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DELEGATE TO INNOVATE

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ABOUT THE AUTHOR

Dr. Thane C. Clare is a Senior Fellow at the Center for Strategic and Budgetary Assessments. His work focuses on naval, air, and space power, strategic war planning, defense planning in an era of great-power competition, and the nexus between operational planning and defense acquisition. His recent projects have focused on U.S. Navy strategic concepts, rapid innovation in military technology, homeland air defense, command and control, and Ukraine's unmanned surface vessel operations.

Dr. Clare joined CSBA in 2023 following a 25-year career in the United States Navy, retiring at rank of Captain. His final posting was as Branch Head, Navy Analytics, in the Office of the Chief of Naval Operations. Immediately prior to his final tour, Dr. Clare served as Strategic Plans Advisor in the Office of the Secretary of Defense, where he authored Defense-wide operational planning guidance for presidential signature. Dr. Clare also published "The Office of Secretary of Defense," a chapter in the Naval Institute Press volume, *The Naval Officer's Guide to the Pentagon.*

During his Navy career, Dr. Clare deployed to waters around the globe, from the Baltic, Mediterranean, and Arabian seas to the Atlantic, Pacific, and Indian Oceans. He served twice in command at sea, as Commanding Officer (CO) of the coastal patrol ship USS *Whirlwind* (PC 7), deployed to the Persian Gulf for the defense of critical Iraqi oil infrastructure, and most recently as CO of USS *Mustin* (DDG 89), forward deployed to Yokosuka, Japan and operating in the East and South China Seas, Philippine Sea, Pacific Ocean, and adjacent waters.

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Introduction

> *Unless you can point your finger at the one person who is responsible when something goes wrong, then you have never had anyone really responsible.*
>
> —Admiral Hyman G. Rickover[1]

The slow pace of American military innovation presents an urgent problem for U.S. policymakers.[2] China seeks the upper hand in the global balance of power, yet the United States still takes roughly twice as long as China to field new military capabilities.[3] In view of this reality, President Donald Trump issued an executive order stating: "Our defense acquisition system does not provide the speed and flexibility our Armed Forces need.... To strengthen

1 Hyman G. Rickover, Director, Naval Nuclear Propulsion Program, "Statement Before the Subcommittee on Energy Research and Production, House Committee on Science and Technology," May 24, 1979, p. 9, https://www.nrc.gov/docs/ML1932/ML19322C341.pdf.

2 Although this report primarily focuses on the technological aspect of U.S. military innovation, numerous other factors play critical roles in a particular innovation's success or failure: "Although technology is often the most visible form of innovation, it encompasses technological, operational, and organizational innovation, whether separately or in combination, intended to enhance the military's ability to prepare for, fight, and win wars." Thomas G. Mahnken, Evan B. Montgomery, and Tyler Hacker, *Innovating for Great Power Competition: An Examination of Service and Joint Innovation Efforts* (Washington, DC: Center for Strategic and Budgetary Assessments, 2023), p. I, https://csbaonline.org/resource/innovating-for-great-power-competition-an-examination-of-service-and-joint-innovation-efforts/.

3 On Chinese qualitative military advances, see Toshi Yoshihara, Jack Bianchi, and Casey Nicastro, *Focused Force: China's Military Challenge and Australia's Response* (Washington, DC: Center for Strategic and Budgetary Assessments, 2025), p. 2, https://csbaonline.org/resource/focused-force-chinas-military-challenge-and-australias-response/. On U.S.–China military innovation timelines, see Ronald Reagan Presidential Foundation & Institute, *National Security Innovation Base Report Card* (Washington, DC: Ronald Reagan Presidential Foundation & Institute, 2025), p. 15. The U.S. Government Accountability Office (GAO) puts the average initial operational capability timeline for major defense acquisition programs at 12 years. Shelby S. Oakley, Director, Contracting and National Security Acquisitions, GAO, "Clearing the Path: Reforming Procurement to Accelerate Defense Innovation, Statement Before the Subcommittee on Military and Foreign Affairs, House Committee on Oversight and Government Reform," June 11, 2025, p. 8, https://www.congress.gov/event/119th-congress/house-event/118371/text. See also Tai Ming Cheung and Thomas G. Mahnken, *The Decisive Decade: United States–China Competition in Defense Innovation and Defense Industrial Policy in and Beyond the 2020s* (Washington, DC: Center for Strategic and Budgetary Assessments, 2023), p. I, https://csbaonline.org/resource/the-decisive-decade-united-states-china-competition-in-defense-innovation-and-defense-industrial-policy-in-and-beyond-the-2020s/.

our military edge, America must deliver state-of-the-art capabilities at speed and scale through a comprehensive overhaul of this system."[4]

In accordance with the executive order, in November 2025 the Department of Defense (DoD) published a trio of documents that laid out a new approach to defense acquisition, including a capstone *Acquisition Transformation Strategy*.[5] These directives mandate substantial changes to the way DoD does its acquisition business, including attention-grabbing moves such as eliminating the traditional requirements process and replacing system-focused program executive offices with capability portfolios managed by portfolio acquisition executives.[6]

DoD's new acquisition directives focus on speed and accountability by, for example, tying program manager tenure and incentives to on-time delivery.[7] Although an overhaul of the defense acquisition system might reduce barriers to innovation, it will not solve a deeper problem: endemic diffusion of decision-making responsibility and authority across the DoD. Too many cooks spoil the broth, as the saying goes. Diffusion of responsibility undermines group performance by making each individual less accountable for the ultimate outcome.[8] Admiral Hyman G. Rickover—the father of nuclear power, and arguably the most successful innovator DoD has ever produced—emphasized the same point in the quote that introduced this chapter.[9] Diffusion of responsibility for fielding innovative military technology produces delay, cost growth, and failure to meet operational specifications.[10]

4 Exec. Order No. 14265, 90 Fed. Reg. 15621 (2025), https://www.whitehouse.gov/presidential-actions/2025/04/modernizing-defense-acquisitions-and-spurring-innovation-in-the-defense-industrial-base/.

5 Office of the Under Secretary of War for Acquisition & Sustainment, *Acquisition Transformation Strategy: Rebuilding the Arsenal of Freedom* (Washington, DC: Department of War, 2025), https://media.defense.gov/2025/Nov/10/2003819441/-1/-1/1/acquisition-transformation-strategy.pdf; Secretary of War, "Transforming the Defense Acquisition System into the Warfighting Acquisition System to Accelerate Fielding of Urgently Needed Capabilities to Our Warriors," memorandum, November 7, 2025, https://media.defense.gov/2025/Nov/10/2003819439/-1/-1/1/transforming-the-defense-acquisition-system-into-the-warfighting-acquisition-system-to-accelerate-fielding-of-urgently-needed-capabilities-to-our-warriors.pdf; and Secretary of War, "Reforming the Joint Requirements Process to Accelerate Fielding of Warfighting Capabilities," memorandum, November 7, 2025, https://media.defense.gov/2025/Nov/10/2003819442/-1/-1/1/reforming-the-joint-requirements-process-to-accelerate-fielding-of-warfighting-capabilities.pdf.

6 Some elements of these directives were subsequently codified in the Fiscal Year 2026 National Defense Authorization Act, December 7, 2025, https://armedservices.house.gov/uploadedfiles/rcp_text_of_house_amendment_to_s._1071.pdf.

7 Secretary of War, "Transforming the Defense Acquisition System."

8 See, for example, Frederike Beyer et al., "Beyond Self-Serving Bias: Diffusion of Responsibility Reduces Sense of Agency and Outcome Monitoring," *Social Cognitive and Affective Neuroscience* 12, no. 1, 2017, pp. 138–145, https://doi.org/10.1093/scan/nsw160.

9 As described in chapter 2, Rickover fielded the world's first nuclear submarine just five years after the U.S. Navy decided to undertake a nuclear propulsion program—and only 15 years after fission was discovered.

10 The same could be said for routine modernization programs. Indeed, many of this report's critiques of DoD technology innovation processes are equally applicable to DoD acquisition writ large. But innovation—introducing new technologies, operating concepts, training, and so forth—entails uncertainties and the potential for friction with bureaucratic processes and organizational norms that exceed the challenges of ostensibly routine acquisition.

FIGURE 1: ADMIRAL HYMAN RICKOVER AND THE FIRST NUCLEAR SUBMARINE, USS NAUTILUS

U.S. Navy via Wikimedia Commons

Cold War innovation successes show how this cycle can be broken. From the 1950s to the 1980s, one approach has paid consistent dividends: centralizing authority in one leader responsible for fielding a new military technology at an operationally useful scale. The success stories vary in their details but share two vital attributes. Each delivered a major military innovation in roughly five years, and each is indelibly associated with a single leader's name. Among these were Rickover's nuclear submarines and aircraft carriers, General Bernard Schriever's intercontinental ballistic missiles (ICBMs), Admiral William Raborn's *Polaris* submarine-launched ballistic missile system, and Under Secretary of Defense William Perry's F-117A stealth fighter.

Analysis by the Center for Strategic and Budgetary Assessments (CSBA) has pinpointed four prerequisites for successful military innovation: an operational problem with no existing solution, senior leader support, receptive organizational norms and culture, and empowered innovators (see Callout Box 1).[11] This report expands on the fourth prerequisite by examining how Cold War innovators were empowered. Drawing on case studies of Rickover's nuclear power program and Schriever's ICBMs, it argues that the secretary of defense must carve out a comprehensive set of authorities, a set normally delegated to a confederation of subordinates, and hand it to the lead innovator in a neat package. Then, the secretary of defense must personally protect the lead innovator from "those nit-picking sons of bitches at the Pentagon" (to use Schriever's colorful phrase), many of whom report directly to the secretary and are, after all, only doing their jobs.[12]

11 Mahnken et al., *Innovating for Great Power Competition,* p. 11.

12 Neil Sheehan, *A Fiery Peace in a Cold War: Bernard Schriever and the Ultimate Weapon* (New York: Vintage Books, 2010), p. 228.

CALLOUT BOX 1: PREREQUISITES FOR SUCCESSFUL MILITARY INNOVATION

1. The existence of an operational problem without an existing solution.
2. Top-level leadership backing to protect and support the innovators.
3. An open-minded organizational culture.
4. Innovators who are supported and rewarded for their efforts.

It is no coincidence that the Cold War's most consequential innovations took roughly five years from concept to deployment. Responsibility can be diffused across time as well as organizational stovepipes. Today's innovators cannot reasonably be held accountable for the failures of their predecessors. Setting delivery goals beyond the five-year mark practically guarantees that the lead innovator will move on before the project is completed, receiving neither recognition for victory nor censure for failure. As such, today's average delivery timeline of 12 years may be as much a cause of innovation failure as a symptom.[13]

Innovation succeeds when leaders are delegated the authority to plan, prioritize, and act without having to ask permission or fight bureaucracy at every turn. Delegating authority for specific military innovations is therefore a core responsibility of the secretary of defense.[14]

The secretary's dilemma is whether to retain authority and oversight at a high level or to delegate it, promoting speed and agility at the expense of hands-on senior leader control. Defense regulations govern this delegation in routine circumstances. They create predictability and assign authority without incurring disproportionate strategic, institutional, or budgetary risk (at least in theory). In principle, they evolve in response to past successes and failures.

The problem is that new innovations are unlikely to look exactly like past examples. The process of innovation inevitably unearths new challenges that must be dealt with in stride. Real-time breakthroughs and setbacks call for decisions that are out of sync with calendar-based processes and often lie awkwardly across organizational lines. This is a vexing problem for large bureaucracies like DoD: senior leaders have the authority to make decisions but not enough time to focus on any one project; conversely, subordinates have time to focus but lack sufficient authority for on-the-spot decisions.

Complicating matters, the more innovative the capability, the harder it is to predict what sufficient authority looks like. Trying to foster innovation via broad-brush process reform is like trying to craft general rules for solving jigsaw puzzles without reference to any specific puzzle. No matter how thorough and correct the instructions, rote compliance could speed some solutions while imposing gross inefficiencies on others.

13 On delivery timelines, see Oakley, "Clearing the Path."

14 In this report, "authority" refers to the statutory authorities of the secretary of defense and his or her subordinates, as set forth in *United States Code,* Title 10.

A better way to accelerate defense innovation is to empower a capable leader, by name, to develop and field the new capability. But merely naming a leader is not sufficient, no matter how senior and experienced. DoD requirements and acquisition responsibilities are diffused across service and joint bureaucracies and the Office of the Secretary of Defense (OSD). Therefore, only the secretary of defense has sufficient authority to definitively resolve the challenges and conflicts that will assuredly arise during the innovation process.[15]

The next step is for the secretary of defense to delegate to the lead innovator the power to act on their behalf. This is not simply a matter of anointing the lead innovator as a "special assistant" or making them a direct report to the secretary. Rather, it requires the secretary to take back many authorities normally delegated to a constellation of senior officials and reassign them to the lead innovator, scoped for the innovation in question. The secretary must personally ensure that the innovation is appropriately resourced. Then and only then can the secretary (and Congress) hold the innovator accountable for meeting cost, schedule, and performance requirements.

What does this look like in practice? The most successful technique has been to create a single-focus organization under a lead innovator, who has undiluted responsibility for fielding the new capability. Rickover's Naval Reactors, for example, straddled DoD and the Atomic Energy Commission (AEC), uniting the authorities of two cabinet-level agencies.[16] Similarly, Schriever stood up the Air Force's Western Development Division, assuming authorities normally retained by his superiors to accelerate ICBM deployment. Rickover and Schriever, the organizations they led, and the senior leaders who delegated unprecedented authority to them have much to teach about rapid defense innovation.

* * *

For nearly 70 years, U.S. leaders have tried to speed military innovation by reforming the defense acquisition system, with consistently disappointing results.[17] America's Cold War experience demonstrates that DoD can innovate at speed and scale if talented innovators are given tailored authority, resources, and tenure and are protected from normal bureaucratic

15 In some circumstances a service secretary could fill this role as well, but no official below that level is authorized to make decisions about military requirements and acquisition. The former is delegated to the uniformed service chiefs, but the latter is held by the secretaries of the military departments and delegated to the service acquisition executives. Only the secretary of defense, however, can exempt service innovators from detailed oversight by the under secretaries of defense for research and engineering and acquisition and sustainment, the director of operational testing and evaluation, and other departmental authorities who report only to the secretary. See DoD, *DoD Directive 5000.01: The Defense Acquisition System,* Change 1 (Washington, DC, Office of the Under Secretary of Defense for Acquisition and Sustainment, July 28, 2022) https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/500001p.pdf.

16 The AEC's functions are now embodied in the Department of Energy.

17 Hence the title of one comprehensive review of such efforts: J. Ronald Fox, *Defense Acquisition Reform, 1960–2009: An Elusive Goal* (Washington, DC: U.S. Army Center of Military History, 2009).

processes.[18] Today's leaders must embrace this lesson if critical defense innovation efforts are to succeed.

18 Of course, DoD cannot apply this approach to every acquisition program—systemic reform may still be needed to improve DoD's overall acquisition performance.

