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Improving the Development and Utilization of Air Force Space and Missile Officers

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Summary

Numbering about 3,450 officers during 2001, the 13S career field (space and missile operations) in 1994 merged the separate space and missile career fields. While the nation’s intercontinental ballistic missile force has shrunk substantially during the service of many of today’s officers, the space-based systems for navigation, surveillance, warning, and communication have become more numerous. Although missile jobs remain more numerous for junior officers, increasingly more space-oriented jobs are becoming available for mid- and senior-level officers. While missile operations generally follow detailed and rigid standard operating and safety procedures, space system operations are more varied and flexible, although they have also grown more standardized and routinized. Finally, civilians (often contractor personnel) play significant roles for space systems but not in missile operations.

AFSPC has issued inconsistent career guidance to 13S officers, once recommending experience across all five categories of operations and systems—missile combat crew, satellite command and control, launch (also called spacelift), surveillance, and warning—and later recommending only a “major” and a “minor” area of mission exper-

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1 The Commission to Assess United States National Security Space Management and Organization’s 2001 report recommended realigning the space-oriented portion of the workforce along earlier lines, in which teams of scientific, engineering, and acquisition specialists helped design, develop, test, acquire, and operate space systems, succeeding substantially on the basis of technical expertise, innovation, experimentation, and adaptation—almost the antithesis of relying on standardized procedures. The commission is also referred to as the Rumsfeld Space Commission, the term we will use in the remainder of this monograph.
tise. AFSPC leaders have wondered whether the career field is so
diverse and unbalanced that it may not be sustainable. In 2001, the
Rumsfeld Space Commission decried a lack of experience among
space officers; raised the possibility of creating a separate space corps;
called for intensified, career-long education and training for space
professionals; and mandated “specific criteria . . . for the selection,
training, qualification and assignment of space personnel who will
design, develop, acquire and assess military space systems.”

To help address these issues and the adequacy of the overall
assignment and development of 13S officers, this research (1) identi-
fied the backgrounds that 13S officers should have (the demand, now
and potentially in the future), (2) assessed the backgrounds today’s
officers possess (the supply) and the career paths they have followed,
(3) measured the gaps between the demand and supply, and (4) mod-
eled potential development and utilization patterns to see whether
stable policies and sustained flows could match the supply more
closely with the demand, allowing the Air Force to establish and
promulgate corresponding and specific career guidance, now and in
the future. The short answer is “yes.”

Identifying the Backgrounds Needed (Demand)

Instead of concentrating on underlying competencies (knowledge,
skills, and abilities) that space and missile officers should possess, we
collected information about the specific education, training, and
work experience that are important for performing different groups of
13S jobs satisfactorily.2 AFSPC asked senior 13S officers, expert in

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2 We use education, training, and work experience as proxies for sets of competencies. It is
easier to rate their importance for job performance; they are observable in officers’ personnel
records; and they can be used in career-path management. Of course, the mere completion of
education and training courses or of specific kinds of assignments does not guarantee
development of the targeted, but implicit, competencies. The Air Force still must evaluate
individual performance, professional development, suitability for command, and schooling
and base critical assignments and promotion on officers' demonstrated competencies.
Deliberate development can provide the opportunities to develop and demonstrate necessary
competencies, but it cannot substitute for them.
each organization and/or functional area, to rate the importance of 70 specific backgrounds for satisfactorily performing about 1,100 jobs authorized at the grades of major (O-4), lieutenant colonel (O-5), and colonel (O-6). The specific backgrounds are in eight categories:

- **mission operations**, such as missile combat crew, satellite command and control, and either space or missile operations
- **special experience**, such as instructor, standardization and evaluation examiner, safety officer, and weapons and tactics instructor\(^3\)
- **functional experience**, such as assignments in current operations, plans and programs, acquisition, and requirements
- **organizational experience**, such as jobs in the Air Staff, Headquarters AFSPC, the National Reconnaissance Office, the Air Intelligence Agency, and U.S. Space Command
- **command**, such as command of a squadron, operations group, wing, or center
- **academic education**, such as having an undergraduate or graduate degree in science, engineering, or business or having taken specific professional military education courses
- **training**, such as having taken Air Force advanced technical courses in space operations
- **pay grade**, that is, whether the officer must hold the grade authorized for the job.

Each expert (mostly colonels) rated each background as critical, important, useful, or not needed for each of about 20 to 40 jobs within his or her purview, out of a total of 1,092 O-4 through O-6 jobs for 13S core officers. The raters could also target a minimum amount and desired recency for each item.\(^4\)

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\(^3\) These are the jobs that carry specialty prefixes—K, Q, S, and W, respectively, in the examples.

