Czars and Company Men

The Wrong Way to Run Space Acquisition

Eugene Gholz

The U.S. space program has always pushed the technological envelope. The military has invested enormous sums in the research, development, and procurement of satellites for intelligence gathering, communications, and navigational aid, and that investment is widely recognized as having had a tremendous payoff.

Today, space capabilities provide vital support to American power projection. The next generation of satellites, now on the drawing board, is expected to provide the underpinnings of the information technology revolution in military affairs (RMA). To support "network-centric warfare," satellites will provide communications links that constitute the network, remote sensors that improve battlespace awareness, and location information that enables precision targeting.[1]

But space systems are not only important to today's military because of their impact on operations. The American military leadership has also been profoundly influenced by the approach to systems development that was pioneered for space technologies. This article explains some of the pitfalls of that acquisition style, which may block some of the military's transformation plans.

The acquisition process for space technologies has always

Eugene Gholz is Assistant Professor at the Patterson School of Diplomacy and International Commerce at the University of Kentucky, and a Research Associate for the MIT Security Studies Program.

been centralized, but recent reforms significantly increased the level of centralization, especially under Secretary of Defense Donald Rumsfeld's leadership. The Air Force has now been made the "executive agent" for space projects, and a small number of czar-like positions have been created in the Office of the Secretary of Defense to concentrate leadership of national security space acquisition. As transformation changes the military from its current "platform-centric" doctrine (built around aircraft, ships, tanks, and other platforms) to a network-centric one, those key leaders gain broader and broader influence.

At the same time, the government has shifted more and more development and systems management responsibilities to private firms in the defense-industrial base. It was once the military services' job to buy various weapons, platforms, and components, and then to combine them into an operational capability. Now, on some big projects, the government issues a relatively vague "statement of objectives," and a private contractor derives the detailed technical specifications and chooses where to spend research and production resources.

Centralization will eliminate the vitality of competition in space systems design.

The first such "Lead Systems Integrator" (LSI) contract was won by Boeing to develop National Missile Defense, a space-intensive project with important ground-based components.[2] The LSI model has since been applied to the Army's Future Combat System and the Coast Guard's Deepwater program. Each of those projects is intended to essentially replace the service's entire current generation of major equipment—that is, the equipment most vital to defining the service's future operational capabilities and organizational identity. Other major programs like the Joint Tactical Radio System already incorporate components of the LSI approach, too.

It is somewhat ironic that the national security space systems' acquisition approach is spreading throughout the military's transformation project, because several recent space programs have been criticized for poor performance. A joint task force of the Defense Science Board and the Air Force Scientific Advisory Board was charged in late 2002 with studying the systemic causes of cost overruns, schedule slippage, and capabilities shortfalls in space acquisition.[3] The report criticized the hollowing out of the government's systems engineering capabilities, implicitly attacking the LSI approach that shifts most acquisition management from the customer to the defense industry's lead supplier. But it did not go far enough in considering the problems with LSI contracts, and the report actually suggested *still further* increases in centralization of space acquisition responsibilities.

This article proceeds in four parts. First, it discusses the connection between the "systems approach" and national security space projects, as centralization and LSI contracts have deep roots in the military space community. Second, it explains the pernicious effects of centralization on technology development and project

management of military space programs. Third, it reviews several key flaws in the LSI framework for national security space acquisition. The problems identified in this article are with centralization and the LSI approach, not with reliance on space systems for America's defense. Space systems are unquestionably important for America's military doctrine. The concluding section briefly considers potential remedies that could reverse recent costly mistakes in space programs' organization and management.

The Systems Approach. During the Cold War, American military strategy relied on high technology weapons to deter the numerically superior Warsaw Pact. Innovation steadily improved the performance of each American aircraft, tank, and submarine. Even more important, the United States applied the "systems approach" to military operations, so various platforms cooperated to augment each other's strengths, compensate for each other's weaknesses, and combine to produce overall combat power far greater than the simple sum of the system's parts.[4] Military systems always included more than the traditional "shooters," too, as they relied on sensors, communications links, navigational aids, and battle management, command, and control assets. Over time, national security satellites that provided all of those non-shooting capabilities were fully integrated into the American force structure.