CHAPTER 1

Explaining Defense Innovation Failure

> *Delegate authority, delegate responsibility, and hold people accountable — [these are] things that are done in industry routinely that government finds it's very difficult to do.*
>
> —Norman Augustine[19]

Since the 1960s, rapid technological innovation in the DoD has been the exception rather than the rule.[20] As former DoD Comptroller Dov Zakheim remarked in 2013, citing the seminal 1986 Packard Commission on defense acquisition reform, the basic problems "are those of rigid organization and overcomplicated procedure."[21] He went on to say: "Not very much has changed in the nearly three decades since those words were written."[22]

Another decade has passed with little change. "Innovation incubators" like the Defense Innovation Unit (DIU) may represent genuine attempts to solve the problem, but as Zakheim said of similar efforts in the 2010s, they are also "indictment[s] of the current system."[23]

19 Sydney J. Freedberg, Jr., "Take Risks, Norm Augustine Urges Hill, DoD on Acquisition," *Breaking Defense*, September 10, 2012, https://breakingdefense.com/2012/09/take-risks-norm-augustine-urges-hill-dod-on-acquisition-excl/.

20 See, for example, Fox, *Defense Acquisition Reform*.

21 Dov. S. Zakheim, "Twenty-Five Years of Acquisition Reform: Where Do We Go from Here? Statement Before the House Committee on Armed Services," October 29, 2013, https://www.congress.gov/113/chrg/CHRG-113hhrg85330/CHRG-113hhrg85330.pdf.

22 Ibid.

23 On DIU, see "Defense Innovation Unit," Department of War, https://www.diu.mil/. For similar efforts by the military services, see, for example, "Rapid Capabilities Office," U.S. Air Force, https://www.af.mil/About-Us/Fact-Sheets/Display/Article/2424302/rapid-capabilities-office/; and "MC Rapid Capabilities Office," U.S. Marine Corps, https://www.mcwl.marines.mil/Divisions/RCO/. See also "AFWERX," Air Force Research Laboratory, https://afwerx.com/. Quote is from Zakheim, "Twenty-Five Years of Acquisition Reform," p. 56.

Moreover, innovation incubators do not address the fundamental problem: diffusion of responsibility for fielding a new military capability as quickly as possible.

Diffusion of responsibility is the true culprit behind the so-called valley of death: "The point of transition between the research and development side of DoD and the acquisitions and sustainment side," where promising innovations die on the vine.[24] Responsibilities for the opposing banks of the valley are clear: the under secretary of defense for research and engineering (USD R&E) on one bank, and the under secretary of defense for acquisition and sustainment (USD A&S) on the other. But responsibility for shepherding any specific innovation across the valley is blurry.

Offices perched on only one side of the valley can do little to solve the problem. The Defense Advanced Research Projects Agency (DARPA), for example, reports to USD(R&E)—the guardian of the "left" side.[25] It cannot bridge the valley on its own authority. Nor is it sufficient to make a program manager a direct report to the secretary or deputy secretary of defense, as with DIU.[26] Although this may create a foothold on either side of the valley, such managers become peers, not superiors, to USD(R&E), USD(A&S), and the service secretaries, and those managers cannot direct the others to take the actions necessary to move innovations from concept to delivery (and sustainment) at scale. At best, they can appeal to the secretary of defense to task the under secretaries and Services—an awkward, inefficient formula. Furthermore, their responsibilities will compete with those of other direct subordinates of the secretary, including the director of cost assessment and program evaluation, the director of operational test and evaluation, and the DoD comptroller.[27]

Moreover, while USD(R&E) and USD(A&S) oversee DoD innovation and acquisition policy, most military research and development (R&D) and acquisition work is managed by the service acquisition executives under each military department's civilian secretary, who in turn reports to the secretary of defense.[28] Thus, the under secretaries have limited ability to accelerate innovation—but almost unlimited ability to slow innovation through intrusive bureaucratic oversight.

24 Jake Chapman, "Reliance on Dual-Use Technology Is a Trap," *War on the Rocks*, September 8, 2022, https://warontherocks.com/2022/09/reliance-on-dual-use-technology-is-a-trap/. See also "Terraforming the Valley of Death: Making the Defense Market Navigable for Startups," Defense Innovation Board, 2023, pp. 1–2, https://stib.cto.mil/wp-content/uploads/2026/01/2023-1_DIB_Report_Terraforming_the_Valley_of_Death.pdf; and Brodi Kotila et al., *Strengthening the Defense Innovation Ecosystem* (Santa Monica, CA: RAND, 2023), https://www.rand.org/pubs/research_reports/RRA1352-1.html.

25 On DARPA, see "Home," DARPA, https://www.darpa.mil.

26 See "Doug Beck," DIU, https://www.diu.mil/team/doug-beck.

27 For an overview of the Office of the Secretary of Defense, see Thane Clare, "The Office of the Secretary of Defense," in Fred W. Kacher and Douglas A. Robb, eds., *Naval Officer's Guide to the Pentagon* (Annapolis, MD: Naval Institute Press, 2019), pp. 97–117.

28 DoD, *DoD Directive 5000.01*.

Finally, the valley of death cannot be eliminated by filling it with fungible money, such as the now-discontinued Rapid Defense Experimentation Reserve.[29] The most generous budget cannot make up for the lack of a single empowered, accountable leader charged with fielding a critical innovation.

Concentrating responsibility and authority in such a leader is the only reliable solution to the problem, as the nuclear power and ICBM cases show. To speed successful innovation, the main task of senior defense officials—the secretary of defense and the Service secretaries—is to select capable innovators and grant them authority to operate unimpeded on both sides of the valley and everywhere in between.

This is straightforward in principle but difficult in practice. It requires three politically and bureaucratically challenging steps. First, making an airtight case that the innovation will solve a critical operational problem that has no other plausible solution. Second, taking back oversight and decision authority from senior DoD officials in order to delegate them to the lead innovator, who may be junior to the normal decision makers. Third, if insufficient statutory or budgetary authority exists, going to the White House and Congress to seek appropriate changes.

This chapter begins by surveying historical and contemporary perspectives on U.S. defense innovation failure. These analyses consistently find that decades of efforts to fix innovation through acquisition reform have not solved the problem of diffusion of responsibility. Organizational and procedural changes merely diffuse responsibility in new ways, creating different but no less pernicious gaps, seams, and stovepipes.

CALLOUT BOX 2: BIG “A” ACQUISITION

This report uses *acquisition* as shorthand for “Big A” acquisition, a system of systems consisting of the Joint Capabilities Integration and Development System (JCIDS); the Planning, Programming, Budgeting, and Execution System (PPBES); and the defense acquisition process. Highlighting the diffusion of responsibility, historian J. Ronald Fox commented that “these three systems do not report to or fall under an overarching system,” leaving it to the secretary of defense to personally orchestrate these diverse processes—an unrealistic expectation.[30]

Additionally, although critical analyses of DoD innovation often cite a culture of risk aversion, a more accurate view is that innovation failure is the collective result of individually

29 Courtney Albon, “Pentagon Approves First Rapid Defense Experimentation Reserve Projects,” C4ISRNet, December 2, 2023, https://www.c4isrnet.com/battlefield-tech/2023/12/02/pentagon-approves-first-rapid-defense-experimentation-reserve-projects/; Courtney Albon, “Pentagon Officials Tout Rapid Experimentation at Courtyard Showcase,” Defense News, July 17, 2025, https://www.defensenews.com/pentagon/2025/07/17/pentagon-officials-tout-rapid-experimentation-at-courtyard-showcase/.

30 Fox, *Defense Acquisition Reform,* p. 5. On August 20, 2025, the DoD announced plans to disestablish JCIDS: Ashley Roque et al., “Pentagon Terminating JCIDS Process as Part of Larger Acquisition Reform: Memo,” *Breaking Defense*, August 22, 2025, https://breakingdefense.com/2025/08/pentagon-terminating-jcids-process-as-part-of-larger-acquisition-reform-memo/. This was later codified in the FY2026 National Defense Authorization Act.

rational responses to bureaucratic incentives.[31] In fact, risk taking can do more harm than good by upsetting the processes that produce day-to-day military readiness, as discussed later in this chapter. Management expert Peter Drucker went even further, arguing that innovators are not risk takers: "The innovators I know are successful to the extent to which they define the risks *and confine them* [emphasis added]…. Successful innovators are conservative. They have to be. They are not 'risk-focused'; they are 'opportunity focused.'"[32]

Next, this chapter lists "easy" fixes for several longstanding barriers to defense innovation. Of course, these fixes are only easy in theory. They are labor intensive and politically fraught. Chief among these barriers is Congress's use of continuing budget resolutions, which imposes crippling restrictions on defense innovation. Less obvious problems include failure to fully implement legislated reforms or to pare back regulations that exceed what is required by law.

The chapter closes by setting the stage for the analysis of Cold War innovations. Responsibility for defense innovation success or failure has lain at the feet of the secretary of defense since the position was established by the National Security Act of 1947, but the demands of this "nearly impossible job" make it implausible for the secretary to personally lead innovation efforts.[33] Acquisition reform and attempts to instill cultural shifts have proved ineffective at speeding innovation because they do not resolve (and sometimes exacerbate) diffusion of responsibility. The most consequential Cold War defense innovations resulted not from hands-on secretarial leadership or finely tuned organizational processes; rather, they resulted from concentrating authority in the hands of capable innovators.

The Usual Suspects

There is little mystery associated with DoD's persistent inability to innovate rapidly.[34] As the U.S. Army's chief historian observed in 2011, "Many notable studies of defense acquisition with recommendations for changes have been published, and each has reached the same general findings with similar recommendations."[35] Well-known challenges include:

31 This report is not intended as an academic study of institutional culture. For present purposes, *culture* should be read in its plain-English sense as "the customary beliefs, social forms, and material traits of a…social group": *Merriam-Webster Dictionary*, "Culture," https://www.merriam-webster.com/dictionary/culture.

32 Peter F. Drucker, *The Essential Drucker: The Best of Sixty Years of Peter Drucker's Essential Writings on Management* (New York: HarperCollins Publishers, 2007), p. 279.

33 "National Security Act of 1947," Department of State, Office of the Historian, https://history.state.gov/milestones/1945-1952/national-security-act. The 1949 amendment to the act strengthened the defense secretary's central authority over the three civilian service secretaries. On the many responsibilities of the secretary of defense, see Charles A. Stevenson, *SECDEF: The Nearly Impossible Job of Secretary of Defense* (Washington, DC: Potomac Books, 2006).

34 For present purposes, *rapid* is defined as roughly five years, as exemplified by nuclear power and ICBMs.

35 Richard W. Stewart, foreword to Fox, *Defense Acquisition Reform,* p. viii.

> A workforce frequently with too little training, experience, and stable tenure to monitor and manage huge defense acquisition programs; the short tenure of senior politically appointed acquisition officials, averaging a mere eighteen months in office; an irregular and erratic flow of weapons systems appropriations; the very nature of cutting-edge, highly risky research and development; an ill-informed requirements process that virtually mandates changes to contracts as requirements are added or changed; and the many financial incentives that reward lowball contractor bids and provide negative sanctions for failing to spend all allocated funds.[36]

Compounding the problem, post–Cold War defense industry consolidation produced a U.S. defense market that has a few large manufacturers and a single buyer, DoD.[37] This combination of supply-side oligopoly and demand-side monopsony means that defense acquisition is governed by serial bilateral bargains between the same actors rather than the "invisible hand" of the market.[38] The mismatch between structural reality and acquisition regulations geared for a competitive defense market adds friction and time to the innovation process.

Overregulation is another recurring theme. The combined page count of the Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS) exceeds 5,000, which raises the question of whether any decision maker can grasp all the pertinent details.[39]

These diagnoses have remained consistent for decades, yet a survey of nearly 30 studies of defense acquisition reform from 1960 to 2009 found that "despite…the similarity of [the studies'] findings, major defense programs still require more than fifteen years to deliver less capability than planned, often at two to three times the initial cost."[40] Why is reform so elusive?

The overarching explanation is straightforward. Cost growth, delays, and failure to meet operational requirements are the collective result of individually rational decisions by the many participants in the defense acquisition process. Responsibility for nearly every

36 Fox, *Defense Acquisition Reform*, p. xiii.

37 For an overview of consolidation, see Tyler Hacker, *Arsenal of Democracy: Myth or Model*? (Washington, DC: Center for Strategic and Budgetary Assessments, 2025), pp. 63–70, https://csbaonline.org/resource/arsenal-of-democracy-myth-or-model-lessons-for-21st-century-industrial-mobilization-planning/.

38 On defense oligopoly and monopsony, see (respectively) William J. Baumol and Alan S. Blinder, *Economics: Principles and Policy,* 6th ed. (Fort Worth, TX: Dryden Press, 1994), p. 292; and Michael Brzoska, "World Military Expenditures," in Keith Hartley and Todd Sandler, eds., *Handbook of Defense Economics,* vol. I (New York: Elsevier, 1995), p. 53.

39 Margaret Boatner, Vice President for National Security Policy, Aerospace Industries Association, "Clearing the Path: Reforming Procurement to Accelerate Defense Innovation: Statement Before the Subcommittee on Military and Foreign Affairs, House Committee on Oversight and Government Reform," June 11, 2025, https://www.congress.gov/119/meeting/house/118371/witnesses/HHRG-119-GO06-Wstate-BoatnerM-20250611.pdf.

40 Fox, *Defense Acquisition Reform,* p. xi. Another study found that more than 150 studies of wasteful defense spending, cost overruns, schedule slippage, and underperformance have been conducted since World War II. See Moshe Schwartz, Kathryn A. Francis, and Charles V. O'Connor, *The Department of Defense Acquisition Workforce: Background, Analysis, and Questions for Congress,* R44578 (Washington, DC: Congressional Research Service [CRS], July 29, 2016).

aspect of innovation is spread across multiple actors within government and the private sector and is thoroughly stovepiped within DoD itself.[41] Decentralization of research, development, contracting, engineering, production, personnel, training, and logistics responsibilities results in uncoordinated decisions made on the basis of incomplete or inaccurate information, fragmented authority, and competing institutional pressures. Complex, burdensome coordination frameworks merely address tactical details without accounting for the legitimate, broader pressures on each official involved. This regularly produces disappointing outcomes.

From this perspective, what looks like a culture of risk aversion is often simply the cumulative result of well-intentioned decisions made within narrow bureaucratic stovepipes. Prescriptions for managers to take bold risks are unrealistic, because failures will cascade across stovepipes, up to the senior leader, and, worst of all, down to the operating forces.[42] Successful risk taking in one stovepipe, on the other hand, may be undermined by failures in another. In these circumstances, DoD stakeholders quite rationally minimize risk to their own portfolios. The most straightforward way to overcome this structural barrier is to consolidate risk and reward in one stovepipe: that of an empowered lead innovator. Put differently, the secretary of defense must assume all the risk; the lead innovator's objective is to eliminate risk of failure.

Finally, several longstanding barriers to rapid innovation could be easily removed in theory (see Callout Box 3). Fixing these problems is primarily a matter of political will in Congress and management focus within DoD. Failure to address these long-running factors may present insurmountable obstacles to defense innovation.