\(^4\) The instructions that guided them and the questionnaire they used are in Appendix B. In almost all cases, a member of RAND’s research staff met with the respondent to help explain the objectives and process, answer questions, and monitor the assessment of at least the first few jobs. In a few cases, this had to be done via telephone. For about 420 jobs, AFSPC’s 13S
We consolidated the raters’ responses to reflect 56 different backgrounds. An average of 5.0 items per O-4 job had been rated critical or important, with averages of 6.2 and 10.4 for O-5 and O-6 jobs, respectively. Some jobs were rated as needing as many as 25 of the 56 backgrounds, and some were rated as needing none at all. Three panels of colonels reviewed and revised these statements of requirements, concentrating on missile jobs, space jobs, and acquisition jobs, respectively.

The raters considered tactical experience in space or missile operations to be critical or important for about 90 percent of the jobs above O-3. Although they specified a particular type of tactical experience as being preferred for more than 40 percent of the jobs, any other sorts of space or missile experience often would be acceptable if no one with the specific (preferred) experience were available. Indeed, the raters found specific experience to be necessary for only about 15 to 20 percent of the jobs. The background most frequently preferred was missiles—for about 20 percent of the jobs in each grade—but it is actually necessary for only about half as many. For nearly a third of the jobs, experience in any of the space mission areas would suffice; for nearly half, a background in either space or missile operations would be adequate. Fewer than 5 percent of the jobs in each of the three grades above O-3 need experience in a specific space mission (see pp. 21–22).

The other backgrounds identified as needed most often are organizational experience at AFSPC headquarters, the Air Staff, the wing and group levels, and in the joint community; technical experience as instructors and in standardization and evaluation; and functional experience in current operations, plans and programs, requirements, test and evaluation, and acquisition. Command experience is frequently important for O-6 jobs. Technical academic degrees, primarily in engineering, were rated as critical or important for only about 10 to 12 percent of the jobs at O-4 and O-5 and for about 20

Assignment officers identified the backgrounds needed based on recent requisitions for new or replacement officers.
percent of those at O-6. Professional military education and technical military training were seldom marked as needed (see pp. 20–21).

Using statistical cluster analysis, we identified groups of jobs that need similar backgrounds, regardless of which organizations “own” the jobs. Some groups need experience in missiles, acquisition, and plans and programs, for example, and others need satellite command and control, current operations, and joint experience (see pp. 23–30).

The Air Force could use such information to match individual officers to individual jobs and to develop the force proactively to ensure that officers in the space and missile field actually acquire the backgrounds its jobs need.

During the lengthy period it took to collect the requirements data, we worked with participants in Air Force meetings and several integrated product teams that developed ideas and material to create and support the Space Professional Development Strategy in response to the Rumsfeld Space Commission. These interactions yielded valuable insights into potential future changes in requirements—e.g., more officers who understand both the acquisition and warfighting aspects of space systems, possible “weaponization” of space operations (i.e., using space vehicles as platforms for active defense or offense, not only for supporting air and surface operations by others), and further civilianization or outsourcing in such support areas as budgeting, education, and training.

**Assessing Officers’ Backgrounds (Supply) and Career Paths**

For the 3,436 members of the “space core” at the end of FY 2001, we discerned each officer’s accumulated backgrounds, from year-end personnel records covering 1975 through 2001. We used organization codes, function codes, duty titles, locations, duty Air Force specialty codes, and pay grades to translate each year-end observation into
terms consistent with the requirements defined by the experts. The older the data, the more difficult and, in some cases, the less complete the translation. Even so, we believe we identified most of the relevant education, training, and experience that 13S core officers active in 2001 had acquired. Because some types of experience were unavailable in earlier years—e.g., space and missile officers first held jobs with the R prefix (contingency and war planner) in 1995, and only a handful held jobs with the W prefix (weapons and tactics instructor) before 1996—they are missing from older officers’ portfolios. This analysis covered grades O-1 through O-6, not only the top three.

As expected, officers’ backgrounds expand through their careers: Among the same 56 background items for which the jobs’ demands were summarized, 2001’s first lieutenants had acquired an average of 1.9 items; captains, 4.8; majors, 8.6; lieutenant colonels, 11.0; and colonels, 13.5. Across the grades, 71 to 90 percent of the officers had missile experience, and 33 to 55 percent had technical academic degrees (see pp. 38–39).

As the numbers of space jobs and organizations have grown over time, more officers have gained operational experience in space systems, but older officers have often gained their space experience as commanders rather than as crew members. More than one-half the colonels with space operational experience first acquired it as commanders, as did one-fourth to one-third of the lieutenant colonels. But this will change as younger officers advance to the higher ranks. On average, officers had spent five to six years in missile operations, three to four years in satellite command and control operations, and two or fewer years in other space mission areas (see pp. 40–46).