The systems approach was applied to weapons technology development as well as to military operations. In fact, systems engineering and integration were essentially invented to support American military acquisition projects.[5] Space systems often led the way. Like other high-tech military equipment, satellites are complex systems that pack many advanced components (power supplies, communications equipment, mission payloads like cameras, etc.) within tightly constrained volume and weight limits. Because of the unforgiving environment of space, these technical constraints arguably are even more stringent for the development of space systems than they are for other military platforms.

Moreover, space program designers inherently rely more on the system concept, because each satellite has less capability by itself than another military platform would have when considered in isolation from other platforms. While an airplane is relatively self-contained and can often complete a mission on its own, a satellite in orbit cannot "see" all of the earth at the same time. Constellations of satellites are needed to relay messages, broadcast navigational references, and gather image and signals intelligence.

Furthermore, space systems cannot easily be updated once in orbit, and satellites' great expense and the inflexibility of orbital tracks make it hard to move assets or surge additional capacity in a time of crisis. Consequently, satellite systems have to be planned in excruciating detail before they are acquired.

Finally, the extreme technical difficulties in developing space systems force engineers and acquisition planners to accept trade-offs among different aspects of performance and among cost, schedule, and risk of mission failure. For example, in satellite development, designers have to decide whether to send back data in more "raw" form, which generally requires more bandwidth and a larger on-board communications suite, or in partially processed form, which reduces data manipulation flexibility for ground commanders and requires

greater processing power on the satellite, but reduces the burden on communications. Trying to optimize those trade-offs is the core task of systems engineering; in modern defense acquisition, where "systems of systems" link up to share data and operational tasks, the systems integration task is more complex than ever.[6]

That systems of systems integration effort has spurred the centralization of space acquisition authority and the shift to the LSI approach. The idea is that accountability for a fully integrated design can only be ensured when a single agent is charged with developing and executing an acquisition plan. Similarly, a single group of highly trained systems engineers, working for one company or in a "national team" that draws on expertise from several companies, is needed to assess the full range of technical trade-offs within the system of systems. These efforts draw on technology management techniques that were developed in the 1950s for complex space projects at firms like TRW and Hughes—firms that flourished in the national security space business throughout the Cold War and now in the post-Cold War world.[7]

It is possible to imagine an acquisition system in which each military service manages its own projects, yet still transfers the whole systems integration task to a private contractor. It is also possible to imagine a centralized acquisition organization that nurtured enough in-house technical skill to make trade-offs in requirements definition and manage complex systems. But, in practice, the trends in national security space acquisition towards centralization and the LSI approach have progressed in parallel steps—in both cases, to the detriment of the government buyer and the space systems themselves.

Rumsfeld's National Security Space Organization. Recently, under the stewardship of Secretary Rumsfeld, centralization in space systems acquisition has dramatically increased. Before he joined the Bush Administration, Rumsfeld was chairman of the Commission to Assess United States National Security Space Management and Organization; the core of the recommendations in the commission's January 2001 report was a list of steps that would create a centralized authority for space. Not surprisingly, Rumsfeld as Secretary chose to implement almost all of the commission's proposals.[8]

Although the centralizing reforms of the defense establishment are often justified on the grounds of efficiency (reducing wasteful duplication of effort), in this case the primary announced goal was to increase effectiveness. A centralized agent might make trade-offs among systems to optimize performance that could otherwise be distorted by service parochialism. The agent might also dictate interoperability among space systems purchased by the various military services and the intelligence community's National Reconnaissance Office. Such interoperability is crucial for the emerging concept of network-centric warfare. Finally, a senior official focused on space systems could act as an "advocate" for space in budget and military policy debates.[9]

The Rumsfeld Commission recommendations have been slightly modified during their implementation. The Commission called for the creation of a new Undersecretary of Defense for Space, Intelligence, and Information, but instead the Air Force has been made the "executive agent" for national security space, meaning that authority has been delegated to that service to act on the Secretary of

Defense's behalf. The key is that a single, senior civilian, the Undersecretary of the Air Force, has been put in charge.

That civilian also now receives centralized advice on systems integration: the position of National Security Space Architect (NSSA), created in 1998, was "realigned" to report directly to the Undersecretary of the Air Force starting in 2001.[10] The National Security Space Plan, developed by the Air Force with advice from the NSSA, "fulfill[s] a criti cal role in resource allocation."[11] In essence, the United States now has a space acquisition czar who is served by a space technology mini-czar. As a result, all pending developments of new space sys tems, including major initiatives in imaging, communications, and naviga tion, must pass through the wickets set up by that team.[12]

Unfortunately, there are clear disadvantages to this new organization. In par ticular, centralization often inhibits innovation, and it sacrifices the flexibility that a portfolio of approaches would offer. These problems of centralization are especially important during a period of tech nological ferment, experimentation, and change in military operational doctrine.

