's weapons systems, its people remain our greatest asset. Whether it is an Airman basic learning satellite operations or a second lieutenant making time-critical decisions in a Missile Procedures Trainer, 2nd Air Force (2 AF) is dedicated to providing the highest quality technical training to produce the absolute best graduates in support of the Air Force and combatant commanders around the world.

Second Air Force has a distinguished record of conducting technical training for space operators and aiding them in their initial space development. Through the 381st Training Group (381 TRG), 2 AF has facilitated many advancements resulting in providing the best space operations training in the world. One example of space training innovation is Classroom Operation Procedures Training, a Web-based emulator that reproduces the Minuteman III, intercontinental ballistic missile command and control interface in the classroom setting. Also, the Solid State Phased Array Radar Training System is a leap forward in simulator training for space surveillance and missile warning. Both these developments increased students' understanding of initial operational procedures and enhanced their preparations for wing operations. In addition, the Spacelift Fundamentals course was developed to train rudimentary launch operations skills. Finally, in response to an Air Force Space Command (AFSPC) request, the 381 TRG developed the Space 100 course as the first step in the professional development for the next generation of highly trained space and missile acquirers and operators.

Space 100: Past

Following the dissolution of Strategic Air Command in 1992 and a year-long stay in Air Combat Command (ACC), missile operations transitioned to AFSPC in 1993.[1] At the same time, we merged missile operations with space operations creating today's 13S career field. In July 1993, responsibility for missile operations training, then called Undergraduate Missile Training, was transferred from ACC to Air Education and Training Command (AETC).[2]

In September 1994, responsibility for space operations training, including the foundational Undergraduate Space Training (UST) course, was transferred from AFSPC to AETC and consolidated with the missile training units in the 381 TRG at Vandenberg AFB, California.[3] In October 1996, the space training squadrons moved to Vandenberg AFB to complete the 381 TRG's consolidated responsibility for training all future space and missile operators.[4]

In 1996, following the framework of UST, we established Undergraduate Space and Missile Training (USMT). USMT became the Air Force Specialty Code (AFSC)-awarding course for all new 13S officers regardless of which operational track (space or missile) they were assigned. The 10-week USMT course provided an overview of the space environment, orbital mechanics, and space and missile operations, and was organized so system experts taught students in the areas in which they had the most experience.

In 2000, Officer Space Prerequisite Training (OSPT) replaced USMT. OSPT continued USMT's legacy of preparing personnel for follow-on training in the space and missile operations career field by providing instruction in the fundamental knowledge areas and skills associated with space and missile operations. Under the OSPT format, instructors became subject matter experts in multiple operational and functional areas, thus broadening their knowledge of space assets and enabling them to teach the entire course to a single class and mentor the future space operators throughout their training.

Space 100: Present

The findings of The 2001 Space Commission became a watershed event for the evolution of today's American military space community. The Space Commission determined there was a need to "create and sustain a cadre of space professionals"[5] and to "create a stronger military space culture through focused career development, education, and training."[6] Training and education were identified as vital points in this effort. In response, AFSPC and AETC developed and validated requirements for a new initial entry space cadre course, Space 100, to "improve the technical foundation for all space professionals."[7]

Development and delivery of this cornerstone course is conducted by the 392nd Training Squadron. Space 100 sets an educational foundation in space operations and effects and includes "the fundamentals of astronautics, the space environment, electromagnetics, space organizations, law, policy, and the unique processes of space system acquisitions."[8] In order to include all facets of space, the course now instructs 13S (space and missile operations), 1C6 (space operations), 61S (scientist), 62E (engineer), and 63A (acquisition) AFSCs. Space professionals from US services and agencies have also attended Space 100.

Space 100: Future

In October 2006, General Kevin P. Chilton, then AFSPC commander, directed an end-to-end review of the Space 100 curriculum. The vision was a robust, exhaustive foundational course for space community personnel. The Space 100 working group, consisting of the space and missile career field managers, representatives from 381 TRG, and all levels of AFSPC, met in March 2007 to address this vision. At this time, the course training standard has been revised to meet the evolving operational needs of the space community. The revised course is expected to roll

Figure 1. EyasSAT.

out by fiscal year 2010.

Space 100 is progressing to provide a highly trained cadre of space professionals ready to meet the Air Force's future challenges. Some of the areas of future course development are integrating EyasSAT (figure 1), a satellite subsystem demonstrator, into the course to improve satellite operational concepts as students conduct hands-on experiments with a fully functional micro-satellite. Another critical area for future development is space's contribution to joint warfighting and how space power integrates with Air and Space Operations Centers and how it provides enablers and delivers effects on the battlefield in the Global War on Terror. In addition, with the increased emphasis placed on space acquisitions, there is a need for attracting experienced personnel familiar with space's unique acquisition systems into the Space 100 instructor force. This will greatly benefit the operators and acquirers of tomorrow who will be required to design and operate the most complicated and technologically advanced systems ever created.

Summary

More than 50 years have passed since the Soviets launched Sputnik. Since then, the Air Force has seen increasing and evolving roles for space operations and applications. The potential threats to our space superiority are clear and present as evidenced by events such as the Chinese anti-satellite test in January 2007. Airmen who operate and acquire space systems must continue to achieve a greater depth of experience in multiple space functional areas and an extensive understanding of the role space brings to the joint fight. It is imperative to maintain the robust training that is key to the Air Force's continued success in the space arena: that training begins with Space 100.

Notes:

[1] *Air Force Space Command Almanac*, http://www.afspc.af.mil/shared/media/document/AFD-070409-020.pdf.

[2] 381st Training Group, US Air Force, fact sheet, http://www.vandenberg.af.mil/library/factsheets/factsheet_print.asp?fsID=4582&page=1.

[3] Ibid.

[4] Ibid.

[5] *Report of the Commission to Assess United States National Security Space Management and Organization*, executive summary (Washington DC: US Government Printing Office, 2001) 11 January 2001, 18.

[6] Ibid., 42.

[7] Air Force Space Command and Air Education and Training Command, *Space Professional Strategy*, 16 April 2003, 8.

[8] Air Force Instruction, AFI 36-XX, *Space Professional Development*, draft, 9.

Maj Gen Michael C. Gould (BS, Behavioral Science, USAFA; MS Human Resource Development, Webster University) is commander, 2nd Air Force, Keesler AFB, Mississippi. He is responsible for the development, oversight, and direction of all operational aspects of basic military training, initial skills training, and advanced technical training for Air Force enlisted and support officers. The command provides training in more than 250 Air Force specialties through 2,500 courses, graduating 225,000 Airmen, soldiers, sailors, Marines, and foreign students annually in diverse areas. These areas include aircraft maintenance, civil engineering, medical, computer, avionics, security forces, space and missile operations and maintenance, and multiple intelligence disciplines. The command includes training wings at Keesler AFB; Sheppard, Lackland and Goodfellow AFBs in Texas; a training group at Vandenberg AFB, California; and a network of 92 field training units around the world. 2nd Air Force also oversees all Airmen throughout the in-lieu-of/individual augmentee training pipeline at Army training sites across the country and provides an operations center for pre- and post-deployment support.

General Gould has commanded an operations group, an air refueling wing, an air mobility wing and the Cheyenne Mountain Operations Center. His operational and staff assignments include three tours at Headquarters US Air Force, along with duty as an Air Force aide to the president and military assistant to the secretary of the Air Force. He served as the director of Mobility Forces for Operation Joint Endeavor and, more recently, as USEUCOM's Air Expeditionary Task Force commander for the deployment of African Union troops into the Darfur region of Sudan. Prior to assuming his current position, the general was commander, 3rd Air Force, Royal Air Force Mildenhall, England.

His awards inclued Distinguished Service Medal (oak leaf cluster), Defense Superior Service Medal (oak leaf cluster), Legion of Merit (oak leaf cluster), Meritorious Service Medal (oak leaf cluster), Air Force Commendation Medal, Air Force Achievement Medal.

The general is a command pilot with more than 3,000 hours in a variety of aircraft.

General Gould is also a graduate of the Advanced Executive Program, Kellogg Graduate School of Management, Northwestern University, Evanston, Illinois; National and International Security Management course, John F. Kennedy School of Government, Harvard University, Cambridge, Massachusetts; as well as a graduate of Squadron Officer School, Air Command and Staff College, and National War College.

Taking Force Development Into Orbit ... It's Not About You!

Maj Gen Anthony F. Przybyslawski
Commander, Air Force Personnel Center
Randolph AFB, Texas

The price of failure in fighting our nation's wars is too high to leave leadership development to chance. Therefore, the American people demand we produce expeditionary leaders fluent in the domains of air, space and cyberspace who implement our national instruments of power with agility, efficiency and effectiveness in the joint/multinational battle-space. Perhaps our greatest task in fighting and winning the wars of the future is deliberately developing leaders through targeted education, training, experiences, and senior leader mentorship. Tomorrow's leaders must possess the necessary skills to prosecute our national security objectives, yet still be flexible enough to respond to changing requirements.

It's one thing to read a technical order (TO); it is another thing to have faith in it. Faith that your weapons system will work the way it's designed to and that your equipment will keep you safe in combat. That's what all Air Force professionals need, not just faith in our TOs and equipment, but "faith" in our air and space power—your profession. I think General Kevin P. Chilton, former Air Force Space Command (AFSPC) commander, said it best in a speech to the Space and Missile Defense Conference, "We need to continue, and we are focusing on this in AFSPC, to grow space professionals with a warrior ethos, not just a technical ethos, but a warrior ethos, and to take advantage of experiences honed in tactical schools and on the battlefield." The Space Professional Development Program (SPDP), a subset of the larger Air Force's Force Development program, is structured to establish knowledgeable, experienced space professionals skilled in acquiring, launching, and employing space power. SPDP was "cool" long before the rest of the Air Force got into force development! Though not an assignment system, your SPDP sets the benchmark for the Air Force and facilitates effective integration of the space power tenets into the joint warfighting community. As the Air Force refines a systematic process giving present and future leaders a broad perspective of Air Force capabilities, while simultaneously developing individual occupational skills and enduring competencies, we look to the space community to leverage their best practices. SPDP is a methodology and tracking system to articulate requirements and develop required skills within the space community.

We must ensure SPDP integrates seamlessly with Air Force-wide personnel programs. There are several ways we are making this a reality. First, the Headquarters Air Force Manpower, Personnel, and Services and myself are members of the Space Professional Functional Authority Advisory Council to provide coordination within the "Big Air Force" personnel system. Our biggest homework assignment from the council is ensuring that the Space Pro Database capabilities become a part of the new Military Personnel Data System, the Defense Integrated Military Human Resource System (DIMHRS), when it goes operational in the fall of 2008.

In order to accomplish this in a seamless manner we need to get away from spending money on parallel systems. However, we still need to ensure the unique aspects of space professional skill set growth are captured in DIMHRS. A similar example can be found in the rated world where we track flying hours, aircraft type, and experience level such as co-pilot, aircraft commander, or instructor. These types of career-field-specific requirements will roll under one database umbrella, DIMHRS, to provide key data to gain synergies by the senior space development team (DT) leaders and your assignment team to effectively and efficiently cultivate the force.

Both space professional development and Air Force-level force development are concerned with maintaining a sufficient inventory of qualified space professionals to meet joint and Air Force needs. What confronts your DT is often the inherent conflict between producing leaders with the broad perspective of Air Force capabilities, while simultaneously developing individual occupational skills with specific enduring competencies. Shrinking resources coupled with an ever-expanding mission means that tribal mindsets on occasion impede progress. We need to focus on the larger Air Force as a whole and not Air Force Specialty Code (AFSC) specific stove pipes. This means we must ultimately alter the career pyramid to integrate air, space, and cyberspace core competencies. We always must ask the question, "are we meeting the needs of the Air Force?" This is paramount!

In order to function in a leaner, more efficient manner and meet the challenges of our harsh, real-world fiscal realities the Air Force needs to recapitalize, transform and force shape. You may be wondering how we are going to ensure the right mix of skill sets survive after force shaping. Unlike the early 1990s, we are force shaping by AFSC this time around. We are not, however, drilling down and shaping by skill sets within a specialty such as satellite operators vice space launch officers. The trick is to manage this while still securing and growing the proper mix of skill sets balanced among the space and missile operations (13S) community. The good news here is the hard part is behind us. We will not hold a Selective Early Retirement Board or reduction in force in 2008. Your DT and 13S assignment team will have to balance the specific skill sets within the 13S world.

Here's a hint: it is not all about you, it is about what you bring to the fight. We match people to requirements and develop skill sets. We do not have a vacation assignment management system! Your DT is key to ensuring that you are grown with the right skills to meet Air Force requirements. The DT is the "weapons system" of force development. They manage a deliberate, legitimate, visible, fair, and equitable process that is flexible enough to create the credentials Air Force requirements demand. Here at the Air Force Personnel Center (AFPC) your 13S DT meets two to three times a year to steady-state vector officers at key times or trigger points in their career and identify space warriors to attend developmental education (DE) in residence. Like most DTs the 13S chair is a general officer, currently it is Brig Gen Donald Alston. In addition to General Alston, the DT typically consists of senior leaders from Air Staff, AFSPC, the space and missile wings, AFPC, the National Reconnaissance Office, and your training group at Vandenberg AFB, California. Eventually, we hope to move the Vigilant Eagle Squadron Command board, as well as those from other career fields to AFPC. I applaud the space community for de-conflicting command and senior developmental education (SDE). However, most Air Force career fields are saving money and time by lashing up their command boards with their DTs. We realized an annual savings of $126,000 in temporary duty funds alone by hosting boards in conjunction with DT meetings, while also reducing time away from primary duty.

I would like to highlight a few key things about DTs as both general guidance to officers and specifically to our space warriors. Another hint: it is tantamount that officers update their development plans at least annually if not more frequently. This is not just about officers though, our civilian Airmen also need to keep their career briefings current. These are your primary communication tools to both your assignments team and to your DT. Furthermore, development plans inconsistent with 3849s (the form you fill out indicting your preferences for and desire to attend DE in residence) or a statement of intent for command send mixed signals to the DT. The new Airmen Development Plan (ADP) will help with this by combining the Officer Development Plan with the 3849 in one virtual area. However, it is still incumbent upon you and your commander to ensure your forms are in sync. Regardless of new Web-based technologies, force development is a program that requires your participation. It's voluntary and from where I sit, it's okay if you do not want to participate. There's a place for everyone and the Air Force's needs are great. Be honest with yourself, your boss, and do not volunteer to compete for any position because you think you have to.

We have streamlined the way we work these development plans, statements of intent, and 3849s. ADP is the next generation software application that supports force development processes for the Total Force–officer, enlisted, civilian, guard, and reserve. Currently, the first phase of ADP services Air Force active-duty officers. Subsequent phases of ADP will replace the Transitional Civilian Development Plan, Web-based 3849 for Intermediate DE and SDE opportunities, as well as the DT member's scoring and vectoring tool. The beauty of this new system is that instead of filling out separate forms to list your assignment preferences or to compete for DE and command, you will have one-stop shopping in one virtual location. There are other benefits; for instance, commanders will be able to access the electronic records at their desk for all of the Airmen they supervise. No more keeping your executive officer late to print off copies of records. This tool will provide consistencies in the force developmental process and will give the members, senior raters and career field managers an easier program to articulate and match career goals with mission requirements. This new capability will also allow Airmen and their senior leaders to better communicate career desires and close the feedback loop between the individual, senior rater and developmental team. The best time to update your development plan is right after or in conjunction with your annual mid-term feedback and review.

Similarly, I can't emphasize enough the criticality of school "candidates" finishing DE by correspondence when eligible. Allow me to explain a little further. As part of your major's and lieutenant colonel's promotion boards, those selected for promotion are then broken out into two categories depending on how their record racked and stacked during the board. School "selects" are guaranteed to go to developmental education (DE) in residence during their eligibility window, while "candidates" have to compete to go to school in residence via the DT process. For IDE, 20 percent of those promoted are school selects, while for SDE the number is roughly 15 percent.

When your DT determines who to send to DE in residence they have to juggle your timing or school look with seat allocations, strength of record, time on station, and so forth. Your career is not over because you are not a DE select! We have a high percentage of candidates who will attend DE in residence. Air Force wide, 58 percent of those who went to IDE in residence were candidates this summer. For 13S the rate of candidates going to IDE in residence can range from 50 percent to more than 60 percent depending on the year. We also have, in recent years, been awarding in-residence credit in some circumstances to Airmen attending an IDE equivalent program such as Naval Post Graduate School or AFIT as major selects or majors. The DT can grant this in-residence credit to those majors and major selects in this scenario who score well enough at the DT, assuming they go on to finish their ACSC correspondence classes.

Make no mistake though, candidates who fail to complete their DE by correspondence are, in all likelihood, removing themselves from any chance of attending school in residence! Even for school selects, it can't hurt to have your DE completed by correspondence. Operational deferments occur to meet Air Force needs. At the end of the day when the DT looks at who gets to go to school in residence it is your accomplishments and performance that count. Having ACSC or AWC done by correspondence is an accomplishment. My advice to you, get it done.

Similarly, an important change coming down the pike in calendar year 2008 is that master's degrees will be visible to all promotion boards. Those eligible are highly encouraged to complete degrees before their perspective board or risk self elimination. I realize that the Air Force has frequently changed this policy over the years. The wheel turns due to different requirements, different leaders and different manpower scenarios. Another hint: quit procrastinating. Get it done to improve your position in the "next life".

Another exciting career broadening opportunity is the International Affairs Specialist (IAS) program. The Air Force is in the midst of developing a core of officers with foreign language skills and cultural comprehension. Officers are competitively selected for IAS development by their DTs at mid-career (typically seven to 12 years commissioned service). There are two programs under the IAS umbrella. The first is the Pol-Mil Affairs Strategist or PAS. This is a one shot, out-and-back career broadening opportunity to gain international political-military affairs experience and is tied to DE. The 13S career field has one of the highest quotas in the Air Force for PAS through DE programs. Officers who have been all operations until now and need to do a staff tour should consider PAS via the DE program based on careful consideration and mentoring with their commanders. The other IAS option is the Regional Affairs Strategist or RAS. Formerly known as the Foreign Area Officer program, RAS will have officers alternating assignments between RAS and their core career field. Interested officers should indicate their interest (and have commanders add to your comments) on the development plan. You also need to take the Defense Language Aptitude Battery Test and make sure that score shows up on your career SURF.

Space professional development is not just about growing space warriors to guard our freedom. We also need to teach and develop the rest of the Air Force about the importance of your business and what space and missiles bring to the fight in air, space, and cyberspace operations. We fight in three domains, and it is not enough to simply understand how airpower puts bombs on target. The wars in Iraq and Afghanistan are in many ways expeditionary combat support (ECS) wars for the Air Force, where security forces and convoy drivers are in the most dangerous jobs. Our future leaders need to appreciate the non-kinetic and asymmetric ways we and our enemies will fight to include air mobility, special operations, ECS and space. Space is the highest ground. Our space dominance and technological advantages that we leverage through space define victory. More importantly, we need to be able to anticipate the Air Force tenets of air and space power in all venues.

We are creating air, space, and cyberspace warriors who can take their skills to the peak of success and operate seamlessly through the tactical, operational, and strategic levels of war anytime, anywhere on the globe. SPDP and Air Force-level force development are working in concert today to create the greatest future leaders the Air Force has seen. Nuclear deterrence, space launch and control, space warning, acquiring, and developing space systems—your missions are the backbone of our national security now and into the future. Here at AFPC we like to think we are the guardians of our most cherished weapons system—our people. Developing tomorrow's space warriors and leaders is crucial because the Global War on Terror demands we have the brightest, most skilled and capable leaders to lead our Airmen to victory in this conflict. I encourage your participation.

Maj Gen Anthony F. Przybyslawski (BS, Mathematics, US Air Force Academy, Colorado Springs; MS, Systems Management, University of Southern California) is commander, Air Force Personnel Center, Randolph AFB, Texas. The center's primary focus is to ensure field commanders at bases around the globe have the right number of skilled people in the proper grades and specialties to complete their Air Force missions. AFPC consists of about 2,200 Air Force military, civilian, and contractor personnel responsible for developing personnel programs, implementing personnel policies, and conducting personnel operations for almost 500,000 Air Force military and civilians worldwide. The center manages the Air Expeditionary Force schedule and tracks the execution of delivering versatile air and space power to combatant commanders worldwide. AFPC implements comprehensive policies covering all aspects of the personnel life cycle for military and civilian people, to include accessions, education and training, assignments and deployments, promotions and evaluations, and retirements and separations. Additionally, the center provides support for readiness and contingency operations worldwide.

General Przybyslawski graduated from the US Air Force Academy in 1976. His assignments include squadron, group and wing commands in B-52, B-1B and B-2 operations. He commanded the 28th Bomb Wing when the B-1B was first employed in combat during Operation Desert Fox in Southwest Asia, and then in Operation Allied Force in the Balkans. Under his leadership, the B-2 bombers from the 509th Bomb Wing were the first to strike targets in Afghanistan on record breaking 40-hour combat sorties during the first days of Operation Enduring Freedom.

General Przybyslawski is a command pilot with more than 3,800 flying hours, primarily in bomber aircraft. He has held staff assignments at the major command, Air Staff and Department of Defense levels.

The General is a graduate of Squadron Officer School, Maxwell AFB, Alabama; Air Command and Staff College, by correspondence; Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, DC; Columbia Senior Executive Program, Columbia Business School, Columbia University, New York; Program for Senior Managers in Government, John F. Kennedy School of Government, Harvard University, Cambridge, Massachusetts; and participated in the Air Force Enterprise Leadership Seminar, University of North Carolina at Chapel Hill.

General Przybyslawski's additional achievements include: 2002, Honorary Doctorate of Laws, Central Missouri State University; 2006, US Air Force Academy Prep School Hall of Fame; US Air Force Academy Class of 2007 Exemplar.

NSSI Chancellor End of Tour Report

Maj Gen Erika C. Steuterman
former Chancellor, National Security Space Institute
AFSPC, Peterson AFB, Colorado

Although it is only celebrating its third anniversary, the National Security Space Institute (NSSI), the Department of Defense (DoD) center of excellence for space education and training, has matured considerably and made a huge impact on national security space since it stood up in October 2004. The NSSI was the vision of General Lance W. Lord, USAF, retired, former commander, Air Force Space Command (AFSPC), and came about as a direct result of the 2001 Space Commission Report. That report, very simply, concluded that the DoD must create and sustain a cadre of military and civilian space professionals. General Lord accepted that challenge, and the NSSI took on the huge responsibility of educating and developing our current and future space leaders and cadre. General Lord knew that our nation not only needed it, but demanded it. The NSSI has succeeded beyond all expectations!

When named chancellor of the NSSI in July 2005, I had a great deal of experience at a tier-one university in the administration of executive master of business administration (MBA) programs, but absolutely no space education experience. But I used ATMs, electronic banking, pay-at-the-pump gas stations, and owned a small family farm that used precision farming. In my other life as a reserve intelligence officer, I used and benefited from space assets and products many times a day, but, again, I didn't know, or frankly care, how I received those products—I just assumed they would always be there, and they were. That's both a blessing and a curse. It's a blessing because space professionals are doing their job so well that the military and civilian users do not recognize or understand the complexity behind making it all work perfectly. It's a curse when you're trying to explain to Congress what space assets bring to the fight and why you need more/better/different assets and funding. What space professionals provide to the joint warfighter and our civilian population is essentially invisible to those who aren't steeped in national security space.

So, in reality, the NSSI had a two-fold job: firstly, to educate and train our space professionals, which comes directly from the Space Commission Report, and secondly, to educate our senior leaders—regardless of their service, component, or functional expertise—on what space brings to the fight. Hence, in addition to our regular offerings, the NSSI does a great deal of outreach to Congress, our sister services, governmental agencies, and coalition partners using resident and mobile courses, both long and short, standard or tailored for each audience. Although not mandated by the Space Commission Report, all variations of the Space Operations courses are vital to building a strong space cadre and enhancing space effects throughout the spectrum of conflict and national interests.

Equally important is the premise that, once educated and trained, there must be a defined career progression for space professionals in order to leverage their expertise, retain them and provide unsurpassed support to the joint warfighter and our coalition partners. This is being superbly managed by the Space Professional Management Office and the process is being refined every day.

But, back to the NSSI. The first thing I noticed when I came to the NSSI was that the students were primarily Air Force. That's very understandable since 92 percent of the space cadre resides in the Air Force. But from my civilian experience at Purdue University, I recognized that diversity in the classroom, both with students and instructors, is extremely important. We are not a degree-granting institution, and we do not benefit from national and international rankings as experienced at Purdue. NSSI's credibility within the DoD is based on having the best instructors resident at the NSSI—and we do. Our instructors have a wide breath of experience coming from all services and different specialty areas from space to flying to command and control. We also have incredible depth through specialists in the form of adjunct instructors and liaison officers from the National Reconnaissance Office, NASA and Defense Acquisition University.

As space warriors, we should train as we fight, and we fight in a joint and coalition environment. To me, that meant we needed to increase the diversity in the classroom to include not only our sister services, but also our coalition partners. We're proud to say that in June 2007, four Royal Australian Air Force officers attended the Space Fundamentals course, providing a unique opportunity for the US and Australia to learn and share together. In July 2007, an air commodore from the Royal Air Force attended the Space Operations Executive Level course in addition to an Royal Australian Air Force representative. NSSI is known and sought out internationally, as evidenced by the advent of Australian and United Kingdom participation in our courses, and many more countries are seeking admission to our many courses.

Another interesting fact—all Army space professionals, space operations officers/FA40s, complete their first four weeks of their 11-week training at the NSSI by completing Space 200. All the above initiatives ensure that the training and education received at the NSSI will keep our coalition strong and improve support to the warfighter.

But not everyone can attend courses at the NSSI and this has been a big challenge to educating the entire space professional force. Some space professionals are reservists or guardsmen who aren't able to take the requisite three or four weeks off from their full-time positions to take the credentialing courses—Space 200 and Space 300. In order to make education and training available to all components, the NSSI, under the superb leadership of Col David Jones, NSSI commandant, has leveraged the strengths of our Reserve Associate Unit, the Reserve National Security Space Institute, commanded by Col Sue Rhodes, for developing a distance learning version of Space 200. It's conducted in two phases: phase one with approximately two weeks of learning via our Web site, and phase two with two weeks in residence at the NSSI. Although learning at a distance is very effective, nothing can take the place of two weeks of being in a classroom with give and take among students and instructors. Students learn as much from each other as they do from the experts at the podium. It's an important part of the learning process that should never been taken for granted or eliminated. It's also a networking opportunity that works across all services and our coalition partners—one that could be extremely valuable months or years down the road.

An additional challenge for the NSSI is providing our space professionals the opportunity and, most importantly, the desire to earn a master's degree in a space-related technical subject. The establishment of the Space Education Consortium (SEC) is going to make that possible regardless of where the individual lives. Led by the University of Colorado at Colorado Springs (UCCS), the SEC is composed of 12 member universities and institutions within the United States and France, and has a close association with the Air Force Institute of Technology and the Naval Postgraduate School. Established in July 2004, the SEC is focused on education, research, and cooperation to support development of space professionals and enhance space systems design, development, operation, and application. It's a huge task but AFSPC is giving the SEC its full support by currently funding 20 AFSPC students to attend UCCS' distance learning Space Certificate program, a series of five courses that, once completed in August 2008, will be the equivalent of approximately half of a master of engineering in Space Systems, Engineering Management, Space Operations, or MBA with a space emphasis. After the certificate is complete, students may finish their master's degree at UCCS or at any one of the SEC-member universities via distance learning. Articulation agreements, or the ability to transfer course credits among SEC-member schools, are still being worked out, but the goal to be able to complete a space-related technical master's degree wherever one lives will soon be realized.

As for the future, I envision a rotational industry chair at the NSSI, perhaps managed by the National Defense Industrial Association, in concert with the NSSI commandant, to bring a closer alliance and sharing of ideas. We are examining a legal means for industry to make donations to support the NSSI's research and ability to better support the warfighter, but much research needs to be done to see how this can be accomplished. Space education and training needs to be available to space professionals outside our traditional coalition partners and the NSSI is well-placed to do that kind of outreach. Most importantly, NSSI needs to be viewed within the DoD and inclusive national security space community, as the "go-to" place to get answers for all space-related questions. We are recognized for our quality of teaching and instructors, our diverse faculty and students, and eventually, we hope, our state-of-the-art building. Oddly enough, we are recognized more among our coalition partners than within the DoD, but we're working on that! The next step is to be recognized as the place to go for future thinking, for brainstorming, and deciding where vulnerabilities lie for national security space and what we can do to protect our great nation and support our warfighters. Right now NSSI is working hard to fine tune throughput for Space 200 and Space 300, develop additional advanced courses, increase the numbers and scope of mobile training teams for the greatest outreach, and remain a nimble, exceedingly efficient organization in the face of increased responsibilities and dwindling budgets. Ultimately, however, we need to use the vast expertise and experience of our instructors, and students to some extent, to take charge of the "white board," and set the path for the future of national security space. That is when the NSSI will truly soar.

Although I started this article as the chancellor, it was recently announced that I will be reassigned as the Mobilization Assistant to the Deputy Chief of Staff, Intelligence, Surveillance and Reconnaissance in November 2007. I have greatly enjoyed the opportunity to serve as the first, and possibly, last chancellor of the NSSI and work with the premier space professionals in the world. It's been a wonderful educational experience for me and I hope to carry that new knowledge and understanding into my Air Staff position. Space and intelligence are inextricably linked and now that intelligence professionals is part of the space community, the time spent at AFSPC is even more valuable. I would like to end by sending my sincere thanks to Colonel Jones, instructors, and staff at the NSSI for a wonderful two years. I am very proud of what we have done collectively and know the organization will continue to grow in scope and importance to national security space. Keep up the good work!

Maj Gen Erika C. Steuterman (BA, Purdue University, Indiana; MS, Management, Purdue University) is chancellor, National Security Space Institute and mobilization assistant to the vice commander, Air Force Space Command, Peterson AFB, Colorado.

General Steuterman's early assignments as an intelligence officer were to the Strategic Air Command's 7th Bombardment Wing at Carswell AFB, Texas, and then, as a reservist, to Headquarters, 8th Air Force Exploitation Division at Barksdale AFB, Lousiana. She was then assigned for five years to the Defense Intelligence Agency as a reserve air attaché. After serving for two years as the individual mobilization augmentee to the commandant, Squadron Officer School, she was assigned as the individual mobilization augmentee to the deputy political advisor at Headquarters (HQ), United States European Command (EUCOM), Stuttgart-Vaihingen, Germany, and individual mobilization augmentee to the commander, HQ, Air Force Officer and Accession Training Schools at Maxwell AFB, Alabama.

Prior to assuming her current position, General Steuterman was the mobilization assistant to the director, National Security Agency and the director of Intelligence at HQ, United States EUCOM, Stuttgart, Germany.

General Steuterman is a veteran of Operations Desert Storm/Shield and Allied Force and served as director, Information Operations Coordination Element while supporting the Air Force component commander at Al Udeid Air Base, Qatar.

In Search of a Space Culture

Maj Gen Richard E. Webber
Director of Mission Support
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Culture … one of those words everyone understands, but few can really define. A strong culture can be a driving force within organizations and functional groups, but *developing* and nurturing a culture where none exists can be a considerable challenge. Building a culture is a slow, iterative process—it can be enhanced but not effectively accelerated. Perhaps no one understands this better than space professionals.

Over the years, the idea of a space culture has proven elusive—due to a number of variables that somehow keep a full-fledged cultural identity from forming among those associated with space. Rapid organizational growth and change, the multitude of space missions, conflicting career guidance, and the addition of new missions and systems have all contributed to a cultural identity crisis within the space community. But slowly, consistently, a common identity is emerging. We need to move from a community focused on a widget in space to one that owns our combat effects down to our air, land, and sea weapons systems.

The Space Commission recognized the need in 2001 when they called for creation of "… a stronger military space culture, through focused career development, education, and training, within which the space leaders for the future can be developed."[1] This is a critical step in building the space professionals the nation needs. *Webster's Dictionary* defines culture as "… the ideas, customs, skills, arts, and so forth, of a … group, that are transferred, communicated, or passed along …"[2] The sense of culture grows out of shared experiences and values and manifests itself as a feeling of "community" among its members.