CALLOUT BOX 3: POLITICAL AND MANAGERIAL BARRIERS TO INNOVATION

Continuing Resolutions

Congress's use of continuing resolutions (CRs) to fund the federal government prevents program starts, creates uncertainty in existing programs, imposes administrative burdens on DoD and industry, discourages industry investment, and makes it more difficult to attract and retain a motivated workforce.[43] The acquisition system makes innovation difficult enough under normal circumstances; CRs make it even harder. To speed military innovation, Congress must pass annual defense authorization and appropriation laws on time.

41 For example, the lowest layer of the DoD hierarchy at which military requirements, acquisition, and personnel-related authorities fully intersect is at the level of the three service secretaries—and even then, they are subject to oversight (that may amount to effective veto) by defense-wide officials including the chairman of the Joint Chiefs of Staff; the under secretaries of defense for research and engineering, acquisition and sustainment, and personnel and readiness; and the directors, cost assessment and program evaluation and operational test and evaluation, among others.

42 On prescriptions to protect risk takers see, for example, David H. Berger et al., *Strategic Edge: A Blueprint for Breakthroughs in Defense Innovation* (New York: Mike Bloomberg, 2025), p. 29.

43 See, for example, Oakley, "Clearing the Path;" and Lisbeth Perez, "DoD's Hicks: Continuing Resolutions Hinder Innovation," Meritalk, October 17, 2024, https://www.meritalk.com/articles/dods-hicks-continuing-resolutions-hinder-innovation/.

Burdensome Requirements Process
Investments in defense programs are contingent on approval of corresponding military needs. Yet the requirements process typically takes years, leaving critical operational gaps unfulfilled in the interim.[44] DoD has made recent moves to streamline the requirements process, most notably by eliminating JCIDS.[45] This may shave some time from the requirements process, but it will not be a panacea. The competing bureaucratic interests normally adjudicated via the JCIDS process will rear their heads in other ways, imposing new barriers to rapid innovation.

Leaders have long been frustrated by bureaucratic requirements processes.[46] Yet the secretary of defense has never actually been constrained by the bureaucracy. The Joint Requirements Oversight Council (JROC), charged with overseeing JCIDS, exists to assist the chairman of the Joint Chiefs of Staff in his duties as military adviser to the secretary of defense, not to circumscribe the secretary's authority. Indeed, the statute that established the JROC reinforced the authority of the uniformed chiefs of the armed Services to approve military requirements for their own Services without JROC review.[47] And of course, the chairman's advice limits neither the secretary's authority to establish military requirements nor the military departments' ability to plead their cases directly to the secretary. Thus, the requirements process can be arbitrarily short when an innovation offers a compelling solution to a well-defined operational problem.

Excessive Regulations and Incomplete Homework
The 5,000-plus pages of the FAR and DFARS are a major barrier to innovation, especially for new industry entrants.[48] In response, Trump issued the executive order *Restoring Common Sense to Federal Procurement* to streamline federal acquisition.[49] But streamlining will take time. Meanwhile, DoD should complete unimplemented acquisition reforms directed by the Fiscal Year 2017 National Defense Authorization Act, such as updating accounting processes to conform to commercial standards.[50] Likewise, industry organizations have noted that DoD has not yet updated all policies, manuals, and training to match its own adaptive acquisition framework, which is now nearly five years old.[51] USD(A&S) and the service acquisition executives must finish implementing statutory reforms that were instituted nearly a decade ago.

44 See, for example, House Armed Services Committee, *The Need for SPEED: Streamlining Procurement for Effective Execution and Delivery Act,* H.R. Rep. No. 119-231 (2025), p. 2.

45 Bill Greenwalt, "JCIDS Is Dead. Thank God. Here's What Comes Next," *Breaking Defense*, August 27, 2025, https://breakingdefense.com/2025/08/jcids-is-dead-thank-god-heres-what-comes-next/.

46 An example: From the 1950s through the 1970s, according to former Air Force Chief of Staff General Larry Welch, "If I wanted an airplane and the Secretary of the Air Force agreed, we had four key congressional committee chairmen to deal with, and that was that.… But by the time we were dealing with the B-2 project [in the 1980s], we had to jump through all the bureaucratic hoops at the Pentagon." Ben R. Rich and Leo Janos, *Skunk Works: A Personal Memoir of My Years of Lockheed* (Boston: Little, Brown and Company, 1994), p. 317.

47 10 U.S.C. § 181 (2024).

48 Boatner, "Clearing the Path."

49 Exec. Order No. 14275, 90 Fed. Reg. 16447 (2025).

50 Boatner, "Clearing the Path."

51 Ibid.

The False Promise of Acquisition Reform

Risk minimization is a feature, not a bug, of effective organizations. By design, mission-oriented bureaucracies like DoD trade flexibility for predictability.[52] Trying to merge innovation with predictability can "inflict severe damage on one or the other, or both.... It might make an organization much better at innovation, but at what cost?"[53]

Yet it is also true that bureaucracies are poorly suited to the trial-and-error of innovation. Vannevar Bush, who oversaw U.S. defense research during World War II as head of the Office of Scientific Research and Development (OSRD), believed that routine operations and innovation are inevitably at odds.[54] Testifying before Congress in 1945, he stated, "Basically, research and procurement are incompatible."[55]

FIGURE 2: VANNEVAR BUSH

U.S. Office of Emergency Management via Wikimedia Commons

52 Vijay Govindarajan and Chris Trimble, *The Other Side of Innovation: Solving the Execution Challenge* (Boston: Harvard Business School Publishing, 2010), p. ix, noted that "organizations are not built for innovation; they are built for efficiency." For similar analyses, see Larry Bossidy et al., *Execution: The Discipline of Getting Things Done* (New York: Crown Currency, 2002).

53 Govindarajan and Trimble, *The Other Side of Innovation,* pp. 176–177. Clayton M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Boston: Harvard Business School Press, 1997), p. 226, similarly argued, "A company's executives may seem to make resource allocation decisions [for innovation], but the implementation of those decisions is in the hands of a staff whose wisdom and intuition have been forged in the company's mainstream value network."

54 On Bush and the OSRD, see The Manhattan Project: An Interactive History, "Vannevar Bush," Department of Energy, https://www.osti.gov/opennet/manhattan-project-history/People/Administrators/vannevar-bush.html; and The Manhattan Project: An Interactive History, "Office of Scientific Research and Development," Department of Energy, July 22, 2025, https://www.osti.gov/opennet/manhattan-project-history/People/CivilianOrgs/osrd.html.

55 Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 1994), p. 228.

He continued:

> A procurement group is under the constant urge to regularize and standardize, particularly when funds are limited.... Research, however, is the exploration of the unknown. It is speculative, uncertain. It cannot be standardized. It succeeds, moreover, in virtually direct proportion to its freedom from performance controls, production pressures, and traditional approaches.[56]

DoD has used at least five tactics to attack the paradox of innovation-by-bureaucracy. The first four—which typically fail—are process reform, culture shifts, innovation incubators, and direct-report program managers. The fifth, which has proven successful, is the delegate-to-innovate model proposed in this report.

This chapter concludes with a brief review of the first four tactics and their limitations.

Process Reform

Process reform seeks to speed innovation through revision of organizational rules and procedures. This only works, however, if new innovations are "mostly similar to previous-generation products"—i.e., they are not truly innovative.[57] Process reform has serious limitations when applied to leap-ahead innovations like nuclear power, ICBMs, or stealth.[58] It is simply too difficult to anticipate all the technical and organizational challenges that such efforts will face.

Some process-oriented analysts advocate alternative pipelines for innovation. One report argued, for example, that "DoD must move innovation efforts out from under the PPBE [*sic*], instead executing them under a new system that prioritizes urgency and flexibility."[59] This raises the question of how such a system could be designed to avoid new stovepipes, counterproductive incentives, and friction with existing DoD processes, including the

56 Bush's statement requires a significant caveat. Rosen, *Winning the Next War*, pp. 229–230 found that the exigencies of World War II pushed Vannevar Bush's OSRD "into the business not of research, but of production." OSRD was the main government purchaser of solid rockets, radar, and electronic countermeasures for U.S. forces because there was no industrial base for these groundbreaking technologies. Moreover, OSRD's contributions were not limited to initial production: Bush also arranged for OSRD scientists to deploy to the field to service the new equipment, measure its operational performance, and aid in refining technical specifications and operational employment. In effect, Bush created an acquisition organization as comprehensive as the overarching defense production architecture (if not more so) but focused on deploying innovative technology.

57 Govindarajan and Trimble, *Other Side of Innovation*, pp. 7–8.

58 As an example of evolutionary innovation, Govindarajan and Trimble, *Other Side of Innovation*, pp. 7–8, cited Deere & Company's continuous product innovation: "Over many years, Deere & Company has gone to great lengths to perfect its recipe for developing new tractors. Documentation of the process constitutes, literally, several weeks of reading. As a result, everyone on the product development team understands his or her role. Everyone understands that he or she is accountable for completing each step in the design process on time and on budget."

59 Berger et al., *Strategic Edge*, p. 17.

budgeting process overseen by Congress. The very nature of innovation militates against standardized approaches.[60]

Culture Shift

The *culture shift* tactic aims to incentivize grassroots innovation through relevant professional training and education and promises of bonuses or promotion to reward successful risk taking.[61] Individuals are expected to act on their own initiative (and perhaps even on their own time) to drive innovation from below.[62] But culture shifts do not absolve individuals of their day-to-day responsibilities. Moreover, promises of bonuses or promotions are likely to be counterbalanced by the bureaucratic certainty of negative consequences for unsuccessful risk taking.[63]

The development of Sidewinder, the world's first infrared-homing air-to-air missile, is an exception that proves the rule. Naval Air Weapons Station China Lake deployed Sidewinder—for which there was no official requirement, despite the clear need for a missile that could kill Soviet bombers—in 1956, after less than five years in development.[64] Sidewinder was the brainchild of William McLean, technical director at China Lake. Convinced of the operational necessity for a better anti-bomber weapon, he inspired his team of engineers to work unpaid overtime while "commit[ting] one of the military's worst sins: developing technology at the wrong laboratory."[65] Indeed, China Lake had previously been told *not* to develop an air-to-air guided missile.[66] McLean's efforts paid off in spite of the Navy's corporate approach to innovation, not because of it. Lacking the protection of

60 For example, a recent RAND study examined "the activities, functions, and processes by which DoD identifies, develops, and transitions innovative commercial technologies from the private sector to DoD for military use at both the joint and service level," collectively termed the "commercial technology pipeline (CTP)." It found that "there is no single 'pipeline' or pathway of technologies through the CTP" and that "collaboration and handoffs between CTP stakeholders are essential to accelerate the identification, development, and adoption of commercial technology for military use." In other words, the process is different every time. Kotila et al., *Strengthening the Defense Innovation Ecosystem*, pp. ix, xiii.

61 Govindarajan and Trimble, *Other Side of Innovation*, p. 6, noted that "when companies speak of a 'culture of innovation,' this seems to be what they mean—an environment in which creative ideas are plentiful and employees are empowered and motivated to do something with them." On DoD industry experience programs see, for example, "Prestigious Fellowship Program Arms Military Officers with Private Sector Perspective," DoD, https://www.defense.gov/News/News-Stories/Article/Article/3809657/prestigious-fellowship-program-arms-military-officers-with-private-sector-persp/. For another example of the "culture of innovation" prescription, see Berger et al., *Strategic Edge*, p. 9: "It is…important to build a culture of innovation within the DoD and equip workers with the skills and incentives to support national security."

62 Govindarajan and Trimble, *Other Side of Innovation,* p. 6.

63 Ibid.

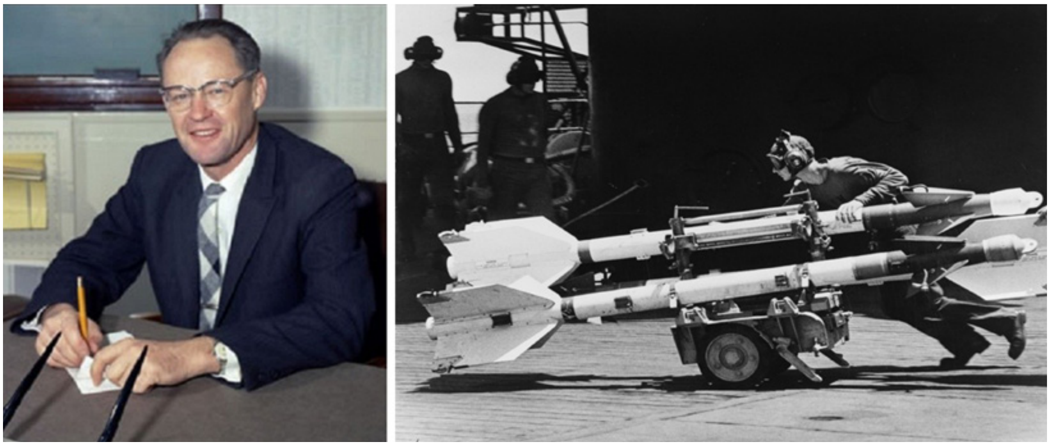
64 Ron Westrum, *Sidewinder: Creative Missile Development at China Lake* (Annapolis, MD: Naval Institute Press, 2013), pp. 25, 88, 130.

65 Ibid., p. 41.

66 Ibid.

senior leadership or a mandate to innovate, McLean and his team took great personal risk to deliver exceptional results. This model is unlikely to be replicated in a bureaucratic system.

FIGURE 3: WILLIAM MCLEAN AND SIDEWINDER (MISSILE PICTURED ABOARD USS HANCOCK, 1967)



U.S. Navy via Wikimedia Commons

Innovation Incubators

Innovation incubators try to sequester innovators from the bureaucratic grind, handing off new capabilities only when they have been proven useful and feasible. But the persistence of the valley of death indicates that the handoff process is far more complicated than DoD leaders generally recognize.[67] DoD's default behavior is to subject the nascent innovation to momentum-sapping bureaucratic scrutiny—just as Bush pointed out in 1945.[68]

Incubators can lay the foundations for new capabilities, but full-scale deployment requires authorities and resources that extend well beyond incubators' remits. The F-117A stealth fighter, for example, moved from program start to operational capability in less than five years—on par with nuclear power and the ICBM, and even faster than the F-15, F-16, and F/A-18 aircraft.[69] This would not have been possible without DARPA's mid-1970s investment in stealth technology under the Have Blue and Tacit Blue programs. But the prime mover for

67 Indeed, management scholar Clayton Christensen found that the most successful companies in the commercial world manage disruptive innovations by spinning off new, self-contained business units to work in emerging, sometimes "fringe" markets (generally at lower profitability) until market forces generate a broader demand for the innovation. See Christensen, *The Innovator's Dilemma,* p. xxv. The challenge with applying this model within DoD is that large-scale technology adoption is driven by organizational processes rather than market forces. "Customers" (the operating forces) are not free to choose which capabilities to invest in and which to discard or ignore.