Competition stimulates new ideas, while monopolies prefer to rest on the laurels of past successes. In short, the establishment of a single acquisition agent creates a monopoly in national security space policy. If the services (and the intelligence community) compete for roles and missions, each can offer a dif ferent response to a threat to America's national security, and each will try to protect its professional jurisdiction from encroachment by the others. Over time, the military services have developed their own standard operating procedures, measures of effectiveness, and design philosophies.[13] These organizational cul tures influence the objectives set for satellite development projects and also the decisions about trade-offs once systems engineering begins. The several approaches to systems development spurred innovation during the Cold War. Centralization, on the other hand, will now force the various acquisition agents to blend their approaches, elimi nating the vitality of competition in space systems design.[14]

Moreover, if several acquisition agents buy space systems independently, the overall American military presence in space is likely to be more adaptable to changing strategic conditions and to program failures. A centralized buyer, of course, has an incentive to purchase a flexible portfolio of assets, too. But the breadth of the requests for proposals released by the single agent—derived from its single organizational culture—or a cobbled-together, least common denominator blend of philosophies is unlikely to span as many technical possibilities.[15] Furthermore, the pressures to eliminate "wasteful duplication" and to exploit economies of scale to reduce costs

The LSI and NIT have compelled the government to continue working with the same suppliers despite program difficulties.

are also likely to limit the single buyer's ability to acquire as broad a portfolio as a less centralized system would allow. The recent centralization of national security space acquisition puts too many of the government's eggs in one basket.

The effects of Rumsfeld's centralization are clearly apparent in the area of military satellite communications (MILSATCOM) acquisition. Following recommendations from the National Security Space Architect, the Transformational Communications Office (TCO) was created in September 2002, initially without acquisition authority, to develop a plan to link legacy communications satellites to the systems now under development for network-centric operations.[16] Fairly quickly, however, the head of the office, who is also the head of the National Reconnaissance Office charged with buying satellites for the intelligence community, announced that any military communications programs not based on the TCO's Transformational Communications Architecture should be killed.[17] While the Transformational Communications Architecture is intended to be broad and adaptable to various communications conditions, the tremendous range of possible demand—for the different military services, operating in different topographies and climates and transmitting many different kinds of raw and processed data with many different requirements for security and robustness—inherently increases the technical complexity of the systems integration task.

Moreover, applying the architecture so broadly obligates the TCO to respond to pressures from many organizations, each of which lobbies to add its favorite requirements to the MILSATCOM project. Even if the various requirements somehow turn out to be technically compatible, their proliferation makes it harder for the TCO to set investment priorities; trade-offs become more difficult as the number of issues in play and the number of stakeholders increase.[18] And the need to respond to requests (and complaints) from so many outsiders reduces the ability of the TCO's leadership to focus on technical and project oversight tasks: bureaucratic leaders beholden to too many masters frequently fail to perform their core tasks well.[19]

The Defense Science Board/Air Force Scientific Advisory Board joint task force report noted problems with requirements proliferation on space projects. Their response, unfortunately, was to recommend further centralization: designation of a senior Defense Department leader to control requirements definition on all national security space projects. The military services and other users could submit requests to this authority, but the leader's primary job would be to deny those requests whenever possible in the interest of limiting complexity.[20] This "solution" fails to acknowledge that the real problem is with centralization itself: the senior leader will be overwhelmed with requests, will be unable to respond to them all, and will stifle innovation by imposing an architecture that cannot respond to all of the specific needs of the various parts of the military.

Problems with the Lead Systems Integrator Approach. Meanwhile, as the government has centralized its national security space acquisition organization, it has also delegated more and more technology management tasks to industry. The format of that delegation—LSI contracts—has required a parallel centralization of the industry. The balance between public and private responsibilities has shifted too far

towards the private, introducing the appearance of conflicts of interest that could undermine space systems' quality. The LSI model also changes political relationships in military acquisition, making appropriate oversight more difficult. While Defense Department leaders quite reasonably want to take advantage of the advanced technical capabilities of private companies, they are abdicating their responsibilities to define and oversee projects.