Within the Air Force, the rated community is the most commonly cited example of a cultural group, yet this culture is the result of 100 years of evolution and consists of various subsets as well as an all-encompassing "stick and rudder" identity. Subtle changes in the rated culture have occurred over time and continue today—impacted by new missions, new (and aging) airframes, personnel changes and a host of other variables. Nevertheless, the commonality of education, training, career development, and shared experiences within the rated community sustains the rated culture. Conversely, the diversity of space missions and lack of a common experiential baseline contributed over the years to diverse backgrounds and perceptions that resulted in a lack of common identity. Common space customs are not readily apparent. Too often space is perceived, and treated, like a functional support specialty rather than a composite group of people and missions sharing a common purpose, with similar skills and values.

Space Professional Development

Since the Space Commission's observations, the Air Force has worked hard to improve development of its space personnel, and as this initiative nears the end of its fifth year, those efforts are beginning to bear fruit. The Space Professional Development Program (SPDP), crafted under the leadership of former Air Force Space Command commander (AFSPC/CC) General Lance W. Lord, retired, and fine-tuned by General Kevin P. Chilton, provides the common *framework* of career development, education, and training called for by the Commission. This approach underscores a recent observation by the Independent Strategic Assessment Group (ISAG) that our space warriors are first and foremost "Airmen" who need to know how to produce and integrate air and space combat effects. In addition, the ISAG found that the space career field is "… more than a 'system,' 'technical,' or 'functional' specialty, but it is also operational … mission-oriented … requiring system knowledge, proficiency, technical expertise, interface with other operational domains …"[3] SPDP offers those directly involved in the fielding, launching, and employing space power a group identity—the space professional community—and consolidates education, training, and experience credentials in a certification program that directly relates to an individual's skill sets. The space badge is simply a visual representation of those skill sets, coinciding with the space professional's certification level. The badge tells others what level they've achieved, but space professionals must answer the questions, "who are we; what do we contribute to national security?" Until the space professional community internalizes the concept of "we" in the context of warfighting, the space culture development will be painstakingly slow.

Career Management

As highlighted by the Space Commission, career development is a key element in building a military culture. The SPDP construct provides several avenues to enhance culture development. Accurate identification of space professionals and their unique qualifications provides immediate and detailed insight into the composition and characteristics of the space professional community—defining it as a special, focused entity. At the same time, exact documentation of space position require-

We need to move from a community focused on a widget in space to one that owns our combat effects down to our air, land, and sea weapons systems.

Skilled leaders reinforce unit pride and a sense of belonging—not only to the unit, but to a broader community of professionals.

ments communicates the breadth of the space mission and enables better person-position matches that improve mission effectiveness and improves job satisfaction. Better identification of individual skills and better requirements definition leads to better vectors from the development teams and timely action by assignment teams. Better matches mean better performance, which produces better leaders. Skilled leaders reinforce unit pride and a sense of belonging—not only to the unit, but to a broader community of professionals. We need to be demanding customers of our Air Education and Training Command basic and functional development courses and processes.

SPDP database tools and Space Professional Experience Codes (SPEC) can quickly provide a snapshot of all or any segment of the space professional community,[4] highlighting its strengths and weaknesses, defining its boundaries, and communicating its distinctive characteristics. In a broader context, these tools illustrate the relationships between space missions, providing a "big picture" of total space personnel capabilities. SPDP's integrated approach to identifying and tracking space expertise and requirements creates a common identity across all the Air Force Specialty Codes that comprise the space professional community: operators, scientists, engineers, program managers, intelligence specialists, and communicators.[5] Increased use of SPDP and its tools by the Air Force Personnel Center (AFPC) teams will further enhance the person-position match. For example, AFPC's new approach using prerequisite SPECs to accurately match enlisted operators with position requirements avoids mismatches of expertise that often occurred using only an individual's time on station as a reference.[6]

The Air Force - National Reconnaissance Office Statement of Intent (June 2006) also introduced a new dimension in career management of space professionals. The integration of personnel management, operations processes, and key leadership positions between the two organizations enhanced their support to joint warfighting and intelligence users. Most importantly, this agreement focused leadership attention on the utilization of space professionals within each organization, seeking a balance of manning and experience levels between the two, development of a larger resource of operations and acquisition experienced officers and a greater appreciation of the strengths and systems of both. This combination merged two previously unique but separate segments of the Air Force space mission and strengthened the space culture.

A significant change to the utilization of a specialized subset of the space professional community will positively reinforce space culture development through better unit-level mission capability. In January 2007, General Chilton directed a revision to the established practice of assigning Weapons School graduates, emphasizing the benefits of returning an officer to his/her unit who becomes "… the tactics, techniques, and procedures person in the squadron, becomes the go-to guy for the squadron commander when it's exercise time, becomes the person every lieutenant looks up to …"[7] Underscoring the importance of this revision, General Chilton noted that "… the fight is going to migrate to the Space Operations Squadron (SOPS) … we're going to need people in the SOPS who are thinking about fighting their weapons systems."[8] These young "whiskey" graduates will become our "train-the-trainer" experts—the seed corn that will ultimately raise the level of the entire crew force. By putting space warfighters in front of vulnerabilities, in front of the threat will ensure prompt delivery of space capability when needed downrange. This builds culture!

Space Education

Another aspect of SPDP addresses the Space Commission's call for enhanced, career-long education—a critical aspect of space culture. The shared skills of the space professional community help define it as a separate domain. Enhancing those skills not only improves mission effectiveness but reinforces the sense of community. One of the first questions when considering a specialty for addition to the space professional community is, "Does your job require knowledge of space?" A broad, consistent exposure to baseline space fundamentals—doctrine, technology, system capabilities, principles—are the basis of the milestone courses in SPDP Certification: Space 100, 200, and 300. Together, these courses provide invaluable knowledge of the fundamentals, application and integration of space in the national security arena. The near term expansion of Space 100 to increase content and depth will expand space professionals' knowledge baseline, ensuring better understanding of space effects and an increased ability to communicate this capability to the greater Air Force. This is not unlike the cultural foundation of air provided through our Undergraduate Pilot Training curriculum. Continual refinement of all three courses ensures constructive linkage of the curricula to guarantee the career-long element of space education is effective.

The National Security Space Institute (NSSI) enhances depth of knowledge through focused advanced courses (AC) that develop mission area experts to effectively manage operation and acquisition of specific systems. Two programs are complete, three are in development. The Missile Warning and Defense AC takes students from concepts and principles to advanced application and employment, including strategy, doctrine, tactics, execution, and theater applications. The Navigation Operations AC provides similar content for operators and acquirees associated with precision, navigation, and timing. In response to AFSPC/CC direction and mission need, ACs in advanced orbital mechanics and satellite communications will be ready in the summer of 2008, and the NSSI is working with 20th Air Force to provide an AC focused on nuclear operations.

Developmental and professional military education are two additional areas that can provide space education to space professionals, as well as to other Air Force personnel and members of the other services. The Space Commission noted that, within this aspect of military education, "… the core curriculum does not stress, at the appropriate levels, the tactical, operational, or strategic application of space systems to combat operations."[9] Unfortunately, this is generally as true today as when the Space Commission completed its report, so this is an area that deserves the attention of the space professional community. Accurate representation of space capabilities, especially in the context of joint warfighting, is critical to a full understanding of Air Force capabilities by all personnel, and sends the right signal across the Air Force and DoD on the importance of space. AFSPC has underscored the need for improvements in this area, and a dialogue with the appropriate schools has begun.

Space Training

Training completes the package of experiences that help build the space culture. Formal positional training is a fundamental part of the development for almost all space professionals, and combines with the Space 100, 200, 300 continuum of education to develop a composite set of skills that define the community. Specialized training adds depth and increases individual skill sets, advancing cultural development. The Weapons School contributes to the space culture, especially with the new "W" assignment policies. Several NSSI courses have a unique niche in culture development, most notably the director of space forces (DIRSPACEFOR) and Space in the Air and Space Operations Center Courses (SAOCC). The DIRSPACEFOR course is critical to preparation of space officers for Air and Space Expeditionary Force deployment, focusing on air and space center (AOC) operations, classified space capabilities, and doctrine. This course draws heavily on the experiences of former DIRSPACEFORs and therefore represents a compilation of lessons learned and real world warfighting experiences that strengthen the knowledge, understanding, and appreciation of the entire community. DIRSPACEFORs are frequent speakers at conferences, symposia, and Air University programs. SAOOC provides similar training as DIRSPACEFOR to space professionals at lower grades. In addition to AOC operations and classified space capabilities, SAOCC covers AOC checklists and hands-on training on applicable theater space tools.

Conclusion

Space professional development is a new concept—barely five years old. In spite of that, it attracts attention across the Air Force, the DoD, and government, and has become the cornerstone for development of a space culture. Its systematic approach to career management, education, and training will provide a sound professional foundation and increase the cultural focus on space as an integral part of the Air Force mission.

Notes:

1 *Report of the Commission to Assess United States National Security Space Management and Organization*, executive summary (Washington DC: US Government Printing Office, 2001).

2 Michael Agnes, ed., *Webster's New World College Dictionary*, 4th ed., (International Data Group Books Worldwide, Inc., 2000).

3 Independent Strategic Assessment Group, Personnel and Training Task Force, Space Officer Development, briefing, 29 January 2007.

4 A Space Professional Experience Code (SPEC) consists of three characters that categorize specific space experience. The first character defines the general category of work—acquisition (A), operations (O), or staff (S). The second character is linked to one of ten space mission categories. The third character is an experience identifier that provides added detail of the specialty in the mission area.

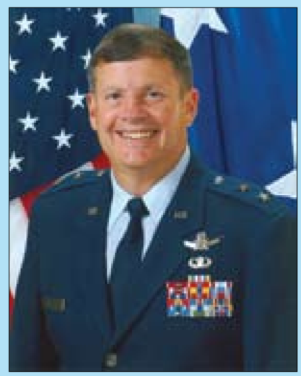
5 Full incorporation of intelligence and communications is projected for October 2007. Additional specialties identified for addition to the space professional community include weather and missile maintenance.

6 Prerequisite SPECs identify the experience requirements for selection to a space position. AFPC has agreed to incorporate prerequisite SPECs into the selection criteria for enlisted operators (1C6), thereby avoiding mismatches in experience and billet requirements by selecting 1C6 personnel solely based on time on station.

7 General Kevin P. Chilton, Space Warfare Symposium, remarks, Keystone, Colorado, 19 June 2007.

8 Ibid.

9 *Report of the Commission to Assess United States National Security Space Management and Organization.*



Maj Gen Richard E. Webber (BS, Management, US Air Force Academy, Colorado Springs, Colorado; MBA, Business Administration and Personnel Management, University of Missouri, Columbia; MA, National Security and Strategic Studies, College of Command and Staff, Naval War College, Newport, Rhode Island) is director of Installations and Mission Support, Headquarters Air Force Space Command, Peterson AFB, Colorado. General Webber directs a multidisciplined staff of approximately 250 people and advises the commander on all matters relating to civil engineering, security forces, and contracting support.

General Webber was commissioned a second lieutenant upon graduation from the US Air Force Academy in 1975. He has commanded a missile squadron, support group, missile operations group, and missile wing equivalent and two space wings. His staff assignments include Headquarters North Atlantic Treaty Organization International Military Staff, the Air Staff, Headquarters Strategic Air Command, Headquarters Air Force Space Command, and vice commander of the Aerospace Command and Control and Intelligence, Surveillance, and Reconnaissance Center. General Webber is a command space and missile operator with qualifications in the Minuteman II, Minuteman III, Global Positioning Satellite and Counter Communications System weapon systems. Prior to his current assignment, he served as commander, 21st Space Wing at Peterson AFB.

General Webber is a graduate of Squadron Officer School, Maxwell AFB, Alabama; Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, DC, Program for Executives, Carnegie-Mellon University, Pittsburgh, Pennsylvania; LOG-TECH Executive Education, University of North Carolina; and a distinguished graduate, College of Command and Staff, Naval War College, Newport, Rhode Island.

People—The Essential Ingredient in Mission Success

Dr. William F. Ballhaus, Jr.
President and CEO, The Aerospace Corporation

Well trained, experienced, and motivated people who accept accountability for outcomes to which they have committed are the key to any successful enterprise.

This is especially the case in the development of new national security space systems because space is a "one-strike-and-you're-out" business. Space assets are typically at the limits of our technological capability and they operate in a very harsh environment. A single engineering or workmanship error can result in a multi-billion-dollar failure. Once in space, operational involvement is limited to remote interaction and operational recovery from problems often depends on thoughtful engineering of alternatives before launch.

The government has a number of key roles in the development of new space systems, all of which require trained, experienced, and motivated people who are accountable and have the resources and authority to execute a program.

Some of the government's key roles and accountabilities are:

1. Defining what it is buying (system requirements), along with appropriate value-trades;
2. Setting and managing the acceptable level of program risk to ensure mission success and program executability;
3. Providing agreed-upon financial resources in a timely manner and managing financial reserves appropriate to the level of program risk;
4. Assessing contractor performance and setting proper incentives;
5. Taking accountability for the work of contractors and their supply chain and ensuring that contractors use validated processes that produce predictable results.

Skill and experience are required on the part of the government program team to ensure that the contractor's interest in growing shareholder value is consistent with the government's interest in mission success.

This article focuses on the needs of the government space professional community regarding workforce skills and capabilities, especially with respect to space system development. It looks specifically at workforce findings and recommendations from the 2003 Defense Science Board/Air Force Scientific Advisory Board (DSB/AFSAB) study of poor space program execution led by Mr. A. Thomas Young, the former president of Martin Marietta Corporation who has led a number of government and industry studies on space system failures and development problems.[1] Here, the progress made in implementing the study's recommendations and some thoughts on the way ahead are provided. The perspectives offered are based on my having served on the study, and also on my nearly 40 years in the aerospace business, especially the last seven as head of The Aerospace Corporation working daily on national security space issues.

One key finding of the DSB/AFSAB study was that "government capabilities to lead and manage the acquisition process have seriously eroded." The study pointed out that the unique responsibilities of the government require a highly competent, properly staffed workforce with authority commensurate with responsibilities. Study participants observed that during the 1990s, reductions in government personnel, cutbacks in systems developments, and changes in acquisition policies that resulted in the use of unproven strategies and practices caused the experienced acquisition workforce to atrophy. A poor work environment, limited career opportunities, lack of appropriate authority, and poor incentives resulted in capable people leaving the government space acquisition workforce and inadequate recruitment and development of technically educated acquisition and operations officers. By 2002 the result—as indicated by the Young Panel—was "too many inexperienced individuals and too few seasoned professionals."

The study recommended a number of remedial actions, many of which have been implemented. Some of the most challenging recommendations for improving the workforce were these:

1. The commander of Air Force Space Command (AFSPC) should establish a dedicated career field for space operations and acquisition personnel.
2. The undersecretary of the Air Force (USECAF) should require that key program management tours last a minimum of four years.
3. USECAF should develop a robust systems engineering capability to support program initiation and development. Specifically,
   a. Re-establish an organic government systems engineering capability by selecting appropriate people from within the government, hiring to acquire needed capabilities, and implementing training programs.
   b. In the near term, ensure full utilization of the combined capabilities of government, Federally Funded Research and Development Centers (FFRDCs), and Systems Engineering and Technical Assistance (SETA) contractors.

Each of the three recommendations is examined below and assessed to determine what has been achieved, and additional remedies are suggested.

Analysis of DSB/AFSAB Recommendation One on the Space Career Field

Intent: The study team recommended the development of trained and experienced space professionals and called for recognition that the space career field is distinctly different from other Air Force career fields (for example, the air operations and intercontinental ballistic missile [ICBM] fields).

Observations: Space acquisition program managers—who actually are space systems developers—must possess business management skills, strong technical backgrounds, and an understanding of operational concepts and employment practices to keep pace with evolving military operational experience and advancing technology. The Air Force has some outstanding acquisition talent, but on average, there is insufficient experience overall given the challenges of managing development of today's complex systems. (Note that of the Air Force's 27 current major defense acquisition programs, 10 are in the Air Force program executive officer for space's (PEO/Space) portfolio.

Space Operations also lacks the level of experienced personnel who were prevalent in the past. In the 1970s and early 1980s, a contractor workforce was used for satellite operations with government leadership at key operational positions. The average experience for the contractor satellite control workforce was 11 years. Today, the satellite operator workforce is military, and this workforce has less than 18 months of experience on average.

General Kevin P. Chilton, former commander of AFSPC, understood the technical needs of his space professional community. In his Vigilant Vector VI document, he commented that (1) the technical requirements for new officers in the space operations career field are increasing, (2) personnel with technical degrees are being encouraged to choose space as a career, with assignments that make immediate use of their academic credentials in a space operations setting, and (3) more opportunities now exist for advanced technical certificates and degrees through the Air Force Institute of Technology, Naval Postgraduate School, and Space Education Consortium.[2]

There has been progress in advancing the space career field, but much remains to be done. First, there is a better balance of rank demographics in place today at the Air Force Space and Missile Systems Center (SMC) compared with the oversupply of lieutenants and undersupply of senior captains and majors that was the norm in the early 2000s. Second, some military-to-civilian conversions have helped retain, in the civilian program management ranks, experienced space acquisition lieutenant colonels and colonels who have retired from active duty. However, a distinct space career field has not been established. There remain two relevant career fields— (1) space and missile operations and (2) acquisition— but the distinction that the study recommended between ICBM operations and space acquisition and operations has not been realized.

SMC has responded to the Young Panel's recommendations regarding the space acquisition career field by:

- Initiating programs to recruit and retain acquisition-certified and space-experienced personnel.
- Increasing workforce competence by improving hiring, assigning "graybeards" to mentor younger personnel, and leveraging the resources of academia.
- Establishing a functional career ladder.
- Retaining personnel through military-to-civilian conversion programs, a robust re-employed annuitant program, and a center retention initiative.

It is too early to determine how completely these initiatives will be implemented and the impact they will have on developing and maintaining the required workforce. SMC has sought to increase experience shortfalls by adding more seasoned officers from other specialties.

Nevertheless, critical workforce issues still exist:

- The size of SMC's workforce is less than its validated manpower requirements.
- SMC's space-experience levels remain inadequate in both the military and civilian workforce, and, for some grades, experience levels are half those at the National Reconnaissance Office.
- The national security space workforce has lost a great many civilian engineers and scientists through retirements and the government does not have adequate organic replacements. This has been partially offset by increased FFRDC and contractor support.
- Even with military-to-civilian conversion, civilian attrition is greater than hiring rates.

Recommendations: The government needs a well-resourced, engineering-based career development program that includes both realistic, experiential training and formal mentoring. Since space is a technically complex and high-consequence business, much could potentially be learned by examining successful training and personnel practices of other high-risk mission areas. For example, manned space flight and nuclear submarines are two areas that face similar personnel career development challenges both in acquisition and operations. Highly skilled and experienced personnel are needed to ensure mission success in these complex, high-consequence mission areas. Training and personnel career management practices employed in manned space flight and nuclear submarines could be studied and best practices instituted to help ensure a continuing pipeline of experienced, technically skilled people for space systems.

Four other actions could be taken to improve the quality of the Air Force space acquisition workforce: (1) initiate either local control on civilian personnel actions or implement a more timely and responsive centralized system, (2) establish higher Air Force priority for military staffing at SMC, (3) establish a civilian grade structure capable of attracting the talent needed for inherently governmental positions that are needed to execute the mission (for example, program management), and (4) although the commander of Air Force Space Command, as the Space Professional Functional Authority, is responsible for managing the career development of space system program managers, system engineers, and operators, the SMC commander should be explicitly designated as the responsible individual, acting on behalf of the AFSPC commander, for space acquisition workforce development.

Analysis of DSB/AFSAB Recommendation Two on Four-Year Tours for Program Managers

Intent: The study team recommended a minimum tour of four years for program managers with a goal of retaining key personnel through major acquisition events.

Observations: Several events have resulted in progress toward the goal of more personnel stability. With war demands and budget pressure, the Air Force has made four-year tours routine. At SMC, space acquisition program managers now stay in place at least three years with the goal being retention through key program decision points. This is up from two-year assignments, which had been the practice. SMC also has outstanding senior program managers—now classified as wing commanders—as a result of a rigorous selection process and the leadership of the SMC Commander, Lt Gen Michael A. Hamel.

Workforce continuity at all levels is extremely important to the space community because increasingly complex space systems need to have reliability, flexibility, and high performance designed in. Workforce continuity provides the basis for developing a "learning" organization—one that continually improves its performance and its ability to manage anomalies while providing vital, consistent support to warfighters. A stable workforce can be held accountable for overall program performance and has better incentives to make strategic, mission-success-driven decisions. A workforce consisting of people on short-term assignments tends to make tactical decisions to meet short-term program milestones at the expense of overall program success. In "pilot-speak," if you are in for the take off, you need to be in for the landing.

Recommendations: Workforce continuity is a crucial factor in successfully fielding space systems, and provides opportunities for people to broaden their base of space experience. The typical communications satellite engineer, for example, will have very limited exposure to a reconnaissance satellite engineer, except in common subsystem levels such as solar panels. Providing opportunities to "cross-flow" into other space planning, acquisition, or operations areas would result in gains in integration and understanding. It is interesting to note that pilots who are qualified in multiple aircraft are viewed as highly trained and knowledgeable professionals. The same kind of broad-based experience also benefits the space career development process. Personnel experience identifiers should be expanded to track and better manage the cadre of experienced space professionals. Unfortunately there is a trend to decrease the number of experience identifiers. Experience identifiers, combined with a space-career-development process that starts at the junior officer level and extends to the most senior space positions, would improve both the experience and motivation of the entire space workforce.

Analysis of DSB/AFSAB Recommendation Three on Systems Engineering

Intent: The study team recommended that the USECAF develop a robust systems engineering capability to support program initiation and development.

Observations: Barriers to strengthening government systems engineering include the lack of qualified government scientists and engineers, the difficulty in recruiting and retaining qualified personnel, and cuts in budgets required to organize, train, and equip personnel.

The government need to attract and retain enough technically educated program managers and engineers is a challenge. In the current environment it doesn't appear that the government will have the required capability for the next-generation workforce. This is a serious concern as much of the space system portfolio is undergoing major recapitalization. Recognizing that it would take a generation to rebuild government systems engineering capabilities, the DSB/AFSAB panel recommended that in the mean time, the government should ensure full use of the combined capabilities of government, FFRDC, and SETA system engineering resources until enough organic capabilities exist.

FFRDCs and SETAs are providing systems engineering skills, but can't replace the government personnel necessary to execute accountabilities and functions that are inherently governmental. FFRDCs can provide workforce continuity and the depth and breadth of science and engineering competence to advise the government and frame technically complex issues for government decision makers. FFRDC and SETA contractors can provide recommendations. But they cannot be placed in government decision-making roles.

Recommendations:

1. Clearly define the system engineering accountabilities across the government, support, and contractor workforce. This is not easy because accountabilities must be tailored to the full life cycle. The proper allocation of systems engineering tasks across the organic government, FFRDC, and SETA workforce, and among the industry team comprising prime contractors, subcontractors, and suppliers, is vital to a program's success.
2. Provide training on government processes, specifications, and standards for members of the space community, including government, support, and contractor personnel. Important processes, specifications, and standards have been defined to ensure quality for high-reliability, high-performance space systems. Tailoring these specifications and standards, and promoting a common understanding of their basis and an understanding of their acceptance criteria, is essential to promoting unity of effort in the workforce. (Note: processes that provide predictable, repeatable results are especially critical for a less-experienced work force.)
3. Provide specific education and training to reinforce the use of government systems engineering plans and contractor systems engineering management plans as "living" documents useful as management tools.
4. Strengthen enterprise system engineering to ensure that the architecture of space systems permits effective integration, not only with other space systems, but also with air and terrestrial systems and the command and control systems.
5. Strengthen the iterative process of requirements definition and engineering feasibility, and design trades in order to define the right system to acquire.

Accountability and Ownership

General Hamel, SMC commander and PEO/Space, is particularly aware that the resources available to him include military, government, civilian, FFRDC, and contractor personnel. For the foreseeable future, he intends to rely heavily on FFRDCs and contractors for technical competence. He has turned to The Aerospace Corporation as the FFRDC for national security space to assist him in ensuring mission success. He does this by holding Aerospace accountable for mission success of launch and satellite systems, and for providing a "heads up" on program execution issues. As I approach retirement from The Aerospace Corporation, I offer some observations here on how we have been striving continuously to increase the value we bring to our national security space customers by driving a culture of accountability and ownership.

Accountability is both organizational and personal, and correlates with value. The value of a person in a position can often be assessed by determining what that person is accountable for and how well he or she meets that accountability.

Organizational accountability is a set of top-level performance expectations that an organization takes on and that "flow down" to individual employees. Individual accountability is especially critical in the "one-strike-and-you're-out" space business. Most space system failures I have seen resulted from someone not doing correctly what we were relying on him or her to do. The individual may have failed to perform because of poor training, insufficient resources, inattention to detail and validated procedures, or a lack of access to channels for making problems known to higher management.

At The Aerospace Corporation over the last six years, we have been driving a culture of accountability that calls for organizations and individuals to change their focus from a "best-efforts" mentality to one of "ownership" of technical issues. This is a result of the SMC commander holding Aerospace management accountable for mission success and for providing a "heads up" on program execution issues. This ownership focus has contributed to SMC's unprecedented record level of mission success in space launch and satellite system performance since 1999.

Since The Aerospace Corporation has a highly educated, experienced, and stable workforce that is collocated with its customers, we have the opportunity to help educate both our workforce and segments of the government workforce. We provide, through The Aerospace Institute, space-related courses for Aerospace employees, which government customers can also attend on a space-available basis. These space and engineering courses represent a culmination of Aerospace's 50 years of space engineering experience, cross-program lessons learned, specifications and standards, and best practices. The courses are eligible for continuous learning credit. Aerospace also makes its extensive corporate library assets available to its government customers to assist in staff development and continuous learning.[3]

Conclusion

Progress in implementing the three DSB/AFSAB study recommendations to improve the space professional workforce has been made:

- Programs to recruit and retain competent employees have been developed.
- The length of military tours has been extended.
- The space acquisition workforce has been supplemented with FFRDC and contractor personnel.

However, shortfalls continue to exist in the areas of acquisition workforce development, government systems engineering competence, and education/training. Committing resources to mitigate the shortfalls is difficult but required to create the skilled workforce that the government needs. The demand for space capabilities in the future will continue to grow, and the space professional workforce will remain the essential ingredient in achieving mission success. Let's make sure that we nurture this indispensable ingredient.

Notes:

[1] Report of the Defense Science Board/Air Force Scientific Advisory Board, "Joint Task Force on Acquisition of National Security Space Programs," Office of the Undersecretary of Defense, May 2003, A. Thomas Young, chairman.

[2] General Kevin P. Chilton, Vigilant Vector VI, AFSPC.

[3] Find out more about the Institute's courses and library resources at www.aero.org/education.

Dr. William F. Ballhaus, Jr. (BS, MS, Mechanical Engineering, PhD, Engineering, UC Berkeley) is president and CEO of The Aerospace Corporation, an independent, nonprofit organization that acts as scientific and technical advisor to the US Air Force and the Department of Defense on space systems.

Dr. Ballhaus joined Aerospace in September 2000 after an 11-year career with Lockheed Martin Corporation, where he was a corporate officer and vice president of Engineering and Technology. Prior to his tenure with Lockheed Martin, Dr. Ballhaus was president of two Martin Marietta businesses, Aero and Naval Systems and Civil Space and Communications. He also was vice president of Martin Marietta's Titan IV Centaur operations.

Before joining Martin Marietta, Dr. Ballhaus was director of NASA Ames Research Center. He also served as acting associate administrator for Aeronautics and Space Technology at NASA Headquarters in Washington, D.C. Earlier at NASA he was director of Astronautics and chief of the Applied Computational Aerodynamics Branch.

He is a member of the Defense Science Board and the National Academy of Engineering and is a past president of the American Institute of Aeronautics and Astronautics.

"We Know Where to Look"

Mr. Dale Bennett
President, Simulation, Training, and Support
Lockheed Martin

Sports columnist Rick Reilly, in a *Sports Illustrated* article titled "Gamers to the End," writes of "five young Americans at the peak of their athletic lives—brave, disciplined, ready to chew through concrete to win the game."[1]

He tells of one young lady and four young men. A volleyball player, a wrestler, the captain of a basketball team, an Olympian and an avid runner. He writes about their tremendous athletic talent. He writes about what they have in common.

The five—an Air Force Airman, an Army captain, an Army specialist, an Army private, and a Marine corporal—were all killed in Iraq during a two-week period in January.

Warfare has never been more demanding on our country, our resources, or our precious youth.

President Ronald W. Reagan once said, *"Those who say that we're in a time when there are no heroes, they just don't know where to look."*[2]

We know where to look.

Mission-focused training can be driven to the unit level, the crew level, and even the positional level.

As training and education professionals, we have the duty to ensure that our Soldiers, Sailors, Airmen, and Marines are equipped with the skills necessary to prevail if ever … and whenever … they are called into combat.

These heroes deserve that we deliver the best. They deserve the highest quality training and mission rehearsal systems that we can deliver. The best—and the focus of this article—includes understanding how to train warfighters and rehearse missions for modern and future warfare, how to plan for a modernized, mission training enterprise, and how to leverage existing and evolving training concepts and technologies.

Delivering this capability begins with understanding what we're asking our men and women to accomplish.

Protect, Prevent, Prevail

The National Military Strategy (NMS) of our country establishes the ways our military will protect the United States against external attacks, prevent conflict and surprise attack, and prevail against adversaries who threaten our homeland, our deployed forces, and our allies and friends.[3]

To meet these objectives, the NMS challenges the services to achieve a state of "full spectrum dominance"—the ability to control any situation and defeat any adversary in the air, on land, at sea, in space, and in cyberspace. Regardless of the domain, there are three common and critical variables necessary for full spectrum dominance. First, superior technology. Second, a clear concept of operations. And third, unrivaled mission readiness.

No one doubts the superiority of our military technology. It is without rival. Likewise, our concept of operations (CONOPs) and Unified Command Plans are continually evolving to meet the changing threat. Mission readiness, though, differs from these first two elements in that it deals with people. Mission readiness … *or people readiness* … is the element that transforms technology and concepts into action. With people totally prepared and available for combat, the full spectrum dominance equation is complete. Without it, mission success is compromised and lives are at risk.

Beyond Platform Training

Warfighters must be superior operators—the best technicians in the world. They must completely understand and be thoroughly proficient operating the complex systems and platforms required to execute their mission. However, today's warfare requires much more.

Operators now require training beyond platform operations to training that addresses full spectrum dominance: end-to-end,

Delivering well-trained troops begins with understanding what we're asking our men and women to accomplish.

sensor-to-shooter mission operations. Soldiers and Airmen must learn to operate with other organizations, other weapon systems and other service branches. They must also learn to operate, react and think in unrehearsed, unexpected, and undocumented situations.

The 2003 Defense Science Board report, *Training for Future Conflict*, refers to the demands of modern warfare:

- Conflicts will all be different and "no plan" contingencies are likely.
- They can arise with little warning. There will be minimal planning, rehearsal, or staging time.
- Conflicts will be fought in unexpected places.
- New technology and tactics will allow us to operate continuously and at a far faster pace than any adversary, but will challenge as often as they will support the warrior.
- Transformed services will force everybody—even the most junior—to think.
- Current training *does not prepare* our individuals or units for the new, dynamic cognitive demands.[4]

Air Force Space Command (AFSPC) will be challenged by these demands as much as any other organization. Space operations supporting theater operations may be "no plan." Contingencies could have little or no warning and may occur at unexpected times or in unexpected places. And during this time of modernizing and recapitalizing space systems, systems operators will definitely employ new technologies and must develop new tactics.

Developing Space Professionals

AFSPC's new mission statement leaves no doubt of the importance of mission-proficient operators.

AFSPC's mission is to deliver trained and ready Airmen with unrivaled space capabilities to defend America.[5]

To achieve the status and reputation of possessing unrivaled capabilities, space operators—and no different than operators in any other domain—require a properly architected training and rehearsal enterprise that will address:

1) An individual's or organization's role in the kill chain.

Training and mission rehearsal must address a unit's role in the context of combined military operations. How does the unit support the kill chain; that is, how does that unit find, fix, track, target, engage, or assess?

Fifth-generation fighter training focuses on air superiority. It focuses on air dominance, developing such superior proficiency as to deter hostile activity and ensuring, if tasked, successful air-to-air engagement. Similarly, AFSPC's operational missions, whether force enhancement, space control, force application, or space support, can be trained and rehearsed in a like manner.

GPS training, for example, from initial qualification training through unit qualification training and integrated exercises, can concentrate on Navigation Warfare (NAVWAR), and how dominant NAVWAR is a critical enabler to those further along the kill chain.