68 Rosen, *Winning the Next War*, p. 228.

69 Peter Westwick, *Stealth: The Secret Contest to Invent Invisible Aircraft* (New York: Oxford University Press, 2022), p. 109.

transforming stealth demonstrators into the operational F-117A was not DARPA, but Under Secretary of Defense for Research and Engineering Perry.[70]

Perry, at the direction of Secretary of Defense Harold Brown, made himself the de facto program manager in 1977.[71] Leading a team of just five officers, Perry then "[ran] interference" against the bureaucracy, allowing builder Lockheed to move rapidly while Perry knocked down Air Force resistance and obtained funding from Congress.[72] By the time DARPA handed the F-117A off to the Air Force for serial production, Lockheed (under Perry's supervision) had already brought the aircraft close to its final operational form, and Perry had caused the Air Force to lay the organizational groundwork to operate it.[73]

Today, DoD has numerous innovation offices reporting directly to the secretary or deputy secretary of defense, such as the DIU and the Chief Digital and Artificial Intelligence Office (CDAO); the service departments have their own counterparts.[74] Innovation incubators may produce new thinking and promising prototypes, but because they parallel rather than replace existing authority structures, they blur responsibility and help perpetuate the valley of death. They can even make it difficult for industry innovators to gain a bridgehead on either side of the valley. As the Congressional Research Service (CRS) has noted, "DoD's innovation organization directory currently includes 294 entities…. The sheer number of DoD innovation-related organizations and their potentially overlapping missions, functions, and responsibilities can pose challenges both within and outside the department."[75]

Officials responsible for innovation per se are unaccountable for fielding any specific innovation. It is therefore unsurprising that DoD "still lacks clear ways to measure if the organizations charged with innovation in the Department of Defense actually work."[76] At any rate, the creation of organizations focused on innovation does not absolve the secretary of defense of responsibility for transition to full-scale deployment.

70 For an overview of DARPA's role in developing stealth, see "Stealth," DARPA, https://www.darpa.mil/news/features/stealth.

71 Edward C. Keefer, *Harold Brown: Offsetting the Soviet Military Challenge 1977–1981* (Washington, DC: Office of the Secretary of Defense, Historical Office, 2017), pp. 579–580. For an overview of Perry's approach to managing the stealth project, see the recollections of General Larry D. Welch, quoted in Leo Janos and Ben R. Rich, *Skunk Works: A Personal Memoir of My Years of Lockheed* (Boston: Little, Brown, 2013), pp. 41–42.

72 Keefer, *Harold Brown*, p. 580; Westwick, *Stealth,* p. 27; and Janos and Rich, *Skunk Works*, p. 66.

73 Keefer, *Harold Brown,* p. 582.

74 On the CDAO, see "Organization," Chief Digital & Artificial Intelligence Office, https://www.ai.mil/About/Organization/. CDAO now reports to USD(R&E): Brandi Vincent, "Feinberg Orders Major Shakeup in Pentagon's AI Enterprise," Defensescoop, August 15, 2025, https://defensescoop.com/2025/08/15/feinberg-cdao-realignment-shakeup-dod-ai-enterprise/.

75 Marcy E. Gallo, *The Defense Innovation Ecosystem* (Washington, DC: CRS, 2025). For a separate summary of ongoing DoD innovation organizations and strategies see "Lowering Barriers to Innovation," Defense Innovation Board, 2024, p. 6, https://stib.cto.mil/wp-content/uploads/2026/01/2024-3_DIB_Study_Lowering_Barriers_to_Innovation.pdf.

76 Casey Perley, "How Can We Measure If Defense Innovation Works?" *War on the Rocks*, February 10, 2025, https://warontherocks.com/2025/02/how-can-we-measure-if-defense-innovation-works/.

Direct-Report Program Managers

Finally, the establishment of *direct-report program managers* (DRPMs) is an attempt to imbue an innovation leader with the institutional weight of a service chief, service secretary, or the secretary of defense himself. A senior official designates a capable, accomplished subordinate to take charge of an innovation, often with an admonishment to "break some eggs if you have to."[77] This is a step in the right direction, but it pits the innovator against the rest of the organization, with stakeholders naturally reacting to defend their interests. After all, permission to break eggs does not extend to other executives, who must keep the entire organization running smoothly.

DoD's Iron Dome for America program (now known as Golden Dome) is a noteworthy example of the DRPM approach.[78] Although the project is nominally led by Space Force General Michael Guetlein, reporting directly to the deputy secretary of defense, the acting USD(A&S) has described the air and missile defense project as a team effort in which "we're going to need all the services and agencies that do this kind of work to step up."[79] Given Guetlein's DRPM status, it is unclear what responsibility USD(A&S) has for this program; moreover, the Missile Defense Agency—a critical partner in Golden Dome—reports to USD(R&E).[80] Amid this array of competing responsibilities, the only DoD officials with clear authority over Golden Dome are the secretary and deputy secretary of defense—not a prescription for success.

The DRPM model also fails to account for the fact that senior leader sponsorship, though necessary, is not sufficient for innovation success. History is replete with failed defense innovations that were top priorities for service leaders and defense secretaries.

In 1961, for instance, Secretary of Defense Robert S. McNamara directed the Army to develop a new tank to replace the Korean War–vintage M60. Dubbed MBT70, the tank would mount the latest anti-tank missile technology and would be capable of fighting the Soviet army on a nuclear battlefield—thus responding to the real operational problems posed by an armor-centric fight in Europe. Moreover, the MBT70 would be codeveloped with West Germany, promoting standardization and interoperability for NATO forces on the front lines

77 Govindarajan and Trimble, *Other Side of Innovation*, p. 8.

78 "General Guetlein to Lead the Office of Golden Dome for America," DoD, July 22, 2025, https://www.war.gov/News/Releases/Release/Article/4251596/general-guetlein-to-lead-the-office-of-golden-dome-for-america/.

79 "Michael A. Guetlein," U.S. Space Force, https://www.spaceforce.mil/Biographies/Display/Article/3632851/michael-a-guetlein/; and C. Todd Lopez, "DoD's Acquisition Community Already Working on Golden Dome, Big Team Effort Required," DoD, March 19, 2025, https://www.war.gov/News/News-Stories/Article/Article/4127682/dods-acquisition-community-already-working-on-golden-dome-big-team-effort-requi/.

80 "DoD Directive 5134.09," DoD, April 25, 2025, https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/513409p.pdf.

of the Cold War. McNamara and his German counterpart set a 1969 deadline for operational capability, with an initial prototype by 1967.[81]

To manage the joint project, the United States and West Germany established combined, bilateral design and engineering teams.[82] Although these would ostensibly provide unity of effort, the MBT70 project exemplified diffusion of responsibility and authority at its worst. The strategic agreement between McNamara and his German counterpart masked fundamental incompatibilities in U.S. and German acquisition processes, engineering standards, and even armored combat doctrine. Costs ballooned, and little progress was made. The program manager was subject to cumbersome bureaucratic oversight by the Army Department despite McNamara's personal support.[83] West Germany began withdrawing from the project in 1969, and Congress terminated the program in 1970.[84] The personal sponsorship of the secretary of defense could not overcome the diffusion of responsibility and authority at all levels, from the most minute engineering decisions to the overall direction of the program.

The Army's next attempt to build a new tank was far more effective, precisely because empowered innovators were put in charge and then supported (and held accountable) by their superiors. The M1 tank is indelibly associated with its first program manager, Brigadier General Bob Baer, who led the program from its inception in 1972 until 1977.[85] Baer had the support of the Army secretary and chief of staff, with whom he was empowered to communicate directly—bypassing several tiers of the bureaucracy. More importantly, Army Chief of Staff General Creighton Abrams summoned Baer and Major General Donn Starry (commander of the Army's Armor Center) and "told them he was holding them personally responsible—Baer as the builder and Starry as the representative of the users—for the success of the tank program." Meanwhile, he protected them from the Washington bureaucracy, for which he had little use—comparing "the Pentagon to 'an asylum run by the inmates.'"[86] The M1 achieved initial operating capability in January 1981, bringing the fruits of innovation to the battlefield: vastly improved speed; accuracy of fires; and survivability by

81 Walter S. Poole, *Adapting to Flexible Response*, vol. 2, *History of Acquisition in the Department of Defense* (Washington, DC: Office of the Secretary of Defense Historical Office, 2013), p. 148, https://history.defense.gov/Portals/70/Documents/acquisition_pub/OSDHO-Acquisition-Series-Vol2.pdf.

82 Ibid.

83 Orr Kelly, *King of the Killing Zone* (New York: W. W. Norton & Company, 1989), pp. 28–29.

84 Thomas McNaugher, *Collaborative Development of Main Battle Tanks: Lessons from the U.S.–German Experience, 1963-1978*, N-1680-RC (Santa Monica, CA: RAND, 1981), p. vii, https://www.rand.org/content/dam/rand/pubs/notes/2006/N1680.pdf.

85 Kelly, *King of the Killing Zone*, p. 271.

86 Ibid., pp. 125, 132–134.

virtue of its groundbreaking gas turbine engine, stabilized fire-control system, and reactive armor.[87] Four and a half decades later, it remains America's main battle tank.

Delegate to Innovate

The fifth and final tactic produced the most dramatic and strategically consequential Cold War defense innovations. This tactic identifies a clearly defined solution to a pressing operational problem and arms a single subordinate with a tailored team and all the necessary authorities to develop, produce, and field that solution.[88] That subordinate need not be a DRPM. Neither Rickover (initially) nor Schriever worked directly for their service chiefs or secretaries, let alone the secretary or deputy secretary of defense. The delegation of sufficient authority to field an innovation rapidly and at scale to the operating force is more important than proximity to power.

A key advantage of this approach is that it allows innovators to tackle the practical problems of research, design, engineering, production, training, and logistics directly, rather than through stovepiped institutional processes. This is especially important when the industrial base lacks the capability and capacity to produce an innovation. This situation is often true today, thanks to post–Cold War industry consolidation, and it was equally true when Rickover began the project that produced a nuclear submarine in just five years. In 1949, after all, there was no nuclear power industry.[89]

An innovation effort must address every practical element necessary to make the innovation real, from concept to production and beyond. But the more novel the innovation, the less likely that all of these elements can be identified in advance.[90] The probability of success

87 Garcia E. Morrow, *Lessons Learned: M1 Abrams Tank System* (Arlington, VA: Information Spectrum, 1983), p. B-9; and Kelly, *King of the Killing Zone,* pp. 118–140, 159–161, 166–168.

88 Govindarajan and Trimble, *Other Side of Innovation*, p. 15.

89 On today's defense industry capacity, see Jennifer Stewart, *Vital Signs 2025* (Arlington, VA: National Defense Industry Association, 2025), p. 6. The report goes on to note (pp. 10–11): "The present U.S. DIB [defense industrial base] reflects a premium policymakers place on just-in time supply chains, lowest-price technically acceptable contract awards, a sclerotic acquisition system, significant increase in the regulatory burden on commercial supply chains, and outdated assumptions regarding workforce availability. It is a U.S. DIB built for convenience and predictability, and it is a U.S. DIB the U.S. government resourced for low-intensity conflict."

90 This observation suggests shortcomings in prescriptions to speed innovation through rapid adaptation of commercial technology. For example, Berger et al., *Strategic Edge*, p. 9: "The U.S. must move away from custom-built production lines and invest in dual-use manufacturing technologies that harness AI for flexibility and are capable of producing commercial goods and seamlessly shifting to military production during conflict." See also "Lowering Barriers to Innovation," Defense Innovation Board, p. 11. It is premature to conclude that there is no place for custom-built production lines, which were key to the development of nuclear power. It is equally premature to assume that military needs can be met without compromise by manufacturers who must respond to both commercial and defense requirements. For a cautionary view along these lines, see Jake Chapman, "Reliance on Dual-Use Technology Is a Trap," *War on the Rocks*, September 8, 2022, https://warontherocks.com/2022/09/reliance-on-dual-use-technology-is-a-trap/. A similar critique applies to the argument in Berger et al., *Strategic Edge*, p. 9, that "we must create a workforce with transferrable talent that can work in both public and private sectors." Although such a workforce could prove very valuable, it is not a guarantee of success when applied to any particular innovation.

is greatest when an innovator is put in charge of a purpose-built organization like Rickover's Naval Reactors or Schriever's Western Development Division, with comprehensive and largely self-contained authority to develop and field a new capability.

Systemic reforms might reduce some barriers to rapid innovation, but there is no substitute for an empowered leader with a tailored team, comprehensive authorities, tenure, and a deadline. Two experts separated by 39 years reached the same conclusion: as David Packard wrote in 1986, innovation calls for "giving a few capable people the authority and responsibility to do their job, maintaining short lines of communication, [and] holding people accountable for results."[91] Moshe Schwartz, testifying in 2025, echoed Packard: "At its heart, defense acquisition is a human endeavor.... Giving capable people the authority to do their job, putting them in positions to succeed, holding them accountable, and minimizing red tape is the recipe for better acquisition."[92]

The next chapter of this report investigates what this looks like in practice.

91 David Packard et al., *A Quest for Excellence: Final Report to the President* (Washington, DC: President's Blue Ribbon Commission on Defense Management, 1986), p. xiii.

92 Moshe Schwartz, "Clearing the Path: Reforming Procurement to Accelerate Defense Innovation: Statement Before the House Committee on Oversight and Government Reform," June 11, 2025.

CHAPTER 2

Rickover and Naval Nuclear Propulsion

Every job I ever had, I ran as if I owned it.

—Rickover[93]

On January 17, 1955, the nuclear-powered attack submarine USS *Nautilus* set sail from its Connecticut building yard, transmitting the historic radio message "underway on nuclear power."[94] Just five years earlier, there had been no formal U.S. Navy requirement for a nuclear submarine, and it was not at all clear that the atom's power could even be safely harnessed to propel a warship. Indeed, no one knew whether safe nuclear power generation was feasible at all, let alone within the confines of a submarine.[95] That *Nautilus* joined the fleet in 1955 (and continued to serve until 1980) was an incredible feat of science, engineering, leadership, and management.[96]

Nautilus was followed by hundreds more U.S. nuclear warships, including the attack submarines and aircraft carriers that underpin America's maritime striking power and the ballistic missile submarines that form the most survivable leg of its nuclear triad. No fewer than 140 nuclear warships were produced during Rickover's tenure at the helm of the Navy's nuclear power program (see Figure 4). Moreover, in over seven decades of continuous operations, the

93 Quoted in Francis Duncan, *Rickover: The Struggle for Excellence* (Annapolis, MD: Naval Institute Press, 2011), p. 107.

94 Duncan, *Rickover,* p. 138; Paul Stilwell, "Looking Back: 'Underway on Nuclear Power,'" *Naval History* 28, no. 6, December 2014.