5 RAND developed the rules for this translation in collaboration with a senior 13S Air Force Officer.

6 Using the same rules of interpretation, we also tracked the backgrounds of some 3,500 officers who were no longer in the space core in 2001—i.e., who had left the Air Force or transferred to other core occupations.

7 The 8.6, 11.0, and 13.5 averages for O-4, O-5, and O-6 officers are notably larger than the numbers of items rated either critical or important for the jobs at those grades (5.0, 6.2, and 10.4, respectively).
To represent career paths, we separated jobs into nine classes, or “aggregate career dimensions,” then grouped these together for comparison, as follows:

- force employment and operations against support and staff
- strategic against operational against tactical scope
- command jobs against other jobs.

We further subdivided many of these classes of jobs according to the type of system or function, ending with 36 categories of career experience. The more detailed the categorization of jobs, the more career paths that are distinguished, and the fewer officers who have followed each path. In any case, the higher the grade, the more paths officers have followed. By the end of captaincy, officers had followed 18 different career paths, with 180 officers following the most numerous path and as few as seven following the tenth most numerous path. In contrast, the 156 colonels active in 2001 had followed 55 different career paths; 22 had followed the most numerous path, and five had followed the tenth most numerous path. Two of three colonels had acquired either four or five aggregate career dimensions when they were promoted; about one in eight had only three; and only 1 percent had all seven (see pp. 53–57).

Beyond the accumulation of specific types of experience, the historical data show somewhat higher retention rates for officers with initial operational experience in missiles, compared with those who started in space. But promotion rates for the two sets of officers have been about the same. And although fewer officers in the higher grades have degrees in engineering and the physical sciences, retention rates have actually been similar between 13S officers with or without technical degrees. The Air Force simply took in fewer officers with technical degrees in earlier years (see pp. 57–58).

**Measuring Gaps Between Demand and Supply**

Considering each grade’s officers as a whole, plenty of 2001’s officers in the grades above O-3 had most of the targeted backgrounds—
technical degree; experience in the various operational mission areas, as instructors, and as commanders; and experience in current operations, logistics, and plans and programs, for example—although too few had experience as contingency and war planners; in safety, intelligence, or acquisition; or in a numbered air force (see pp. 61–64). Shortages were somewhat larger when backgrounds are considered in combination. Combinations in greatest shortage usually included several kinds of experience, typically backgrounds in current operations and one or more functional areas (typically acquisition, requirements, and/or test and evaluation), the National Reconnaissance Office or the Space and Missile Center, a major command and/or a higher headquarters (Air Staff, Office of the Joint Chiefs Staff [OJCS], or Office of the Secretary of Defense [OSD]), and technical education. It is very difficult for officers to accrue that many backgrounds before becoming lieutenant colonels, so the Air Force might consider either shifting some of the O-4 jobs that demand many types of experience to a higher grade or reevaluating the need for this targeted breadth of experience (see pp. 68–72).

Gaps between the experience jobs needed and what officers had were far greater at the individual person-and-job level, where they really count. For about 90 percent of the jobs above O-3 that needed an officer with certain experience, the incumbent in 2001 lacked one or more of the needed types of experience. Most often missing were experience as a weapons and tactics instructor (W prefix) and a war planner (R prefix), in certain functional areas (politico-military, communications, intelligence, research and development, acquisition, requirements, and test and evaluation) and in certain organizations (Air Force Operational Test and Evaluation Center, Defense Threat Reduction Agency, OJCS or OSD, and a numbered air force). Even operational experience in space or one of the specific space missions frequently was missing. Too many assignments may be made without enough regard for either the job’s background requirements or the officer’s needs for additional experience to prepare for future jobs (see pp. 73–76).
Improving Space and Missile Officer Development and Utilization

We developed an optimization framework to identify paths that would develop and utilize officers (via assignments) more deliberately, e.g., by using a grade’s less-demanding jobs to give officers the experience needed for more-demanding jobs scheduled later.

The aim for the optimization was to prepare and assign officers at each career stage so that their backgrounds would meet or exceed their jobs’ needs. It uses a scoring scheme that awards points each time an incoming officer brings a type of experience regarded as critical or important for his or her new job. To limit the model’s size, we consolidated most of the backgrounds considered in the earlier analysis of demand and supply into 12 categories. For example, experience in satellite command and control, spacelift, surveillance, or warning became “space operations experience”; experience in acquisition, research and development, test and evaluation, or at the Air Force Operational Test and Evaluation Center or the Space and Missile Center became “acquisition experience”; and experience at OSD, OJCS, or a unified command became “joint experience.” Even using these aggregated categories (and assuming that backgrounds within a category substitute for each other), the officer force in 2001 still exhibited substantial person-to-job mismatches. For example, 58 percent of those in jobs needing a background in acquisition lacked it; the numbers were 74 percent for requirements, 53 percent for Joint Staff, and even 21 percent for space operations. Compared with a perfect score of 100 percent if each incumbent had experience in all the categories his or her job needed, 2001’s officers scored 63 percent (see pp. 95–96).