2) The technology provided to execute the role.

Without mastery of the technology, the mission will fail. But training and rehearsal capability must help the operator (and instructor) understand that the weapons system is the tool used to participate in the overall mission of the kill chain … not the mission itself.

3) The organization's sequence in the kill chain, and its ability to communicate and coordinate with other nodes as the mission dictates

Real-time discussions and coordination between nodes in the kill chain further advances operational proficiency. Distributed mission operations and technologies such as high level architecture and the Distributed Mission Operation Center provide organizations with dissimilar roles and platforms the opportunity to train and rehearse together in a networked, synthetic battle space.

Networked, mission-focused training and rehearsal provides immediate feedback to operators. Airmen, Soldiers, Sailors, and Marines at any point in the kill chain and operating any weapon system can in real-time experience and understand the results of their actions on any other part of the chain. A misapplied checklist, a superior tactical decision, or applications of new techniques and procedures will have an immediate, tangible impact on all other players. The end result: *bloodless learning and a steepened learning curve.* Important lessons are learned as part of intense training and mission rehearsal rather than in the turmoil of an actual engagement.

4) Training at all levels of operations

Mission-focused training can be driven to the unit level, the crew level, and even the positional level. With the demand for critical thinking at all levels of operations, space mission training—and particularly mission rehearsal—can be applied to positional operations at the unit, wing command post operations, at the Joint Space Operations Center, and even in-theater for the director of Space Forces. The status of being "unrivaled" can apply to the most junior of operators and to the most senior of decision-makers. Mission training no longer should be re-

Trained space professionals ultimately support tactical air operations and ensure mission success.

Mission training no longer has to be reserved solely for more senior operators selected for specialized programs.

served solely for more senior operators selected for specialized programs.

Planning for Performance

AFSPC's vision for training is very clear:

> "… Space training, education, and exercise capabilities of the future will provide a virtual, global, synthetic battlespace in which space forces, fully integrated with other US and allied forces, will not only train but rehearse missions. Moreover, the synthetic battlespace will permit individual and crew training of our space forces in addition to linking US units to each other and allied forces for integrated live and simulated operations."[6]

This vision lists training, education and exercises together. Though each is different, collectively they form the foundation for "human performance." Human performance simply translates to preparing and supporting the most complicated "machine" known to man—the warrior—to survive and win.

Developing human performance … developing space professionals … through the integration of training, education, and exercises is a complex process requiring deliberate planning, analyses, funding and action—in short an enterprise approach.

The newly formed Space Professional Functional Authority Advisory Council provides oversight of space's human performance development, and has already made significant improvements to education opportunities available to space operators. But training and exercises—both integral components of a human performance development—require equal planning, funding, and action which can now be integrated.

Proven practices are applied in other domains to assist in planning for a modernized training and rehearsal system. Recently, the F-35 Lightning II program completed a comprehensive training needs analysis for all Air Force, Navy, Marine, and Royal Navy pilots and maintainers. Similarly, Air Force Special Operations Command (AFSOC) completed an analysis for the Aircrew Training and Rehearsal Support (ATARS) program. ATARS, which provides AFSOC crews a distributed, fully-networked training and mission rehearsal enterprise, trains six different mission areas, and involves three different fixed-wing platforms and three rotary-wing systems. ATARS addresses policy and procedures for both AFSOC and Air Education and Training Command in a coordinated bi-command approach.

At the foundation of this enterprise, training needs analyses (TNAs) provide recommendations for:

- ***Platform Proficiency.*** The human performance required to best operate the platform: the satellite, tank, submarine, communications terminal, fuel truck, and so forth.
- ***Mission Performance.*** The human performance required to ensure proper execution and success of the mission: to find, fix, track, target, engage, or assess in a joint, collaborative, networked battlespace.
- ***Enterprise Management.*** Policy, processes, requirements, present and future technologies, and funding profiles required within an organization to ensure optimized, modernized training across multiple platforms and missions.

Organizations with complex professional development requirements, changing mission requirements, or resource challenges greatly benefit from an integrated training roadmap. A roadmap provides tangible, actionable steps towards achieving a strategic training vision. It serves as the foundation for all present and future educational programs and training technologies.

A TNA addresses dynamics that could be associated with developing and deploying modernized training concepts and technologies. Training concepts evolve rapidly, training technologies race forward, and missions change. The requirement for near real-time mission rehearsal increases. And as in the F-35 and ATARS examples above, training enterprises can be complex, often crossing major command, service, and even international borders. A training roadmap orchestrates these dynamics, provides an objective master plan, maximizes warrior readiness, and optimizes training resources.

Applying the Proper Media

Training and education occur in a variety of forms and through a variety of media. The selection of the proper forum or technology is best determined by a thorough TNA. Even then, the media selection should be weighed against the user's priorities and constraints.

Training Pyramid.

Priorities might include time to train, realism of the training environment, networked opportunities, and availability of rehearsal partners. Constraints could be the culture, costs, or instructor availability.

Today's college and high school students are completely tuned-in to technology. Using a laptop, an i-Pod, a cell phone or two are not at all technically challenging for the current generation of learners. We are witnessing a generation of Airmen and lieutenants—successful multi-taskers—future warfighters—who will be able to respond to an overflowing river of informa-

The military must train and rehearse missions for modern and future warfare and leverage existing and evolving training concepts and technologies to ensure success.

tion and make split-second decisions.

Likewise, training technology is advancing at light speed. Computer-based training, e-learning, self-paced training, and vastly improved training technologies such as automated courseware development, desktop simulation, electronic classrooms, distributed training, and virtual instructors provide unprecedented capabilities to make training engaging and responsive.

Understanding how generations learn—applying the "science of learning"—and leveraging technology that presently exists in the marketplace is paramount to getting the best performance from warfighters and preparing them for the complexity ahead.

Blended learning acknowledges the need for each type of training media, from low resource computer-based training and gaming to more costly integrated simulations and exercises. All are normally required at some point in the professional development continuum. The objective is to achieve mission readiness in the most cost-effective manner by ensuring a quality training effect using the least costly method.

Conclusion

For AFSPC, ensuring *people readiness* is the cornerstone of space professional development; that is, providing space warfighters totally capable of supporting the NMS. Space professional development is complex and challenging … and exciting. It highlights AFSPC's determination to train its space professionals to fight. Not just to know about the fight, but to engage. To protect. To prevent. To prevail.

Regardless of the platform … regardless of the service component … our Airman, Soldiers, Sailors, and Marines deserve the highest degree of mission readiness. It is our duty to provide them a modernized, mission-focused training and rehearsal enterprise. When mission readiness is married to world-class technology and a clear CONOPS, our military is unbeatable.

Full spectrum dominance.

Heroes.

An Air Force Airman, an Army captain, an Army specialist, an Army private and a Marine corporal.

We know where to look …

Notes:

[1] Rick Reilly, Gamers to the End, *Sports Illustrated*, 12 February 2007, http://sportsillustrated.cnn.com/2007/writers/rick_reilly/02/12/reilly0205/index.html.

[2] President Ronald Reagan, Inaugural Address, 20 January 1981, http://www.bartleby.com/124/pres61.html

[3] The National Military Strategy of the United States, *A Strategy for Today; A Vision for Tomorrow,* 2004, http://www.defenselink.mil/news/Mar2005/d20050318nms.pdf.

[4] Office of the Undersecretary of Defense for Acquisition, Technology and Logistics, Defense Science Board Task Force, *Training for Future Conflicts*, final report, Washington DC, June 2003.

[5] Air Force Space Command Mission Statement, various documents, public domain, http://www.afspc.af.mil.

[6] AFSPC FY06 and Beyond, Mission Support Plan, http://www.wslfweb.org/docs/afspaceplan02/CHAPTER%202%20AFSPC%20VISION.htm.

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Prior to his current position, Mr. Bennett served in a dual role as president of the Integrated Coast Guard Systems joint venture and as vice president/general manager of Lockheed Martin's Coast Guard Systems office. His responsibilities included the Coast Guard's "Deepwater" program to modernize and replace aging ships, aircraft, command and control and logistics systems.

Mr. Bennett's career spans 29 years of service to industry and the military. He joined Lockheed Martin in 1981 as a systems engineer and held many assignments of increasing responsibility within operations, including manager of Systems Engineering, Advanced Programs, and technical director of the Life Cycle Support Facility in Ventura, California. His diverse background also includes experience in business development, strategic planning, operations analysis, Independent Research and Development, and bid and proposal efforts.

In 1975, Bennett enlisted in the US Air Force and received an honorable discharge in 1979. A strong supporter of educational enrichment programs for children, Bennett has served on the Executive Board for Junior Achievement of Central Maryland as well as the Maryland Science Center Board of Directors. He is a member of the US Naval Institute, Navy League of the United States, and American Society of Naval Engineers.

Defining the Space Professional

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At the half century mark, space has truly reached a major point in our nation's history. It has become a critical domain, enabling military operations, global commerce, and civil research around the world. In 50 years, it has grown from a fledgling capability of various systems and programs, to a major government and industry sector with an entire host of applications from communication and weather to scientific research and national defense. While the first half century of space was dominated largely by a sense of urgency to develop and field military space capabilities, the new millennium has shown that the capabilities and space systems we have come to depend so much upon, may now be threatened with the prospect of disruption, denial, and even destruction. As such, the USAF, as the designated Department of Defense (DoD) Executive Agent for Space, must vigorously invest in a long-term human capital and investment strategy geared at developing a cadre of space professionals, that are not only proficient at defining, developing, fielding, and sustaining the military space systems of today, but predicting, assessing, and accounting for potential threats, thereby ensuring adequate protection and assured access of those systems in the future. In a bold step to address this critical need, Air Force Space Command (AFSPC) has developed a Space Professional Development Program (SPDP) with a deliberate focus on growing the *thought leaders* for space, by arming them with the expertise, experience and skill, that will guarantee the preservation of the nation's freedom to access, operate, and eventually traverse this next frontier.

Space capabilities today can be viewed as ubiquitous—enabling and enhancing nearly all aspects of modern day society. From commercial application in banking and automated teller machines, radio, and television, to civil roles such as weather and research, and military defense of the nation, space capabilities are central to our well-being and way of life. It has such a point of criticality, few things can operate without it, and loss of these capabilities would in effect, hamper or even paralyze society. For this very reason, the events of the past year have given pause for those in the space community. International testing of missiles, and anti-satellite technology have highlighted the threat to assuring space capabilities, and clearly announced the fact that space can no longer be viewed as a sanctuary. While the first 50 years of space dealt chiefly in understanding space, and fielding capabilities to enhance our way of life, the next 50 years may very well be spent not only sustaining those capabilities, but protecting our ability to employ and operate those assets. Responsiveness in defining, developing, fielding, and sustaining capabilities in space will also demand a new paradigm and approach. Fortunately, the legacy of the nations space heritage provides a valuable blueprint and starting point in addressing the development of the next regime of space leaders and pioneers.

Sculpture of General Bernard A. Schriever.

While not always termed "space professionals," talented personnel within the greater space enterprise have always been a hallmark of the community. From the early days, space professional pioneers like Dr. Wernher von Braun of NASA and Gen Bernard A. Schriever of the USAF, Western Development Division (WDD), led the research, development, and fielding of capabilities and systems in support of our nation's defense. The launch of Sputnik in 1957 by the Soviet Union, sparked the nations resolve, and led to relentless pursuit as the world's two superpowers raced into this new frontier. The initial cadre of preeminent engineers, scientists, and program managers assembled by General Schriever at the WDD, began managing ICBM and satellites systems development; and provided an incubator for some of the nations greatest ideas for space. The culture that emerged espousing values such as strong leadership, intense mission focus, technical expertise and competence, healthy checks

Space Professionals in Action.

and balances across processes and organizations, personal and organizational accountability, skill and workforce diversity, and high standards of conduct, enabled the organization to achieve remarkable successes.

Consequently, the foundation laid by these first "space professionals" provided the momentum that has carried the nation forward for the last 50 years, bearing such remarkable military space programs as GPS, Defense Support Program, Defense Meteorological Satellite Program, Evolved Expendable Launch Vehicle, and a host of reconnaissance and surveillance systems. Acknowledged as the "first space war," Operation Desert Storm proved that space would play a critical role and serve as a key enabler of joint warfighting. As the demand for military space increased, it was evident that the role it would serve in warfare would require those who not only "grew up" in the space environment, but also those who followed clearly defined paths, to ensure that space was advocated and articulated, and capabilities delivered in order to produce maximum combat effects.

The recommendations of the Space Commission also served to formally establish the Air Force as the lead service and executive agent for space within the Department of Defense (DoD). The ensuing realignment of organizational roles and responsibilities included establishing the undersecretary of the Air Force as the senior space official within the DoD, creating a budgeting mechanism for space programs, consolidating oversight of space acquisition, and enhancing the development of space professionals. Realigning space responsibilities to the United States Strategic Command (USSTRATCOM) represented a major step in integrating space power with joint warfighting, making it the combatant command for space with responsibility and authority for global military space capabilities. This command now looks to its service components and defense agencies to provide operational expertise, mission capabilities, resources, and knowledge to deliver joint space warfighting capabilities and effects to other supported regional combatant commands around the globe. The United States Air Force space professional of the future will serve in this role, focusing not only on systems and satellites, but also on the operational capabilities and effects they provide. The space professional will be regarded as the *thought leaders* in space, taking full responsibility and standing accountable for the combat effects space produces, resulting in a well-integrated global space operational force and commander able to execute USSTRATCOM's space mission. This will serve to bolster the Air Force in its role as executive agent for space, with the authority, responsibility, and accountability for developing and fielding space capabilities, making the service not only the mandated focal point for DoD Space, but also the preferred provider by virtue of the talent and expertise of the space professional.

In an era of society's increasing reliance on the assured use of space capabilities, it is clear that a dedicated and deliberate effort needs to be made regarding the development of the military space professional. While the early history in space served as a template for general values and culture inherent in developing space cadre, as we approach the next half century in space, new dimensions, demands, and dynamics will require a new approach to cultivating the future space leaders of tomorrow. We will need to define and develop the right people, with the right experience and the right knowledge into the right jobs, at the right time to assure the United States' continued dominance as the leading spacefaring nation of the 21st century.

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Ms. Robey's previous assignment was the director, Human Resources and Manpower Division, Office for the Secretary of the Air Force, HQ USAF, Washington DC. She has served in various personnel management specialist capacities to include chief, Affirmative Employment, Civilian Personnel Directorate, Pentagon, Washington DC. She was selected for a career-broadening assignment at HQ USAF, Force Sustainment Division, Pentagon, Washington DC, where she was the Air Force Special Emphasis Program Manager for various programs and the Air Force representative to other federal agencies such as Office of Secretary of Defense, Equal Employment Opportunity Commission; Office of Personnel Management; and the Department of Labor.

Ms. Robey served honorably in the Air Force Reserve during which she held various specialty codes over the course of a decade.

Ms. Robey has been awarded the Meritorious Civilian Service Award, the Exemplary Civilian Service Award, numerous Notable Achievement Awards, and numerous Letters of Commendation and Performance Awards. Ms. Robey is also a twice-recognized Distinguished Graduate (Manpower Basic Officer Course and Intelligence Operations Specialist).

Forward to the Future: A Roadmap for Air Force Space (Part II)

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From Now (Part I) Forward to the Future

This article is the second in a two-part series focused specifically on the Air Force future in space. Part I of *Forward to the Future: A Roadmap for Air Force Space* was featured in High Frontier, volume 3, number 4. The thesis of the article is that the nation will be vitally dependent on Air Force space personnel and capabilities, but the Air Force has not defined a future path that will enable space professionals to develop capabilities that will satisfy the nation's pressing needs. Part I took a retrospective look at Air Force space culture, with an emphasis on how our culture is shaped and defined by our history and emphasized that culture is the central ingredient for future success. Part I concluded with four findings highlighting the key areas driving erosion of the US lead in across the board space capabilities. Part II will make recommendations for significant steps toward reversing that trend. Because the background, context, and justification for many of the recommendations are detailed in Part I of this article, it is important that the reader fully digest all of Part I before tackling Part II. The changes required are not short term or superficial, but will require a fundamental review and comprehensive action plan and should not be tied to, nor constrained by, current structures, approaches, and norms. Our recommendations are interconnected, so we believe all are necessary if the Air Force is to successfully lead future space power development and move the nation's military space capabilities *Forward to the Future*.

Focus Area 1: Recommended 2025 Capability Goals

Primary Finding: 2025 space capabilities must include the ability to establish space superiority as needed to enable US freedom of action; assured and robust strategic global utilities (services); and new capabilities that deliver a flexible range of globally responsive, precise, tailorable combat support and combat effects focused on the needs of combatant commanders. All of these capabilities must be fully integrated into the global information grid and merged onto the battlefield with manned and unmanned systems operating in all domains.

The key is having a set of clear goals and supporting objectives to guide our community actions and to create focus among leaders at all levels.[1] Consistent focus over time is required to achieve long term success and overcome the cultural and organizational fragmentation detailed at length in Part I of this article.

The task of reforming ourselves to ensure the Air Force is capable of meeting the challenges of 2025 would be simple if we knew with certainty what the future holds. In the first half of this article we outlined a scenario that demonstrated how one of our competitors might take actions that could fundamentally threaten military operations by 2025. However, a major power confrontation is not the only scenario that must be addressed. It is prudent to build a view of the future that is not too specific yet addresses the most likely challenges—a capability versus threat-based approach. After describing our view of this future, we will make recommendations to ensure our immediate actions produce appropriate culture, personnel, and processes robust and flexible enough to confront these threats and rapidly adapt to the unexpected. For these reasons, and in the interest of brevity, we will limit this discussion to the central challenges as we perceive them. These challenges are both international and domestic in nature.

Internationally, trends indicate US space capabilities will be challenged. America's highly-effective employment of space-derived information and services in Desert Storm, Iraqi Freedom, and Enduring Freedom did not go unnoticed. Worldwide military writers and planners have written very detailed accounts of how the US exploits space and how this US reliance may be an Achilles' heel since much of it is unprotected. Many of these writers realize that negating US space capabilities is necessary in order to confront or challenge the US military.[2] Additionally, space technologies, which were considered exotic in the 60s, 70s, and 80s are now common-place—launch and on-orbit capability is available to almost any nation willing to invest the money to buy products or services or develop an indigenous program.

In addition to major power competitors, we must remain prepared to counter non-state actors and other organizations, which will continue to threaten modern society by committing targeted acts of terror designed to erode trust in governments and civil institutions. These groups have demonstrated a talent for employing the newest technology in support of their ends. The US will have to develop a complex measure and countermeasure model to deal with sophisticated non-state actors. This will require the US to rapidly develop new tactically flexible capabilities in order to keep pace. Of course, catastrophic events of the magnitude of 9-11 can cause extensive excursions, which will force us to rethink our foundations. Therefore, 2025 capabilities must bring with them the flexibility to respond to a world that will be very different than today's with any number of potential threats and requirements.

Another likely trend in warfare is the continued increase in the requirement for data, including space-derived data, at all organizational levels during all phases of operations and conflicts. Information enhanced combat will require the space community to provide assured data and data pipes for both the production and distribution sides of the enterprise. In addition, the community will need to be able to protect and reconstitute space elements of the information grid.[3]

Simultaneously, while planning to prevail at both ends of the spectrum of conflict, the Department of Defense (DoD) must plan to do so in light of domestic politics. Primary domestic challenges include limited budgets, and the internationally provocative nature of military space capabilities. The costs associated with health care for an aging population, continued conduct of the Global War On Terror (GWOT), and recapitalization of conventional forces will each contribute to severe budget constraints that will force hard decisions.[4] However, these same constraints, while making advancement more difficult, may also stimulate true innovation, if we embrace the opportunity.

In total, this picture presents a significant challenge for our 2025 force. In a contested environment, this force must improve upon the availability and quality of global space capabilities, be responsive to small scale highly-dynamic tactical challenges, ensure seamless delivery of space effects, identify and neutralize adversary threats and capabilities, and rapidly replenish lost capabilities. These challenges warrant close examination of all our past assumptions about who we are and how we function. Assumptions that are counter to building this type of force must be identified, challenged, and replaced. Failure to do so now, will likely be paid for in American casualties on a future battlefield or in the homeland.

Recommendations:

- The assumption that space is a sanctuary must be abandoned. Since the launch of Sputnik 50 years ago, space has been a medium open for competition. The level of competition and the public's awareness of it has ebbed and flowed over the decades. However, the 11 January 2007 launch of the Chinese anti-satellite weapon had a "Sputnik-like" effect on global politics and reinforced the reality that space is open for competition, whether economic, diplomatic, political or military (by force). Because it is open for competition, rules must be established, sanctions agreed to and an ability to enforce them established. For that very reason, America's defenders of the space medium must work to make others aware that the era of unchallenged space exploitation is rapidly ending, if it did not end on 11 January 2007. Commensurate with this shift in mindset must be a shift in resources. It is folly for our nation to continue to build and deploy military, civil, scientific, and commercial space capabilities without accompanying plans to defend them.
- Do not allow political debates about space weaponization detract or impede the imperative to achieve space superiority in conflicts or abstain from advocating for necessary space defense capabilities. Diplomacy and the political impacts of the US developing space-based weapons are serious concerns, however, we need to forge a national consensus that space superiority is as critical to our nation's defense as air or maritime superiority. National leadership needs to consider the full risks and consequences associated with each course of action. To date, we do not believe the risks of failed space superiority have been clearly understood, nor are the benefits of US forbearance as convincing as some suggest. If diplomacy fails, our nation will look to the military as the final defender. We cannot fail to be prepared. As space operators we must remember it is our job to defend against capabilities, not intentions; intentions can change overnight. Space power cannot be developed overnight.
- Formally include space systems as part of deterrence and escalation control. Work to establish unambiguous tripwires that when crossed by other nations will result in the US taking prompt, firm, and effective response actions of our own—be they political, diplomatic, or military. It is likely that some of these have already been crossed in the areas of development of ground based jammers, directed energy weapons, the Chinese direct ascent antisatellite (ASAT), micro ASATs, and ballistic missile technology.[5]
- Strengthen the space career field to ensure the Air Force produces technical and operational experts that are capable of conceiving, building, and employing the 2025 force described above. It is the full spectrum of future space capabilities that drives our urgent need to develop training, education, and promotion models that will ensure our people can fight and prevail in the space domain, and deliver space capabilities as part of an integrated military force. The individuals must have the expertise to develop, field, and employ capabilities to enable rapid adaptation to dynamic threats in an environment characterized by short planning timelines, uncertain support, and austere funding. This cannot be accomplished by technicians, but only by individuals with a broad and deep understanding of joint warfare, developing threats, and an engineering level understanding of space technology limitations. Stated another way, the force needs individuals who can recognize and predict the threats, determine counter measures, and develop doctrine, processes and technology that enable development and implementation cycles that are substantially shorter than those that are currently the norm. We need to develop people who are not only able and comfortable with manipulating the data our weapon systems discharge, but who also understand what makes them work and better yet what to do when they fail.
- Space operators must take a stake in ownership and development of a global information grid, which is robust and well defended to ensure that access to data and services can freely flow between those engaged in a geographically isolated area and those who are engaged on a global scale. The full realization of the global information grid will be as revolutionary as the steam engine or the microprocessor, as it will fundamentally alter the nature of how we prosecute war. The space community will play a critical role in this revolution. Space operators will need to

(1) establish their segments of the global information grid, (2) develop tactics, techniques, and procedures (TTPs) for requesting and delivering tailored information in the most effective, efficient, and expeditious manner possible, (3) develop hardware and TTPs to rapidly detect and neutralize threats to the space segments of the grid, and (4) be capable of rapidly restoring services after any threats have been neutralized.

Focus Area 2: The Intellectual Framework—It Drives Everything and It Must be Right

Primary Finding: Space is a medium (domain), not a mission. The intellectual framework for space power must be driven by the inherent attributes and principles of space power. The current framework is organized around who owns what and unnatural groupings of dissimilar missions. The current mindset is heavily slanted to utility/service areas. Warfighting principles and terminology to describe and guide the proper use of space forces in military operations are essential for long-term continuity of action and capability growth. To date they have not been developed. The current organizing principles drive the ineffective approaches to how we are organized, how we define and manage our work force, what types of skills sets are needed by our people, and where we spend our money. The Air Force has adopted a one size fits all model for space operations, training, and evaluation for a set of fundamentally different missions. In many cases, this model negatively impacts mission accomplishment.

Warfighting principles and terminology, essential to describing and guiding the proper use of space forces over the long-term, have not been developed. Space is a medium for military operations in its own right—much the same as land, air and sea—not simply a functional area like intelligence, logistics, or personnel.[6] However, the DoD's overall approach to this issue has been to treat the space domain as a set of disparate missions, systems, or functions spread across a multitude of services and agencies.[7] To correct this weakness, a new and comprehensive intellectual framework for space power is required to provide the principles that are needed to link critical concepts such as grand strategy, operational art, tactics, and capabilities.[8] Such a framework is also critical to grounding our approach to organizing, training, and equipping space forces. Though there have been some efforts in the past to develop a framework for space power, none have really impacted US military space thinking. Furthermore, the authors can find no body of work that describes any proposed linkage between a top level framework and how we should organize, train, and equip space forces.

Without this vitally needed framework, the Air Force will be unable to develop a consistent set of space beliefs, warfighting principles, and terminology to describe and guide the organizing, training, and equipping or the proper use of space forces in military operations that are essential for long-term continuity of action and capability growth. It is also likely that we will have the wrong principles driving the wrong approaches to how we are organized, how we define and manage our work force, what types of skill sets are needed by our people, and where we spend our money.

Implementing the following recommendations will enable the Air Force to move forward in this critical area and begin to make the adjustments necessary for the future.

Recommendations:

- Acknowledge that space is a medium, like sea, air, and land. It has different inherent attributes and operates by a set of physical principles unlike any of the others. The authors recommend that Air Force Space Command create a dedicated doctrine staff, perhaps aligned with the National Security Space Institute (NSSI) assigned to AFSPC. Results of the effort should consolidate space community thinking regarding updated doctrine that would be shared broadly within rest of the military and public. Doctrine is not static: it should comprise an ongoing dialogue and debate among practicing space professionals, and will continually evolve and incoporate fresh thinking and ideas.
- Recognizing the fundamental principle of space as a medium, realign AFSPC's space missions around five separate, but interrelated communities with permeable boundaries: Space Superiority, Strategic Spacelift, Global Information Services, Global Surveillance and Tracking, and Space Special Operations (focused on tailorable, responsive, combatant commander support for theater level effects in any mission area).[9] Much like the fighter, bomber, tanker, airlift, and special operations communities, they would be linked by the common attributes and competencies involved with operating in the space medium, but would be functionally separate. Each area would be allowed and encouraged to develop their own sub-culture and would require different TTPs and methods of employment, different concepts of operation, different capability requirements, and training. This step is critical if we are to grow the expertise and depth of experience to progress in each area. The authors recommend that the AFSPC commander (CC) establish processes to create separate mission-driven, commander-owned tactical doctrine, TTPs, training and evaluation, skill set requirements, and so forth for each of the five space communities.

  AFSPC should create a separate ground-based Global Strike mission area for both intercontinental ballistic missile (ICBM) operations and the emerging Conventional Strike Missile mission. This sixth AFSPC mission area would be separate from the five space mission areas in every regard. There would be different accession requirements, career paths, and so forth. The premise behind this recommendation is sound, though expected to be controversial. It is not meant to foster a theological debate or suggest that great leaders can't succeed when placed in jobs outside their primary field of expertise. However, the vital nature of our mission must drive a brutally candid assessment and a discussion that acknowledges the fact that the military mission must always drive the need for unique and specific skills sets, technical competencies, experiences, TTPs, operational art, and cultures. While we are all airmen, there are other areas where the mission drives unique attributes for its people. The differences between the missions of our current space and missile missions are one of these areas.[10] The authors would recommend that AFSPC initiate a study to determine the best mechanism for achieving this goal.

- Increase emphasis on the delivery of combat effects and combat power, as opposed to today's heavy emphasis on operating machines. Determine which of these missions require uniformed military operators due to their inherently military nature. Focus attention on developing military operators in those areas that provide the most direct military effects.
- In a related step, AFSPC could contract out functions such as basic satellite telemetry, tracking, and commanding (TT&C), network, and range operations positions in the Global Information Services and Global Surveillance and Tracking mission areas. This action would replace all enlisted and most officers involved in satellite TT&C operations with contractors. Officers would be retained in selected roles to make key operational decisions and to gain necessary experience.

Both authors have extensive experience in military and national satellite operations and have fervently argued against such a move during the course of their careers. However, our views have changed for two fundamental reasons. First, the current Air Force paradigm has made it difficult for Air Force satellite operators to move away from the machine-oriented focus on operating satellites to an effects-oriented focus on delivery of capability to an end user. As a relevant analogy, Air Combat Command has dealt with similar issues in those mission areas involving aircraft such as the RC-135 Rivet Joint and E-3 Sentry. In both cases, the Air Force came to realize that the mission was being conducted in the rear of the plane and the aircrew supported the back-end mission. AFSPC needs a similar transformation focused on the "back end" mission of satellite operations. Another reason is to consider this approach is practicality. AFSPC has many new missions on its horizon, especially in areas such as operational command and control of space forces, delivery of integrated space effects, space defense, space situational awareness, and so forth. However, the continuing GWOT and other budgetary pressures signal there will be no new people available to the Air Force, especially aligned against space-related mission areas. AFSPC could solve many, if not most of its manpower shortfalls by realigning and prioritizing its space operations personnel and space career paths. The authors recommend AFSPC initiate the necessary efforts to plan and implement this recommendation at the earliest possible date.

Focus Area 3: People: Nurturing Our Most Important Resource

Primary Finding: The majority of today's space operations officers, at all levels, do not have the needed technical background, training, and educational and operational experiences required to foster innovative growth and warfighting impact needed in the future. This shortfall exists at all levels, but is perhaps most acute in the current generation of Air Force Space company grade and junior field grade officers who are on the verge of leading our community. Inadequate educational guidelines and goals, the constant movement of officers between mission areas combined with procedure-focused training structures leave the community without well prepared, capable space professionals.

This finding is written with an eye firmly cast on the future. The space capabilities required in 2025 imply weapon systems we have barely imagined and those weapon systems will need experts to operate, employ, and command them.

The Air Force and AFSPC made a number of positive changes in response to recommendations from the Space Commission, such as creating the National Security Space Institute, the Space Professional Functional Authority, the Space Professional Management Office, and the creation of the Space Professional Development Database that allows th command to track space professionals and their experience. However, the effectiveness of these changes was limited. Part I of this article described the cultural evolution of the space community within the Air Force and AFSPC over past decades.[11] In the period immediately following the Space Commission, it is arguable that cultural views and interests within AFSPC, rather than an objective analysis of future mission needs, were key factors in determining how the space culture would be defined and how it would change. For that reason, the command was unable to develop separate career fields based on specific mission area needs, to establish stringent technical requirements for new accessions, to outline new career paths that emphasize technical depth and experience in specific mission areas, or from adding the needed technical depth and rigor to space professional training.

Ensuring our Air Force has the right people to lead and execute future space missions is one of the most important responsibilities of our service. It is too important to allow cultural bias to dictate our way ahead or to adopt solutions based on the lowest common denominator among dissimilar weapon systems and "tribes" within our command. Our most senior leaders should make decisions in this key area based on our current and projected assigned missions and on brutal, objective assessments of what each mission area demands in terms of our people.

Finally, space leaders of tomorrow will carry a much heavier burden than today's senior leaders. Their mastery of technology and the ability to apply it in highly complex and integrated environments (experts in operational art) are what must drive us to get it right in terms of career field definition and development, education, and training.

For the above reasons, the current model of growing space professionals should be substantially modified to (1) revamp existing education and training policy for accessions to ensure we have the correct career field entrance criteria, better educational guidelines and goals, and the training structures needed to support each of the five recommended space mission areas (Space Superiority, Strategic Spacelift, Global Information Services/ Utilities, Global Surveillance and Tracking, and Space Special Operations); (2) we need to create mission driven, directly managed selection, and professional growth models specifically tailored to the five new space mission areas proposed in this article; and (3) create targeted opportunities to build professionals within each mission area that today are separated by arbitrary functional boundaries, especially between the current 13SXX space operations community and the 6XXX acquisition community.

Recommendations:

- Create a new set of AFSCs within the 13XXX umbrella for each mission area within AFSPC. The recommended breakouts are in table 1 below:

Mission Area	AFSC
Space Superiority	13FXX
Strategic Spacelift	13LXX
Global Information Services/Utilities	13UXX
Global Surveillance and Tracking	13RXX
Space Special Operations	13SXX
Ground Based Global Strike	13NXX

Table 1. New AFSC Breakout.