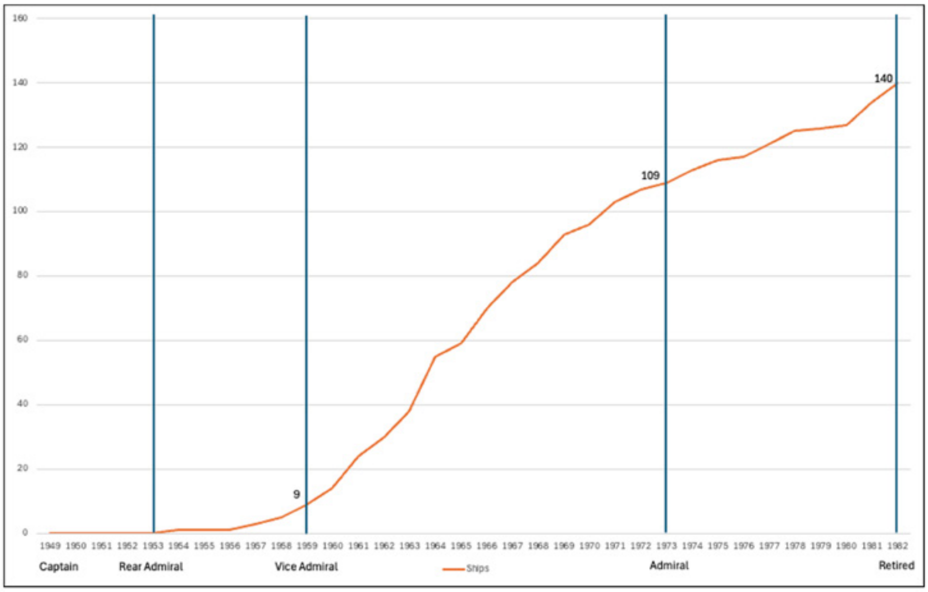
95 Duncan, *Rickover,* pp. 99, 111.

96 "Nautilus (SSN-571)," Naval History and Heritage Command, http://public2.nhhcaws.local/browse-by-topic/ships/submarines/uss-nautilus.html.

U.S. Navy has never suffered a major nuclear reactor accident. In contrast, the Soviet Union and Russia have had at least 13—many deadly.[97]

The Navy's nuclear fleet is largely attributable to one person: Rickover, whose vision, expertise, and tireless commitment were directly responsible for the birth of the nuclear power program and for its speed, performance, and cost effectiveness.[98]

FIGURE 4: NUCLEAR SHIPS COMMISSIONED DURING RICKOVER'S TENURE[99]



Rickover succeeded despite lukewarm support from the Navy as a whole. Active opposition from members of the Navy's flag officer community nearly forced him into retirement before

97 Dave Oliver, *Against the Tide: Rickover's Leadership Principles and the Rise of the Nuclear Navy* (Annapolis, MD: Naval Institute Press, 2018), p. 3.

98 The program to build *Nautilus* cost $75 million in 1955 dollars—approximately $2.5 billion in 2025 dollars, or the cost of a single *Arleigh Burke*-class destroyer in serial production. On *Nautilus* cost, see Norman Polmar and Thomas B. Allen, *Rickover* (New York: Simon & Schuster, 1982), p. 114, cited in Oliver, *Against the Tide*, p. 9; Hewlett and Duncan, *Nuclear Navy,* p. 403. On the cost of an *Arleigh Burke* destroyer, see Department of the Navy, *Department of the Navy Fiscal Year (FY) 2026 Budget Estimates: Shipbuilding and Conversion, Navy, Justification Book*, vol. 1 (Washington, DC: DoD, 2025), Exhibit P-40, p. 207.

99 The chart data includes all nuclear-powered submarines, aircraft carriers, and cruisers commissioned from 1954 through 1982. Data aggregated from the following sources: Richard G. Hewlett and Francis Duncan, *Nuclear Navy, 1946–1962* (Chicago: University of Chicago Press, 1974), pp. 399–401; "Important Links and Info," U.S. Navy, https://www.airpac.navy.mil/Organization/Distinguished-Visitor-Info/Important-Links-and-Info/; "Cruisers," Naval History and Heritage Command, https://www.history.navy.mil/our-collections/photography/us-navy-ships/cruisers/nuclear-powered-cruisers.html; and "Complete Nuclear Submarine Lineup," General Dynamics, https://www.gdeb.com/about/oursubmarines/lineup/.

Nautilus was built.[100] Through savvy institutional maneuvers, forthrightness, technical know-how, uncompromising standards, and tangible results, he achieved authority over every aspect of nuclear power and vested it in a new organization: Naval Reactors. Rickover thereby established the foundation for over seven decades of naval striking power and the assured second-strike capability essential to U.S. nuclear deterrence.

This chapter begins with a brief biographical overview of Rickover and his initial association with nuclear power. Next, it analyzes naval nuclear power using the variables identified in the military innovation research conducted by the Center for Strategic and Budgetary Assessments (CSBA): an operational problem without a solution, an empowered innovator, senior leader support, and organizational norms and culture.

The Leader: Rickover and the Dawn of the Nuclear Age

Rickover was born in Poland in 1900, emigrated with his family to America, and graduated from the United States Naval Academy in 1922. After initial sea duty, Rickover was selected for postgraduate training in electrical engineering and in 1929 earned a master's degree with distinction from Columbia University.[101]

He was then assigned to submarine duty. As chief engineer aboard S-48, a submarine with a ramshackle propulsion plant, he placed himself in danger of injury or death while combatting fires and toxic gas leaks. His unhesitating actions demonstrated the personal accountability that would underpin his leadership of the naval nuclear power program.[102]

After duty on the battleship USS *New Mexico* and as commanding officer of the minesweeper USS *Finch*, Rickover embarked on the next phase of his career, becoming an engineering duty officer (EDO).[103] While overseeing ship maintenance and repair at a naval shipyard in the Philippines from 1937 to 1939, he established a reputation for competence and attention to detail. He insisted on going to sea with ships entering overhaul so he could observe the equipment in operation himself, rather than relying on paper reports.[104] He did not trust bureaucratic processes to provide an accurate picture of reality.

100 The U.S. Navy engineering duty officer community "provides technical and business leadership in the design, acquisition, construction, maintenance, modernization, conversion, overhaul and disposal of ships, submarines, and onboard systems." "Engineering Duty," MyNavy HR, https://www.mynavyhr.navy.mil/Career-Management/Community-Management/Officer/Active-OCM/Restricted-Line/Engineering-Duty/.

101 Duncan, *Rickover,* p. 29.

102 Ibid., pp. 38–44.

103 Ibid., p. 62. Rather than commanding ships or fleets, U.S. Navy EDOs are responsible for the maintenance, repair, modernization, and material readiness of the fleet's warships. In this role, Rickover would demonstrate such keen technical acumen and leadership ability that he would ultimately advance to the rank of four-star admiral—an unheard-of accomplishment for EDOs, because four-star rank was typically only held by line officers serving in operational command.

104 Ibid., p. 68.

Next, Rickover was assigned to the Bureau of Engineering (later the Bureau of Ships, or BuShips) in Washington, DC, where he played an important role in America's World War II victory in the Pacific. In April 1942, for example, he traveled to Pearl Harbor to oversee the repair of the battleship *California*'s propulsion plant after it was raised from the harbor floor. He orchestrated an unprecedented complex effort to recondition *California*'s main engines after four months underwater. In June 1942, *California* sailed for Puget Sound under its own power for repairs and later rejoined the fleet, participating in several major battles.[105]

The bombings of Hiroshima and Nagasaki in August 1945 revealed the destructive power of atomic fission. In 1946, Rickover was assigned to the Oak Ridge National Laboratory in Tennessee, one of the key Manhattan Project facilities, to investigate potential naval applications of nuclear power.[106] But amid demobilization and declining defense budgets, nuclear power was just one of many science projects competing for resources and senior leader attention.[107] Harnessing the atom to power warships was not even on the drawing board.[108]

On August 1, 1946, President Harry S. Truman signed legislation establishing the AEC, which would oversee all U.S. nuclear matters beginning on January 1, 1947.[109] In November 1946, Captain Rickover and Lieutenant Commander Louis Roddis Jr. coauthored a memo to the incoming AEC leadership, summarizing Navy nuclear research to date. The memo argued audaciously that with "sufficient funds, and proper resources…a shipboard plant might be in operation in five to eight years."[110] The memo had little impact.[111]

With coconspirator Roddis, Rickover then backchanneled the memo to the Chief of Naval Operations (CNO), Fleet Admiral Chester Nimitz. Rickover was chastised by his BuShips superiors for this insurgent act, but the memo impressed Nimitz and created momentum in the Navy for a nuclear power program, with Rickover as prime mover.[112]

Four main obstacles remained. First, it was unclear whether a nuclear reactor was technically feasible. Second, even if it was feasible, shoehorning it into a 1940s-era submarine

105 Ibid., pp. 76–77.

106 Ibid., p. 28.

107 From 1945 to 1946, U.S. defense expenditures decreased by more than 50 percent; and by 1948 defense spending fell to only 10 percent of the 1945 level before climbing again in response to Cold War tensions and the outbreak of the Korean War. See "U.S. Military Spending, 1945–1996," Center for Defense Information, https://academic.brooklyn.cuny.edu/history/johnson/milspend.htm.

108 Rear Admiral Harold G. Bowen, Chief of Naval Research, recognized the possibility of naval nuclear propulsion as early as 1939. He kept up a steady drumbeat of advocacy throughout the war, but the idea remained purely theoretical as of 1946. Duncan, *Rickover*, p. 28.

109 Alice Buck, *The Atomic Energy Commission* (Washington DC: Department of Energy, 1983), p. 1.

110 Duncan, *Rickover,* p. 101. Remarkably, *Nautilus* sailed in January 1955—just eight years and two months later.

111 Ibid., p. 102.

112 Ibid.

hull might pose insurmountable challenges. Third, the Navy would have to create suitable infrastructure—shipyards capable of nuclear construction and repair, trained personnel, operating procedures, safety protocols, etc.— to operate nuclear submarines without killing their crews in the process. Fourth, there was no funded requirement for nuclear propulsion.

Meanwhile, Rickover's position at Oak Ridge ended upon the AEC's formal establishment on January 1, 1947.[113] He was named assistant for nuclear propulsion at BuShips, but the title came with no authority or resources.

Rickover was temporarily sidelined. Taking matters into his own hands, he drafted letters for the CNO and secretary of the Navy to sign, stating that the Navy "required a nuclear-propelled submarine" by the mid-1950s. Nimitz signed the letter on December 5, 1947, and directed BuShips to liaise with the AEC to explore the possibility of nuclear propulsion.[114]

The AEC agreed in principle to pursue nuclear propulsion but displayed no urgency for the project. Moreover, the Navy had not made a fiscal commitment to it. Rickover stepped in again. In July 1948, he convinced BuShips to make him the liaison with the AEC. As Francis Duncan wrote, Rickover "did not own much beyond his title. [But] he knew what he wanted. It was an organization that he—not a contractor—would run. He would set the technical standards and specifications that industry and the Navy would have to follow."[115]

Now, Rickover simply needed a compelling reason for the Navy to fund such a program.

The Operational Problem: Soviet Submarines vs. U.S. Sea Control

World War II demonstrated the importance of securing transoceanic lines of communication. During the Cold War, these lines linked America's vast productive capacity to a European continent now under threat of Soviet invasion. The Soviet blockade of Berlin in 1948 demonstrated Moscow's willingness to threaten these lines of communication, even at the risk of strategic escalation. Soviet submarines posed the single greatest threat to the sea lines.

In wartime, German U-boats had threatened to cut the United States off from its European allies. In April 1948, Nimitz reported to the Joint Chiefs of Staff that "the seriousness of the Russian submarine menace is emphasized by the fact that they now have *over five times the number of undersea craft that Germany had at the outbreak of World War II* [emphasis added]."[116]

113 Ibid., p. 103.

114 Ibid., pp. 105–106, 154–155.

115 Ibid., p. 107.

116 Hewlett and Duncan, *Nuclear Navy,* p. 72.

Worse, the Soviet Union had captured advanced German submarines—and their blueprints and builders. The Type XXI *Elektroboot* had a new propulsion system that gave it a maximum underwater speed double that of previous U-boats, providing Soviet submarines a significant tactical advantage.[117] The Type XXI could run silent and submerged for up to 60 hours at five knots, covering 300 nautical miles.[118] Earlier German submarines' optimum submerged speed was 1.75 knots, and they could cover only 51 nautical miles at that speed before surfacing to recharge their batteries.[119] U.S. anti-submarine warfare tactics and equipment honed in World War II were now, according to a 1948 Navy report, "virtually nullified."[120] The Type XXI (wrote Pacific Fleet commander Admiral Raymond A. Spruance in February 1948) was, therefore, "probably the greatest threat that exists today to safe use of the sea. Until a solution is reached to the problem of how to destroy this submarine, and until the forces are made available for this work, we shall be in a poor position to operate our armed forces overseas."[121]

Atomic fission offered a solution. The best countermeasure against a submarine with long underwater endurance was a submarine with essentially indefinite underwater endurance: one that could silently stalk its prey for weeks at a time, striking when its opponent had to surface to recharge its batteries. Only nuclear power could provide this capability.[122]

Delegation: Rickover Consolidates Authority

Nuclear propulsion promised to solve a critical operational problem, but AEC cooperation remained tepid. The AEC was almost entirely consumed with expansion of the U.S. nuclear arsenal, especially after the Soviet Union detonated its first atomic bomb in 1949.[123] Because the AEC was not part of DoD, only Truman had the authority to direct its participation in a nuclear propulsion program. But the Navy itself had not yet committed to funding nuclear power, so presidential interest was unlikely.

Enter Captain Rickover. In just two years, he prodded the Navy, the AEC, Truman, and Congress to fund a nuclear power program with him in charge. The program would not be a mere experimental power plant: Rickover saw to it that the 1950 defense authorization bill included funding for an operational nuclear submarine.[124]

117 Marcus O. Jones, "Innovation for Its Own Sake: The Type XXI U-Boat," *Naval War College Review* 67, no. 2, 2014, p. 6.

118 Ibid., p. 6.

119 Michael Gannon, *Black May* (New York: HarperCollins Publishers, 1998), p. 245.

120 Hewlett and Duncan, *Nuclear Navy*, p. 73; Theodore Rockwell, *The Rickover Effect: How One Man Made a Difference* (Annapolis, MD: Naval Institute Press, 1992), p. 63.

121 Rockwell, *Rickover Effect*, p. 63.

122 Hewlett and Duncan, *Nuclear Navy,* p. 73.

123 Buck, *Atomic Energy Commission*, p. 2.

124 Duncan, *Rickover,* p. 115.

Rickover's organizational coup began in earnest in August 1948, when the Navy formalized his position by establishing a Nuclear Power Branch within BuShips. This created a formal demand signal for AEC participation. In November 1948, the AEC duly established a Division of Reactor Development.[125]

At Rickover's prompting, the Navy issued orders for him to "report for duty with the Division of Reactor Development in the Atomic Energy Commission and to the chief of the Bureau of Ships for additional duty."[126] This masterstroke made Rickover the prime mover for nuclear power in both the Navy and the AEC. It allowed him to coordinate the activities of two separate executive departments, often by proposing an action from one department and then convincing the other to approve that recommendation.[127] Moreover, because Rickover's primary duty was with the AEC, he had placed himself in a position of authority relative to the entire Navy where reactors were concerned. His dual office came to be known as Naval Reactors.