The Department of Defense approved the first LSI contract in August 1997 for the National Missile Defense (NMD) program.[21] The idea was to develop an integrated architecture for radars, other sensors (including satellites), and ground-based interceptors—a system of systems—that allegedly could not be developed effectively or quickly through another contracting mechanism. Boeing won the contract in the spring of 1998.

Over time, as the commitment to deploy a "layered defense" against ballistic missiles grew, NMD was redesignated the Ground-based Midcourse Defense component of an overall Ballistic Missile Defense System. The system of systems now required data interchange and integrated battle management with a planned host of additional sensors and interceptors. The Missile Defense Agency decided that neither the government nor any one contractor had the expertise to lead the entire project, so responsibility passed to a "national industry team" (NIT) for systems engineering and integration: all six missile defense prime contractors contributed engineers, with Boeing in overall charge.[22]

This team was not meant to develop the system of systems to match government requirements; instead, it was charged initially with assessing options for overall missile defense development.[23] The Missile Defense Agency only approved the "Technical Objectives and Goals," which included a list of "broadly defined" capabilities rather than specific requirements. The project was hailed as a major increase in cooperation between users and developers compared to past programs that were defined by users alone.[24]

At first, the defense industry rightly resisted the national team concept. Industry leaders feared that team members would not want to contribute their best ideas to an effort for which they would not be individually rewarded. Perhaps more importantly, they wondered who would be blamed if (or when) cost, schedule, or performance problems arose.[25] Under even the best of circumstances, the national team format sets the stage for rancor between the firms and their customer: even contractors that try their hardest on very difficult technical tasks may later face criticism that they held back proprietary technologies from the national team. Because the government has withdrawn to a very limited role in technical requirements definition, it may be hard to find an "independent" adjudicator to deflect the perception of contractor malfeasance.

A simple tilt to traditional "systems acquisition" would alleviate the strains in the development and procurement of space assets.

However, defense contractors have lit-

tle recourse when their one customer, the government, sets new terms for their relationship, so all of the "big six" prime contractors joined the NIT. And the Ballistic Missile Defense System has already been troubled by the perceived conflicts of interest. A series of scandals hit the front page in 2003 when, on several projects, Boeing engineering teams gained access to competitors' confidential documents. Although the Boeing teams never received the documents *because* Boeing was the LSI, media coverage of the incidents has not carefully emphasized that distinction.[26] So far, the scandal has been contained, and the missile defense enterprise and national security space acquisition continue. But Still, no system has been built and deployed, and no customer is truly dissatisfied. The real political crises are yet to come.

Moreover, the LSI concept and the NIT have compelled the government to continue working with the same suppliers despite program difficulties. With all of the possible suppliers committed to the same Ballistic Missile Defense System approach, what recourse does the government have? Even after Boeing had problems on its initial three-year LSI contract—cost, schedule, and documents management problems—the government not only renewed Boeing's contract but also expanded Boeing's role, rolling what had been three separate efforts into a single contract.[27]

Finally, with one, big contract for the Ballistic Missile Defense System supported by the combined lobbying power of all the major defense contractors, critics and reformers have a relatively limited constituency to which they can appeal for political support. The national team approach helps to lock in the current missile defense plan.

As the LSI/NIT approach concentrates national security space acquisition on a single, centralized team, all of the buyer's eggs are in one basket—the direct analog of the problem imposed by centralization on the buyer's side. In fact, as transformation spreads to all military systems acquisition, the problems in national security space acquisition are infecting the entire defense industrial base.

A Return to Systems Acquisition.

A simple tilt back to traditional "systems acquisition" would alleviate most of the strains in the development and procurement of innovative national security space assets. Trying to buy "systems of systems" all at once is a bridge too far, needlessly increasing complexity, reducing oversight, and overloading bureaucratic management capabilities. Centralization under a single executive agent for space and a National Security Space Architect pretends that one plan can encompass all space acquisition. But while various systems need to be able to work together at some minimum level of interoperability, mandates for a fully integrated design cannot wish away the technical overreach. Similarly, privatizing technical management of national security space investment can help the government get access to top experts employed by the defense industry. But that access does not absolve the government of its responsibility to provide technical direction and to nurture a flexible political coalition to support national security space programs.

American defense management won the Cold War with a series of successful innovations. Let's not give up on that acquisition system too easily.

NOTES

1 Eugene Gholz, "Military Transformation, Political Economy Pressures, and the Future of Trans-Atlantic National Security Space Cooperation," *Astro politics* 1, no. 2 (Autumn 2003): 28–37.