  The Air Force will have to manage overall space and ground based global strike personnel resources at the macro level, however, each AFSC should be managed separately as they will have specific and unique technical and experience requirements, cultures, career tracks, and so forth. It would be important to understand which mission areas best lend themselves to cross-flow, whether cross-flow is beneficial, and at which points in a career cross-flow should occur. As a general rule, cross flow opportunities should be created early in a career, and should be discouraged once officers reach field grade ranks. The authors recommend the AFSPC/CC, as the Space Functional Authority, direct the development of an implementation plan for the above recommendations.
- Manage accessions into the above AFSCs to ensure each new accession meets requirements driven by the mission. This is a necessary requirement for any military mission area and should be reemphasized in Air Force space mission areas. For space AFSCs, place a heavy emphasis on the ability to meet stringent technical prerequisites in space-related disciplines such as engineering, mathematics, and physics. In many cases, space career field entrants should hold bachelor degrees in technical fields. However, it would be useful to create a series of tests to allow officers with non-technical degrees to qualify based on technical aptitude. This would allow for a needed mix of academic pedigrees in the space community. The authors recommend the AFSPC/CC, as the Space Functional Authority, direct the development of an implementation plan for this recommendation.
- Educate all space accessions on the science and art of space, not just the procedural actions required at the first assignment. For each new accession, detailed training and education in space-related science, engineering, application, theory, and doctrine curricula should be developed. The curriculum should be intense and detailed with the goal of producing officers well versed in the science and engineering necessary for the flawless yet innovative operation of complex space systems. The goal will be achieved by teaching broad background on theory and underlying mechanics of space systems, space flight, and space operations. Initial training should first focus on ensuring each student possesses a strong science and technical foundation to provide theoretical background knowledge on space systems design and operation. Subjects might include advanced propulsion, power systems, control and guidance, space communications, space environment, and orbital mechanics. Fundamentals of spacecraft, launch vehicle, and ground system design would also be part of the curriculum. This is only a representative sample of the training that might comprise initial space training. The authors recommend AFSPC work with Air Education and Training Command to institute an undergraduate space training program for new accessions into any of the five space AFSCs and to institute an undergraduate global strike program for new accessions into that career field.
- Establish separate weapon system lead-in courses for all undergraduate course graduates, based on their initial operational assignments in Global Strike, Space Superiority, Strategic Spacelift, Global Information Services/Utilities, Global Surveillance and Tracking, and Space Special Operations, that would then be followed by weapon system specific initial qualification training.
- Develop new career tracks within the new space AFSCs that grow officers with depth in the space mission and breadth across a variety of space disciplines—RDTE&E, acquisitions, and operations. This will require the AFSPC/CC to take an active role in breaking down the existing functional stovepipes in the 13SXX, 6XXX, 33XX, and 14XX communities.
- The Air Force must ensure that space operations personnel are promoted in sufficient numbers and competed for key leadership jobs, including senior positions in service and joint staffs to ensure the appropriate experience level of a sufficient number of senior space officers.

Focus Area 4: Processes and Programs—Making it Happen

Primary Finding: Air Force space organization, management, processes, and programs are fractured, overly bureaucratic, and often underachieving—there are few in-depth institutional competencies, little focus on developing fundamentally new capabilities, and a limited ability to act in a flexible or responsive manner. The communities' core processes are less effective than the demanding security environment requires. At times they are too cumbersome, hierarchical, and bureaucratic. Past procurement problems with replacement constellations and the lack of sustained focus on development of innovative new concepts has limited truly "new" responsive capabilities.

The primary space mission of the Air Force and AFSPC is to organize, train, and equip space forces for today's missions and to ensure the Air Force can do the same in support of our missions in the future. Unfortunately, the attention of our most senior space leaders is often focused on the crisis or the initiative of the moment. Defending the budget, advocating support for acquisition efforts, and dealing with budget cuts are examples of major time demands for our leadership. In this environment, our senior leaders are unable to devote attention and have less direct insight "under the hood" of the fundamental processes underpinning every aspect of the Air Force space organize, train, and equip mission, especially at the levels below their direct level of supervision.

Why is this important? Because the lower level processes and the manner in which they are manned and organized are the primary engine behind any large bureaucratic organization. Understanding the innermost, core issues is essential for any senior leader to find and manipulate the necessary controls to make the organization respond and meet their intent. Despite concerted and creative effort by recent leaders, AFSPC still suffers from this weakness.

The current A-staff structure organized around functional groupings places the majority of focus on specific functional issues versus on how those issues (i.e., requirements, manpower, funding, concept of operations (CONOPS), etc.) come together in an integrated fashion to produce operational level capabilities at the execution/unit level. This paradigm forces numbered air forces (NAFs), wings, groups, and squadrons to constantly 'battle' with various 'functionals' in the major command (MAJCOM) that are mainly concerned only with their area of responsibility. Significant, often critical, issues go unresolved for months on end forcing the operational organizations to 'live' with or work around very inefficient, inaccurate, or even disabling deficiencies, without the time, people or resources to get them resolved. The approach required to resolve even a few key issues involves units engaging multiple MAJCOM sections that rarely work together and are almost never integrated in their activities. The bottom line is large expenditures of effort that focus attention away from mission accomplishment resulting in suboptimum support processes and outcomes.

Another significant issue for AFSPC is SMC integration into the command based on recommendations of the Space Commission. While the Commission was not prescriptive in how the integration was to occur, the Commission's clear intent was to create a vastly different AFSPC organization with cradle-to-grave responsibility for space RDT&E, acquisition, and operations.[12] In most regards, this transformation failed to materialize and most would argue the SMC merger was simply a patch change from Air Force Materiel Command to AFSPC. Many senior leaders are beginning to openly discuss this issue and some are wondering if the merger was a mistake.[13]

This phenomenon is not the result of malfeasance or a direct desire to hamper the mission. At the highest level, it is driven by aspects of the previously defined findings in this article. The lack of an overarching intellectual framework for Air Force space capabilities, no consistent Air Force articulation of space capability goals, and the inability to produce the expertise our command needs, all exacerbate this problem. Because of these weaknesses, our command is not organized properly, does not have the right experience in the right places, and does not have the processes needed for the future. There are some indications that senior leaders are beginning to grasp this issue. Current efforts, such as the "Lanes in the Road" study, are indications that the command is beginning to ask the right questions. However, the authors offer the following recommendations to address stated shortfalls.

Recommendations:

- Immediately move toward a flatter, leaner, mission-focused MAJCOM structure for organizing, training, and equipping space forces. In particular, the bulk of the command would become organized around cradle-to-grave responsibility for providing end-to-end capability in each of the five recommended AFSPC space mission areas (Space Superiority, Strategic Spacelift, Global Information Services/Utilities, Global Surveillance and Tracking, and Space Special Operations), as well as a similar team for Ground Based Global Strike. This would be a much different concept than the "mission team" concept tried in AFSPC during the late 1990s. In this case, significant elements of the HQ AFSPC functional staff, Space and Missile Systems Center, and 14th Air Force would be re-aligned to the mission and capability focused organizations.

  As a notional example, the command should create a new Directorate of Space Superiority Requirements, Acquisition, and Operations led by a flag officer. This organization would have cradle-to-grave responsibility for delivery of space superiority capabilities that could be tasked by COCOMs. Specifically, this organization would be responsible for requirements, acquisition, and operations, as well as overall programmatics, CONOPs, personnel/manpower, and communications needs in the space superiority mission area. The directorate would be comprised of personnel from each of the current AFSPC functional staffs currently dedicated to the space superiority mission (i.e., A3C, A5C, etc.), personnel from SMC's Space Superiority Systems Wing, and some operational personnel from 14th Air Force and 21st Space Wing.

  Each of the flag officer billets assigned to A3, A4/6, A5, A7, and A8/9 would be moved to lead the new Global Strike, Space Superiority, Strategic Spacelift, Global Information Services/Utilities, Global Surveillance and Tracking, and Space Special Operations two-letters. Each of the mission area directors would report to the AFSPC/CC, but similar to the model at AFSPC launch wings the director would report to the Program Executive Officer for Space for all acquisition issues.[14] 14th Air Force (14 AF) and its Wings would also be aligned against the five mission areas. 14 AF would continue to organize, train, equip, command, control, and employ Air Force space forces to support operational plans and missions for US combatant commanders and remain the Air Force Component to US Strategic Command for space operations. However, their focus in the operational wings would be strictly on readiness, operations, tasking and employment of space capabilities in response to combatant commander needs. Philosophically, this role would be similar to the missions performed by the National Security Agency for overhead signals intelligence and the National Geospatial Agency for overhead imagery intelligence in that those agencies are responsible for tasking and employing overhead capabilities that are provided by the National Reconnaissance Office.

Mission Area directors should be held accountable for current and future overall mission performance. They should have authority to create mission-focused, tailored operational instructions.

Small functional staffs would be retained in the HQ MAJCOM and led by colonels, but the control of requirements and resources would be shifted to the new mission area-focused directorates. These 'functionals' would ensure that appropriate processes are followed in their area of responsibility. Continuing the notional example from above, the requirements functional would ensure that requirements related documents are produced at the right time, with appropriate justification, and recorded in the correct format for a particular program. However, the mission area director would lead the development of requirements for Space Superiority, would determine their final form and would be the MAJCOM level approving official.

- In addition, the command should create a program and warfighting integration organization reporting directly to the vice commander. This office would have two primary purposes. First, it would be charged to establish the common operational standards and approaches to which all AFSPC mission areas would have to conform. Second, they would help establish relative priorities for the command. In particular, this office would have the ability to conduct analysis and recommend inter-mission trades and priorities. While this office would not have direct control of resource execution, it would have power by virtue of the fact that it reported directly to the vice commander.
- In order to eliminate unnecessary red tape and bureaucracy, the MAJCOM should supersede and/or cancel all MAJCOM instructions. This drastic step is the only way to radically streamline core processes that have become overly cumbersome, bureaucratic, and unresponsive to the needs of the mission. Immediately empower an outside agent (not associated with the function) to review deleted functional instructions for partial reinstatement based on merit and value-added to the mission.
- Give SMC responsibility for creating development plans, and authority for allocating all space science and technology (S&T) funds consistent with mission area director guidance. Continue to increase funding within Defense Advanced Research Projects Agency (DARPA) and Air Force Research Laboratory (AFRL) for Space S&T, but more directly tie DARPA and AFRL efforts to focused S&T activities within each of the five space communities, as opposed to recent trend towards building, integrating, and operating spacecraft.

Successful Implementation: The Hard Part[15]

There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success than to take the lead in the introduction of a new order of things. Because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new. ~ Niccolo Machiavelli[16]

While each of the changes we recommend are in themselves important it is critical that they be addressed as a group. We have attempted to structure our recommendations so as to cover the range of mechanisms, from picking the right accessions through MAJCOM management, required to ensure we drive fundamental cultural changes that will produce long term effects.

We must conclude with a call for urgency among our space professional brethren on these nationally critical issues.[17] Our opportunity to maintain a lead in space sufficient to sustain the international advantages our current military status provides is likely waning. This sense of urgency must be supported by real commitment at all levels to push the envelope of capability for decades to come.[18] Finally, we must overcome our "fear of innovation" and instead be known as leading edge thinkers who are adept at smart risk taking willing to delegate sufficiently to allow this climate to flourish.[19]

The future of Air Force Space is in the hands of the current and future space professionals. While skilled leaders such as our current senior officers leading our major space organizations will be important to this future, the future really lies in the hands of the thousands of young people that will shape the Air Force over the next several decades. *Forward to the Future* is geared to them more than anyone.

Notes:

[1] Lt Col Fred Gaudlip contributed to this section.

[2] Wang Hucheng. As quoted in Part I clearly articulates this view from the Chinese perspective.

[3] Max Boot, *War Made New* (New York: Gotham Books, 2006), 426-7 addresses the criticality of space capabilities in the information age.

[4] George W. Bush, *The Budget Message of the President*, 6 February 2006, http://www.whitehouse.gov/omb/budget/fy2007/message.html; Robert M. Gates, *Testimony before the Senate Appropriations Committee, Defense Subcommittee*, 9 May 2007, http://www.defenselink.mil/speeches/speech.aspx?speechid=1150 provide discussion of the budgetary challenges we face now and into the future.

[5] Boot, 443-5, gives a brief but relatively thorough overview of potential threats to satellites and other space-based possibilities.

[6] *Report of the Commission to Assess United States National Security Space Management and Organization,* executive summary (Washington DC: US Government Printing Office, 2001), xviii.

[7] Col Bruce M. Deblois, *Beyond the Paths of Heaven: The Emergence of Space power Thought,* (Maxwell AFB: Air University Press, 1999), ix-x. Col Bruce M. Deblois argues persuasively that the argument that "Aerospace" represents one medium is fundamentally misguided. In addition to the profound differences between the physical laws governing operations in Air and Space, the real issue is "not whether the two environments can be merged technically, but … should they be merged." Just as with space the transition between the land and sea is clouded. "The

amphibious mission certainly illustrates the fact that there is no absolute boundary between land and sea for military purposes." Land and sea have not been merged, because the optimum system approach is to design vehicles to operate on land and sea respectively and not to design a system to do both. It is technically possible but not advisable. A land vehicle will out perform a land/sea vehicle as will a sea vehicle. "Most missions are either at land or at sea; only a few cross the hazy boundaries." We could create a doctrine for surface power, but we do not. "Doctrine, organization, and strategies flow from the environments and the systems employed to exploit those environments.

[8] James Oberg, *Space Power Theory,* 2003, http://space.au.af.mil/books/oberg/index.htm. James Oberg lays a foundation for national level thought but does not sufficiently establish space power concepts for military purposes to support consistent planning and action. Additionally some of his fundamental precepts have not been incorporated into our thinking; Brent D. Ziarnick, "The Space Campaign Space-Power Theory Applied to Counterspace Operations," *Air & Space Power Journal,* Summer, 2004, moves from Oberg's concepts to application in terms of space superiority representing a positive start in this direction.

[9] Space Special Operations is the mission area that should evolve from the current Operationally Response Space mission set. It should focus on delivering tailorable and responsive combat effects for the combatant commander in a time relevant to his needs. This mission area would also drive to develop new and unknown special capability options across the spectrum of space warfare.

[10] Per the argument in note 7 on amphibious capabilities, we would argue that ICBMs fit into this neither nor category between air and space and thus require their own doctrine, training, etc.

[11] Col J. Kevin McLaughlin also authored the Space Commission Staff background paper on this topic, which provides additional detail on the evolution of "Tribes" within the space community.

[12] Space Commission report, 90.

[13] This issue, as well as a number of other Space Commission recommendations, have been discussed by senior leaders in the Air Staff and AFSPC over the past year or two. The authors have been direct witnesses to some of these discussions and have heard of others second hand.

[14] Careful study would be required to understand how the acquisition lines of authority would flow to the mission areas directors, with a specific focus on how the Program Executive Officer (PEO) for Space would discharge his or her duties in this model. The model established with the Launch Groups at the 30th and 45th Space Wings might be used to allow the mission area directors to report to the AFSPC/CC for non-acquisition issues and to the PEO for Space for all acquisition issues.

[15] The authors believe the proposed changes in this article and the keys to successful implementation are consistent with the reinventing government and Air Force Smart Operations 21 (AFSO 21) initiatives.

[16] Niccolo Machiavelli, *The Prince,* trans. W.K. Marriott (Ann Arbor, MI: Ann Arbor Media Group, 2006), written in 1513, 27.

[17] Boot, 463. Points out that most of the more successful innovators were insiders not outsiders.

[18] John P. Kotter, "Leading Change: Why Transformation Efforts Fail," *Harvard Business Review,* March-April, 1995, 59-67. There are dozens of books and articles on the topics of managing change, transformation, reinventing government and innovation. Kotter provides an excellent, concise, and common sense set of guidelines. An article on how these changes should be managed would add considerably to the debate.

[19] Boot, 458-466. Articulates the role that innovation, culture and other forces play in military success over the long term. "Overcoming the dread of innovation" and "Building Better Bureaucracies" are presented as critical steps in taking advantage of "disruptive breakthroughs" that the authors believe space can continue to offer in the future. Realizing these breakthroughs requires more than revolutionary technology but also "revolutions in organization, doctrine, training and personnel."; Bob Stone, *Confessions of a Civil Servant: Lessons in Changing America's Government and Military* (Lanham, MD: Rowman & Littlefield Publishers, Inc., 2003), provides multiple valuable anecdotes on successful and unsuccessful change initiatives in DOD and the government. A consistent theme in many of the works on these topics is the need to reward innovation and change the rules to allow innovation to flourish at low levels in an organization (see chapters 2 and 3).

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Colonel McLaughlin was commissioned through the US Air Force Academy in May 1983. He has served in a variety of space operations and staff positions. His experience in space operations includes space control; space launch; satellite positioning, navigation and timing; and satellite command and control. His operational assignments include commander, 50th Operations Group; commander, 2nd Space Operations Squadron; and chief, Current Operations Flight, 45th Operations Support Squadron; deputy chief standardization and evaluation, 45th Operations Group; chief, Launch Operations and Titan IV Launch Controller, Titan Combined Task Force; and chief satellite officer, Space Defense Operations Center, Cheyenne Mountain Complex.

Colonel McLaughlin has served in staff assignments at the Office of the Secretary of Defense, Headquarters Air Force, the National Reconnaissance Office, and Headquarters AFSPC. He also served as a professional staff member on the Commission to Assess National Security Space Management and Organization chaired by Secretary of Defense Donald Rumsfeld.

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Colonel Crawford has served in various duties including as a satellite operator, as a space surveillance crew commander, and as chief of Standardization and Evaluation. He served on the AFSPC staff as chief of Space Control Mission Concepts and on the Headquarters Air Force Staff as chief of Space Control Plans and Operations, executive officer, and deputy chief of the Space and Reconnaissance Division. Colonel Crawford also served in National Security Space operations as director of Missions and chief, Operations and Engineering. While deployed he served as Space and Information operations officer to the director of the Coalition Forces Land Component Command, Air Component Coordination Element during Operation Iraqi Freedom. He also commanded the 50th Operations Support Squadron, Schriever AFB, Colorado.

United States Air Force Academy Physics Department and Space Activities

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The Physics Department of the United States Air Force Academy (USAFA) offers an extensive set of space-related academic courses and operates several research centers and complexes in which faculty, full-time researchers, and cadets conduct real-world space research. Both the academics and research activities are highly collaborative and integrated with the space curricula of the Astronautics, Economics and Geospatial Sciences, Military Instruction, and Political Science departments. They are also collaborative with the other USAFA centers executing space efforts. As an example, a cadet who decides to major in physics at USAFA can choose the applied physics track of space vehicle design, which is a combination of space physics courses taught by faculty in the Physics Department and astronautical engineering courses taught by faculty in the Astronautics Department. Additionally, cadets have the option to tailor this applied physics track. For example, they might choose to include space-related coursework from various other USAFA academic departments, such as the Political Science Department's senior-level course on US National Space Policy and Law. The remainder of this article is divided into sections that briefly describe the space-related work being done at the research centers directed by the Physics Department, as well as other ongoing and planned departmental space research activities. Particular emphasis is placed on how these efforts are used to train, educate, and develop our cadets so that they enter the Air Force with a great foundation and understanding of the importance of space to our military and our nation.

Laser and Optics Research Center

The Laser and Optics Research Center (LORC) pursues research and cadet education in optical technology relevant to the Air Force. As part of this effort, the LORC has several projects relevant to space situational awareness (SSA). For example, researchers have successfully developed methods by which inexpensive holograms can correct distortions in large optical components. In essence, this is much like creating corrective glasses for mirrors that are no better quality than hub-caps. This has potential for next-generation high resolution imaging from gossamer (e.g., inflatable) optics or distributed phased arrays such as free-flying satellites. Another experiment has shown it is possible to replace conventionally formed optics altogether and create gossamer imaging elements from photon sieves—flat sheets containing millions of microscopic holes.

Beyond the immediate surveillance applications, several other projects are aimed at better understanding the environment in which Air Force assets operate. A novel holographic wavefront sensor is being built to characterize atmospheric turbulence at a rate 100 times faster than any existing device while removing the need for complex computer hardware. This will have immediate applications in directed energy weaponry, optical communications, and laser targeting. In another project a high spectral resolution detector has been developed to characterize atmospheric temperatures—something which will allow for improved weather modeling and prediction. In the future this device may also be used in laser radar systems for turbulence avoidance systems at airports and within aircraft themselves. The future of these and other projects is guaranteed through collaborative efforts with the Air Force Research Laboratory (AFRL), the Joint Technology Office, the National Reconnaissance Office (NRO), and several other agencies.

The LORC has eight full-time PhD research members and an additional five part-time teaching faculty members performing $1 million of research annually. The LORC has 10,000 square feet of laboratory space dedicated to research in lasers, optics, and optical materials. The laboratory includes nearly 20 continuous-wave or pulsed-power lasers covering a wide range of powers and frequencies. These laser systems, in addition to a vast collection of optical sensors, electronics, optical tables, vacuum equipment, and shared machine shop are worth in excess of $6 million.

Space Physics and Atmospheric Research Center

The mission of the Space Physics and Atmospheric Research Center (SPARC) is to give cadets a chance to participate in real-world applications of space to the Air Force mission. Cadets work one-on-one with a SPARC faculty member on projects spanning the basic areas of SSA, defensive counterspace (DCS), and force enhancement (FE). The SPARC has three full-time PhD research members and an additional seven part-time PhD teaching faculty members performing $500 thousand of research annually. SPARC has over 3,000 square feet of laboratory space dedicated to plasma and applied physics research directly applicable to the SSA, DCS, and FE missions. The laboratory includes a large vacuum chamber capable of testing small satellites and satellite plasma sensor subsystems, and a small clean room for space sensors fabrication. The plasma chamber has multiple ion sources capable of emulating a low-Earth plasma environment. The laboratory is also equipped with optical tables, electronic benches, and a full machine shop.

In the area of SSA, SPARC members believe it is critical that the Air Force develop better space weather prediction capabilities. One way to improve these capabilities is with the collection of ubiquitous in-situ ionospheric measurements so that we move to a data density that supports reliable space weather forecasts.

Currently the only continual in-situ space weather ionospheric measurements are provided by the National Oceanic and Atmospheric Administration's Polar Orbiting Environmental Satellites and the Department of Defense's (DoD's) Defense Meteorological Support Program satellites (in the future the Communications Navigation Outage Forecast System satellite will join this mix). These satellites provide excellent ionospheric measurements for inclusion into space weather models, such as the Global Assimilation of Ionospheric Measurements model. Unfortunately, each of these satellites, despite their sophisticated their instrument suites, can only sample one location in the space environment at any time, limiting the data available as inputs to the models.

We need to consider every future satellite as a potential platform to house space weather sensors. To accomplish this it is necessary to determine which measurements are needed, and then provide a simple instrument which gives a sufficiently accurate measurement of this parameter. Most importantly, the instrument must be small enough in terms of mass, power, and telemetry that it is under any payload margin of the host spacecraft.

With extensive cadet participation through independent study, the SPARC has developed a suite of plasma sensors we call smart skin sensors. These sensors are physically small, and contain embedded electronics allowing them to become part of the skin of the satellite. An example of the smart skin sensor is the prototype Integrated Miniaturized Electrostatic Analyzer (iMESA), shown in figure 1.

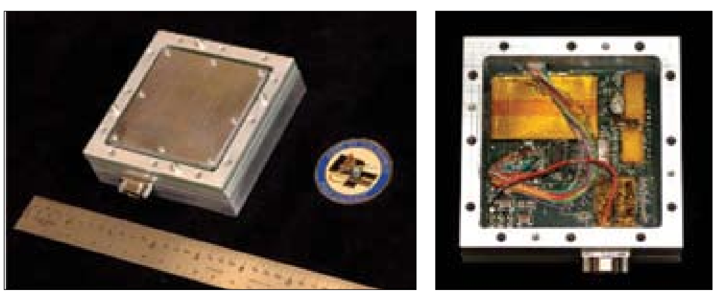


Figure 1. Proto-type of the iMESA instrument, left image is the sensor head (exposed side of the instrument), right the electronics (back side of the same instrument).

The sensor head is a series of flat metal plates, with all electronics for the package contained on a printed circuit board mounted behind the sensor head. The electronics contains an embedded microprocessor and internal flash memory. We call this prototype version of iMESA the Smart MESA since the electronics are not yet embedded into the ceramic sensor. The iMESA sensor provides ionospheric plasma density and temperature measurements. Effectively, iMESA provides the Air Force with a simple "space weather thermometer."

Cadets worked with SPARC faculty to deliver Smart MESA to the National Aeronautics and Space Administration (NASA) and will be sent to the International Space Station in the summer of 2007. Cadets are currently working to put iMESA onboard the Academy's newest small satellite, FalconSAT-5. In addition to putting smart skin sensors onboard Academy small satellites, cadets are working to put Smart Mesa on the Atmospheric Neutral Density satellite developed by the Naval Research Laboratory. Smart skin space weather sensors are about to become a reality.

Other smart skin sensors developed by SPARC are the Plasma Local Anomalous Noise Experiment (PLANE) designed by USAFA physics faculty and the Flat Plasma Spectrometer (FLAPS), designed by Dr. Frederico A. Herrero of Goddard Space Flight Center and manufactured by the John Hopkins University Applied Physics Laboratory.

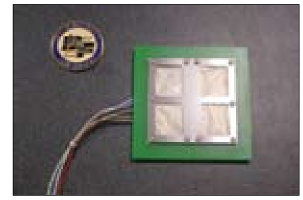


Figure 2. The bifurcated retarding potential analyzer, which is the sensor head for Plasma Local Anomalous Noise Experiment (PLANE).

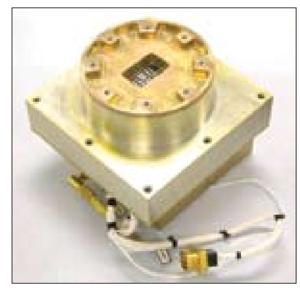


Figure 3. Qualification model of Flat Plasma Spectrometer (FLAPS).

PLANE characterizes in-situ plasma turbulence around the spacecraft by distinguishing variations in the global plasma environment from plasma fluctuations that originate with the spacecraft itself. FLAPS is a true micro electro-mechanical instrument, and is more capable than iMESA, holding out the promise of being able to detect the presence of other satellites by observing the ion trails left by the propulsion systems of external satellites in the low-Earth or geosynchronous orbital environments. Figure 2 shows a picture of PLANE and figure 3 a picture of FLAPS which are currently flying on the USAFA's FalconSAT-3 small satellite. FalconSAT-3 was a secondary payload on the Secondary Payload Adaptor ring of the Orbital Express mission, which launched in March 2007.

SPARC believes cadets learn best when motivated and challenged in equal parts. Both the motivation and the challenge come from being actively involved in a "real" Air Force program, like the development of smart skin sensors.

Gravity Probe-B

In a joint effort between the Astronautical Engineering and Physics Departments, the USAFA has established a fully functioning Mission Operations Center to take control of the NASA Gravity Probe-B (GP-B) satellite. This satellite was developed by NASA and Stanford University to test subtle, previously unobserved aspects of Einstein's general theory of relativity. These measurements required precise, unprecedented gyroscopes, which required an extremely low cryogenic operating temperature. The expendable cryogen has been exhausted, and the primary relativity mission has been completed. However, there remains a significant residual science capability that the Academy, along with partners at AFRL, will endeavor to take advantage of for the remaining life of the spacecraft.

Besides the residual science capability of the satellite, and in the interest of developing technically competent officers to serve as national security space professionals during their careers, USAFA will maximize cadet involvement in the operation and analysis of the GP-B satellite and its data. This will provide the cadets with a priceless opportunity to plan and execute operations and perform data analysis on a NASA satellite system comparable in scope and complexity to space platforms that they may encounter later in their Air Force careers. Cadets will be exposed to a broad array of issues and challenges that face all space missions. They will gain invaluable experience dealing with mission planning and execution involving interfacing with NASA's network of ground stations and their Tracking and Data Relay Satellite System.

The residual science capabilities for the satellite fall into two basic categories. The former relativity gyroscopes are still able to function as precise accelerometers. This fact would conceivably allow measurements in the areas of aeronomy (e.g., a detailed study of atmospheric upwelling and the drag this causes to orbiting satellites), or geodesy (e.g., detailed measurements of earth's gravity gradient). The second category of science capabilities would deal with using the attitude sensors for measuring effects other than originally intended. The star cameras could be used astronomically to measure stellar fluctuations. The GPS receivers could be used to measure radiofrequency scintillation or other effects degrading GPS performance.

The turnover of command and control of this NASA satellite to USAFA represents an unprecedented opportunity for an undergraduate institution. The potential for future payoff both in terms of both science and developing space savvy Air Force officers is enormous.

Space Weather Education

The Physics Department has been at the heart of the development of an undergraduate, interdisciplinary course on space environment and space weather. Space weather is a long-standing concern for DoD and has recently been added to the list of hazards requiring mitigation at a national level. Upper-class cadets from any major have the opportunity to take this course and learn about space weather influences on the signals, hardware, and humans that constitute space systems. Originally developed to answer a need in the Academy's meteorology program, this course has broadened to serve physics, astronautical engineering, space operations, and basic science majors. The course investigates the sources of space weather in the sun's atmosphere, the earth's atmosphere and in the cosmos. The cadets can develop a basic familiarity with the physics of the space environment and go on to investigate effects on natural and human-made systems. Of particular interest are the newly realized effects on GPS systems.

To support this course development effort, the department has teamed with the AFRL, the National Science Foundation and USAFA's Center for Physics Education Research to produce an undergraduate text for the course entitled "Space Weather and the Physics Behind It." Physics faculty members are in the midst of a three-year effort to define and condense the basic physics knowledge required for such a course. In addition to outlining the basic elements of the quiescent and disturbed space environment, the text includes individual chapters on impacts on humans, hardware, and signals. The final chapters deal with observing, modeling, and forecasting space weather.

Individual cadets enrolled in USAFA's space weather course and those enrolled in related independent study courses have the opportunity to present course projects at the National Space Weather Workshop in Boulder, Colorado, and at the local multi-institution Undergraduate Research Forum held each year in Colorado Springs, Colorado. NASA also provides summer research opportunities for cadets interested in investigating cutting edge models likely to transition to DoD. Additionally, these cadets are able to investigate plasma bubble models and solar irradiance models, both headed for applications in the realms of GPS signal scintillation and satellite drag, respectively.

Faculty members maintain and develop their skills in this discipline by staying involved in the Academy's small satellite program; interaction with the Air Force Weather Agency and Air Force Space Command; and panel and committee work with the National Space Weather Program (NSWP). The NSWP (a joint program between DoD and the Departments of Commerce, Energy, and the Interior, as well as the National Science Foundation) focuses on transitioning research to operations and championing space weather education for the public and space professionals.

Intelligence Education

The Physics Department is proud to have a number of faculty and staff who have served in the intelligence community. As a result, we understand the great need for future Air Force officers to be familiar with how the physics we teach directly applies to intelligence systems and operations. For the last few years, the department has worked with the NRO to send cadets on summer research projects to gain exposure to how technically challenging space intelligence systems are. In addition, many of these cadets return and conduct research during the academic year with department faculty and staff. Starting in summer 2007, these summer experiences are being extended to mission ground stations where cadets will also experience first hand how these highly complicated technical systems support the warfighter and other intelligence users on a minute-by-minute basis. These cadets will enter the Air Force with a better appreciation of how their technical education can help the warfighters execute their mission. They will be better informed customers of intelligence—its benefits and limitations—as well as have real-world experience as acquisition officers. In addition, we are investigating adding application blocks of material to our upper division physics courses that show cadets how the concepts they are learning apply to the basic design of space systems. These topics will be at both the unclassified and classified levels as needed to give the most benefit to the cadets' learning.

The Physics Department is also working with the NRO to develop additional research opportunities at USAFA. With the existing LORC and SPARC research capabilities as well as the soon-to-be-constructed 1.6-meter telescope, we are uniquely equipped to help solve technical problems for the NRO, as well as serve as an avenue of new technology demonstration in concert with the FalconSAT program.