In mid-1949, Rickover drafted a formal requirement for a nuclear-powered submarine. As an EDO rather than a line officer, it was not his bureaucratic place to do so. But he obtained the concurrence of the appropriate officer, Rear Admiral Charles Momsen, assistant chief of naval operations for undersea warfare, who attached his name to the document. The new CNO, Admiral Louis Denfeld, signed the requirement on August 19, 1949.[128] It stated that the submarine should be ready for operational evaluation "by 1955." True to form, Rickover told his staff that "he was shooting not for 1955 but for *1 January 1955* [emphasis added]."[129]

To meet a 1955 deadline, nuclear submarine construction would need to begin no later than 1953 using funds appropriated in 1952, which would require DoD to include the submarine in its 1950 budget request.[130] Leveraging his access to the AEC's inner workings, Rickover told Navy leaders in spring of 1950 that if they did not commit to funding the submarine they would lose AEC support given the increasingly acute demands on the nuclear weapons complex—the Soviet Union had detonated its first atomic bomb in August 1949.[131] Rickover also sold the program to the congressional Joint Committee on Atomic Energy (JCAE), making "an excellent impression" on its members during a hearing at which he was the sole witness.[132]

125 Ibid., p. 108.

126 Chief of Naval Personnel to Rickover, 15 February 1949, Rickover Papers. Cited in Duncan, *Rickover*, p. 108.

127 Ibid.

128 Hewlett and Duncan, *Nuclear Navy,* pp. 154–155.

129 Duncan, *Rickover,* p. 111.

130 Ibid., 114.

131 Ibid.; and Rockwell, *Rickover Effect*, p. 99.

132 Duncan, *Rickover*, pp. 112–113.

As a result, the Navy included a nuclear submarine in its budget request, which Congress approved and Truman signed into law on August 8, 1950. The Navy was now committed to building a nuclear submarine, with the AEC taking the lead on reactor development, in accordance with its statutory role. The only person in a position to lead and coordinate the efforts of both organizations was Captain Rickover.

Senior Leader Support

The saga of Rickover's promotion to flag rank illustrates the importance of senior-leader support for innovators. Although the particulars are unique to Rickover, the dynamics are typical of the tension between bureaucratic routine and high-risk innovations.

By July 1951, when the Navy first considered Rickover for promotion to rear admiral, he had already achieved a funded requirement for a nuclear submarine and made substantial technical progress toward its construction. Yet the Navy passed him over, signaling that his remaining time in uniform might be short.[133]

Disappointed but undaunted, Rickover continued charging ahead, earning a sterling reputation on Capitol Hill in the process by treating senators and representatives as teammates rather than adversaries.[134] As Rickover associate Theodore Rockwell put it, "By laying out requirements years in advance, by having the same people present the same story year after year, and by making Congress a party to the problems as well as to the achievements, Rickover created an atmosphere of stability and predictability," contrasting favorably with the budget and schedule fluctuations of other DoD programs.[135] Senator Brien McMahon and Congressman Melvin Price of the JCAE lauded Rickover during a hearing on DoD's nuclear programs. At the same hearing, Navy Secretary Dan A. Kimball offered complimentary remarks about Rickover.[136]

The hearings piqued Truman's interest. On February 9, 1952, Rickover briefed him on the progress toward nuclear propulsion. Capitalizing on Truman's enthusiastic response,

133 Rockwell, *Rickover Effect*, p. 90.

134 Ibid., p. 164: "Military people generally assume that Congress is an enemy, or at best an untrustworthy friend, and not a very bright friend at that. So they go before Congress and give them a cock-and-bull story, a P.R. pitch. Rick works just the opposite. He treats them as valued senior advisers and members of his team. He tells them he has lots of troubles and he needs their help. They know he's leveling with them, and he's made them believe in his program—he's made them partners in it—and so they knock themselves out to help him when he asks for it. If you haven't been around [Washington, DC], you can't appreciate what a novel approach that is. To the congressmen, it's a breath of fresh air."

135 Rockwell, *Rickover Effect*, p. 84.

136 Ibid. As Price noted, Rickover "was interested in [nuclear power] and he pushed it himself and he did a lot of pushing." McMahon added, "he stepped on a lot of toes…and I think he has made some enemies, but I think I think he is a tremendous little guy."

Rickover asked him to preside at the keel-laying ceremony for USS *Nautilus* that June. Truman agreed.[137]

The ceremony revealed the breadth and depth of political support for Rickover and nuclear power. Truman praised his leadership, as did AEC Chairman Gordon Dean.[138] Weeks later, Kimball awarded Rickover the Legion of Merit, declaring that nuclear power was "the most important piece of development work in the history of the Navy." He cited Rickover's tenacity in "[holding] to a single important goal through discouraging frustration and opposition," noting that the Navy reactor project and *Nautilus*'s construction were ahead of schedule.[139]

Yet, the very next day:

> Captain Rickover was passed over for admiral a second time. Since he had also completed thirty years of active duty, he would be required to retire from the Navy by 30 June 1953. There was no precedent on the books under which he could continue on active duty after that time.[140]

This sparked concern from government officials and even from the press. Representative Carl Durham, chair of the JCAE, wrote Kimball that "it may be that the Navy has someone else who could carry on the job just as effectively. If so I do not know him."[141] The *Boston Herald* ran the headline "Forced Retirement of Expert on Atomic Subs Held 'Shocking.'"[142]

As luck would have it, the flag promotion list had not cleared White House review and Senate approval when Dwight D. Eisenhower took office in January 1953. Congress held up its review while investigating the Navy's promotion process, later mandating a special selection board to pick EDOs to retain on active duty for one year beyond their statutory retirement date. This retention board's precept favored officers "experienced and qualified for atomic propulsion of ships"—i.e., Rickover.[143]

By mid-March, Rickover and a handful of other captains were selected for retention on active duty. This gave Rickover one more opportunity for promotion, this time by a board whose precept called for selection of "an engineering duty captain experienced and qualified

137 Duncan, *Rickover,* p. 119.

138 Rockwell, *Rickover Effect*, p. 114.

139 Ibid.; and Duncan, *Rickover,* pp. 120–121.

140 Duncan, *Rickover,* p. 114.

141 Ibid., p. 122.

142 Ibid., p. 126.

143 For a detailed account, see Ibid., pp. 123–128.

in nuclear propulsion."[144] As the only officer who fit that description, Rickover was duly selected in July 1953 for promotion to rear admiral.[145]

The story of Rickover's near-banishment reveals several important considerations surrounding senior-level support for military innovators. First, it demonstrates bureaucracies' reflexive aversion to iconoclasts. Although this can suppress innovation, it can also be viewed as a logical reaction by the Navy bureaucracy, which values by-the-book team players. Senior leader empowerment of key innovators therefore requires not just rhetorical support but the expenditure of time, effort, and political capital to overcome bureaucratic inertia.

Second, Rickover's promotion reflects congressional leaders' understanding that Rickover was the driving force behind nuclear power. Progress flowed from his expertise, character, and capabilities, not just his rank and nominal position. From his modest perch as a captain in BuShips, he coordinated groundbreaking innovation by two cabinet-level agencies, DoD and AEC. Congress did not accept the Navy's argument that it had other captains capable of taking over the nuclear program. As Senator Henry M. Jackson noted, "If Captain Rickover hadn't stuck his neck out, we wouldn't have this program, and I can cite chapter and verse over a long, long period of time in that connection."[146]

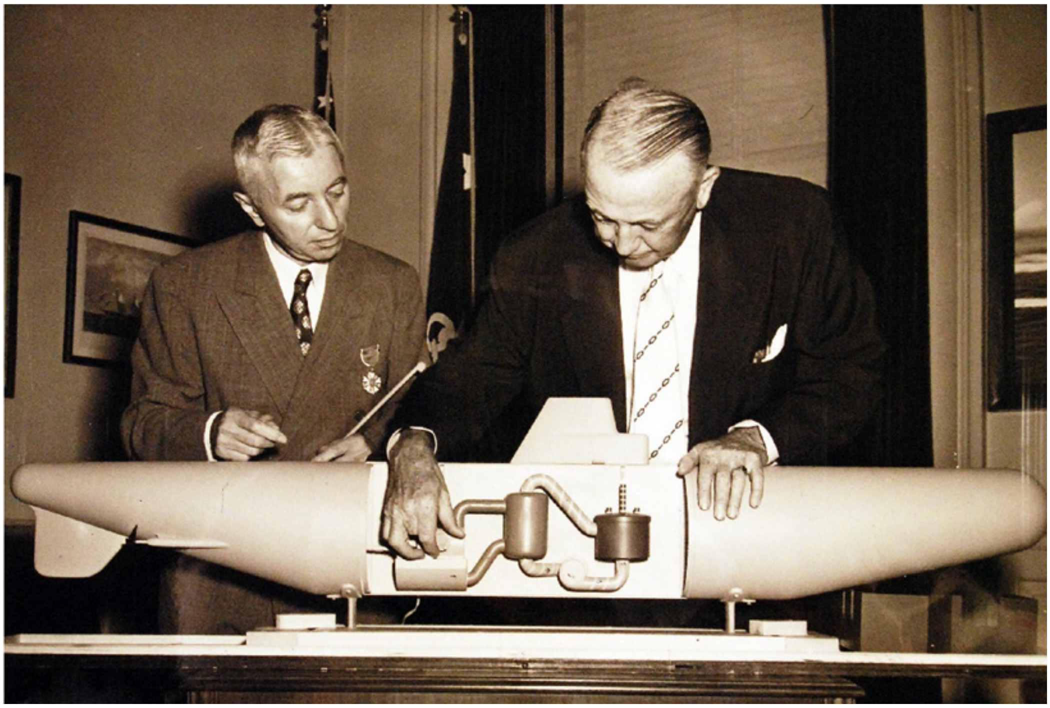
Finally, Rickover's congressional support affirms the importance of tenure. His technical and organizational accomplishments testified to his effectiveness. Congress, the AEC, and ultimately the Navy deemed his personal leadership vital to completion of the nuclear submarine program.

144 Ibid.

145 "Hyman G. Rickover Papers, 1916–2000: Finding Aid," https://www.usna.edu/Library/sca/man-findingaids/view.php?f=MS_561.

146 Duncan, *Rickover,* p. 128.

FIGURE 5: RICKOVER WITH NAVY SECRETARY DAN KIMBALL IN 1952



U.S. Navy

Rickover as Risk Manager

Risk aversion can be an asset. Rickover was convinced that nuclear submarine propulsion was feasible, and his detailed knowledge enabled him to convince the Navy, the AEC, Congress, and Truman of this fact. There was an irreducible risk that the scientific and engineering challenges could prove insurmountable, but Rickover was determined to minimize every other risk, whether technical, contractual, organizational, or cultural. The remainder of this chapter provides examples of his risk management approach.

Dual Paths

The essence of naval propulsion engineering is the generation of heat to produce pressurized gases that drive turbines, which in turn are connected to propellers. Nuclear reactors are superb heat sources because they can generate almost unlimited heat without the need for frequent refueling. Moreover, because they do not require combustion air, nuclear submarines can stay submerged and on task indefinitely. But safely harnessing the heat of fission (while containing radiation) is key. A reactor explosion or meltdown can cause mission failure, not to mention a nuclear disaster.

Reactor cooling was therefore a central engineering challenge. Two technical approaches appeared feasible: One involved using liquid sodium as the cooling medium; the other, pressurized water. Taking a lesson from the Manhattan Project, which pursued two detonation mechanisms in parallel to ensure at least one nuclear bomb was completed as quickly as possible, Rickover decided (and persuaded his Navy and AEC bosses) to build both.[147] *Nautilus* would be powered by a pressurized-water plant, and the second nuclear submarine—*Seawolf*, launched in July 1955—employed a sodium-cooled or "liquid metal" reactor.[148]

As with cooling technology, Rickover pursued dual paths for nearly every aspect of his program, reducing the risk of single points of failure.[149] Likewise, he selected two firms to develop the reactors: Westinghouse for the pressurized water model and General Electric for sodium.[150]

Concurrency

Rickover controlled the risk of schedule slippage through what would later be called concurrency: condensing design, production, testing, training, and other aspects of nuclear power development into integrated or parallel efforts.[151] A major example was the near-parallel construction of the first reactor prototype, Mark I, and the operational reactor for *Nautilus*. Consistent with standard engineering development practices, the Westinghouse team proposed constructing Mark I in a large building, with its components spread out for ease of operation and testing, and only later build the shipboard version. Rickover, however, insisted that Mark I—the world's first operational power-generating reactor—be built to shipboard specifications, including construction of a mock-up submarine hull in a pool of water, and that it be operated by Navy sailors to provide critical human-factor insights. Meanwhile, *Nautilus*'s reactor would be built almost simultaneously, with just enough lag to permit incorporation of lessons learned from construction and operation of Mark I. "If we did it your way," Rickover told the Westinghouse engineers, "it would take another five years."[152]

Rickover had authority over the reactor, but he could not directly control construction of the submarine itself. Its hull would be constructed by Electric Boat under the auspices of other divisions of BuShips. His decision to build Mark I to shipboard size and configuration mitigated the risk of unforeseen challenges when installing *Nautilus*'s reactor. Indeed,

147 Rockwell, *Rickover Effect*, pp. 62, 99.

148 Hewlett and Duncan, *Nuclear Navy,* pp. 273, 399.

149 Rockwell, *Rickover Effect*, pp. 62, 92. On the dual-path approach used by the Manhattan Project (the plutonium implosion bomb and the highly enriched–uranium gun-type bomb), see Julie Miller, "A Tale of Two Bomb Designs: Why Were Both Little Boy and Fat Man Created," Los Alamos National Laboratory," October 10, 2023, https://www.lanl.gov/media/publications/the-vault/1023-a-tale-of-two-bomb-designs.