We used the optimization to find ways to “flow” officers through jobs that would increase the match to 99.5 percent and leave fewer than 4 percent of the jobs with incumbents who lacked even one targeted type of experience. The few remaining shortfalls would be for experience as a commander, in planning and programming, or

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8 These categories were identified and agreed to in cooperation with staff at AFSPC.
as a technical leader and would be almost entirely at grade O-4. Officers following optimized development and utilization patterns would exhibit only about half as many different experience profiles as we observed among 2001’s officers. While it would be impossible in practice to manage officer flows as precisely as the model proposes, these results demonstrate the potential for greatly improving person-to-job matches in the 13S career field, for stabilizing and sustaining officer flows, and for targeting limited numbers of development and utilization patterns.

Assessing Policy Options

Because many different development and utilization patterns would do equally well in meeting the jobs’ background needs, the model can be guided using additional objectives. To illustrate, we used three cases that we based on 2001’s jobs and their associated requirements for experience:

- Case 1 simply maximizes the match score.
- Case 2 maximizes the match score; places as many officers as possible (42 percent) on a missile, space, or acquisition ladder by the time they complete eight to nine years of service; and builds technical depth by concentrating officers’ careers in fewer experience categories.
- Case 3 is like Case 2 except that it favors breadth over depth, working to give officers experience in many categories.

Case 1’s results generally fall between those of Case 2 and Case 3. The average length of experience in some background categories would be up to 50 to 60 percent greater in Case 2 than in Case 3 and roughly 15 to 45 percent greater than for the force in 2001 (see pp. 101–105).

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A technical leader is defined as having had a job at group or wing level with the instructor (K) or standardization and evaluation examiner (Q) prefix.
Two additional cases examined possible future changes in requirements:

- Case 4 (further integration of warfighting and acquisition) is like Case 2, except that experience both in acquisition and on a joint staff are regarded as important for command jobs, elevating the targets for 199 jobs and raising the perfect match score by 10 percent.

- Case 5 (weaponization of space and civilianization of some support activities) is like Case 2, except that the numbers of jobs of different types have been changed, resulting in a net increase of 15 percent in 13S officers.

The optimization found flows for Cases 4 and 5 that would also exceed 99 percent of the perfect match scores, but the numbers of officers on a missile, space, or acquisition track and the force’s overall depth of experience would be somewhat less than for Case 2 (see pp. 106–107).

Along with almost complete coverage of the jobs’ needs would come considerably higher utilization of officers’ experience: 66 percent, 69 percent, and 72 percent for O-4s, O-5s, and O-6s in Case 2, for example, compared with only 31 percent, 37 percent, and 49 percent in 2001, respectively (see pp. 115–116). The more their experience matches the jobs they fill, the more productive officers should be than others, the more satisfied they may be with their jobs and careers, and the more likely they will expect the Air Force to continue their deliberate development and utilization.

**Conclusions and Recommendations**

In 2001, although adequate numbers of each grade’s 13S officers (in grades above O-3) possessed most of the needed backgrounds, these officers did not necessarily possess them in the right combinations; many lacked backgrounds needed for their jobs; and many were in jobs that did not make good use of their backgrounds. Our modeling work shows that the match between the types of experience jobs need
and those of incoming officers can be improved substantially, that career tracks can be established allowing concentrations on missile or space operations or on acquisition, that officers’ depths of experience can be increased in many areas, that development and utilization patterns can be stabilized and sustained, and that limited adjustments can accommodate potential changes in future requirements. To achieve these goals, the Air Force’s assignment process must increase its emphasis on deliberate development and utilization of officers’ experience, working to encourage the development of particular combinations of qualifications and increased utilization of their backgrounds.

In particular, we recommend the following:

- AFSPC leaders and the 13S career-field management staff should refine the development and utilization patterns that this research has identified, work with the Air Force Personnel Center and the relevant commanders and supervisors to coordinate the officer-assignment system in pursuit of the targeted patterns, publish revised career-field guidance, and consider extending the approach to enlisted and civilian space professionals (see pp. 124–126).

- The Air Force personnel community and functional managers should adapt this approach for selected other career fields and even across career fields (see pp. 126–127).

- The analytic framework should be extended—e.g., to increase flexibility in making assignments (by increasing selectivity, the numbers of individuals qualified and available to fill openings) and to reflect education and training as well as work experience (see pp. 127–128).