Space Situational Awareness

The Department of Physics operates an observatory near the cadet area which houses a 61-cm telescope, a 41-cm telescope, and several smaller telescopes. Cadets obtain practical experience with SSA techniques by operating these telescopes in various physics courses and during cadet independent research projects. Current observatory research and the various laboratories in the cadet physics courses focus on three main astronomical techniques: astrometry, photometry, and spectroscopy. A wide variety of astronomical objects are studied, including minor planets and eclipsing binary stars, as well as Earth-orbiting satellites. Much of this research is conducted collaboratively with astronomers at other universities and researchers in the AFRL. For example, the photometry lab in the observatory's astronomical techniques course includes obtaining a light curve of a geostationary satellite and then using this light curve to construct a model of the satellite using non-resolved space object identification. The forward-modeling, light-curve inversion code used in this lab was originally written by department faculty and physics research cadets while working at AFRL's Maui High Performance Computing Center during summer research.

The USAFA observatory will soon be expanded to include a 1.6-m telescope, with rapid slew capability, based on the central segment of an existing 4-m primary mirror from the Air Force's Large Aperture Mirror Program. This new telescope will be capable of tracking satellites in low-Earth orbit (down to ~200 km) and will greatly expand the USAFA's SSA research activities. In particular, we plan to use the new facility to provide training for cadets and other DoD personnel, as a test bed for instrument development, and for additional collaborative activities in conjunction with Air Force SSA assets such as the Starfire Optical Range located at Kirtland AFB, New Mexico and the Air Force Maui Optical Station in Maui, Hawaii. Furthermore, the proximity of the new telescope to the Laser and Optics Research Center will permit exploration of additional research areas such as lidar, laser communications, and satellite illumination. Construction of the new telescope and facility is scheduled to begin in early 2008 and be completed by mid 2009.

Col Rex R. Kiziah (BS, Physics, US Air Force Academy; PhD, Physics, The University of Texas at Austin) is a permanent professor and the head of the Department of Physics, US Air Force Academy (USAFA), Colorado Springs, Colorado. He leads a 50-member department which educates, trains, and inspires 2,700 future Air Force officers annually across 30 physics and meteorology undergraduate courses.

Lt Col Michael E. Dearborn (BS, Physics, USAFA; MA, Physics, The University of Texas at Austin; PhD, Optical Sciences, University of New Mexico) is deputy head of the Department of Physics, USAFA, Colorado Springs, Colorado. Colonel Dearborn also serves as chief scientist for the USAFA small satellite program.

Dr Delores Knipp (BS, Atmospheric Science, University of Missouri; PhD, Atmospheric Science, emphasis space physics, UCLA) is a professor of physics with the USAFA, where she teaches courses in physics, solar-terrestrial interactions, space weather effects, and astronomy. She also teaches in the USAFA's interdisciplinary meteorology program.

Dr. Geoff Andersen (BS Physics, Adelaide University; PhD Physics, Adelaide University) is a research physicist in the Laser and Optics Research Center at the USAFA. His area of research is large optics for space applications. Specific topics of interest include holographic correction of aberrated mirrors, wavefront sensing and diffractive optics. Recently he has become involved with the construction of a meter class telescope at the Academy.

Lt Col David J. Lee (BS, Electrical Engineering, North Dakota State University; MS, Space Operations, Air Force Institute of Technology; PhD, Engineering Physics, Force Institute of Technology) is an assistant professor of Physics at the USAFA. Prior to this assignment he was a SPO division chief for advanced imagery programs at the National Reconnaissance Office.

Maj Brian K. Bailey (BS, Physics, Carnegie Mellon University; MS, Astronautical Engineering, Naval Postgraduate School; MBA, University of Colorado) is budget officer and assistant professor of Physics, USAFA, Colorado. He is responsible for the Physics Department budget planning and execution as well as instructing over 70 cadets a semester in physics and systems engineering.

Lt Col Charles J. Wetterer (BS, Physics and Astronomy, University of Maryland; PhD, Physics, University of New Mexico) is the director of faculty development in the Department of Physics, USAFA, Colorado. He has served as the director of the USAFA Observatory, Director of Research, Director of Advanced Programs, and Personnel Officer during multiple tours in the department.

Dr. M. Geoff McHarg (BS, Physics, Missouri Southern State College; MS, Engineering Physics, Air Force Institute of Technology; PhD, Physics, University of Alaska, Fairbanks) is the director of the Space Physics and Atmospheric Research Center (SPARC) in the Department of Physics at USAFA. As SPARC director, Dr. McHarg is responsible for leading cadets and faculty in developing scientific payloads for the USAFA small satellite program.

Naval Postgraduate School—Committed and Prepared to Support the Space Cadre

CDR Mark M. Rhoades, USN, retired
Lecturer, Naval Postgraduate School
Systems Engineering/Information Sciences Departments

CDR William Joseph Welch, USN, retired
Lecturer, Naval Postgraduate School
Information Sciences Department
Monterey, California

When former Air Force Space Command Commander (AFSPC/CC), General Lance W. Lord, retired, stated, "The concept of Space Professional Development goes well beyond the United States Air Force [USAF]," the Naval Postgraduate School (NPS) Space Systems Academic Group (SSAG) heard a vision in the making. So as General Lord set a course to address Space Professional Development, the NPS SSAG committed itself to meet some of the graduate education needs of the nearly 10,000 members of the space cadre.

Education is an essential element to upgrading the space cadre according to several Government Accounting Office (GAO) and Space Commission reports and NPS could not agree more. In addition to making the space cadre more technically skilled, education is also an effective tool to promote employee retention. Given the recent criticism that much of the space cadre work is being performed by contractors,[1] retention of knowledgeable, skilled government employees is critical to continue to build a robust cadre.

Recent GAO reports also indicate that the percentage of new acquisition managers coming into the Air Force with technical degrees has declined over the past 15 years, from 68 percent in 1990 to 16 percent in 2005.[2] This decline in acquisition managers with technical degrees, coupled with other factors, threatens to undermine the Air Force's ability to strategically manage its space acquisition workforce and meet national security space mission needs.[3] NPS has designed curricula and methods of remediation to allow students with demonstrated good academic performance to succeed in the Space Systems Operations programs even if they do not have a technical undergraduate degree.

Distance Learning Offers Best Method to Reach Majority of Space Cadre

US Air Force space professionals, as well as other Air Force officers, are now encouraged to complete career-relevant advanced education. This educational requirement can be serviced by combinations of resident and distance learning (DL) programs. NPS's resident Space Systems curricula are world-class and are regularly attended by a number of Air Force officers. The space cadre, however, is not limited to the officer corps; there must be a plan to provide educational opportunities to the enlisted and civilian members as well, including the reserves and national guardsmen in the operation, development, sustainment, application, and integration of military space systems.[4] Many of these personnel and a significant number of officers cannot attend residential education due to operational requirements. DL programs, which bring the education to the cadre member's location, are better suited to meet the educational requirements for these personnel. In addition, DL programs have the added advantage of being able to follow the student through temporary additional duty or permanent change of station moves. Educational technologies have grown over recent years, now allowing almost all forms of instructor/student engagement over the student's desktop computer. So as long as the student has access to high-speed internet with a properly equipped computer, he/she can attend classes. DL education provides an opportunity for space cadre members to pursue an advanced degree while still contributing to the unit. The unit itself benefits immediately as the student builds and applies his/her skill set gained through the education program. The most successful students have been those who also receive support from their units through flexible work schedules and regular periods each week that can be dedicated to DL.

NPS is set to fully engage this requirement with demonstrated excellent resident and DL programs. NPS offers a master of science in space systems operations and master of science in space systems engineering in residence and now offers two DL options—a Space Systems Certificate (SSC) program and a masters of science in space systems operations degree. All educational avenues need to be pursued if a significant percentage of the space cadre is to achieve the educational goals set by former AFSPC/CC General Kevin P. Chilton in his Vigilant Vector VI document.

Naval Postgraduate School Space Systems Certificate

The NPS SSC is an accredited four-course, graduate-level distributed learning certificate degree involving the completion of the four courses listed below. The courses are offered sequentially, once per academic quarter.

SS3011	Space Technology and Applications
PH3052	Physics of Space and Airborne Sensor Systems
SS3613	Military Satellite Communications
PH2514	Introduction to the Space Environment

The SSC courses are delivered through asynchronous Web-based interaction. The assignments, content, and engagement are paced week-to-week by the instructors, and students have great flexibility to do their coursework at times of their choosing during each week. The only prerequisite is a baccalaureate degree.[5]

Feedback from recent SSC students:

> There has been a change over the last five to seven years on the educational expectations of high performing professionals. Many organizations and companies have embraced the policy of lifelong learning for their most capable leaders. Given the requirement to complete a solid BS program, almost continuous subsequent education is required. This education takes the form of short courses, both resident and distant, as well as DL courses. The previous educational model, an 18-month (approximate) out-of-cycle resident educational model is less embraced. Companies, such as Cisco, IBM, Motorola, and so forth, expect their technical and supervisory personnel to be in some type of class continuously. USN leaders have taken a step toward this approach with the NPS certificate classes. (Captain, USAF)
>
> I found the discussions on the current and future of the military space programs to be of the most interest to me. This subject directly impacts areas of my responsibility. I also believe every officer would benefit from this knowledge. Studying this subject would give them an appreciation of the complexities of receiving data on a deployed unit in the field. (Captain, USAF)

In dedicated support of General Chilton's recent Vigilant Vector VI, the Naval Postgraduate School Space Systems Academic Group extended an invitation to 10 USAF space professionals for enrollment into the SSC program. Despite short notice, the response from the Air Force space professionals was astounding. NPS received more than 130 applications in less than two weeks. NPS has offered the SSC to USAF, Navy, Army, and Marine Corp officers since September 2002. More than 110 students have completed the certificate program, including officers, government civilians and senior non-commissioned officers. Engagement into this challenging program by Air Force space professionals will further cement the Naval Postgraduate School's commitment to educating USAF space operators.

The four courses of the SSC are also part of the NPS master of science in Space Systems Operations (MS SSO) online degree program. Completion of the SSC represents 25 percent of the course work necessary for the degree program.

Naval Postgraduate School Master of Science in Space Systems Operations Program

The MS SSO-DL curriculum is designed to provide officers and US government civilians with knowledge of military opportunities and applications in space. Students are provided instruction about the operation, tasking, and employment of space surveillance, communications, navigation, and atmospheric/oceanographic/environmental sensing systems as well as payload design and integration—specifically for the exploitation of space and information products. Courses are delivered at the students' local site using a combination of video teleconferencing, Web-conferencing tools, and Web-enhanced online courses. The MS SSO-DL degree program is open to all qualified uniformed officers, federal employees, and defense contractor civilians. Admission requires a baccalaureate degree with a grade point average of 2.6 or better, completion of mathematics through differential equations and integral calculus, and at least one course in calculus-based physics. A security clearance is not required for most courses, but is highly recommended. Students in the MS SSO-DL degree program meet the same degree requirements as on-campus students.

Current Course of Study - SSO - Fall Entry

Quarter 1	
SS3011	Space Technology and Applications
PH2514	Introduction to the Space Environment
Quarter 2	
SS3500	Orbital Mechanics and Launch Systems
PH3052	Physics of Space and Airborne Sensor Systems
Quarter 3	
EO3516	Intro to Communication Systems Engineering
AE4830	Spacecraft Systems I
Quarter 4	
EO4516	Communications Systems Analysis
SS3613	Military Satellite Communications
Quarter 5	
SS3041	Space Systems & Operations I
AE4831	Spacecraft Systems II
Quarter 6	
SS0810	Thesis
IO3100	Information Operations (or sponsor directed course)
Quarter 7	
SS0810	Thesis
SS4051	Military Space Systems and Architectures
Quarter 8	
SS0810	Thesis
(TBD)	(2nd Sponsor Directed Course, if desired.*)

* Plans are in development to offer courses in Space Control and MASINT/Remote Sensing. Classified courses could be delivered over SIPRNET/JWICS, provided students have the clearances and access.
* More information about the MS SSO DL program can be found at http://www.nps.edu/DL/Degree_Progs/MSSSO.asp, including how to apply.

Central Sponsor Funding Greatly Enhances Participation

NPS has several limitations imposed by Title 10. NPS is not allowed to accept Department of Defense (DoD) Tuition Assistance, GI Bill, or Graduate Education Voucher funds. NPS can accept Acquisition Workforce Tuition Assistance because it is managed by a DoD component. NPS recommends that large commands centrally sponsor opportunities for their or their subordinate commands' employees. Based on experiences with other NPS DL curricula, funding by a central sponsor is the most efficient due to the following reasons: (1) students are confident that funding is present and sponsor support is provided, (2) funding efficiencies can be gained (NPS offers tuition discounts for sponsors who commit to 10 or more students), (3) the sponsor(s) has opportunities to recommend and guide areas for student research, (4) the funding sponsor(s) can influence the enrollment selections, (5) the funding sponsor(s) can tailor some of the curriculum content, and (6) people are nearly 10 times more likely to apply for educational opportunities that are little or no financial burden for them, which ensures a good field of top-quality applicants.

Naval Postgraduate School Program Strengths

NPS has a faculty with a wealth of space experience. As an interdisciplinary association of professors, the SSAG serves as the focal point for all space-related research performed at NPS. In addition to resident faculty, the SSAG has a number of full-time chair professors to bring industrial, military, and government expertise to the space program at NPS. Organizations providing chair professors include the NRO, NASA, Navy Tactical Exploitation of National Capabilities Program, Navy Space Technology Program, and the Naval Network and Space Operations Command. This entire package brings a national security focus to the NPS space program.

A major goal is to couple NPS space research efforts with the graduate education of military officers. This is typically accomplished through space-related thesis research in several areas and includes small satellite projects created specifically as an educational tool for students. The SSAG oversees classified and unclassified student involvement in research activities and helps facilitate their placement in follow-on tours. In addition, student-produced Space Capstone design projects are critically reviewed by an external panel composed of members from industry, the military and the government. Lastly, NPS offers truly "joint" education exposing students to members from all other services, including civilians.

Conclusion

Space education is a critical enabler for a sound and robust space cadre. DL curricula, when properly designed, delivered and funded, can reach a majority of the space cadre where they work and live. NPS has a long legacy of providing world-class space education and prestigious alumni, including 33 astronauts. NPS stands ready with its robust space education programs to continue its legacy of serving the space cadre.

Notes:

[1] US Government Accountability Office, GAO-06-908 Report, *Defense Space Activities: Management Actions Are Needed to Better Identify, Track, and Train Air Force Space Personnel*, Report to the Chairman, Subcommittee on Strategic Forces, Committee on Armed Services, House of Representatives, September 2006, 9.

[2] Ibid, 14.

[3] Ibid.

[4] General Lance W. Lord, "Welcome to the High Frontier," *High Frontier* 1, (Summer 2004): 3.

[5] Additional information on the SSC is available at http://www.nps.edu/DL/Cert_Progs/SS.asp.

CDR Mark Rhoades, USN, retired (BS, Aerospace Engineering, University of Michigan; MS, Aeronautical Engineering, Naval Postgraduate School [NPS]; MS, Systems Engineering Management, NPS) is the academic associate for the NPS Master of Science Space Systems Operations Distance Learning (DL) Program. He is also a lecturer in the NPS Systems Engineering and Information Sciences departments. He is responsible for the management of more than 300 distance learning students in the Systems Engineering, Systems Engineering Management and Space Systems Operations DL programs.

Commander Rhoades has served as a Systems Engineer for Naval Air Systems Command and as a Deputy Program Manager at the GPS Joint Program Office located at the Los Angeles, AFB. In 2001, he was assigned to the Naval Postgraduate School as the Program Officer for Aerospace Engineering, Space Systems, Systems Engineering and Analysis, and Systems Engineering Management (PD-21) curricula where he developed postgraduate educational programs that reflected excellent academic standards and were operationally relevant to the Department of Defense.

CDR Joe Welch, USN, retired (BS, General Engineering, US Naval Academy; MS, Space Systems Operations, Naval Postgraduate School [NPS], Monterey, California) is an instructor at the Naval Postgraduate School, teaching courses in Information Science and Space Systems. He is currently the program coordinator for the Naval Postgraduate School Space Systems Certificate program.

In 1997, Mr. Welch was assigned to NPS as the curricula officer for Aerospace Engineering, Space Systems, and Systems Engineering Integration curricula. Commander Welch coordinated the delivery of postgraduate educational programs which reflected both excellent academic standards and an emphasis on fleet and operational relevancy.

Commander Welch entered Naval Flight Officer Training and was winged as an E-2C Naval Flight Officer. His first operational tour was with VAW-121 aboard USS Dwight D. Eisenhower. He has completed a variety of cruises to the Mediterranean and the North Atlantic. During his career he served as a carrier aviation tactics instructor, operations officer, carrier qualification OIC, executive officer, and engineering officer.

In 1991, Commander Welch was designated as an aerospace engineering duty officer and assigned as the director of the Program and Technical Support Division, Defense Plant Representative Office, Grumman Corporation.

Your United States Air Force Weapons School

Maj Christopher S. Putman
Operations Officer, 328th Weapons Squadron
Nellis AFB, Nevada

Space professionals must acquaint themselves with the air, land, and sea operations so they can define better what goods and services they can contribute, while the non-space forces had better learn how they can support space operations so the whole force becomes more lethal and responsive.[1]

~ General Charles A. Horner, USAF, retired

Weapons School graduates, also known as "whiskeys" or "patches," have been a common sight at fighter aircraft units throughout the United States Air Force (USAF) for over 50 years. Recently, their numbers increased significantly throughout Air Force Space Command (AFSPC). Space weapons officers bring to AFSPC an intimate knowledge of joint air and space power application, contributing to effective employment of space capabilities. Concurrently, graduates who remain outside the command continue to integrate with and teach non-space forces.

The Space Weapons Instructor Course (WIC) at the United States Air Force Weapons School (USAFWS) has produced 173 space weapons officers for the USAF since its inception in 1996. Initially, graduates completed their first assignment predominately with operational level organizations outside of AFSPC, notably at numbered air forces around the world. The focus of these graduates was and continues to be integration of space capabilities across the joint spectrum of warfare. Chief of Staff General T. Michael Moseley highlighted this focus in the August 2007 *High Frontier Journal*, "The growing presence of space expertise in combat theaters cultivates the integration of space into the planning and execution decision-making process, ensuring our warfighting combatant commanders have full access to space effects."[2] However, recent emphasis from General Kevin P. Chilton, former commander of AFSPC, has provided a vector that now sends a significant percentage of Space WIC graduates back to tactical level AFSPC units where the graduate "becomes the tactics, techniques, and procedure (TTP) person in the squadron, becomes the go-to guy for the squadron commander when it's exercise time, becomes the person every lieutenant in the squadron looks up to."[3]

On the surface these distinct post-USAFWS assignment tracks seem to compete for limited educational resources within an already crowded weapons school curriculum. The USAFWS and 328th Weapons Squadron (WPS) meet these diverse needs of the entire Air Force and graduate qualified space weapons officers by executing a single Space WIC syllabus twice a year from Nellis AFB, Nevada.

In illustrating how the 328 WPS meets the varied USAF space weapons officer requirements, this article addresses three interrelated audiences and their potential questions with respect to the Space WIC. First, squadron, group, and wing leadership throughout the Air Force who seek to nominate an applicant to the Space WIC: *what is the Space WIC so that I can recommend the right personnel?* Second, prospective applicants: *what can I expect as a USAFWS student?* Third, Space WIC graduates: *how is the course currently structured so that I can better prepare personnel selected to attend?*

Weapons School History

The USAFWS began with the signing of letter 53-24 by General Hoyt S. Vandenberg on 12 April 1949. Initially established as the USAF Aircraft Gunner School at Nellis AFB, the school was officially known as the Fighter Weapons School until 1993 when it dropped "Fighter" and assumed its current name.[4] The stand up of Air Combat Command the previous year began a shift away from exclusively fighter aviation and was consummated with the introduction of the B-52, B-1, and Intelligence WICs. The post Desert Storm era saw the USAFWS build upon integration lessons learned and add additional WICs to include HH-60, RC-135, EC-130, Space, MC-130, and AC-130. Since the beginning of the Global War on Terrorism, the USAFWS has furthered its integration efforts by incorporating stealth platforms to include the F-22A scheduled for an initial class in 2009. The most recent change to the USAFWS was the 5 July 2006 merger of Mobility Weapons School C-130, KC-135, and C-17 aircraft with the USAFWS. This act created a single integrated weapons school executing the current USAFWS mission: "Teach graduate-level instructor courses, which provide the world's most advanced training in weapons and tactics to officers of the Air Force."[5]

The USAFWS consists of 16 squadrons implementing 20 WICs representing 17 aircraft types plus two Intelligence WICs and the Space WIC. Nine squadrons are located at Nellis AFB with seven geographically separated across the United States. The current structure permits the USAFWS to annually graduate approximately 200 students over the course of two classes lasting five and a half months each.[6]

Although separated, all students are brought together three times during the program for core academics at the beginning and middle of the course and for the Mission Employment (ME) Phase just prior to graduation. Additionally, WICs interact on a more limited basis throughout the course to support syllabus requirements.

Weapons School Focus

This is not your father's Weapons School. With the uncertainty and ambiguities of combat in the 21st century, the premier school for advanced instructor training and employment of USAF weapon systems continues to adapt to the challenges of today while keeping an eye on the emerging threats of tomorrow. The Commandant of the USAF Weapons School, Col Scott Kindsvater, recently summarized today's Weapons School. "Because the battlefield is and will continue to be chaotic, volatile and uncertain, we owe it to our Air Force and our nation to produce the most lethal warriors capable of integrating and executing our nation's combat capabilities at the tactical and operational levels. We must increase the realism and complexities of today's training to ensure we win the current fight while at the same time prepare our force for tomorrow's unknowns."[7]

To accomplish its mission, the USAFWS focuses on building specialized and core skill sets to create humble, approachable, and credible weapons officers. Students develop their skill sets throughout the course, evolving into a credible expert in their respective weapon system. But, a weapons officer can not stop at just being credible, he will be ineffective as both a teacher and advisor if he is not also humble and approachable. Weapons officers must teach in a way that does not intimidate the training audience and allows free interaction with students. A less than humble weapons officer can easily lose the trust of leadership and peers and ultimately diminish his utility to the unit despite his technical expertise.[8]

The humble, approachable, and credible mindset permeates all aspects of instruction on the specialized and core skill sets. Specialized skills pertain to the students' specific weapon system, as discussed later in this article with respect to the Space WIC. Core skills are those which all weapons school graduates must possess regardless of weapon system background.

The core skills focus on communication, problem solving, integration, organization, and leadership. Communications skills necessary for effective instruction include mastery of briefing, debriefing, and platform instruction as well as advanced writing ability. Students learn advanced problem solving techniques and how to function as a unit advisor on tactics. Students also venture beyond their weapon system so that they become well-versed in air and space operations center (AOC) processes, USAF and joint weapons and tactics, and integration of forces for composite operations. Additionally, students learn organizational and leadership skills necessary to run the weapons and tactics function. Finally, graduates hone their leadership and planning skills as they function as a mission planning cell chief.[9]

The USAFWS uses a building block approach to train weapons officers. The course begins with fundamental missions and academics. As the difficulty grows, instructors teach advanced communications skills, time management, and coping with stress. Students grow as they give and receive constructive feedback. Ultimately, they will critique their own performance and develop corrective actions. The USAFWS certainly can not teach the students every technical detail or expose them to every situation they will face as a weapons officer. Graduates will, however, have the skills necessary to critically analyze problems, develop solutions, execute, and debrief to any problem they may face. By developing the core skills throughout the course, the USAFWS produces humble, approachable, and credible weapons officers for the USAF.[10]

Space WIC

The Space WIC syllabus, 328 WPS mission statement and 328 WPS objectives support both the USAFWS objectives and AFSPC guidance. The Space WIC syllabus details the overall training strategy and approximate amount of instruction required to attain course goals and graduate. Total training time consists of 473.5 hours of academic classroom instruction plus 419 hours of mission events over the five and a half month course.[11]

The current 328 WPS mission statement used to support the syllabus reads as follows: "Develop Airmen through advanced instructor training in the employment of select weapons systems and TTPs fundamental to space superiority."

Additionally, the 328 WPS developed six primary squadron objectives (and 113 sub-objectives) to define the requisite specialized skill sets for Space WIC students and guide syllabus implementation.[12]

1. Graduate weapons officers who are experts in space effects and space superiority.
2. Graduate weapons officers who are proficient in planning/execution of air and space power.
3. Graduate weapons officers who are expert problem solvers.
4. Graduate weapons officers who are expert leaders.
5. Graduate weapons officers who are expert instructors.
6. Apply security measures in any given situation.

Instructors use the squadron objectives when evaluating student mission performance and providing feedback. The performance standard for the students gradually increases throughout the course. The rising scale allows students to learn the new, and in some cases foreign, core skills, make mistakes, identify fix actions, and then improve upon their performance during subsequent graded events.

Clearly defined objectives and sub-objectives allow instructors to adapt the course structure and instructional techniques to the diverse and sometimes unique background of our students. The 328 WPS can also quickly incorporate emerging space issues, ensuring students graduate armed with current TTPs and system knowledge.

Systems Phase

The space syllabus begins with approximately seven days of Core 1 instruction attended by all USAFWS WIC students. Classes cover subjects such as infrared and radar missile theory, precision guided munitions, and threats. The commonality of this instruction builds a baseline among all students and provides the space students their first opportunity to interact with students from other WICs.

Upon completion of Core 1, students enter the longest phase of the syllabus, Systems Phase, which lasts approximately two and half months. Students build their space systems knowledge through the course of the five blocks that comprise the phase: theater command, control, and communications, navigation warfare, intelligence, surveillance, and reconnaissance (ISR), theater missile defense (TMD), and space superiority (SS).

While the phase concludes with the SS Block, space superiority has been integrated into all blocks of instruction. As students learn each system, they analyze how to protect that system for friendly use and deny its use by the adversary.

Each block of instruction begins with two to five days of classroom academics with associated exams. Systems Phase academic instruction focuses on the requisite amount of system knowledge so that the students can employ space systems in attaining space superiority and supporting the joint fight. Thus, a student will not need to know how to update the GPS navigation message, but may need to know the structure of the GPS navigation message in order to assist F-15E students in developing small diameter bomb tactics.

Further, Systems Phase not only introduces system capabilities and limitations but also concentrates heavily on their application. For instance, instructors use the combat search and rescue (CSAR) mission area during the ISR Block to highlight the application of space-based systems. Students then take their system knowledge and apply to specific CSAR scenarios during the block's missions.

Throughout the phase, instructors from other WICs teach relevant supporting weapon systems to the space students as applicable to the current block. As an example, students learn RC-135 Rivet Joint capabilities and limitations during the ISR Block. Students must then be able to integrate these weapon systems with space systems during subsequent academics and missions.

Each Systems Phase block concludes with two missions over the final three to five days. A mission consists of a tactical or operational problem presented to the student. Students may perform the mission solo or as part of a group. The student has a set amount of time to solve the problem, known as mission planning. The problem may consist of anything from teaching space-based ISR capabilities to an HH-60 pilot to performing a GPS interference and navigation tool (GIANT) run to developing a personnel recovery command and control architecture. Instructor assistance during mission planning decreases throughout the course as students build their problem solving skills. At the appointed time, the student presents the mission solution to instructors who will evaluate the student's performance.

Weapons School Graduates at the Combined Operations Center.

Missions may be observed by instructors from other WICs as well as supplemental personnel such as 57th Wing leadership, Air Force Warfare Center leadership, and previous weapons school graduates. These audiences provide critical feedback to students but do not evaluate the mission.

Upon completion of the mission, the student will debrief their performance to determine (a) what went wrong, (b) what was the root cause of the problem, and (c) how to fix the problem so it does not happen again. As the final mission event, the student teaches the debrief to the instructor.

Throughout the phase's missions, instructors place emphasis on developing the student's debrief skills. Unlike many initial qualification training courses where a student experiences a trainer ride many times, a space WIC student may only be evaluated once on his proficiency with a particular tool (or skill) such as GIANT. It is up to the student to accurately identify errors and create fix actions through the debrief and then execute those fix actions at the appropriate time later in the course (and possibly after graduation).

In addition to applying space knowledge and developing core skills, students begin to integrate with other WICs during Systems Phase missions. Students will not have all the answers to complete many missions and must utilize student and instructor expertise from other WICs to accomplish the mission.

The diverse background of the students presents a unique challenge. A class typically has students from different space backgrounds, each with their own area of expertise. The volume and complexity of the material throughout the course means the students must teach each other based on their individual strengths during both missions and academics: one can not accomplish the syllabus alone. To aid in this process, instructors assign specific mission tasks providing an opportunity for students to improve any weaknesses they may have with respect to specialty or core skills.

Plans Phase

Upon completion of Systems Phase, students begin the operationally focused Plans Phase. Because many space effects are planned and executed at the operational level of war (by both the theater and space joint functional component command), students are exposed to space doctrine and how it is applied to deliberate and crisis action planning. This phase is directly applicable to graduates assigned to a theater AOC. Graduates assigned to AFSPC squadrons can also use this knowledge in developing unit actions to effectively support operational objectives. Further, these graduates can expect to deploy to a theater AOC or equivalent joint organization sometime in their career. Finally, these skills are equally applicable to the large number of graduates who will be assigned to (or augment) the Joint Space Operations Center (JSpOC).

The Plans Phase consists of two blocks: Deliberate Planning Block and Crisis Action Planning Block. Each block follows a construct similar to the previous phase where academics precede several days of mission planning, concluding with mission execution. Phase academics concentrate on operational level processes and TTPs. The Plans Phase also adds numerous seminars to the educational method where instructors and students work together to solve planning problems.

A unique aspect to Plans Phase is that all student developed planning products are cumulative and will be used in subsequent seminars and missions. Students thus continue to hone problem solving skills by identifying and correcting errors; their ability to correct product deficiencies directly contributes to the level success on the next event. Additionally, all products are used in the first two missions of the next phase, the Integration Phase.

The Plans Phase uses a fictional operational scenario for students to integrate space into theater campaign plans. Through numerous academic seminars, instructors work with students to develop the air portion of the campaign plan and then assign students the task of developing the supporting space components. Among other tasks, students develop appropriate tactical objectives, tactical tasks, and measures of effectiveness to gain and maintain space superiority and contribute to the joint fight. During the process, students must demonstrate their credibility as a weapons officer by correctly applying Systems Phase tactical knowledge when building their planning products.

While the seminars admittedly have a theater AOC focus, instructors introduce students to JSpOC (and subordinate space unit) planning considerations throughout the phase. The students' strategy to task analysis of the scenario determines which space effects best meet the commander's intent and objectives. The desired effects establishes which space units support the campaign. Further, students decide how to best integrate the space effects with the overall campaign plan to achieve unity of effort.

JSpOC personnel, temporary duty (TDY) to the 328 WPS, integrate with students during mission planning and provide realistic feedback with respect to the legitimacy of the students' planning decisions. Through this process students realize the symbiotic relationship between theater and JSpOC planning and that neither can operate in isolation.

Integration Phase

Unlike the previous phases, the Integration Phase has no testable academic lessons. Students do, however, attend Core II classes with the other WICs at approximately the halfway point of the course. Core II classes continue to build a common level of knowledge among all students and focus on weapon system capabilities, limitations, and employment considerations. As part of Core II, all students receive a tour of the extensive Nevada Test and Training Range (NTTR) complex. Two days of Core II academics concludes with tactical problems. Students are divided into focused groups to develop solutions to tactical problems such as integrated air defense system takedown or CSAR. This is the initial opportunity for students from all the various WICs to work together to solve a common problem.

The first Integration Phase mission requires execution of the space superiority actions for a select time slice of the air tasking order (ATO)/space tasking order (STO) developed during the Plans Phase. While there are technically no outside agencies supporting this mission, the students experience integration when they are divided into different agencies to execute their plan: space control squadrons, AOC operations floor, and AOC vault. Instructors act as other supporting agencies. Students execute from the 328 WPS building where each room is designated as a different agency. The essential value of this mission is developing fix actions for the errors that reveal themselves during execution. The students then apply the fix actions to the distributed operations mission (DOM).

As the name implies, students accomplish DOM actions while embedded with various space units. The specific units which participate may vary from class to class, but typically include the JSpOC, 76th Space Control Squadron (SPCS), 4 SPCS, and the 21st Operations Support Squadron. In addition to their normal mission requirements, students must lead personnel assigned to the exercise at each supporting unit. Thus, the students embedded at the JSpOC lead the JSpOC team planning and executing the mission.

The DOM uses the same operational scenario as Plans Phase but rolled forward in time to a later ATO/STO period. Students essentially reaccomplish all planning actions from the Plans Phase, as necessary, over the course of a single week. On the final mission day, the participating units execute a time slice of the ATO/STO.