150 Hewlett and Duncan, *Nuclear Navy,* pp. 84, 115.

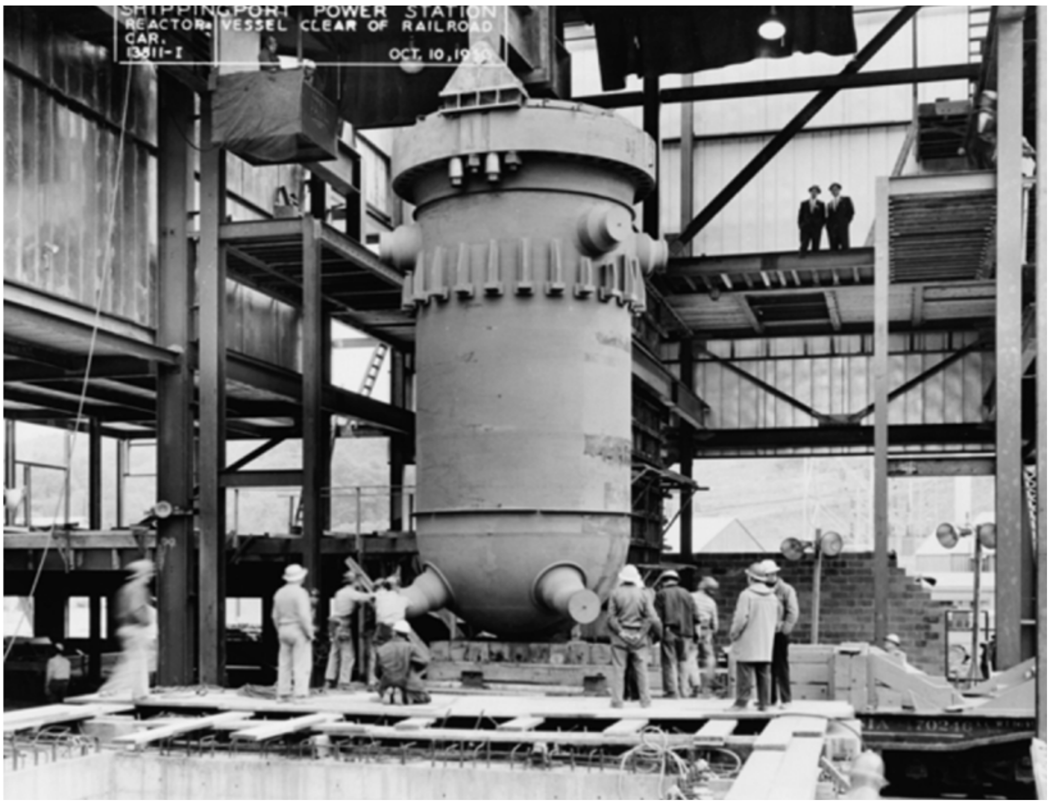
151 The term "concurrency" is generally attributed to Schriever, who used the term to describe his successful ICBM development approach. See, for example, "Gen. Bernard A. Schriever," National Museum of the U.S. Air Force, https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/197700/gen-bernard-a-schriever/.

152 Rockwell, *Rickover Effect*, p. 92.

rapid progress on the two reactors enabled Rickover to push Electric Boat to accelerate hull construction by several months to keep pace.[153]

As a result, Mark I achieved criticality (a self-sustaining nuclear fission reaction) on March 30, 1953, less than four years after the Navy issued a requirement for a nuclear submarine.[154] *Nautilus* went to sea just 22 months later, on January 17, 1955. Incredibly, amid Rickover's naval work, in 1953 the AEC placed him in charge of developing America's first civil nuclear reactor in Shippingport, Pennsylvania.[155] Shippingport achieved criticality on December 2, 1957— "fifteen years to the day after Enrico Fermi had achieved the first nuclear chain reaction in [the laboratory in] Chicago." Shippingport began producing electricity for the civil grid on December 23, 1957. By this time, the Navy had already launched five nuclear attack submarines.[156]

FIGURE 6: SHIPPINGPORT REACTOR UNDER CONSTRUCTION, 1956



U.S. Department of Energy

153 Hewlett and Duncan, *Nuclear Navy,* p. 181.

154 Duncan, *Rickover,* p. 129. Had Rickover not been promoted, he would have been forced to retire just three months later.

155 Hewlett and Duncan, *Nuclear Navy,* p. 234.

156 Ibid., pp. 254, 399.

A word of caution: the effective use of concurrency—or any nonstandard approach to innovation and acquisition—is inextricably entwined with leadership tenure. Rickover staked his personal and professional reputation on his ability to deliver an operational submarine by 1955. Knowing he was accountable for outcomes and not just incremental progress, the specific circumstances of the naval nuclear power program led him to choose a concurrency-based approach. This does not mean concurrency is optimal in every situation, but it does mean that a tenured innovator accountable for outcomes must be trusted to effectively manage risk. It is the responsibility of the secretary of defense to select an innovator worthy of that trust.

This chapter is not intended to be a hagiography of Rickover, nor does it suggest that such a unique individual is essential for military innovation. Rather, Rickover's approach to innovation was so far outside the bureaucratic norm that it provides an ideal-type model of how to innovate quickly, effectively, and at scale. Rickover himself engineered the delegation of authority that he ultimately received from the Navy, DoD, the president, and Congress, but his success provides a model of innovation that could be proactively implemented today by foresighted defense and Service secretaries committed to solving the most pressing military operational problems.

Rickover's own words provide the best summary of what he called his "method of operation":

> We have built up something unique and new, and I believe this method of operation is in itself an important development. We have worked out a system which combines the peculiar abilities and experience of industry…the Atomic Energy Commission, and the Congress.… This arrangement combines centralized decision-making and responsibility—which enables us to move just as fast as would be possible in a totalitarian state—but with private industrial ingenuity and with democratic processes.[157]

157 Hyman G. Rickover, "Remarks prepared for delivery at the American Public Power Association Convention," Seattle, Washington, May 28, 1959; https://rickovercorpus.org/?file=https%3A%2F%2Frickover-corpus.s3.us-east-1.amazonaws.com%2FShippingport%2BLessons%2BLearned.pdf.

CHAPTER 3

Schriever and the ICBM

No one had told Bennie Schriever...to find out how to build an ICBM. He was initiating something entirely on his own.

— Schriever biographer Neil Sheehan[158]

Rickover's nuclear power program showed how an empowered leader can overcome structural barriers to innovation. Analysis of Schriever's ICBM program lends further support to the broad applicability of the four-part prescription for successful innovation: an operational problem with no existing solution, senior leader support, receptive organizational norms and culture, and, crucially, empowered innovators. The formula does not guarantee success, but ignoring it is likely to produce costly failures rather than game-changing successes like nuclear power and the ICBM. These two cases show that the specific mechanisms of empowerment merit close attention and diligent tending by senior leaders if innovation efforts are to succeed.

The Leader: Schriever and the Dawn of the Missile Age

Schriever's military career, and indeed his life, shared many similarities with Rickover's. Like Rickover, he was an immigrant. Born in Bremen, Germany, he emigrated to the United States at age seven.[159] Also like Rickover, he served in operational roles before shifting his focus to research, development, and engineering. He initially served as an Army Air Corps pilot, becoming a test pilot in 1939. He attended Air Corps Engineering School in July 1940 and then, on the strength of his performance, was selected to complete an engineering master's degree at Stanford University. When World War II broke out, Schriever expected to be transferred immediately to combat duty, but the Army—showing great institutional

158 Sheehan, Fiery Peace, p. 179.

159 Jacob Neufeld, *Bernard A. Schriever: Challenging the Unknown* (Washington, DC: Office of Air Force History, 2005), pp. 1–2.

foresight—kept him at Stanford until he finished his degree. Upon completion, he was assigned in June 1942 to Army Air Services, Southwest Pacific Area, based in Australia: a command responsible for maintaining and repairing Army aircraft in the Pacific theater.[160]

FIGURE 7: SCHRIEVER AND THE ATLAS ICBM

U.S. Air Force

Like Rickover, Schriever showed great skill in this engineering role. He was quickly elevated to chief of the Fifth Air Force Service Command's Maintenance and Engineering Division, and then to division chief of staff. In these jobs, he delivered operational aircraft "at a pace faster than anyone had achieved before" while also flying combat missions.[161] Before one such mission, he improvised a flare-dropping mechanism for his B-17 bomber and used it to illuminate Japanese warships at Rabaul so follow-on bombers could target them more effectively.

160 Sheehan, *Fiery Peace*, pp. 29–31.

161 Ibid., pp. 36–38, 43.

In September 1944, Schriever was put in charge of building airfields and depots just behind the forward edge of Douglas MacArthur's island-hopping campaign and ensuring that fuel and other supplies were routed efficiently, often under fire. Again, he delivered exceptional results thanks to his talent for improvisation and practical, speedy solutions. Moreover, as one general wrote on Schriever's officer efficiency report, "he [was] not afraid of anybody."[162]

Schriever's wartime record earned him his choice of assignment. After Japan surrendered, he chose to go to Washington, DC, to "get involved in research and development."[163] He cut his teeth in the world of Pentagon R&D from 1945 to May 1954, first as chief of the Army Air Force's Scientific Liaison Branch, and then as the assistant to the Air Force deputy chief of staff for development.[164] In these roles, he was instrumental in several innovations, including the turbofan engine and the Air Force's "flying boom" aerial refueling capability.[165]

As deputy chief of staff, Schriever made a decisive, Rickover-like move. In May 1953, still just a colonel, he went to Princeton University on his own initiative to meet with the renowned mathematician and physicist John von Neumann, seeking insights on the feasibility of an ICBM with a thermonuclear warhead. Convinced by von Neumann's affirmative arguments, he went immediately to Trevor Gardner—special assistant to the secretary of the Air Force for research and development—and recommended that the Air Force proceed with an ICBM program. Gardner made his own pilgrimage to von Neumann and came back an ICBM evangelist.[166] Just as the nuclear program's very existence flowed from Rickover's initiative, so did the ICBM flow from Schriever's.

The Operational Problem: Soviet ICBM Strikes

The Soviet Union detonated its first atomic bomb on August 29, 1949, ending America's nuclear monopoly.[167] Just over two years later, on November 1, 1952, the United States detonated its first hydrogen bomb; on August 12, 1953, the Soviets did the same.[168] Both countries began producing nuclear weapons in large quantities, along with bombers that could drop them on enemy territory. There followed a measure-countermeasure competition between bombers and air defenses on both sides, the latter exemplified by the continent-spanning U.S. Semi-automatic Ground Environment system and the Soviet Berkut air

162 Ibid., pp. 45–46, 142.

163 Ibid., p. 117.

164 "Gen. Bernard A. Schriever," National Museum of the U.S. Air Force.

165 Sheehan, *Fiery Peace in a Cold War*, pp. 161–172.

166 Ibid., pp. 161–172, 179, 194, 199.

167 "Soviet Atomic Program: 1946," Atomic Heritage Foundation, https://ahf.nuclearmuseum.org/ahf/history/soviet-atomic-program-1946/.

168 Ibid.

defense system designed to defend Moscow and Leningrad.[169] Early warning of approaching bombers offered the possibility of shooting them down before they reached their targets: a technical challenge, but one within the realm of possibility.

Two factors combined to upend the emerging bomber-vs.-air defense competition and create a dramatic new operational problem. First, U.S. and Soviet engineers made substantial advances in miniaturizing nuclear weapons. ICBMs' three main operational requirements are simple in principle (if technically complex): intercontinental range, accuracy, and payload. In March 1953, the Air Force Science Board determined that it was feasible to build a hydrogen bomb with megaton-range yield that would weigh less than one ton. This made accurate delivery over intercontinental ranges more realistic than before.[170]

Second, in late 1953, the Soviet Politburo adopted a plan to develop an ICBM to deliver its own hydrogen bomb.[171] Air Force intelligence assessed that this was technologically feasible; worse, by 1960 the Soviet Union would have enough ICBMs to destroy most of Strategic Air Command's bombers on the ground with little or no warning.[172] This threatened to negate U.S. nuclear deterrence: as RAND analysts Albert Wohlstetter and Fred Hoffman argued, a massive Soviet ICBM strike against the U.S. bomber force would mean that "our advertised capability for retaliation will be fictitious."[173]

The United States sought to restore a favorable strategic balance by developing a missile force of its own. Gardner established an Air Force committee to evaluate strategic missiles, appointing von Neumann chairman.[174] Von Neumann's accomplishments during the Manhattan Project (he calculated the specifications of the plutonium bomb's implosion design) had established him as a preeminent authority on defense technology.[175] His word therefore carried considerable weight in bureaucratic arguments.

In February 1954, the committee recommended that the Air Force undertake a crash program to field an ICBM by 1960, one based on Convair's nascent Atlas rocket.[176] Furthermore, von Neumann argued that "because these new weapons posed consid-

169 "SAGE: Semi-automatic Ground Environment Air Defense System, " MIT Lincoln Laboratory, https://www.ll.mit.edu/about/history/sage-semi-automatic-ground-environment-air-defense-system; and Steven J. Zaloga, "Defending the Kremlin: The First Generation of Soviet Strategic Air Defense Systems 1950–60," New York Military Affairs Symposium, https://archive.nymas.org/text_resources/The+First+Generation+of+Soviet+Strategic+Air+Defense+Systems+1950-60/defendingthekremlin.htm.

170 Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945–1960* (Washington, DC: U.S. Air Force Office of Air Force History, 1990), pp. 98–99.

171 Sheehan, *Fiery Peace in a Cold War*, p. 154.

172 Fred M. Kaplan, *The Wizards of Armageddon* (Stanford, CA: Stanford University Press, 1991), pp. 117–119.

173 Albert Wohlstetter and Fred Hoffman, *Defending a Strategic Force After 1960* (Santa Monica, CA: RAND, 1954).

174 Ibid., p. 3.

175 "John von Neumann," Atomic Heritage Foundation, https://ahf.nuclearmuseum.org/ahf/profile/john-von-neumann/.

176 Neufeld, *Development of Ballistic Missiles*, p. 3.

erable technical uncertainty, their development required a unique, highly competent scientific organization" with a single, empowered leader.[177] That leader would be Brigadier General Schriever.

Delegation: Sidelining the Nit-Pickers

In May 1954, Gardner offered Schriever the opportunity to lead the development of America's first intercontinental ballistic missile, the Atlas. "I'll take the job, provided I can run it," Schriever responded. "Completely run it—without any interference from those nit-picking sons of bitches in the Pentagon."[178] Agreeing to these terms, Gardner placed him in charge of a bespoke Air Force organization, the Western Development Division (WDD), situated near Los Angeles in the heart of the 1950s aviation industry.[179]

Five years and four months later, on September 8, 1959, the first operational Atlas squadron was activated.[180] For nearly seven decades since then, U.S. Air Force ICBMs have maintained a continuous alert status, providing the most responsive leg of the U.S. nuclear triad.[181]

Senior Leader Support

The development and fielding of the ICBM was hardly inevitable. Gardner's political savvy—starting with his enlistment of von Neumann to examine and validate the concept—and Schriever's expert leadership and management, combined to make Atlas a reality. Indeed, Air Force historian Richard H. Kohn argued that Atlas might not have succeeded if not for the "herculean efforts" of these three men.[182] However, another critical factor in the ICBM's success was that Gardner and Schriever realized that simply gaining support at the highest levels of DoD would not be enough to make sure Atlas survived.

On May 14, 1954, Air Force Chief of Staff General Nathan Twining made Atlas the highest Air Force development priority, with the concurrence of the secretary of the Air Force and the secretary of defense.[183] This was a powerful indicator of DoD-wide support for Atlas *in* principle, but because the prioritization did not extend beyond the Air Force, it left the ICBM vulnerable to bureaucratic politics within DoD. Gardner and Schriever therefore sought and obtained permission to brief Eisenhower, convincing him that Soviet ICBMs posed a critical threat and that an American ICBM was both strategically necessary and technologically

177 Ibid.

178 Quoted in Sheehan, *Fiery Peace in a Cold War*, p. 228.

179 Neufeld, *Development of Ballistic Missiles,* p. 107.

180 Ibid., pp. 105, 208, 343.

181 "America's Nuclear Triad," DoD, https://www.defense.gov/Experience/Americas-Nuclear-Triad/.

182 Richard H. Kohn, foreword to Neufeld, *Development of Ballistic Missiles*, p. iv.

183 Neufeld, *Development of Ballistic Missiles,* p. 106.

achievable. As a result, Eisenhower designated Atlas a top national priority in September 1955, above all other DoD research and development programs.[184] DoD leaders were now on notice that the president expected them to fully fund Atlas as a matter of strategic urgency.