2 The National Missile Defense program has since evolved into the Ground-Based Midcourse Defense program. Acquisition of missile defenses is centralized in the Missile Defense Agency, and systems inte gration and technology management responsibilities remain with the private defense industrial base.

3 *Acquisition of National Security Space Systems* (Washington, D.C.: Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, 2003).

4 For example with respect to ground combat, see Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton: Princeton University Press, forthcoming, 2004), chapter 3. For antisubmarine warfare, see Owen R. Coté, *The Third Battle: Innovation in the U.S. Navy's Silent Cold War Struggle with Soviet Submarines*, U.S. Naval War College Newport Paper no. 16, 2003.

5 Harvey M. Sapolsky, "Inventing Systems Integration," in Andrea Prencipe, Andrew Davies, and Mike Hobday, eds., *The Business of Systems Integration* (New York: Oxford University Press, 2003), 15–34.

6 Eugene Gholz, "Systems Integration in the U.S. Defense Industry: Who Does It and Why Is It Impor tant?" in Andrea Prencipe, Andrew Davies and Mike Hobday, eds., *The Business of Systems Integration* (New York: Oxford University Press, 2003), 279–306.

7 Davis Dyer, *TRW: Pioneering Technology and Innovation since 1900* (Cambridge: Harvard Business School Press, 1998).

8 Linda de France, "Rumsfeld Concurs with Most of Space Commission's Organizational Reforms," *Aerospace Daily* (10 May 2001), 7.

9 Commission to Assess United States National Security Space Management and Organization (Rumsfeld Commission), *Report, Executive Summary* (Washington, D.C.: U.S. Government Printing Office, 2001), 9, 32.

10 U.S. General Accounting Office, *U.S. Space Activities: Status of Reorganization* (Washington, D.C.: U.S. Government Printing Office, 2002), 5.

11 Marc Selinger, "DOD Space Plan Expected to Affect Resource Allocation," *Aerospace Daily* (1 April 2002), 6.

12 Marc Selinger, "National Security Space Programs to Undergo Yearly Review," *Aerospace Daily* (26 August 2003), 3.

13 Carl H. Builder, *The Masks of War* (Baltimore: Johns Hopkins University Press, 1989).

14 Harvey M. Sapolsky and Eugene Gholz, "The Defense Monopoly," *Regulation* 22, no. 3 (Fall 1999), 39–43.

15 Robert J. Art, *The TFX Decision: McNamara and the Military* (Boston: Little, Brown and Company, 1968), 105–07, 118–9.

16 Kerry Gildea, "Air Force Forms New Office To Lay Groundwork For Future Satellite Communications," *C_4I News* (12 September 2002).

17 Kerry Gildea, "TCO Maintains Military Communications Must Adapt To Transformational Architecture," *Defense Daily* (28 February 2003).

18 Thomas P. Hughes, *Rescuing Prometheus: Four Mon umental Projects that Changed the World* (New York: Vintage Books, 1998), 166–89, 236–50.

19 James Q. Wilson, *Bureaucracy: What Government Agencies Do and Why They Do It* (New York: Basic Books, 1989), 181–85, 317–25.

20 *Acquisition of National Security Space Systems*, 19–21.

21 "BMDO Gets Green Light on NMD Acquisition Plan, LSI Award," *Aerospace Daily* (13 August 1997), 235.

22 Marc Selinger, "MDA Questioned on GMD Tests, National Team Approach," *Aerospace Daily* (5 May 2003), 5.

23 Kerry Gildea, "MDA to Award Second Round of Contracts to Missile Defense National Team," *Defense Daily* (14 August 2002).

24 "Kadish Sets 'Technical Objectives and Goals' for Missile Defense System," *Aerospace Daily* (1 July 2002), 7.

25 Kerry Gildea, "New Missile Defense National Team Faces Tough Technological, Integration Task," *Defense Daily* (11 April 2002).

26 "Draft HAC Defense Panel Report Calls for LSI Firewalls Report," *Defense Daily* (25 June 2003). For a detailed examination of a key case, see U.S. General Accounting Office, Missile Defense: Events Related to Contractor Selection for the Exoatmospheric Kill Vehicle, GAO-03-324R, 23 January 2003.

27 Kerry Gildea, "Boeing, BMDO to Negotiate Follow-on Contract for NMD," *Defense Daily* (27 Octo ber 2000).

AD