Several details focus development of core weapons officer skills during the DOM. The distributed nature induces a new type of fog and friction, forcing students to rapidly adapt their problem solving and communications skills. Location assignment ensures that students lead personnel who likely have more technical expertise than themselves: a definite leadership challenge for the students. Students also test their skills as a credible advisor when they brief recommendations to senior leadership at each location rather than instructors. The senior leaders then provide critical feedback. Finally, students continue refining instructor skills by teaching not only integration concepts to supporting personnel but also the debrief process.

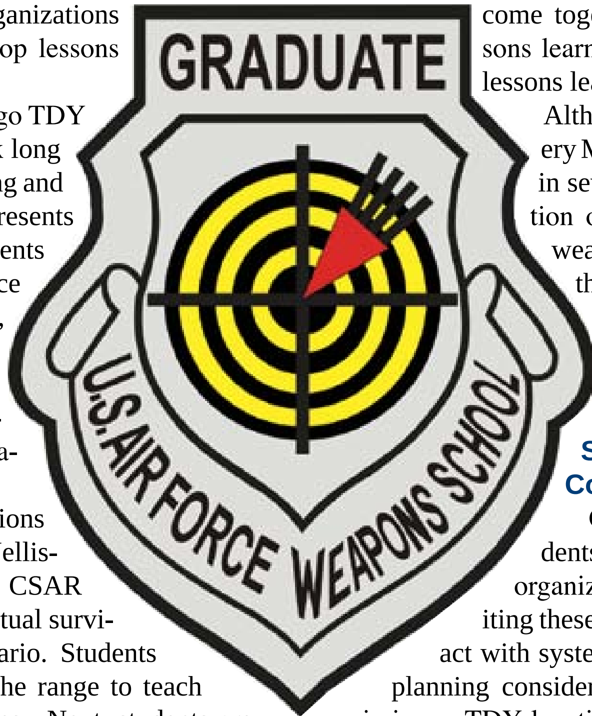
Instructors observe students to see how well they lead the debrief: collecting observations from distributed locations, identifying problems and associated root causes, and then developing fix actions. Instructors also evaluate how students teach the mission's lessons learned to all personnel supporting the exercise: a significant core weapons officer skill.

Ultimately, the DOM is not only an opportunity for the students to meet syllabus requirements, but also a chance for students to build relationships with the supporting organizations and learn first hand the processes involved. Additionally, DOM provides an arena for supporting organizations to refine their procedures and develop lessons learned.

Following the DOM, the students go TDY to Hurlburt Field, Florida, for a week long joint special operations forces planning and execution mission. The scenario presents numerous opportunities for the students to present informal lessons on space capabilities, develop exercise inputs, and assist in developing command and control procedures. Toward week's end, students have the opportunity to fly on various special operations aircraft.

Remaining Integration Phase missions concentrate on integration with the Nellis-based WICs. Students learn tactical CSAR procedures then play the role of an actual survivor on the NTTR in support of a scenario. Students then use the knowledge gained on the range to teach a focused lesson on CSAR procedures. Next, students are exposed to fighter air-to-ground procedures and planning processes before flying the mission in a fighter aircraft. Two missions focus on AOC execution. Space students develop and execute appropriate AOC processes from the Combined Air and Space Operations Center-Nellis to support the CSAR or TMD scenario being flown on the NTTR.

Throughout Integration Phase, students should take every available opportunity to teach students from other WICs space capabilities and limitations as they apply to the problems they must solve. At the completion of each mission, the space students share their lessons learned with the other WICs as well as help construct overall group lessons learned that apply to all WICs.



Mission Employment

The capstone phase for all students is ME. ME consists of multiple large force employment missions, each with its own focus such as strategic attack and dynamic targeting. ME participation is not limited to the USAF WICs but receives support from across the services, enabling true joint planning and execution.

Core III precedes formal commencement of ME and focuses on exposing all students to operational level planning and AOC processes. Core III concludes with an operational planning exercise, typically lead by a space student.

Space students participate in two to three ME missions over the course of two weeks. Missions start with one to two days of mission planning followed by execution and debrief. Instructors provide the space students a list of space assets available for the mission. Students determine where space can and cannot support the overall plan and integrate appropriately during planning, execution, and debrief. Instructors and space unit augmentees simulate supporting organizations during all aspects of the mission. As in Integration Phase, all students come together to determine overall group lessons learned and share weapon system specific lessons learned.

Although space does not participate in every ME mission, space effects play key roles in several missions. For example, elimination of an adversary's SC-19 anti-satellite weapon to preserve friendly assets forms the basis of the dynamic targeting mission. In effect, all Weapons School students work together to maintain space superiority.

Supporting Syllabus Components

Outside the phase construct, the students go on several TDYs to the space organizations discussed in the syllabus. Visiting these organizations allows students to interact with system experts, ask questions, and solidify planning considerations students will use during their missions. TDY locations include the JSpOC, the Colorado Front Range, and the national capital region. Timing of the visits varies with each class based on availability of supporting organizations.

Also spread throughout the course, Weapons Officer Training (WOT) classes directly contribute to developing core weapons officer skills. WOT subjects include mission briefing, mission planning, debrief procedures, tactics development, and the Tactics Review Board process. Of note, instructors lead students in developing Tactics Improvement Proposals based on the DOM execution as part of the WOT process.

All students refine their writing skills by completing a 15-20 page paper on a near term issue (less than 18-24 months) that can be solved through the use of TTPs rather than a material fix. Ideally, a student would write on a problem facing either their gaining or losing squadron and then go on to implement the solution after graduation. Students that do well on their paper focus on a specific problem (or portion of a problem) and explore all details necessary for an executable solution rather than generically covering a broad topic. The paper can be a daunting challenge to fit into the already crowded syllabus, and certainly tests the student's time management and prioritization skills. Assigned soon after selection to the USAFWS, each student's advisor provides guidance throughout the process.[13]

Finally, two supplemental programs outside the 328 WPS help prepare students for success in the Space WIC. All students attend a Weapons School Preparation Course (WSPC) at the National Security Space Institute before arriving at Nellis AFB. WSPC facilitates smooth transition into Core I and Systems Phase by highlighting space and Air Force systems contributing to the joint fight.[14] While still in its formative stages, local spin-up conducted by the wing weapons and tactics function further prepares students for the rigors of the Space WIC. Unlike WSPC, wing spin-up is unit and individual dependent. Areas of focus for wing spin-up programs can include unit specific TTPs and individual student weaknesses such as platform instruction. Wing spin-up also provides an excellent opportunity to begin work on the student paper with a weapons school graduate who is familiar with the unit's TTPs.

A View From the 328 WPS

Although the Space WIC syllabus teaches students the skills necessary to become an effective weapons officer, certain traits lend themselves to success in the program. First and foremost, an applicant should be a competent classroom and weapon system instructor. Spending extra time at the Weapons School honing one's instructor skills can detract from academics and missions. The applicant should be comfortable learning and teaching technical concepts, disciplined to learn on one's own, and be a creative thinker. These traits facilitate solving complex problems in a resource constrained environment. Finally, to master the debrief process, an applicant should be receptive to constructive feedback and have an ability to conduct an honest self assessment.

The Future

As previously stated, the Space WIC syllabus constantly changes to meet the needs of the USAF. The 328 WPS is considering several changes to the syllabus and squadron objectives to ensure the USAFWS continues to provide quality graduates to the USAF. One recent, significant change is splitting every Systems Phase mission into two shorter sorties: effectively doubling the number of Systems Phase missions. This provides each student additional opportunities to refine their communication, planning, problem solving and, most importantly, debrief skills. Additional initiatives include further integration of JSpOC processes throughout the syllabus, live (vice simulated) support from space units during ME and DOM, and transferring select courseware to read-ahead manuals that can be discussed as part of wing spin-up programs.

To ensure these changes meet the needs of the USAF, the 328 WPS will host a syllabus review conference in the summer of 2008 at Nellis AFB. The 328 WPS welcomes inputs prior to and attendance by all concerned parties during the rewrite conference.

Conclusion

Adherence to squadron objectives and flexible instruction allow 328 WPS instructors to develop core and specialized weapons officer skill sets in all space students. Graduates leave the USAFWS equally prepared to assume either the weapons and tactics function in an AFSPC squadron or to integrate space effects at a theater AOC. The program will evolve and continue to meet the diverse needs of the USAF for space weapons officers.

The USAFWS and 328 WPS are key components of an Airman's professional development. By training humble, approachable, and credible space weapons officers for the USAF, the USAFWS executes the AFSPC mission every day, "To deliver trained and ready Airmen with unrivaled space capabilities to defend America."

Notes:

[1] Gen Charles A. Horner, "The Legacy of the First Space War," *High Frontier* 3, no. 4 (August 2007): 11.

[2] General T. Michael Moseley, "Dominating the High Frontier: The Cornerstone of Global Vigilance, Global Reach, and Global Power," *High Frontier* 3, no. 4 (August 2007): 7.

[3] General Kevin P. Chilton, Space Warfare Symposium, remarks, Keystone, Colorado, 19 June 2007, http://www.afspc.af.mil/library/speeches/speech.asp?id=334.

[4] USAF Weapons School, "History of the USAF Weapons School," https://wwwmil.nellis.af.mil/usafws/wshistrys.htm.

[5] Col Scott Kindsvater, "USAF Weapons School," PowerPoint presentation, USAFWS, Nellis AFB, Nevada.

[6] Ibid.

[7] Col Scott Kindsvater, USAFWS/CO, Nellis AFB, Nevada, interview, 4 October 2007.

[8] Kindsvater, "USAF Weapons School."

[9] Ibid.

[10] Ibid.

[11] ACC Syllabus, *Space WIC*, April 2007, 11-13.

[12] Michael J. Lutton, commander, 328 WPS, "328th Weapons Squadron Objectives," 9 July 2007.

[13] See the Weapons School links in the bibliography to read previous student papers.

[14] Peterson AFB, "National Security Space Institute," fact sheet, http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=4933.

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After graduating from OTS in 1995, Major Putman began his career as an aircraft maintenance officer assigned to the 16th Special Operations Wing, Hurlburt Field, Florida. Major Putman led both flightline and backshop maintenance functions concluding as Weapons Flight commander, 16th Equipment Maintenance Squadron. After completing USMT (Top Graduate) and DSCS III IQT, he performed satellite vehicle operator, launch officer, and chief, DSCS III Operations duties at the 3rd Space Operations Squadron. Major Putman completed Weapons School in 2002 prior to becoming chief, Space Operations and later chief, Space Plans with the 609th Air Operations Group, Shaw AFB, South Carolina. He deployed numerous times to the Prince Sultan AB and Al Udeid AB CAOCs in support of OIF, OEF, and HOA operations.

Maj Putman is a graduate of Squadron Officer's School, Air Command and Staff College (non-resident), and USMC Command and Staff College (non-resident).

Sustaining Nuclear Expertise in AFSPC: A Way Ahead for ICBM Maintenance and Operations[1]

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I was to go back to a flying assignment, but General Curtis E. LeMay said, 'Go to maintenance. You need some experience in logistics' … It was a great move. It gave me a much better understanding of logistics and maintenance. I had thousands of airmen working for me. Normally commanders under the centralized system had few enlisted men working for them … It was a risk since in operational flying I could have moved up quickly to wing commander, but I realized, as General LeMay advised, I could learn a great deal more in maintenance.[2]

~ General David C. Jones, former Air Force chief of staff and chairman, Joint Chiefs of Staff

Building and preserving Department of Defense (DoD) nuclear expertise is a critical part of the nation's defense. The United States Air Force (USAF) plays a significant role in this endeavor by organizing, training, and equipping space and missile operations officers (Air Force Specialty Code [AFSC]: 13S) and munitions and missile maintenance officers (AFSC: 21M) to perform nuclear duties. Nevertheless, a 2001 study of DoD staff nuclear expertise "observed a general theme that officers with specialized nuclear expertise are getting harder to find."[3] Further, the report suggested that "nuclear expertise has become "diluted" (i.e., officers possess less depth of expertise/have fewer total years in nuclear assignments) compared to a few years ago."[4] For 13S officers, this "dilution" occurs when missile launch officers are cross-flowed to space operations assignments. In the 21M community, dilution occurs when officers crossflow into strictly conventional munitions billets. Other clear causes of the nuclear expertise challenge include: "smaller force structure/career fields, the loss of mission preeminence, and perceptions that nuclear experience is of declining value in an Air Force career."[5] These challenges must be addressed effectively because nuclear weapons in general and intercontinental ballistic missiles (ICBMs) in particular, will continue to play a vital role in the defense of the US for the foreseeable future. The purpose of this article is to discuss these issues and offer potential solutions to the nuclear expertise challenge.

The shrinking size of the ICBM community over the past 15 years has decreased the number of USAF officers with nuclear expertise. Specifically, the smaller number of experienced ICBM maintenance officers has forced the ICBM community to place either junior officers in billets normally reserved for more senior officers or accept ICBM operations personnel with no maintenance experience into leadership roles as operations officers (DO) or squadron commanders (Sq/CC) in maintenance groups. Additionally, the prospects for developing quality, experienced ICBM maintenance officers to fill DO or Sq/CC positions for the future are not positive. Force shaping policies and the fact ICBM maintenance is a subset of munitions maintenance could mean that many officers may not have the required experience in the ICBM community. In short, the Air Force is simply not growing enough future ICBM leaders with an understanding of maintenance and operations. The ability for officers to cross-flow back and forth between ICBM operations and maintenance is clearly needed. Senior leaders must create a vision for the future to ensure knowledgeable, experienced personnel are in charge of maintaining US Strategic Command's (USSTRATCOM) nuclear global strike capability.

Personnel in the combined munitions and missile maintenance and the combined space and missile operations career fields perform so many different tasks that the unique nuclear focus is often lost. This is a result of the 1999 merger between munitions and ICBM maintenance, as well as the 1994 merger between space and ICBM operations. "As an unintended consequence, the Air Force's core nuclear expertise became dispersed across the force and harder to identify and track."[6] The majority of 21M officers on the munitions side of the career field focus primarily on conventional operations and 13S officers are now expected to major in one aspect of space operations and minor in another to remain credible in their career field. The result in both cases is an erosion of nuclear expertise. Moreover, today's Air Force officers are receiving less education on nuclear issues than they have in the past. Of the nearly 700 officers who attend intermediate development education, only seven are selected each year for internships at the national labs.[7] Moreover, as a National Defense University study stated, "senior service colleges spend less time on strategic nuclear planning and targeting and deterrence theory."[8] While this may be somewhat appropriate given the current strategic environment, the DoD and the USAF must guard against a lapse in the nation's capability to operate, sustain, and employ nuclear weapon systems. 20th Air Force (20 AF) has done a good job over the past two years addressing education at the basic and intermediate levels by creating the Minuteman III tactics, techniques, and procedures volume, as well as developing an advanced ICBM course to be administered by the National Security Space Institute. However, these initiatives will take time to build the nuclear expertise the service will need in the future. Further, education is only one piece of the puzzle, the appropriate level of experience is also necessary. Part of an approach to filling this experience gap will be better management of nuclear career fields such as 21M and 13S.

Establishing a path by which 13S officers can both broaden their knowledge while at the same time increasing their understanding of the nuclear and ICBM missions is needed. A tour in ICBM maintenance following an ICBM operations assignment provides this breadth and depth of nuclear experience. In other words, an ICBM operator who broadens into ICBM maintenance should be as competitive for senior leader positions as the officer who broadens into space operations or space acquisitions. Making ICBM maintenance a safe option (with regard to future command competitiveness) for ICBM operations personnel to pursue will build more well-rounded ICBM officers and provide the command with another avenue for producing both nuclear and maintenance expertise.[9] Additionally, ICBM maintenance officers also face uncertain futures as part of the larger 21M community. They too must be allowed to broaden their ICBM experience.

Force shaping has eliminated and may continue to eliminate too many junior ICBM maintenance officers from the pool of future senior flight commanders, DOs and Sq/CCs. Since 21M officers include ICBM maintenance and munitions maintenance personnel, balancing the year groups could negatively impact the nuclear experience in 20 AF. For example, if a 21M year group is the "correct" size, a solid percentage of that year group with a strong background in ICBM maintenance may or may not exist. Complicating this issue is the fact that prior-service officers with 15 or more years in service are ineligible for force shaping. The prior service officers in the affected year groups are so senior (as far as total active Federal military service to date—15 plus years) that the possibility of those officers remaining on active duty to assume leadership roles is remote. This is an important factor because many of these prior-service officers may not serve long enough for DO or CC opportunities to open for them.[10] While force shaping is certainly a factor, another problem facing the ICBM maintenance community is that the 21M career field consists of munitions and ICBM maintenance officers and the cross-flow between these two communities is minimal despite the same AFSC. With limited cross flow and the small size of the ICBM maintenance community, future force shaping decisions are sure to impact missile maintainers, as the afterthought of the career field, more than those officers assigned to aircraft related duties. So, where does this leave the ICBM maintenance community?

The gap in strategic leadership and vision on the part of the ICBM maintenance community has forced maintenance group commanders (MXG/CC) in 20 AF to place inexperienced officers in critical positions. For example, the Missile Maintenance Squadron's Generation Flight and the Maintenance Operations Squadron's Maintenance Operations Flight are typically forced to place five-year captains in billets designated for majors. Moreover, these officers may or may not have had ICBM experience for their entire career. At one base, for example, these two premier flights are led by five-year captains with a combined ICBM maintenance experience level of only five years. One would hope that with such junior officers leading flights, the DOs would provide the oversight of a more seasoned officer. Unfortunately, a high percentage of the maintenance DO positions (O-5 billets) in 20 AF have been typically filled with junior majors. Further, these junior officers rarely have any significant level of experience at a systems wing, major command or combatant command working ICBM issues. While these officers may be very knowledgeable of field maintenance activities, they have not been allowed to mature into the ICBM leaders and capable mentors needed by 20 AF.

Senior leaders in the ICBM maintenance community are responsible for addressing these personnel issues both internally and externally. Internally, MXG/CCs have to weigh the drawbacks of placing junior officers in billets more appropriate to a senior officer. In 20 AF, the response to this internal challenge has been to "settle" with whatever the external environment (21M community at large) provided. One of the risks of settling for junior officers in key roles is that senior noncommissioned officers (SNCOs) carry more than their fair share of the burden as opposed to the officer serving as an equal counterpart. Additionally, the ability of junior officers to mentor subordinates becomes problematic because of their own lack of experience. Finally, in the case of settling for younger DOs, Sq/CCs are forced to use an officer five years (or more) their junior as their deputy in the unit. As with junior flight commanders, junior DOs lack the broad USAF experience to be an effective leadership asset for mentoring. While these internal considerations impact leaders at the tactical level, the external environment also presents challenges at the strategic level.

Two external pressures will challenge senior leaders when addressing the problem of declining ICBM maintenance experience. The first is the dogmatic adherence to maintaining a combined 21M career field. Despite the reality that munitions leaders prefer officers with predominantly munitions experience and ICBM leaders prefer those officers with a majority of ICBM maintenance experience, many senior ICBM maintenance leaders still argue for a combined munitions and missile maintenance career field. This argument lacks merit because there are no commanders in 20 AF with a primarily munitions background. Further, as of September 2007, there are only two officers in the position of operations officer or above with operational munitions experience in the 20 AF maintenance community.[11] Additionally, while there are a few officers hired for munitions command, ICBM maintenance units prefer officers with ICBM experience—operations and maintenance. This remains the case with all three of the current MXG/CCs (and their deputies) having ICBM operations experience. Moreover, a clear majority of the current ICBM maintenance leadership in 20 AF have ICBM operations experience, including some who have spent the majority of their careers in operations.[12] A second external pressure is the resistance within the ICBM community to allow 13S cross-flow to maintenance. Despite the fact that most ICBM maintenance leaders came from operations, maintenance parochialism and operations bias in favor of operations-specific jobs prevents the much needed ICBM cross-flow to increase nuclear expertise. The operations-maintenance conflicts that naturally occur have prevented some senior missile maintainers from viewing a merger of the ICBM operations and maintenance career fields in a positive light. Additionally, 13S leaders resist the idea of cross-flowing some of their sharp officers to maintenance for fear of sidetracking their careers. All senior leaders in the ICBM community need to challenge these beliefs and work to move beyond tribal loyalties to establish the good of the ICBM mission as their primary goal.

Conforming to the status quo with regard to maintenance officer manning is a "caretaker" approach and equates to accepting less capable leaders than our SNCOs, troops and the mission deserve. A vital element to improve maintenance officer manning is the ability of ICBM leaders to negotiate a viable solution with disparate factions. In this case, the two groups that need to be educated on the value of ICBM maintenance manning changes are the ICBM operations community and the senior leaders in the ICBM maintenance community who believe that better 21M career paths reside in the larger USAF maintenance community (aircraft and munitions maintenance). The first step to effective negotiation is to understand not only what outcome should occur but why that outcome is desired. 20 AF needs to create and maintain a strong corps of nuclear and ICBM experts as the final outcome. To create this expertise, officers must build a solid foundation in both missile operations and missile maintenance. In order to better accomplish this task, a formalized cross-flow between operations and maintenance is needed. Missile operations duty provides 20 AF officers with skill sets vital to maintaining safe, secure ICBMs on alert. These skills include a thorough understanding of security, technical order usage, code procedures, weapons system safety rules, standardized training and evaluation processes, and an intimate knowledge of emergency war order execution requirements. Maintenance officers are taught how to produce credible combat capability and sustain a weapon system. They understand the challenges associated with modernizing a weapon system and the monetary and logistical factors that impact that mission. Moreover, these officers gain important leadership and management skills not typically available to operations crew members who rarely get the opportunity to supervise Airmen as junior officers. Another important aspect is that 13S and 21M officers both possess valuable expertise in nuclear weapon systems.

To build a more solid corps of "missileers," it is essential that nuclear expertise in both ICBM operations and maintenance be tracked as part of the Air Force Space Command (AFSPC) space professional program. In order to ensure the ICBM mission remains viable through at least 2030, experts in ICBM operations, maintenance and acquisition need to be created and maintained.[13] 13S officers are already a part of space professional cadre but core 21M officers should also receive space professional credit because they maintain and sustain AFSPC's only force application system. Additionally, 21M officers have the skill sets to provide logistics and maintenance expertise to the command as a whole. To ensure AFSPC preserves this logistics and maintenance expertise while maintaining the ability to carry out the ICBM mission in the future, the cross-flow between the 13S and 21M communities needs to be encouraged and tracked within the space professional program. There is a precedent within AFSPC for such a program. AFSPC acquisition professionals have been successfully able to cross-flow back and forth between space operations and space acquisition assignments. Typically these cross-flows occur between Space and Missile Systems Center or the National Reconnaissance Office (NRO) acquisition programs and either NRO operations duty or AFSPC space operations assignments. As part of the AFSPC space professionals program, space acquirers have been able to cross over between space acquisition (System Program Office/NRO) assignments and operations assignments easily. Despite being part of the larger Air Force acquisition community, the pressure upon these acquisition officers to flow to air acquisition is reduced because space acquisition professionals have a four-star advocate, the AFSPC/CC who defends the need for a focused cadre with space acquisition expertise. This ability to transition between operations and acquisition assignments throughout a career provides breadth and depth to these acquisition officers. Similarly, officers in the 13S or 21M career fields who are allowed the unfettered ability to move between ICBM maintenance and operations builds a depth of nuclear and ICBM experience as well as breadth in the logistics/maintenance area. Further, this breadth and depth is far more valuable to the ICBM mission area than the ICBM operator who performs a space operations crew tour or the 21M doing conventional aircraft munitions or maintenance duty. This is not to say that all officers should stay in the ICBM business. However, it is important to establish a core number of officers to champion this critical nuclear mission area. Weapons School graduates will eventually provide one avenue for ICBM operations experts to remain in the ICBM community without fear of negative career impacts. An increase in 13S cross-flow opportunities to ICBM maintenance will likewise help to provide an expanded career path for ICBM experts. Further, this cross-flow will meet the need for more leaders on the 21M side.

ICBM leaders of the future need to have knowledge depth in the nuclear business. Operations and maintenance experience at the unit level is a must. However, the growth of nuclear experts must continue through the field grade ranks. The following is a vision for how future ICBM experts should be developed. After completing an initial assignment in ICBM maintenance, an officer should transition to ICBM operations for a three-year crew tour. Successful performance during this tour will open doors for future operational assignments. These future assignments include instructor and planner duties in unit weapons and tactics flights, staff officer duties at 20 AF or AFSPC in nuclear areas, or as strike planners or nuclear command and control experts at USSTRATCOM. Following a staff assignment, this officer could then return to the 21M community as the generation flight commander or the maintenance operations flight commander or back to an operations group as chief, standardization and evaluation or training flight commander. On the operations side of the house, crew members with a mix of instructor, evaluator, and/or emergency war order experience should cross over for a maintenance assignment. These officers could then move on to an acquisition assignment at the depot to perform ICBM sustainment duties at Hill AFB, Utah, or transition back to operations for duties at 20 AF, AFSPC, or USSTRATCOM. The key to the success of this endeavor for either the core 13S or 21M officer is the ability to freely cross flow back and forth between the operations and maintenance communities.

Establishing a 21M/13S cross-flow program will meet with institutional resistance. 20 AF lacks 13S officers with a solid understanding of missile maintenance although these officers fill the majority of ICBM officer billets at both AFSPC and USSTRATCOM. This lack of maintenance knowledge leads to operations-centric decisions. Further, maintenance officer duty is not seen as a positive career option by most senior 13S officers and results in a lack of leadership support for 13S to 21M cross-flow. 21M officers are similarly discouraged from performing an operations tour. Many senior 21M leaders in AFSPC see themselves as part of the larger USAF maintenance community despite the reality that the missile maintenance career field is not valued by the maintenance fields associated with aircraft. Indeed, the future of ICBM maintenance is tied more closely to ICBM operations than it is to the aircraft maintenance community. Senior 20 AF leaders need to address these challenges and create a structure by which strong officers can flow between operations and maintenance for an entire career. Officers who possess solid experience in both communities will possess the nuclear expertise required to be better able to effectively address the future challenges of the ICBM force.

General Wilbur L. "Bill" Creech, former Tactical Air Command commander said, "the first duty of a leader is to grow more leaders." In 20 AF, senior ICBM maintenance leaders have not intentionally grown leaders like themselves. Despite the fact that most ICBM maintenance leaders have performed in both operations and maintenance, they have been slow to adjust maintenance career paths to formalize a process to continually do so. The ICBM officers of the future must be able to work in either the operations or logistics communities. This ability will not only be good for the ICBM community, it will communicate to outsiders that AFSPC and the USAF are good stewards of the nuclear mission. The creation of group (maintenance and operations) and wing commanders with a mix of ICBM operations and ICBM maintenance experience will encourage the needed cross-flow to sustain nuclear expertise in the ICBM business. Senior leaders must provide a vision for the future larger than the challenges associated with putting missiles on alert. Without such a vision, the endeavor to safeguard nuclear expertise and develop more ICBM leaders is at risk of failure.

Notes:

[1] I wrote the following article as an ICBM officer--not as an ICBM maintainer or as an ICBM operator. This article is a think-piece that I hope will encourage serious discussion about the improvement of the nuclear mission in general and the ICBM mission in particular.

[2] Edgar F. Puryear, *American Generalship—Character is Everything: The Art of Command* (New York: Ballantine Books, 203).

[3] Nuclear Deterrence Issues and Options Study: A Baseline Assessment of DoD Staff Nuclear Expertise Final Report, 21 December 2001, 7.

[4] Ibid., 6.

[5] Tom Neary, "Twentieth Air Force – From B-29s to ICBMs: A Proud Past…A Bright Future," *Air Force Magazine*, 17 February 2000, 6, http://www.airpower.maxwell.af.mil/airchronicles/cc/neary.pdf.

[6] Center for Counterproliferation Research--National Defense University and Center for Global Security Research--Lawrence Livermore National Laboratory. "US Nuclear Policy for 21st Century: A Fresh Look at National Strategy and Requirements Final Report," 4-34, http://www.ndu.edu/inss/books/Books_2001/US%20Nuclear%20Policy%20-%20Nov%2001/USNPAF.pdf.

[7] Information taken from 2007 message from AFSPC dated 141553Z March 2007, Subject: CY07 Intermediate/Senior Developmental Education (IDE/SDE) Designation Board (DEDB) Nomination Procedural Message and Civilian Developmental Education (CDE) Nomination Call.

[8] US Nuclear Policy for 21st Century, 4-35.

[9] AFSPC needs to change the lens through which they view 13S officer experiences. Moving from one operations assignment to another operations assignment does not broaden our officers' knowledge and capabilities; it only exposes them to multiple systems. In short, an ops to ops move is not the correct broadening endeavor to build nuclear expertise.

[10] Since most of these officers have four to six years of commissioned service plus another 10 years of enlisted time, becoming a Sq/CC will require officers to stay on active duty beyond 26 years—a commitment many are not willing to make. Unfortunately, the effects of these manpower decisions will not be felt for 10 to 12 years when the lack of qualified/experienced ICBM maintenance officers manifests itself just as we try to fill critical Sq/CC positions.

[11] For the purpose of this article, operational munitions experience is defined as munitions flight commander or munitions accountable systems officer (MASO).

[12] In 2007, the majority of the top seven positions at ICBM maintenance groups—MXG/CC, MXG/CD, QA chief, MMXS/CC, MMXS/DO, MOS/CC, MOS/DO—were filled by officers with ICBM operations and maintenance backgrounds. 13 of 21 MXG leaders in 20 AF have ICBM operations and ICBM maintenance experience. The experience of the remaining eight includes: two with ICBM and aircraft mnx experience; one with ICBM mnx and space acquisition experience; one with engineering, space lift mnx and ICBM mnx experience; one with only three years of ICBM mnx and rest space operations; one with space operations and ICBM mnx experience; one one with communications and ICBM maintenance experience.

[13] The nuclear competency in the space professional program needs to include the following shred outs: ICBM operations, ICBM maintenance, ICBM depot (sustainment), ICBM acquisition, and Nuclear munitions.

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The Dark Arts: Nuclear Education in the US Air Force

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Background: On the Shoulders of Giants

On 6 December 1941, the government of the United States discretely began assembling the nation's greatest minds and setting them to work on a single project. Under the aegis of the Manhattan Engineering District, around 130,000 physicists, engineers, mathematicians, Soldiers, Sailors, Airmen, and representatives of nearly every trade and profession attempted to, in the words of physicist Dr. Leó Szilárd, "… set up a nuclear chain reaction in a large mass of uranium, by which vast amounts of power … would be generated."[1] The Manhattan District's effectiveness in developing the first nuclear weapon can be attributed to the talents of the people involved, as well as to the amount of support the program received at the highest levels.

Spurred on by the aggressive leadership of Brig Gen Leslie R. Groves and the brilliance of J. Robert Oppenheimer, the progress was amazingly rapid, especially considering the scope of the program. Extending from coast to coast, the Manhattan District constituted a responsive infrastructure that conducted basic and applied research, obtained and refined raw materials, assembled components to precise technical specifications, weaponized the components, acquired the delivery aircraft, and trained the operators who later flew the attack missions.

Nuclear weapon education also received its start during this period, most notably with a series of five lectures given by Dr. Robert Serber during April 1943. His "indoctrination course" explained to a group of 50 young physicists, chemists, and engineers the aim of the Manhattan District's work at Los Alamos: "The object of the project is to produce a *practical military weapon* in the form of a bomb in which the energy is released by a fast neutron chain reaction in one or more of the materials known to show nuclear fission."[2] Serber's lectures became famous among the small group of *cognoscenti* familiar with the highly classified work and later became the theoretical grounding for what this paper will refer to as "nuclear education," that is, education in the science and mechanics of nuclear weapons.[3]

Naturally, there are many aspects of nuclear weapons, including policy, strategy, and tactics, which are all vital to a well-rounded nuclear education, but it is the true "dark arts"—the inner workings of nuclear weapons and their effects with which this article is concerned. Just as the Manhattan District physicists and engineers built upon their existing educational backgrounds to become conversant in the complexities of nuclear fission, hydrodynamics, and neutron scatter, a certain number of Air Force personnel will extend themselves into the realm of nuclear weapons so that they can competently advise policy makers on Air Force needs and capabilities and those of potential adversaries. This paper intends to examine why an aggressive nuclear education program is needed, the state of the Air Force programs, and discuss opportunities for those who wish to deepen their nuclear knowledge.

In today's post-Cold War world, the emphasis on nuclear weapons and warfare has been considerably lessened. However, as modern technology makes it increasingly easy for other nations to construct or acquire nuclear weapons, it is apparent that "the bomb" will be with us for a very long time, waxing and waning in its prominence on the world stage. In order to exact due diligence in the defense of the nation, therefore, it is incumbent upon the Air Force to maintain not only a capable deterrent to forestall enemy attack, but also to sustain an elevated level of discourse on this frequently very emotional subject. Engaging others domestically and internationally on nuclear issues helps to ensure that the implications and responsibilities they oblige are understood, as well as the consequences of failing to abide by them. How then, does the Air Force preserve the capability

The Trinity Site, Location of First Nuclear Test.

to enable both deterrence and discourse? As with any other difficult topic, the answer lies in education.

The Cold War

With the signing of the Atomic Energy Act of 1946, the military-led Manhattan District was dissolved and responsibility of design and assembly of nuclear weapons passed to the civilian Atomic Energy Commission, with military interests being taken into account via a Military Liaison Committee.[4] The Nuclear Weapons Complex (NWC), fueled by the competition of the Cold War grew progressively larger, eventually comprising 27 design and production sites as well as the Nevada Test Site. Employing hundreds of thousands of people and eventually spending more than $0.52 trillion for weapon development testing and manufacturing (in FY 2006 dollars), the NWC was an enormous undertaking by any standard.[5] During this time, nuclear weapons evolved from crude devices with questionable safety provisions and low yields to highly efficient weapons that could withstand all but the most cataclysmic accidents without fear of nuclear detonation.

The scientists and engineers who developed these weapons were some of America's best, helped into their careers by knowledge of the importance of their work to national security. On the military side of the equation were the designers and developers of the various delivery systems, platforms, and defense systems, which, between 1940 and 1996, consumed an additional $6.4 trillion (FY 2006 dollars) or approximately 29 percent of all military spending.[6] From 1950 to 1963, the US produced 39 new nuclear weapon systems and reached a maximum level of output of 7,000 weapons per year, a startling indication of both the level of talent organic to the NWC and the pressure the Cold War placed on it.[7] It is important to realize the scope of the effort to better understand the necessity of education and training. By no means was nuclear specialization unusual. In many circles within the military, it was simply expected. Stories of munitions personnel who spent their entire careers working on a single type of weapon abound (the B28, for example, had a particularly long 33-year operational lifespan). However, nuclear education was generally left to universities, most notably as part of the Air Force Institute of Technology's (AFIT's) Graduate Nuclear Engineering (GNE) program and augmented by weapons laboratories (Lawrence Livermore National Laboratory, Los Alamos National Laboratory [LANL], Sandia National Laboratories [SNL]) where required. During the 1980s, the GNE program took in from 14 to 16 officers per year.[8] The large number of active weapons programs provided many opportunities for military personnel to become educated.

Post Cold War and Nuclear Marginalization

The dissolution of the Soviet Union clearly delineated the start of a decline in the fortunes of the US nuclear establishment. The Cold War was won and the tactical Air Force pressed its new-found advantage over the strategic. Strategic Air Command (SAC) was eliminated as an Air Force major command, with US Strategic Command emerging as the joint strategic warfighting command. Responsibility for organizing, training, and equipping the former SAC personnel fell to a variety of other commands, none of which were initially well-equipped to handle it. Just as telling was the reduction in active weapons programs, which dropped to zero. Many opportunities to continue the nuclear education of military members were lost. By the mid-1990s, the AFIT GNE program's billets for Air Force personnel were cut from 16 to just two to four per year, with Army FA52 (Nuclear Research and Operations) officers eagerly taking the available slots.[9] Problems with the handling of nuclear weapons and personnel emerged almost immediately. A Defense Science Board Task Force report on Nuclear Deterrence published in 1998 noted several trends directly affecting or affected by nuclear education:

- Credible deterrence requires that policy and strategy be underpinned by ready forces (trained and exercised) and national leaders' confidence in the forces.[10]
- The most difficult issue and the one with the most long term implications is the widespread perception in both the Navy and Air Force that a nuclear forces career is not the highly promising opportunity of the past era.[11]
- Issues (i.e., weapons of mass destruction threats from proliferation, ambiguous requirements, etc.) are more, not less complex, than the classic Cold War issues and require far deeper and broader intellectual focus than is evident at present.[12]
- The Navy has significantly downsized nuclear capability but has maintained a strong program of managing nuclear experienced personnel. There are programs to train, track, and provide career growth to officer, enlisted and civilian personnel with nuclear expertise.[13]
- While the level of expertise in Air Force nuclear capable operational units remains robust, the Air Force has been through a serious decline in focus on managing, tracking, and nurturing nuclear qualification in support forces and staffs.[14]

The report also highlighted a number of "go-dos" for the Air Force in the area of tracking military nuclear expertise, specifically:

- Assign experienced individuals to critical billets
- Develop career paths to ensure future experience
- Nuclear science and engineering track
  - Small, critically important, scientifically oriented
  - First assignment experience in nuclear systems
  - Select for MS/PhD-level education
  - Career development in Department of Energy (DOE) labs, Defense Threat Reduction Agency (DTRA), United States Strategic Command (USSTRATCOM), major command
  - Available for key assignments at HQ/AF, Project Officers Groups, and so forth
- Nuclear operations track
  - First assignment in intercontinental ballistic missile (ICBM), space, aircraft nuclear systems
  - Broaden in key billets in HQ/USAF, Office of the Secretary of Defense, Joint Staff, STRATCOM[15]

As will be seen, most of these suggestions were taken to heart by the Air Force and later implemented.

In addition to the Defense Science Board report, the National Defense Authorization Acts of 1997 and 1998 contained language establishing a "Commission on Maintaining United States Nuclear Weapons Expertise," chaired by ADM Henry "Hank" G. Chiles, USN, retired, former USSTRATCOM commander. In February 1999, the Commission issued its final report, which noted 12 deficiencies and offered 12 recommendations for addressing them.[16] The report highlighted problems that the DOE had known for quite some time, specifically: the lack of new weapons programs, competition from the private sector and an aging workforce represented clear threats to the ability of the NWC to maintain existing weapons under the Stockpile Stewardship Program and to reconstitute a weapon development program should the need emerge.

Two of the Chiles Commission recommendations dealt specifically with the Department of Defense (DoD): "strengthen the DOE-DoD relationship" and "create a permanent Defense Programs Advisory Committee," though neither contained specific nuclear education language.[17] However, the recommendation to "expand training and career planning programs" later had a direct impact on the Air Force's program to educate nuclear experts, as it specifically called out the SNL Weapon Intern Program and the LANL Theoretical Institute for Thermonuclear and Nuclear Studies (TITANS) as being positive examples of ways to bring new laboratory employees up to speed on nuclear weapons.[18] These two programs later formed the basis for the Air Force National Laboratory Technical Fellowship Program (NLTFP), which continues today.

The problems highlighted by the Chiles Report were sufficient for the Congress to demand a response from both the DOE and the DoD. The National Defense Authorization Act for Fiscal Year 2000 required that the secretaries of Energy and Defense present "a joint plan setting forth the actions that the secretaries consider necessary to retain core scientific, engineering, and technical skills and capabilities within the DOE, the DoD, and the contractors of those departments in order to maintain the US nuclear deterrent force indefinitely."[19] The resulting report indicated that while "[t]he Air Force does not have a specific retention program for personnel with nuclear experience," it was making progress in identifying and tracking "existing nuclear experienced personnel, both military and civilian" and that it annually sponsored "three personnel to attend an intern program at SNL" (i.e., the Sandia Weapon Intern Program).

Maj Gen Robert L. Smolen, then director, Nuclear and Counterproliferation on the Air Staff summed up the problem succinctly in testimony before the Senate Armed Services Committee in April 2003:

> The warfighting edge depends on the dedication, professionalism, and sacrifice of the men and women in our Air Force. Without our people, even our most effective weapon systems are of little value. As always, we will continue to place the utmost emphasis on recruiting, retaining, equipping and training our entire nuclear force. However, our cadre of experienced nuclear engineers, scientists, and even military leaders is declining. As they retire, they take years of experience away with them.[20]

It should be noted that General Smolen was one of the strongest voices advocating the rebuilding of nuclear expertise in the Air Force. Air Force participation in the Sandia Weapon Intern Program and later creation of the NLTFP is largely attributable to his efforts and those of his office.

Most recently, the Deputy Assistant to the Secretary of Defense for Nuclear Matters, Mr. Steve Henry offered up another look at nuclear personnel and skills retention as a topic for a 2007-2008 Defense Science Board study. Being almost ten years removed from the original Chiles study, it seemed fitting that ADM Chiles once again lead the study. Interviews are currently being conducted around the country in an effort to once again characterize the health and status of the nuclear workforce. According to Mr. Dan Wilmoth from the Nuclear Matters Office, "Mr. Henry is keenly interested in nuclear deterrence skills." He pointed out that as the number of weapons decreases, each weapon becomes proportionately more important, with experts on the weapons growing consequently in importance. As the size of the workforce decreases, finding experienced personnel becomes proportionately more difficult as well. These factors combine to make finding leaders and experts for specific weapon systems more difficult, particularly in a timely fashion. Though the results of the study won't be released until June 2008, Mr. Wilmoth indicated that preliminary results seemed to show an improvement in the state of the workforce as compared to the 1999 Chiles study. As one might expect, those work centers that are conducting meaningful research and development on high priority programs seem to be doing the best. "People want real weapons programs doing real work," he said.[21]

Why Do We Still Need Nuclear Experts?

For sixty years, nuclear weapons have been one of the Air Force's most vital mission areas. The end of the Cold War thrust the nuclear mission into a rhetorical back seat, and, for a variety of reasons more political than logical, it appears moribund. But while some voices in the US wish to free the nation from its nuclear past, other significant national actors envision a nuclear future that will either allow them to exert their influence upon their neighbors or destroy them outright. These more recent concerns about proliferation combined with the increasing probability of acts of nuclear terrorism have once again increased the likelihood that nuclear weapons will see use somewhere in the world. Because of this increasing danger, it is vital that the Air Force have not only people who understand how to employ nuclear weapons in wartime, but also understand their construction, inner workings, and effects. A nuclear detonation in peacetime is most likely to be either the result of a terrorist attack or an accident, and in either case, decision makers will need to understand the implications of the event, which are manifold—though not necessarily apocalyptic. When thinking about nuclear weapons, a cool head—both rare and immensely valuable—comes from education given by true experts on their subjects. Fortunately, capable teachers are readily available in the programs available to Air Force personnel.

In addition, it is important for the Air Force to ensure that its

Bringing younger Airmen into the nuclear fold is essential for maintaining its vitality and allows for them to be further mentored by their superiors, ideally vectoring them into assignments and opportunities that are valuable for both the Air Force and the individual.

corps of nuclear expertise is constantly being revitalized. Having a force that is too old and retiring and having one that is too young both present problems, as the National Laboratories have discovered. Bringing younger Airmen into the nuclear fold is essential for maintaining its vitality and allows for them to be further mentored by their superiors, ideally vectoring them into assignments and opportunities that are valuable for both the Air Force and the individual. A similar danger lies trying to reconstitute a nuclear cadre with new or inexperienced personnel. The cessation of underground testing and active weapons programs makes it more difficult for personnel to "learn by doing." Nations attempting to regain expertise long neglected will find it an expensive undertaking. There are many hard-won "dark arts" lessons involved in the design and construction of nuclear weapons that were learned only through experience and that are soon forgotten. The example of reinstating nuclear pit production in the United States should be indicative of the difficulties involved. From the closure of the Rocky Flats plant in 1989 to the completion of the first QUAL-1 pit at the LANL TA-55 Plutonium Facility 4 in 2003, no nuclear pits were produced in the United States, nor could they be.[22] It took the intervening 14 years to build the infrastructure and relearn the required skills needed to produce a pit that could be qualified using DOE's QC1 quality control policy, meaning that the pit could be used in an existing weapon without requiring qualification through underground test.

The answer for the Air Force is to enthusiastically encourage and support a coherent and constant program of nuclear education paired with meaningful assignments to further sharpen skills and the ability to think critically about nuclear issues. The strategy currently being embraced by the Air Force comprises several programs that, while of limited availability, are also of very high quality. Additionally, nuclear experience is methodically tracked by the Air Force Personnel Center and the Space Professional Management Office for AFSPC personnel. The goal should be to produce well-informed personnel who can step into a variety of roles and lead whatever nuclear-related effort they are assigned with confidence.

Educational Opportunities: For Those Select Few Who Possess the Predisposition …

The opportunities available today for an Air Force-sponsored nuclear education are some of the best that have ever existed, despite the end of the Cold War and the current nuclear malaise. The NLTFP (formerly the Nuclear Technology Fellowship Program or NTFP) has expanded from the original SNL program with the addition of LLNL, Oak Ridge National Laboratory (ORNL) and Argonne National Laboratory (ANL) at the Intermediate Developmental Education level and LANL, ANL and ORNL at the Senior Developmental Education level. The LANL program encompasses the first year of the aforementioned three-year TITANS course. From its first military participation in 1999 until the class of 2004, participants in the NTFP were chosen by a special board made up of nuclear-credentialed personnel from the Air Staff. The Class of 2005 represented the first year in which participants were chosen from IDE- and SDE-selected personnel under the Air Force Fellows program. The Sandia Weapon Intern Program started as a two-year program with a transfer credit agreement for an optional accompanying master of science degree in engineering mechanics from New Mexico Tech. Starting with the class of 2005, it was reduced to a single year as an Air Force fellowship and lamentably lost the master of science degree in the process.[23] The other laboratory fellowships have always been a one year in length and never carried an accompanying degree. They have, however, permitted a larger number of personnel to participate. While the Sandia program only accepted three or four Air Force interns, the NLTFP accommodates ten per year.

Other excellent opportunities to expand or establish one's nuclear education exist, including masters- and doctorate-level degrees through AFIT in nuclear engineering. This program has available courses in generic weapon effects as well as specific areas of concentration, such as prompt and residual effects, nuclear explosives engineering at a classified level as well as courses in simulation.[24] At a less technical level, numerous other courses exist for military personnel, such as courses via the DTRA Defense Nuclear Weapons School (DNWS). These courses tend to be targeted toward specific needs, such as for using nuclear fallout simulation software or for accident response command and control, but some more general classes are also available, such as "Introduction to Weapons of Mass Destruction for the 21st Century" and "Nuclear Weapons Familiarization Seminar."[25] Most courses are taught on campus at Kirtland AFB, New Mexico, but some of the courses travel to various bases with personnel requiring training and a distance learning program is under development. The DNWS is also the home of the excellent Weapons Display Area, a classified museum of nuclear weapons with many unique nuclear artifacts.

For those not able to travel to Kirtland AFB, there are additional courses available, such as the 20th Air Force-sponsored Advanced ICBM course. This course provides a background in a variety of ICBM disciplines including tactics, strike planning, security, and testing. Another option is a four-day Chemical, Biological, Radiological, and Nuclear class offered by Headquarters Air Force Directorate of Space and Nuclear Operations and generally targeted toward Air Force scientists.[26] It also contains a unit on the workings of nuclear weapons. This sort of "grass-roots" educational opportunity is an example of what can be done with a cadre of enthusiastic nuclear experts to expand the educational opportunities for those with an interest in nuclear matters. Additionally, those interested in improving their understanding of the nuclear community may want to consider joining an organization such as the Project on Nuclear Issues (PONI), sponsored by the Center for Strategic and International Studies. Founded in 2003 to discuss how to sustain the nuclear deterrent in a post-Cold War world, PONI amounts to a professional organization for discourse on all things nuclear and presents several conferences annually both in the US and the UK. It also provides a forum for the publication of scholarly papers on deterrence and nuclear-related issues.[27]

When taken as a whole, the Air Force nuclear education program can be characterized as small but relatively healthy, with excellent opportunities available at various levels. Improvements still need to be made, particularly with regard to more junior Airmen and civilians, easily achievable through an increased emphasis on nuclear studies in Air Force educational programs such as the excellent space professional courses taught at the National Security Space Institute and more support for the grass-roots efforts like the Advanced ICBM course.[28] While the NLTFP manning of 10 per year is probably sufficient, increasing available billets in the GNE programs would also be helpful for mid-level officers and civilians, as would making more PhD-level opportunities available for the more senior. The Air Force has always placed a strong emphasis on education for its people, and, considering the extremely high stakes involved, the field of nuclear weapons should be no different.

Notes:

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15 Ibid., 29.

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25 Defense Threat Reduction University, *Course Catalog 2008* (Albuquerque, NM: 2008) http://www.dtra.mil/documents/oe/FY08_DTRU_CATALOG.pdf.

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27 For those wishing to learn more about PONI, see their Web site: http://www.csis.org/isp/poni/.

28 When the author attended the 25-day 300-level Certified Space Professional course in August of 2006, ICBMs and nuclear employment merited less than 4 hours of instruction out of approximately 175 hours total.

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One Giant Leap for Space Intelligence Professionalism

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During the quarter-century of Air Force Space Command's (AFSPC) existence, the relationship between space and intelligence operators has been a strong partnership, albeit one that was marred by occasional mutual misunderstanding and frustration. Partially these problems were the result of an overall Air Force culture that was ambivalent about the role of the intelligence, surveillance, and reconnaissance (ISR) community. Partially they were the result of a space culture that, in the words of Lt Brent D. Ziarnick, "believed every problem in space is either technical or economic in nature."[1] And part of the blame falls on the Air Force intelligence community itself. The space intelligence community failed to build a space intelligence formal training program for nearly a decade after such rigorous training and education had become standard in the flying world. Thus intelligence professionals assigned to space units had less expertise than their counterparts in fighter or bomber units. This hurt the credibility of intelligence personnel within the command and thus perpetuated a culture in which intelligence could be largely ignored.

Taken together, these factors led to much wailing and gnashing of teeth among many intelligence professionals assigned to units in the space community. They believed that despite the fact that AFSPC operates platforms with ISR capability, there had been insufficient attention to both the systems architecture and the tactics, techniques, and procedures to process, exploit, and disseminate this information to the warfighter and the wider intelligence community. Despite the growing awareness of risk to space platforms, too often the space situational awareness (SSA) and defensive counter space communities neglected the vital questions of threat analysis and intelligence preparation of the battlespace that might better define the risk and increase survivability. Despite the growing awareness of the role of ISR personnel within the non-rated operations career family, there was no all-encompassing formal integration of intelligence personnel within the space community.

Despite awareness of these areas for improvement, there was little incentive for ISR personnel to spend enough time in the space community to truly develop expertise with the mission set. Hence, most intelligence professionals who were assigned to space command did a single assignment with a "touch-and-go" mentality. There was simply little reason to stay longer or to seek a second assignment in the community. But that is beginning to change.

Qualified intelligence personnel will soon be able to wear the space badge once the AFSPC commander as the Space Professional Functional Authority approves the final list of intelligence space professional positions. By taking this step, General Chilton recognized and acknowledged that formally adding ISR personnel into the space community is fundamentally a good thing for both the command and the Air Force as a whole. Properly training ISR personnel, and officially tracking their expertise, helps to fully integrate intelligence into the series of space missions, and thus helps to ensure that intelligence is no longer an afterthought in the space community.

From Conception to Reality

This change has been a long time coming. Indeed, the 2001 Commission to Assess US National Security Space Management and Organization (chaired by Donald H. Rumsfeld) spelled out a number of mission areas for space operations and prominently included ISR. But the initial implementation of formalized space professional accreditation largely bypassed ISR personnel and began by focusing the process on space operators, scientists, engineers, and acquisitions personnel. Some enlisted and officer Air Force Specialty Codes (AFSCs) were included in the initial plan, but other ISR AFSCs and some intel officers were prohibited from inclusion, even if they were serving in space or space intelligence squadrons.

This appears to have been more a factor of the inevitable growing pains of organizational change, rather than an intentional slight. As the professionalization concept matured, more AFSCs were added. Thus, inducting intelligence personnel formally into the space community finally acknowledges the unique training, skills, and contributions of ISR personnel to the space mission set.

It is important to note that, as with other specialties inducted into the space professional program, earning space badges does *not* constitute the granting of a secondary AFSC. Indeed, the space badge is not an AFSC emblem. Rather, it is a badge worn by those of any applicable AFSC who are qualified space professionals to include communications and logistics professionals. In fact, even Army personnel attached to that service's Space and Missile Defense Command are wearing the Air Force space badge. Intelligence and communications personnel who earn their space wings will be granted a special experience identifier (SEI) for space operations.

This does not mean, however, these newly-minted space professionals will be "trapped" in space billets for the rest of their careers. There is a persistent worry among ISR personnel that being granted any particular SEI will pigeonhole them and dramatically limit their future viability across the incredibly broad spectrum of positions within the intelligence community. These fears, however, appear to be groundless.

"We'll manage space intelligence specialists appropriately," said Maj Jeff Stockwell, deputy chief of the Intelligence Officer Assignment Team. "We'll diversify them outside of space but tap into their expertise as required at appropriate points in their career." Major Stockwell also noted that intelligence personnel with space backgrounds could use that expertise outside of space command (for example within the Air Force ISR Agency or at the Air Staff) just as easily as they could move along an entirely different career path (such into targeting or collections). "I don't see more than two assignments within AFSPC itself," he said.

The Space-Intelligence Partnership

Space professional accreditation helps to forge a stronger partnership between space and intelligence personnel. The complex nature of space operations in the modern world makes the old paradigm of having space personnel viewed as the sole operators of the mission (with support provided by ISR personnel) obsolete. Today's operations call for members of multiple AFSCs working in tandem as a single organized crew to ensure mission success. Although this may be a new concept within AFSPC, it isn't as big of a paradigm shift as it first may seem.

Predator crews, for example, are an inseparable mix of a pilot and intelligence specialist, who collaborate to fly the aircraft, operate the sensors, identify targets, and fire missiles. They are backed up by a team of communicators, maintainers, and so forth, and are tied into the larger command and control ISR community via the Distributed Common Ground System. For space systems and missions, one should look at the role of intelligence operators in much the same way.

Indeed, there is a great deal of mission growth potential in the space ISR realm, and in order to take full advantage of it, trained space intelligence operators are required. For example, the new Space-Based Infrared Systems does not merely have an impressive constantly staring surveillance capability. With its steerable and taskable sensor, it adds a reconnaissance potential that is new to the command.[3]

This means that AFSPC has the potential to add a vast amount of battlefield characterization data and measurement and signature intelligence to combatant commanders. But it takes trained ISR specialists to manage the process of tasking, collecting, processing, exploiting, and disseminating. With a greater partnership between AFSPC space and intelligence operators, the command has the potential to substantially increase America's information superiority. This should be a key priority for space intelligence professionals. As the Space Commission reported, the intelligence community "needs to take new initiatives and dedicate more resources to planning and funding its [TPED] system for intelligence. If not delivered in a timely way to the user, even the best information is worse than useless."[4]

Greater involvement in the process by ISR personnel poses a threat neither to AFSPC's nor the space and missile operations (13S) community's command, control, and ownership of orbital surveillance and reconnaissance assets. Intelligence personnel have neither the expertise nor the desire to own and operate the satellites—they care simply that the data gets into the system and gets to the warfighter. On this, space and intelligence personnel should be in violent agreement.

Training and Accreditation

It's also important to note that ISR operators are not simply being granted space wings by fiat. Rather, they are required to fulfill virtually the same requirements that the 13S community must complete. For an intelligence specialist to earn the basic badge, for example, requires completion of the Space Intelligence Formal Training Unit (IFTU) course (which has been accredited by the Space Professional Management Office as the equivalent of Space 100), and serve one year in a space intelligence position. Those who attended earlier versions of the IFTU course, or entered into the community prior to the creation of the course, will be grandfathered into the program after two years in an appropriate position, much as 13S personnel were grandfathered into the space professional community based on their previous experience.

As space professionals advance in their career, the requirements for higher level accreditation line up more exactly with those of their space brethren. Earning the senior space badge, for example, requires completion of the requirements for the basic badge, plus completion of Space 200 and 60 months of experience in space positions. To earn the command badge requires the addition of Space 300 completion as well as 84 months in space positions. These stringent requirements ensure that only the best-qualified intelligence personnel will wear space wings on their uniform.

Due to the breadth of the intelligence career field, and the resultant breadth of assignments a typical officer will fill, few intelligence officers will meet the criteria to earn the command badge. Those rare few who do, however, will be among the elite space intelligence professionals, and will be more than qualified for virtually any position within the space community.

The Way Ahead

The inclusion of ISR personnel within the ranks of Space 200 and 300 classes will also help to build esprit-de-corps and a sense of common purpose, and will, over time, break down some of the cultural barriers that regrettably still exist between some space and intelligence personnel.

One of General Chilton's top four priorities for 2007 was to "attract, develop, and retain people with the expertise necessary to meet the challenges of the future." This small step for the intelligence career field opens the ranks of space professionals to qualified intelligence operators, and gives greater incentive for those professionals to have more than one assignment in the space community throughout their careers, building expertise as they do so.

That expertise will then be leveraged into providing improved ISR support both internally and externally. Internally, AFSPC gains better threat insight and target analysis to improve SSA, as well as offensive and defensive counterspace operations. Externally, certified space intelligence professionals will help to dramatically increase the amount, quality, and timeliness of ISR support to the warfighter. Thus, including intelligence personnel in the space professional cadre represents not just a small step for intelligence personnel, but a giant leap for the combat capability of AFSPC as a whole.

Notes:

[1] Lt Brent D. Ziarnick, "To Command the Stars: The Rise of Foundational Space Power Theory," *High Frontier* 3, no. 4 (August 2007): 63-66.

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[3] SIBRS, fact sheet, Air Force Space Command, http://www.losangeles.af.mil/library/factsheets/factsheet_print.asp?fsID=5330&page=1.

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The Space Professional Functional Authority Advisory Council

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Change has been the watchword since the Space Commission recommended—and the secretary of defense directed—the restructuring and revitalization of the Department of Defense space community. The reforms called for by the Space Commission presented a special challenge since the changes needed to be consistent with current Air Force processes—including the emerging force development construct. Since the Air Force space professional development effort began in earnest in 2002, the Air Force has witnessed the emergence of new education requirements, new ways to measure and document space experience, a new certification program and a new occupational badge. Even the term "space professional" conjures up a mix of opinions and emotions, misunderstanding and misinformation among a wide range of people internal and external to military space (remember when it was "credentialed" space professionals?). The space badge had a similar effect, but there's more to space pro (space professional) than the "new" badge.

Until this year, the Air Force Space Professional Development Program (SPDP), one of the Air Force's answers to the Space Commission, has been perceived as a uniquely Air Force Space Command (AFSPC) initiative, with minimal recognition or support across the Air Force. To get the details of the SPDP, space professionals had to hear the Space Professional Management Office's (SPMO) "Spread the Word" briefing or glean information from policy memos and AFSPC's "Vigilant Vector" newsletters. Formal policy and an Air Force-wide process were lacking, yet *needed* to give the SPDP legitimacy. Efforts are underway to satisfy these needs. The required policy is being addressed by an Air Force instruction on SPDP, currently in Air Force-wide coordination—and expected to be completed next year. More significantly, a high-level Air Force process is in place to garner buy-in and guidance from key stakeholders who influence the development and sustainment of space expertise. This process is driven by the Space Professional Functional Authority Advisory Council (SPFAAC), under chairmanship of AFSPC commander (AFSPC/CC) as the Space Professional Functional Authority (SPFA). Exactly what is this body with the unwieldy title and awkward acronym, and what does it do for our space pro community? The SPFAAC underscores the importance of SPDP, sanctions its programs and initiatives, and makes it work effectively within the Air Force framework.

In July 2003, the secretary of the Air Force designated the commander of AFSPC as the SPFA.[1] In that role, AFSPC/CC must ensure integration of force development with the SPDP and is responsible for the health of the Air Force space professional community. Additionally, SPFA interacts with the other Air Force functional authorities (FA), whose oversight and responsibilities focus on a specific Air Force Specialty Code (AFSC), in order to ensure effective development and utilization of all space pros across the Air Force. SPFA's responsibility and authority for managing the space pro community is a special challenge, since this responsibility currently spans four officer AFSCs: operations (13S), scientists (61S), engineers (62E), and program managers (63A), along with one enlisted AFSC: operations (1C6). The addition of intelligence (14N and 1NX) and communications (33S) AFSCs are almost complete. General Kevin P. Chilton (former AFSPC/CC) made the concept of a dedicated space functional authority a reality, and was a positive step toward ensuring the need for space expertise across all space pro AFSCs is recognized as a legitimate Air Force concern. General Chilton underscored the importance and unique aspect of this role during CORONA Top in February 2007 and again at the initial SPFAAC meeting in April 2007. General Chilton emphasized that he was not fostering a "hostile takeover" of the other FA's roles, but is instead a "demanding customer"—seeking to ensure that the SPFA is on equal footing with the traditional AFSC-associated FAs, working cooperatively with them to guarantee Air Force *and* space needs are met. Figure 1 illustrates the relationship of the SPFA to the other FAs.[2] Notice that the responsibilities of the SPFA and the FAs are fundamentally the same, except the SFPA's role is focused exclusively on space. The shaded areas represent the percentage of individuals in the applicable AFSCs who are considered space pros. The SFPA doesn't "own" these individuals, but has an interest in tracking their expertise in case it is needed to meet space needs. The challenge for the SPFA and FAs is to collaborate in the development of these individuals to ensure that an ample inventory of space expertise—while at the same time adequately addressing other Air Force needs for that AFSC. The SPFA relies on the SPFAAC to ensure this process is effective and successful.

The SPFAAC provides Total Force, strategic oversight for the Air Force SPDP to meet current and future space mission requirements.[3] In essence, the primary role of the SPFAAC is to assist the SPFA in developing policy regarding the management of the Air Force space pro community. This includes developing overarching policies on the composition and professional

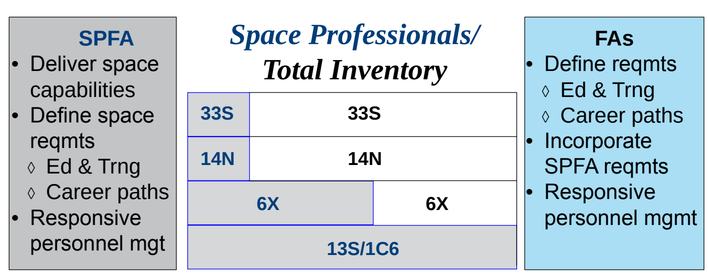

Figure 1. SPFA-FA Relationship.

development of space pros, and more specifically, the SPFAAC provides guidance to the developmental teams, who provide assignment vectors for officer space pros. The SPFAAC members provide the directions to develop and maintain a sufficient number of space-qualified personnel to support Air Force space planning, programming, acquisition, operations, intelligence, and communications. The SPFAAC has gained momentum and now includes the right membership to effectively address space needs. The expansion of the SPFAAC membership is consistent with a recent report submitted by the Independent Strategic Assessment Group (ISAG) which cited the SPFAAC as a "solid beginning and forum to address needs and issues in the career field."[4] SPFAAC membership is also based on an ISAG recommendation.

Space Professional Functional Authority Advisory Council Composition

The Council is composed of a broad and diverse group of key individuals with direct impact on space professional development. Chaired by the AFSPC/CC, the principal members from AFSPC are the vice commander; numbered air force and center commanders; applicable headquarters directors (A1, A2, A3, A4/6 and A7); the NSSI commandant, and the command chief. Representatives from Air Education and Training Command (AETC) include the commander, AETC; the Air University commander; as well as the 2nd Air Force and 381st Training Group commanders. Air Force-level representation includes the assistant secretary of the Air Force for Acquisition (SAF/AQ), chief of warfighting integration and chief information officer (SAF/XC), selected deputy chiefs of staff (A1, A2, A3/5), and the commander of the Air Force Personnel Center (AFPC/CC). Finally, the deputy director of the National Reconnaissance Office and the director of the National Security Space Office complete the council membership. Clearly, every aspect of space pro development is well represented at the highest levels.

In only two meetings, the SPFAAC has identified numerous action items—all currently underway—designed to enhance the SPDP and make the space pro community more effective. There are many significant efforts, but this article will take a closer look at three: (1) expansion of the space pro community, (2) revamping the Space 100 course, and (3) advancing educational opportunities to enhance space pros' technical competence.

Space Professional Community Expansion

Each meeting of the SPFAAC requires a review of space pro community expansion. The goal of the expansion effort is to ensure that all specialties directly impacting the space mission are factored into the SPDP framework; it will taper off as the community matures, but is a key near-term focus area. The space pro community needs to include all those who contribute to the space mission for proper development of space expertise, and is not simply a loose grouping of functional areas with some space affiliation. The numbers of individuals or groups wanting to join the space pro community are higher than one might expect—and not always in the best interest of improved delivery of space capabilities. That is why consistency in determining if a functional group ought to be considered for inclusion is critical. Before an AFSC is recommended to the SPFAAC, the SPMO considers a standard set of factors. First, do the duties include *direct* responsibility for fielding, launching, or employment of space power? Second, for a position to be considered "space," at least half of the duties must be space-related. Therefore, while it may seem obvious that an AFSC fits the space professional community mold, not all those in the AFSC will considered space pros—only those who perform space duties. For example, engineers can complete an entire career without performing space duties; however, those with space backgrounds may prove valuable for selected space-related follow-on assignments as more senior officers and therefore should be tracked and developed as space pros. Additionally, *space knowledge* must be required to do the job. Finally, each career field must develop *educational and experience milestones* that are consistent with the framework and rigor of SPDP certification.

There is still much work to do once the SPFAAC recommends adding a new space pro career field to the SFPA. The SPMO works closely with AFSPC representatives and the associated Air Staff functional managers. Buy-in from the FAs and functional managers is essential from the start. Individual and billet space qualifications and requirements are documented. In some cases SPDP is tailored to meet the specific needs of the career field. For example, the intelligence career field has elected to replace Space 100 as the initial SPDP certification requirement with the Space Intelligence Formal Training Unit, a career-field specific course taught by HQ AFSPC/A2 personnel in conjunction with the National Security Space Institute. However, intelligence personnel will take Space 200 and 300 to achieve Level 2 and Level 3 certification respectively. If a career field must significantly deviate from what are considered standard SPDP criteria, inclusion as a space pro requires further scrutiny. As mentioned earlier, there are many who desire to be space pros, but determining the "right fit" requires diligence. Ultimately, the SPFA makes the final determination.

The addition of intelligence and communications career fields should be official by year's end; weather officers and missile maintainers will be considered next. Finally, there are many government civilians that fit the space pro mold, and development of a version of SPDP tailored for civilians will be underway this fall. The rate of expansion has tapered off, but requests continue to surface and each one is considered on its own merit.

Space 100 Restructure

The April 2007, the SPFAAC meeting focused specifically on space education and the technical competence of space pros. Space education has undergone a significant amount of change over the years, and some space professionals feel the change has not always been in the best interest of space operations. Space 100, the introductory non-AFSC awarding course, has come under particular scrutiny—and for good reason. Initial space training has gone from the highly technical, in-depth approach of the 1980s to a high-level overview of space fundamentals. For a truly effective introductory course, AFSPC and AETC must find a happy medium. The SPFAAC recognized this and concurred with an ISAG recommendation to assess and modify the content of Space 100 to make it a more viable introduction to space.

There is a need for more technical competency for space pros, beginning with Space 100. Space 100 graduates should be well-versed in all space missions, capable of articulating the importance of space effects to the warfighter. Furthermore, recent ISAG recommendations point to a need to focus on both breadth and depth.[6] Space 100 should provide both a cultural and professional foundation.

With this guidance in mind, the SPMO took a working group approach to the task of enhancing Space 100. The working group was composed of all of the key Space 100 stakeholders.[7] Over the course of six months, groups at various levels developed a detailed course training standard (CTS) that called for an increased level of technical competence and increased focus on the fundamentals of space systems. The group took the traditional CTS structure one step further by providing specific educational outcomes desired for each phase of the course. These outcomes covered topics such as space effects and warfighter impact, operations and acquisition relationships, mission systems and capabilities, technical fundamentals, and joint space integration. Clearly, the revised Space 100 is a major change from the current version—undoubtedly longer, more challenging, with high expectations from the stakeholders. Optimism that the course will better prepare space pros will be validated through prototype presentations, student and leadership feedback and SPMO oversight. The CTS is now in the hands of AETC. The biggest concern is not the length of the course, rather the content. This course is ever-evolving and it is the first space pro education experience for both space operators and acquirers. Our youngest space pros deserve a Space 100 that is both a challenging and productive experience. The SPFAAC promises to keep space education in its sights.

Technical Competence

Space education does not end with Space 100, since space pros also take Space 200 and 300 at key career milestones. But Space 100, 200 and 300 are not the only means of increasing technical competence—there are an increasing number of educational opportunities not included in the SPDP framework. Today, space operators do not necessarily have technical backgrounds. Another goal of SPDP is to increase the technical credentials of 13S accessions to ensure a standard technical base across the space pro community. Another SPFAAC initiative is aimed at doing just that, establishing mandatory technical credentials for 13S accessions. In the meantime, there are officers already in the career field lacking the desired technical baseline. To help fill this gap, AFSPC has begun to fund small groups of junior space pros to complete a graduate level Space Certificate program through the University of Colorado at Colorado Springs (UCCS). In addition, a recent Naval Postgraduate School (NPS) offer, in a show of support to Air Force space pros, funds a small group of individuals to participate in the NPS Space Systems Certificate program. If funding permits, AFSPC hopes to fund these individuals through the associated master's degree program upon completion of the certificate. Expanded opportunities available through the Air Force Institute of Technology and increased participation by the Space Education Consortium, led by UCCS, are also realistic options.

Education is a priority now and the SPMO makes every effort to continue that charge. Our people and the nation deserve nothing less. After all, "investment in science and technology resources—not just facilities, but people—is essential if the US is to remain the world's leading space-faring nation. The US government needs to play an active, deliberate role in expanding and deepening the pool of military and civilian talent in science, engineering and systems operations that the nation will need."[8]

The initiatives mentioned here aim at deepening the pool and accurately identifying space expertise to ensure US space supremacy. The Air Force must continue to develop knowledgeable, technically competent space pros. The SPFA, aided by the SPFAAC, is responsible for a wide range of space personnel responsibilities, but the most critical is development of space professionals. As the council matures, the SPMO will highlight areas for added emphasis obtained through leadership feedback, key metrics and performance assessments. The SPFAAC's central role in development of space capabilities, manifested by top-caliber professionals, is a critical element.

Notes:

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[2] Steve Hamilton, "Space Professional Functional Authority Advisory Council (SPFAAC)," 5 April 2007 (Peterson AFB CO: 2007).

[3] Thomas Boland, "Space Professional Functional Authority (SPFA) Advisory Council (SPFAAC)," (HQ AFSPC/A1FX: 2007)

[4] Personnel and Training Task Force of the Independent Strategic Assessment Group, "Space Officer Development," 29 January 2007 (Peterson AFB CO: 2007).

[5] Gen Kevin P. Chilton, comments SPFAAC meeting, 8 August 2007.

[6] Personnel and Training Task Force of the Independent Strategic Assessment Group, "Space Officer Development," 29 January 2007 (Peterson AFB CO: 2007).

[7] HQ AF/A3O-ST, HQ AFSPC/A3T, HQ AFSPC/A1FX (SPMO), 14 AF, 20 AF, SMC, NSSI, 381 TRG

[8] *Report of the Commission to Assess United States National Security Space Management and Organization*, executive summary (Washington DC: US Government Printing Office, 2001).

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A Layman's Guide to the Space Professional Development Database System

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Wanted: *O-4 with a minimum 24 months satellite operations experience, preferably in global positioning system; space warfighting command and control experience highly desired. Acquisition experience desired. Masters degree completed.*

This position requires a specific set of space experience and education—how many space professionals meet these criteria? Five years ago, no tool existed that would be able to screen the 11,000 space professionals to find someone with credentials to fill the position. Today, through the power of the Space Professional Development Database (SPDD), we know the answer: three personnel have the experience and education specified for the position.

The above example illustrates two important aspects of the assignment process in relation to the SPDD: first is the billet requirement—the education-training-experience needed to fill the job; second is the personnel qualification to meet the requirement. In concert with traditional assignment processes, SPDD is a tool that enables matching personnel to billets; it is also used to generate metrics that measure the health of the space professional community and the effectiveness of Space Professional Development Program (SPDP). The genesis of the SPDD begins with force development (FD) and the formation of the SPDP.

Force Development and Space Professional Development

FD is a term Airmen have heard a lot over the years, but most Airmen are more concerned with practical application. They want to know what jobs exist that they might be qualified to fill; they wonder how FD will affect their careers and will they need more training or education. Air Force Policy Document (AFPD) 36-26 *Total Force Development*, states: "The Air Force will develop and maintain a capabilities-based manpower requirements system that captures sustained and surge billet requirements and is comprised of the appropriate force mix (active duty/air reserve component/civilians) of the Air Force Core Competencies to produce a diverse, flexible, and responsive force capable of succeeding in a global environment."

As the Air Force began to implement the FD concept, the Space Commission recommended changes to the organization of the space community and called for enhanced career development to form a space cadre.[1] Accepting the Commission's findings, the Department of Defense (DoD) issued a memo directing services to implement the recommendations. The Air Force followed with guidance in the form of the Air Force Space Professional Strategy,[2] in line with the Air Force's FD framework, and led to the SPDP. As outlined in AFDP 36-37, *Space Professional Development,* SPDP is "designed to expand knowledge, increase understanding and raise the overall qualifications of Air Force … space professionals … to serve as equal partners with other warfighting components in the joint warfare environment." The directive, linked with SPDP execution efforts, established policies to ensure appropriate space education, training, and experience programs are available to all eligible Air Force space professionals. An underlying foundation of SPDP is the certification program that establishes levels based on space education, training, and experience in space related positions.

The SPDP certification program drove the need to accurately identify and track space professionals' skills. Certification provided a structure to systematically characterize the depth and breadth of skills across the space professional community. However, the structure was useless without an effective tool to document, update, manipulate, and retrieve personnel data in a timely manner necessary for career management. An additional focus point from the Space Commission was the need for improved personnel-billet management: "Personnel managers in the Air Force need to have a comprehensive view of all space career positions within the national security space community and the means to manage individual assignments among the acquisition, operations, and intelligence communities."[3] The SPDD, as illustrated in figure 1, allows SPDP managers: to identify and track all Air Force space professionals; document their experience; track their SPDP certification level (including education, training, and experience criteria); and capture requirements for each Air Force space billet in the national security space community. It is also a ready source of valuable metrics that measure the health of the space professional community and SPDP effectiveness.

Space Professional Experience Codes

An integral element of the SPDD is the ability to identify specific space expertise, tracing to two Space Commission findings:

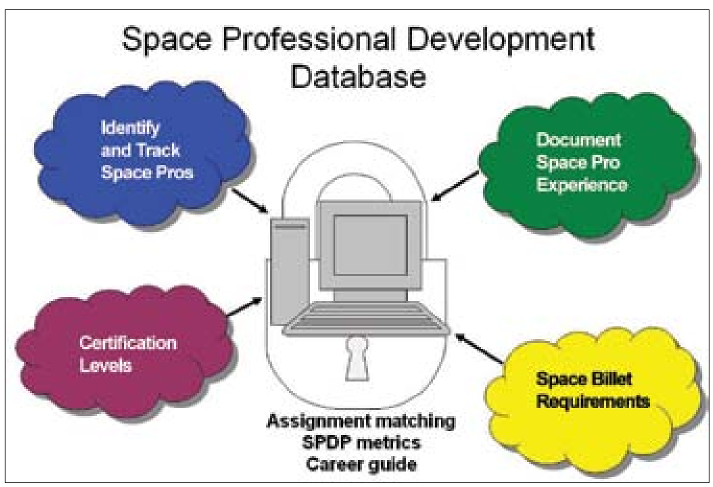

Figure 1. Space Professional Development Database Functions.

"Space professionals need more depth of experience in their field …" and "Space professionals need a broader understanding of operations across the range of space mission areas…" The challenge: identifying and tracking depth and breadth of experience across diverse space mission areas. The Space Professional Task Force, the Site Project Management Office's (SPMO's) predecessor, considered existing special experience identifiers (SEI) or developmental identifiers (DIDs) in the Air Force personnel system, but found that while SEIs/DIDs flagged experience, they were not common identifiers across the Total Force and could not gauge depth of experience. Instead, the task force devised an innovative approach to track an individual's space experience and the experience requirements for space positions through Space Professional Experience Codes (SPECs).

SPECs enable the matching of space skills to job requirements, enhancing mission effectiveness, and provide a broad, flexible approach to document experience with a range of valuable capabilities to include:

- Identification of cumulative space experience based on duty effective dates; critical capability to measure depth and breadth.
- Capturing common space experience for the Total Force and any Air Force specialty code (AFSC) or functional group.
- Applicability to positions and people—used to establish space billet requirements and identify the experience gained while in the position.
- Ability to track a broad range of mission/functional categories.
- Broad enough to be manageable, narrow enough to capture unique skills and experience.

A SPEC consists of three characters that provide insight into specific space experience. The *first character* defines the general category of work—acquisition (A), operations (O), or staff (S). A core space operations officer (AFSC 13S) assigned to a space systems development job would earn "A-Acquisition" experience; conversely, an engineer (AFSC 62E) assigned to a space operations squadron would earn "O-Operations" experience. The second character, illustrated by the "SPEC wheel" on the right in figure 2, is linked to one of 10 space mission categories. The *third character* is an experience identifier that provides added detail of the specialty in the mission area.[3] The 62E working in space operations might have a SPEC of "OA3": O-Operations; A-Satellite Systems; 3-Precision, Navigation, and Timing.

SPECs form a comprehensive construct to delineate operations, acquisition and staff duty and capture a host of experience categories across the space mission areas, AFSCs, functional concepts, and the entire range of space missions and systems (figure 2). The easily-tailored third character (experience identifier) is able to pinpoint a broad selection of task-based competencies. The SPEC concept provides a user-friendly, manageable means of defining experience. A detailed SPEC breakout is available on the Space Professional Development Web site.[4]

SPECs are flexible and adaptable to the needs of the space professional community. For instance, the National Reconnaissance Office (NRO) adds two additional characters to the three character SPDP baseline. This five character SPEC refines experience tracking and provides the NRO added fidelity in personnel management. The HQ AFSPC Counterspace Division (A3C) is planning to adopt a similar construct for tracking space control expertise. Due to the detail provided by five character SPECs, these databases are maintained on a classified network.

What is the Space Professional Development Database?

The SPDD system is a combination of computer programs and databases residing on a Microsoft SQL server.[5] Six databases, each with multiple tables, store various types of information for officer, enlisted, and civilian space professionals, and space billets. SPDD users access data through a Microsoft Access front-end,[6] with one front-end for each database. The front-ends allow users to manage and retrieve space professional information.

SPDD development was evolutionary; SPDP maturation, growth in the space professional community and the need to field new capabilities contributed to the system's evolution. Initially fielded in Microsoft Access, database size restrictions in Access drove the migration to Microsoft SQL. Currently, the six SPDD databases store over 25 gigabytes of data. The SPMO has invested over $50 thousand in hardware and software and 7.5 man-years in the development of the SPDD—a bargain compared to the initial commercial estimate of $1.3 million startup and recurring cost of $50 per year per record. With over 500,000 records in the current databases, recurring maintenance costs would top $25 million. SPMO programmers continue to develop, modify, and enhance the system to meet SPDP needs; for instance, adding additional fields to track education programs and developing an all-in-one front-end to enhance the user interface across the databases.

The SPDD employs multiple software packages to manage the databases. SAS©, a commercial database program, converts the Air Force Personnel Center (AFPC) data to a usable form for updating the databases on a Microsoft SQL server. Visual Studio 2005 is used to develop stand-alone routines to correct and convert data from the AFPC SAS© data files into a file easily imported by the SQL server.[8] SQL programs are then used to expand AFPC codes into more descriptive text. Microsoft Access is used for the database front-ends, with over 100,000 lines of code written in Visual Basic for Applications to generate forms and perform utilities.

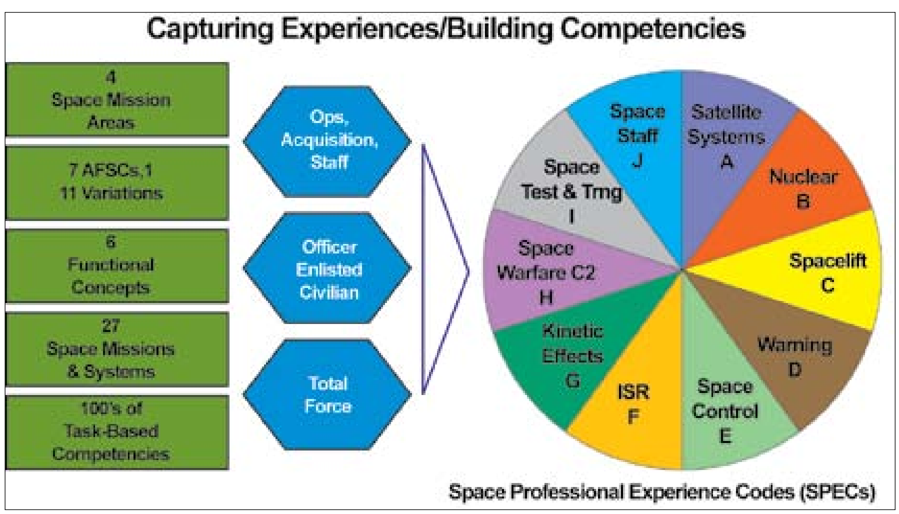

Figure 2. Space Professional Experience Code Capabilities.

Components of the SPDD

Figure 3 illustrates the SPDD structure in simplified form: inputs; databases; and outputs. *Inputs:* Military Personnel Data System (MilPDS) and Millennium are AFPC systems that provide the SPDD underpinnings for personnel and billet information; SPMO adds SPDP specific information to build a space professional's data record. *Databases:* six individual databases contain most of the Total Force records, making SPDD a system of databases. *Outputs:* Single Unit Retrieval Formats (SURF), Personnel Accounting System (PAS) reports, Miscellaneous (Misc) reports and queries. The following paragraphs provide detailed description of the database system.

SPDD data originates from three sources. MilPDS contains duty information for all Air Force personnel, including over 500,000 individuals: active duty (AD) military, Air Force civilians, and subsets of Air National Guard (ANG) and reserves. An extract from AFPC's Authorized Manpower Master contains all Air Force positions, including more than 800,000 billets (AD, guard, reserve, and civilian). The Millennium database was used to initially populate space billet information. On a monthly basis, the SPMO imports data files from MilPDS and updates the SPDD. The SPMO maintains SPECs, SPDP certification levels, space education, and training data for more than 11,000 personnel and more than 11,000 space billets Air Force wide. Organizational input is vital to maintain the billet database with the required education-training-experience-certification required for their positions.

As depicted in figure 3, the databases contain all of the information used by the SPMO.

- Officer Database: all AD officers
- Enlisted Database: all AD enlisted
- Civilian Database: all Air Force civilians
- ANG Officer Database: contains a subset of ANG officers
- ANG Enlisted Database: contains a subset of ANG enlisted
- AFRC Database: contains a small subset of AFRC officers and enlisted

SURF: The most common SPDD product is the space professional SURF—a snapshot of each individual's Air Force duty history tailored to provide relevant SPDP data such as SPECs and accumulated time, space education completed and certification level. The SPMO generates individual SURFs based on phone or email requests and usually turns the request the same day. Commanders may also request multiple SURFs for the space professionals in their organization to use for mentoring, assignment actions, and general information. In addition to individuals and commanders, the AFPC DT, assignment teams (AT) and the AFSPC Vigilant Eagle (VE) squadron commander board use the SURF as a snapshot of a person's space credentials.

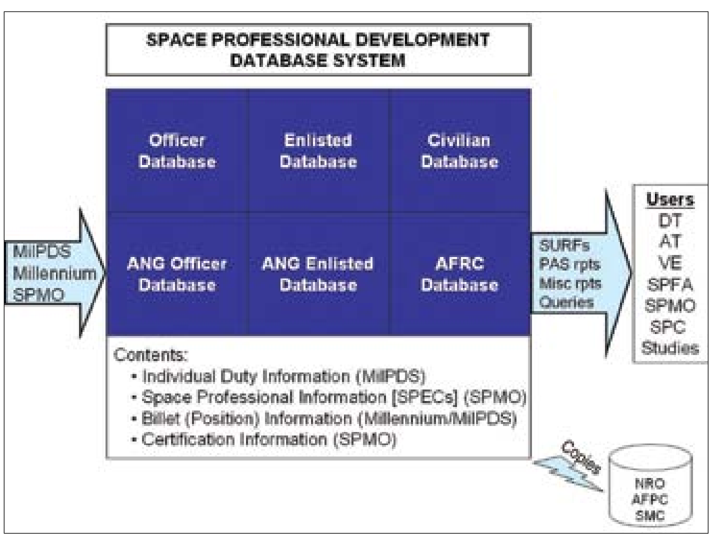

Figure 3. Space Professional Development Database Structure.

PAS reports: PAS reports contain billet information used to build the Career Opportunities Guide (COG), a tool that gives space professionals insights into space billets.

Misc reports: Requests for Misc reports originate from multiple organizations for a variety of reasons. A key user of these reports is the SPFAAC that uses a set of standard metrics to assess the health of the space professional community and effectiveness of SPDP. The SPMO has generated reports to support Congress, Air Staff, National Security Space Organization and AFSPC inquiries. Recently, the SPMO supported data requests for the Defense Science Board as they assessed the depth of nuclear (ICBM) expertise in the Air Force. Additional Misc reports include:

- Breakouts of space professional experience by organization, SPEC and time categorized by rank and AFSC.
- Assessments of personnel inventory against current and forecasted billet requirements.
- Assessments of diversity and amount of space experience across the various mission areas.

Queries: Database queries support a diverse range of SPDP needs, from generating the course eligibility lists for Space 200 and 300 to determining the SPDP certification level of a space professional. As illustrated in the example at the start of this article, SPDD users, such as the AFPC assignment teams, can use queries to find personnel who meet specific criteria.

The SPDD can only be accessed two ways: online through Peaknet, the Peterson AFB Intranet, or by using separate, standalone copies of the database distributed to AFPC, SMC, and the NRO. The SPMO controls access for the online SPDD; current users include the SPMO (including the functional managers for 1C6 enlisted space operators), HQ AFSPC/A1FC (officer assignments), HQ AFSPC/A3TT (functional manager for 13S officer space operators), and HQ AFSPC/A3C (space control). Due to Privacy Act concerns, the SPMO does not allow external access to the SPDD via the Internet (i.e., space professionals cannot independently generate their own SURF). Plans are in work to incorporate SPDD into the Defense Integrated Military Human Resources System which will allow users to access their space pro SURFs through the Air Force Portal in the future.

A unique product of the SPDD is the Space Professional Career Opportunities Guide (COG), a searchable compendium of all Air Force space positions. The COG is an invaluable career management and mentoring tool, providing detailed information on positions, locations, organizations, and job requirements. Space professionals must request access through the COG Web site.[7] The SPMO validates the access request and establishes a user account. The site requires a user identification and password for initial access; once on the Web site, users may elect to enable common access card (CAC) login. Currently, more than 1,727 user accounts exist and the number grows daily. The COG is updated monthly and consists of two main parts:

- Billet Database
  - An online, searchable compendium of all Air Force space jobs

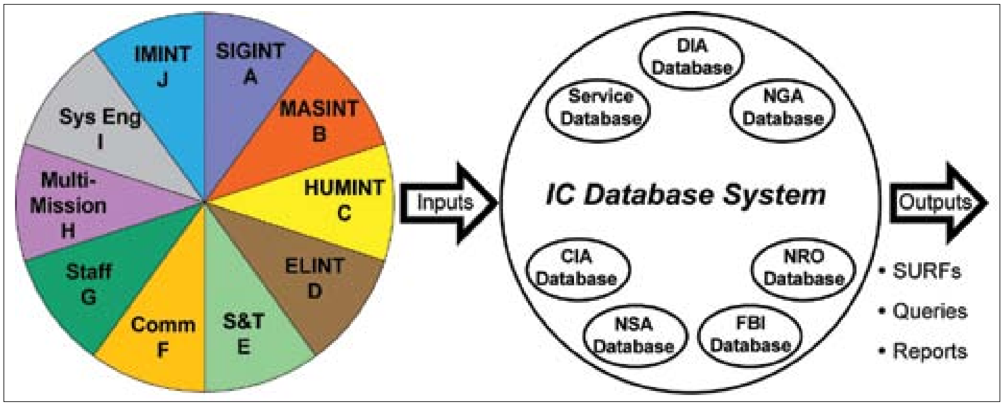

Figure 4. Notional Intelligence Community Concept.

  - Job descriptions, experience required (prerequisite SPECs), SPEC earned, other requirements, locations, and required education (if applicable)
  - Insight into 'what jobs are out there'
- COG document[9]
  - SPDP framework
  - Career guidance for officers, enlisted, and civilian space pros
  - Detailed unit descriptions, mission statements, and hyperlinks to units' Web sites (if available)

Broader Application

Although designed for SPDP, the SPDD has potential for use by other communities. The SPEC and database construct can be applied to any mission subset with a mix of skill requirements and personnel categories applied to missions, functional areas, or skill sets. To illustrate, figure 4 depicts an intelligence community (IC) construct with notional SPECS and database structure.

Another example is Air Force Cyber Ops/Info Ops, which includes electronic warfare operations, network warfare operations, and influence operations mission subsets. It can also be used in DoD and national mission areas to track personnel with multiple skill sets, working in related mission areas. For instance, the NRO has broadened their SPDD application to track all personnel regardless of parent organization with their expanded SPECs.

Conclusion

The SPDD is a cost-effective and versatile system that has allowed the rapid maturation of the SPDP. Going back to FD and the ultimate question: what does FD, SPDP, and the SPDD mean to their Airman doing the day-to-day job? If they're working in space-related Air Force positions, the SPDD system has documented the skill sets and provides a means of shaping career decisions. The SPDP education, training, and certification milestones are accurately recorded in the SPDD to allow personnel matching to billet requirements. The COG provides the career guidance and insight into all Air Force space positions. The space professional, wondering what his next job is going to be and what training may be required, can request a space professional SURF, access the COG, discuss options with supervisors and craft a development plan for the future—enabled through the power of the SPDD.

Notes:

[1] *Report of the Commission to Assess United States National Security Space Management and Organization*, executive summary (Washington DC: US Government Printing Office, 2001).

[2] General (USAF, retired) Lance W. Lord, Space Professional Strategy (2003), September 2007, https://www.my.af.mil/gcss-af/USAF/AFP40/Attachment/20070131/Strategy.pdf.

[3] The 3rd SPEC character identifies more specific types of experience (particular to a unit or weapons system) than the 10 space mission categories itemized in the 2nd character.

[4] Space Professional Development, Air Force Portal, membership required, https://www.my.af.mil/gcss-af/afp40/USAF/ep/globalTab.do?command=org&channelPageId=-1717017.

[5] Structured Query Language (SQL) is a standard language used in the database industry. There are different variations that have been implemented by commercial concerns, but all are based on a SQL standard.

[6] A front-end is used to access information from a database and can be a commercial product or created by the user. The front-end for the SPDD is a group of form and programs that allow the user to access, view, and manipulate the information in the database in a friendly format. Microsoft Access is used to create projects which act as front-ends and can be developed to the user's preference.

[7] Visual Studio 2005 is a development suite that allows the user to write and compile programs in different languages, such as, Visual Basic, C++, Java ++, C#, etc. It is used by the SPMO to develop small programs for supporting the database and for a large application to will be like a consolidated front-end accessing all of the different databases from one program.

[8] Space professionals must request access through the COG Web site at https://halfway.peterson.af.mil/COG/.

[9] For the access instructions and COG User's Guide, access the SPMO site on the Air Force Portal (search on "SPMO" in the Air Force Portal search field).

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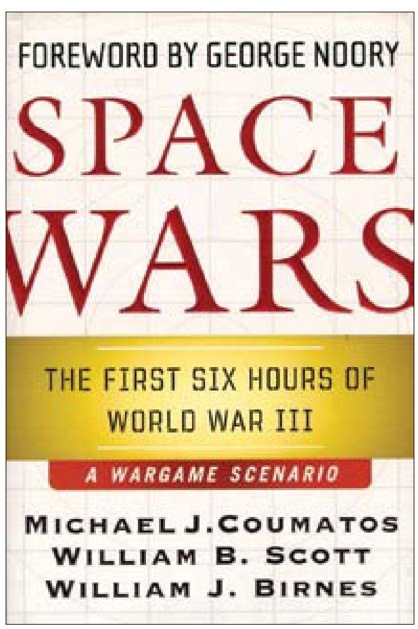
Space Wars: The First Six Hours of World War III

Space Wars: The First Six Hours of World War III. By Michael J. Coumatos, William B. Scott, and William J. Birnes. New York: Forge Books, 2007. Pp. 400. $25.95 Hardback ISBN: 0-7653-1379-0

Editors of professional journals, generally speaking, solicit reviews only for relevant works of nonfiction. By that standard, some *High Frontier* subscribers might judge as misplaced an examination of *Space Wars*. Written by Michael Coumatos, William Scott, and William Birnes, this book certainly transcends past and present. Nevertheless, its details about US space systems, facilities, organizations, and capabilities adhere closely to what currently exists or, reasonably, might be contemplated. We need only listen, furthermore, to the evening news to recognize the book's cast of rogues: drug lords, unemployed Russian scientists, terrorists, Iran, China, and North Korea. Whether properly categorized as science fiction or futurology, *Space Wars* contains sufficient factual material to render frighteningly plausible its fictional scenarios.

Lest divulging too much of the plot spoil the suspense for first-time readers of *Space Wars*, this reviewer will do his best to highlight only the barest minimum. Faulty signals from global positioning system satellites cause US missile strikes to go awry, followed by sudden service disruptions involving other military and commercial satellites. Defense, intelligence, and other US national security organizations scramble to explain and respond to this unexpected situation. After identifying the immediate source of the on-orbit problems and acting successfully by various means, mostly covert, to neutralize further threats, US military and political leaders barely find time to congratulate one another before "another horrible nightmare" begins. Everything occurs during thirty springtime days in 2010.

The authors' experiential backgrounds offer clues about why this fictional work should interest both space professionals and a general audience. A former naval aviator, Coumatos served with US Space Command during the early 1990s before joining the Pacific Fleet as its wargaming director. An electrical engineer, graduate of the Air Force Test Pilot School's flight test engineering program, and officer at the National Security Agency, Scott recently retired as Rocky Mountain Bureau Chief for *Aviation Week & Space Technology* magazine. Birnes, a UFO enthusiast, has written or edited more than twenty-five books and encyclopedias on a wide variety of topics. By pooling their respective talents, this trio infused *Space Wars* with incredibly rich technical detail and presented it in terms understandable to lay readers.



Anyone familiar with today's US military space organizations and capabilities should not have much difficulty stretching their imagination to entertain the plausibility of what occurs in *Space Wars*. Members of the US defense establishment undoubtedly will nod in agreement when one character bemoans how bureaucratic "stovepipes and turf wars" can delay any kind of action. Others might second the authors' rather obvious disdain for "tightwad congressmen" who resist unlimited defense spending or a "weak" president who, in their opinion, listens too frequently to idealistic, naïve, non-military advisers. Above all, the need for the United States to protect its military, civil, and commercial space systems in both peacetime and wartime—i.e., to maintain space control—will lead many of these readers to admit that a defensive posture could blur into offensive action.

Not everyone, however, will rate *Space Wars* outstanding or necessarily agree with the authors' perspective. Some might find the characters too one-dimensional and the plot too simplistic. Others might judge the authors too biased in their support of preemptive military action at the expense of diplomacy. A few readers might focus on the thriller's many covert operations, diplomatic and military, and notice these tend to have more negative than positive long-term consequences. A handful even might fault the authors for allowing the "good guys" to stray across legal, ethical, or moral boundaries in pursuit of the "bad guys." Occasionally, the authors' nonfictional objective—to startle the American people, their representatives in Congress, and high-level officials in the Executive Branch into near-term action on critical, real-world space issues—creeps too near the surface of their fictional story.

When all else is said and done, perhaps the most intriguing and innovative aspect of *Space Wars* is the use of wargaming to aid decision making in near-real time—to expose hostile intent and to develop strategies to counter that intent. The authors remind readers that Sun Tzu advocated wargaming twenty-five centuries ago to expose the asymmetries—the traditional and the unexpected—that are organic to warfare. In *Space Wars*, the wargamers and the battle staff at US Strategic Command convene in parallel to help their commander and other national leaders understand, in a much wider context and at an accelerated pace, what is required to employ specific military options. Ultimately, however, the best insight might come from "an old China hand" who, being familiar with the subtleties of Taoism, knows that the key to survival in an ongoing confrontation is to know what one should not do and when not to do it.

Reviewed by Dr. Rick W. Sturdevant, Deputy Command Historian, HQ Air Force Space Command.

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