With money no longer a constraint, time became the driving factor. Eisenhower's formal endorsement provided insurance against the threats of interservice politics and resource competition. But it did not insure against time-wasting friction arising from institutional norms and culture. Schriever therefore insisted on unique institutional arrangements to circumvent bureaucratic delay, and he devoted significant effort to overcoming cultural resistance—specifically, that of General Curtis LeMay, commander of Strategic Air Command and bomber advocate.

Schriever as Risk Manager

Schriever was determined to overcome at least four bureaucratic norms that could derail the ICBM program: diffusion of responsibility, a one-size-fits all approach to contracting, rigid adherence to bureaucratic processes, and sequential engineering development.

First, Schriever insisted on being allowed to "completely run" the ICBM program. Gardner fully agreed; as a result, the Air Force created the WDD in Inglewood, California, where Schriever would have sole authority over all aspects of Atlas program development—from design, engineering, and testing to contracting, training, and maintenance. Like Rickover, Schriever had his own purpose-built, single-focus organization—in this case, across the continent from Washington, DC, and in the heart of the American aerospace industry.

Second, Schriever insisted on an unprecedented management approach: the use of a systems integrator, Ramo-Wooldridge Corporation, to help him manage other contractors, including Convair, which would be responsible for the rocket but not the warhead or other key elements of the missile. This contrasted with the standard procedure of using a single prime contractor, which simplified management but gave the Air Force little insight into or control over individual engineering decisions. In effect, Ramo-Wooldridge functioned as the Atlas chief engineer, providing independent technical and management expertise to help Schriever resolve disconnects between the subcontractors, helping keep the project on time and on budget.[185]

184 Neufeld, *Bernard A. Schriever*, p. 16.

185 Ibid, p. 10: "At the time, the Air Force used a single prime contractor to develop a new weapon system. When relatively minor technological advances were involved, the single-prime approach worked reasonably well. However, when applied to major technological developments, this approach proved less effective because constantly changing design, components, performance specifications, and inventory planning resulted in program slippages and cost overruns. Clearly, if the ICBM program was to succeed, a new management philosophy was needed."

FIGURE 8: SCHRIEVER WITH TREVOR GARDNER (LEFT) AND DR. SIMON RAMO (RIGHT), 1956

U.S. Air Force

Third, Schriever knew that nit picking could cause needless delay. Therefore, with Gardner's support (and that of von Neumann via the Teapot Committee), he argued for Atlas-specific rules that would leapfrog normal bureaucratic swim lanes and decision processes.[186] This resulted in the Gillette Procedures, named after their chief architect: Gardner's ally, Hyde Gillette, a civilian appointee in the Air Force's budget directorate.[187] The procedures gave Schriever direct access to the highest levels of DoD, cutting out numerous officials in the process, including his direct boss, General Thomas Power, commander of Air Research and Development Command. As Neil Sheehan related:

186 Neufeld, *Development of Ballistic Missiles*, p. 3: "The Teapot Committee believed that the Air Force's conventional aircraft development approach would not work for ballistic missiles. Because these weapons posed considerable technical uncertainty, their development required a unique, highly competent scientific organization. Thus, Schriever was granted broad powers in running the Atlas program. He engaged he Ramo-Wooldridge Corporation to provide WDD with systems engineering and technical direction. [He] also held contracting authority through a special field office of the Air Materiel Command (AMC) collocated with WDD."

187 Ibid.; and Sheehan, *Fiery Peace in a Cold War*, p. 301.

> Power…objected to the…[Gillette Procedures]. He was carrying out the directive because it was an order, but he didn't like it, Power said. The whole arrangement was unfair. He was being instructed to create a separate ICBM organization out on the West Coast run by a general officer who was to have complete authority over every detail of the program. *Yet the directive also made Power responsible for the ultimate outcome. In short, he was to be held responsible for what he could not control* [emphasis added]. (His objection here was understandable, given the justly venerated military principle that there can be no responsibility without command)."[188]

This was a highly unusual measure, but the Air Force's civilian leadership prized results more than rigid adherence to the normal chain of command.

Fourth, like Rickover, Schriever employed the engineering approach that came to be called concurrency: the simultaneous development of multiple components of the system in parallel, rather than sequential development of one component after another. Sequential development was less risky from a technical standpoint, but "risk was unavoidable if the Americans hoped to win their race with the Soviets."[189] The Gillette Procedures made concurrency possible by giving Schriever near-instantaneous control over engineering management, contracting, and testing—control that he would not have had under normal bureaucratic processes.

One additional obstacle remained: the Air Force's bomber-centric culture, embodied by LeMay. As head of Strategic Air Command in the 1950s, LeMay led America's most powerful striking arm. LeMay believed that Atlas was "an extravagant boondoggle" and that the United States needed a supersonic bomber instead. Years before Atlas, Schriever earned LeMay's ire by opposing the general's favored supersonic bomber project due to then-insurmountable engineering challenges.[190] When Schriever earned his star as a brigadier general in 1953, LeMay attempted to sideline him by sending him to Korea. "Had LeMay succeeded," wrote Sheehan:

> History would not have been the same. As Curtis LeMay had been the indispensable man in the success of the strategic bombing so important to victory in the Second World War, Bernard Schriever was to be the indispensable man in the creation of the intercontinental ballistic missile during the Cold War and the enormous consequences that were to flow from it—America's penetration of space and an unspoken but permanent truce of mutual deterrence with the Soviet Union.[191]

188 Sheehan, *Fiery Peace in a Cold War*, p. 251.

189 Neufeld, *Development of Ballistic Missiles,* p. 15.

190 Sheehan, *Fiery Peace in a Cold War*, pp. 157, 223.

191 Ibid., p. 173.

Fortunately, senior officers who appreciated the importance of the ICBM and Schriever's abilities went to the Air Force chief of staff, General Tommy White, and had the orders rescinded.[192]

This episode illustrates two major considerations related to organizational culture and its consequences. First, the culture should encourage extremely frank advice to senior leaders. Even as a colonel, Schriever refused to budge from his technical and operational convictions when opposing LeMay's supersonic bomber. Like Rickover, Schriever was "constitutionally incapable of caving to pressure he considered unjust."[193] But this required personal fortitude in the face of implacable opposition by a legendary four-star combat general. A more sustainable solution would be to encourage or even require pushback rather than relying on it to emerge naturally.

Second, though the influence of culture may be diffuse and hard to pin down, solutions to cultural challenges require decisive, tangible action by senior leaders—like the actions of the generals who had Schriever's orders to Korea canceled.

Schriever was placed in charge of Atlas ICBM development in 1954. Five years later, Atlas missiles stood on alert as operational elements of Strategic Air Command. But Atlas was not the only fruit of his efforts. Even before Atlas was complete, his outstanding progress inspired Air Force leadership to consolidate all ballistic missile development under WDD. As a result, beginning in 1958, Schriever also fielded the Thor intermediate-range ballistic missile in Europe.[194] Beginning in 1960, he fielded the Titan ICBM, based in part on subsystems built as part of the Atlas risk-reduction strategy.[195] By the time of the Cuban Missile Crisis in October 1962, the Air Force had 10 of Schriever's solid-fueled Minuteman ICBMs on alert.[196] Minuteman III ICBMs continue to stand guard today as the land-based component of the U.S. nuclear deterrent force.[197]

192 Ibid.

193 Ibid., p. 167.

194 Neufeld, *Development of Ballistic Missiles*, p. 4.

195 Indeed, Titan itself was a parallel backup plan for the entire Atlas program. When Schriever briefed President Eisenhower on July 28, 1955 (in the meeting that led to Atlas's national-priority designation in September of that year), he specifically "told the president of the plan to develop a second ICBM…as a hedge in case the Atlas did not fulfill expectations." Sheehan, *Fiery Peace in a Cold War*, pp. 287, 297.

196 Ibid.

197 "LGM-30G Minuteman III," U.S. Air Force, https://www.af.mil/Home/Article/104466/lgm-30g-minuteman-iii/.

FIGURE 9: (LEFT TO RIGHT) ATLAS, TITAN, AND MINUTEMAN MISSILES

U.S. Air Force

Schriever's decisive leadership produced America's first ICBM in only five years. He succeeded in large part due to his personal vision, commitment, and expertise. But Atlas's lesson for today's DoD leaders is that innovation is not solely about picking capable innovators. Senior leaders must put their money where their mouths are—literal money, but also political capital. Just as Rickover's dual roles in the Navy and AEC gave him the expansive authorities necessary to develop nuclear power, the Gillette Procedures extended Schriever's authorities to encompass the requirements of rapid ICBM development. And just as Congress saved Rickover from premature retirement, foresighted Air Force leaders saved Schriever from exile to Korea. Finally, just as Rickover established a nuclear power subculture within the Navy to ensure the continued viability of nuclear propulsion, Schriever's rapid fielding of a comprehensive suite of ballistic missiles helped create a missileer subculture that would become the organizational peer of the Air Force's bomber clique.

CHAPTER 4

Conclusion

My simple philosophy of management [is] find good people, tell them what you want, and get out of the way.

—Norman Augustine[198]

If the United States is to regain the upper hand in its military competition with China, DoD must accelerate innovation. Administrative overhaul of the defense acquisition system may be necessary, but it will not be sufficient. In addition to streamlining rules and regulations, DoD leaders must empower key innovators to produce solutions to the most pressing operational problems. As Rickover and Schriever demonstrated, near-miraculous results are possible when the right person is given comprehensive authority to field a complete solution to a clearly defined problem.

A caveat is in order. Major innovations like nuclear propulsion and ICBMs succeeded because the right leaders were given authorities tailored to the circumstances at hand. No set of regulations can capture all the challenges and opportunities of any specific innovation effort, and routine personnel assignments may not ensure that the best candidate is put in charge of critical innovation efforts. Senior leaders must therefore scrutinize candidates' past accomplishments, prioritizing achievement over rank or nominal position. Having picked a lead innovator, senior DoD leaders must empower them with suitable authorities (such as Rickover's dual DoD–AEC hats or Schriever's Gillette Procedures) based on the innovators' own recommendations about what the job will require.

Moreover, even the most accomplished innovators can stumble. An approach that succeeded in one instance may fail in another. Schriever, for instance, went on to become the four-star general in charge of all major Air Force acquisitions, including the system program office for the C-5A Galaxy. Though the C-5A ultimately met technical specifications, it suffered

198 Freedberg, "Take Risks."

massive cost growth and maintenance problems that made it "a public scandal," with critics dubbing it a "billion-dollar blunder."[199] Without a Gillette Procedures equivalent, the Galaxy was just one of the many programs subjected to bureaucratic oversight by McNamara's DoD, resulting in constant program reviews and adjustments that produced "death by a thousand cuts."[200] Schriever's expertise, seniority, and title were countered by bureaucratic inertia and by diffusion of his attention across multiple major projects.

Rickover did not stumble, for one important reason: Naval Reactors was the last job he ever had. From 1948 until his retirement in 1982, he devoted his professional life to leading the Navy's nuclear power establishment and cementing a culture of nuclear safety. His tenure was an essential factor in making nuclear propulsion the bedrock of the modern Navy's striking and deterrent power rather than a tenuous and dangerous experiment.

Winning the Innovation Cold War

U.S. defense innovation does not take place in a strategic vacuum. Its value lies in the military advantages it affords the United States in its long-term competition with potential adversaries, especially China.

CSBA analysis has identified several factors that will shape the outcome of the long-term defense innovation competition between the United States and China. Among these are the nature and configuration of the defense leadership and management coordination systems, the governance regime that regulates the behavior of actors within the system, and the role of public–private partnerships.[201] These three factors overlap neatly with the delegate-to-innovate framework and, when combined with the findings of this report, indicate that the United States is losing ground in its defense innovation competition with China.

This is not, however, cause for despair. China is outpacing the United States despite its structural disadvantages, whereas the United States is lagging because it is not taking advantage of its most successful approach to major military innovation.

China employs a centralized, top-down approach to defense innovation. In contrast, the United States usually relies on decentralized, bottom-up coordination. This provides China with a speed advantage and helps it sustain momentum despite the organizational and

199 Fox, *Defense Acquisition Reform,* pp. 207–208. In fairness, however, McNamara protégé Alain Enthoven and coauthor K. Wayne Smith noted that cost estimation is as much art as science: "We know of no easy answer to the problem of cost growth. Congressional and public expectations of what can be accomplished in this respect are probably too high.... The estimation of requirements is far from an exact science. The same is true of cost estimates. If the Department of Defense ever reached the point where actual costs were within 25 percent of the original estimates, it would be doing remarkably well (and much better than many other organizations)." Enthoven and Smith, *How Much Is Enough? Shaping the Defense Program, 1961–1969* (Santa Monica, CA: RAND, 2007), p. 315.

200 Fox, *Defense Acquisition Reform*, p. 209.

201 Cheung and Mahnken, *Decisive Decade*, p. ii.

cultural challenges of disruptive technical innovation.[202] Meanwhile, the United States struggles to field even modest innovations without years-long delays.[203] More ambitious innovations have been even less successful. For instance, DoD spends more than $1 billion per year to develop directed energy weapons, but "has had trouble getting these technologies out of the lab and into the field."[204]

Yet China's advantage here may not be as pervasive as it seems. Although central planning has inarguable benefits for fielding existing technology at speed and scale, America's preference for bottom-up initiative in seeking and developing groundbreaking technologies may be the more effective innovation model. Nevertheless, DoD's ability to deploy new capabilities at speed and scale relies as much as China's on decisive top-down direction. The delegate-to-innovate approach is a characteristically American way to rapidly field disruptive military capabilities—to bridge the valley of death—yet it has not been tried since the Cold War.

China largely relies on authoritarian controls to penalize poor performance by public and private actors. The United States, conversely, has historically attempted to indirectly incentivize good performance through promotions and other recognition for military personnel and public servants and profits for private industry.[205]

The American model produced impressive (if inconsistent) results during the Cold War. Today, however, rapid U.S. defense innovation at an operationally relevant scale is the exception rather than the rule. One major reason for this is that failed, delayed, and over-budget programs typically pass through the hands of many uniformed program managers and political appointees who are serving terms of three to four years or fewer. This allows them to evade accountability for negative outcomes but also cheats them out of a realistic possibility to see an innovation through to success. This creates a completely understandable, if counterproductive, incentive to minimize personal risk rather than program risk. Project timelines of greater than five years all but guarantee poor performance.

Seen through this lens, China is outpacing U.S. defense innovation despite its authoritarian governance practices, not because of them. U.S. innovation shortcomings, in contrast, result from a failure to capitalize on the traditional American approach of aligning professional incentives to innovation program outcomes—which requires that the same delegated leader be kept in place until the innovation is fully fielded. This in turn calls for innovations that

202 Ibid., p. 32.

203 To cite just one example, the U.S. Navy's *Ford*-class carrier's weapons elevators (used to move ordnance from the ship's magazines to its flight deck) were not fully certified for use until 2021, four years after the *Ford*'s commissioning. Brian O'Rourke, "The Saga of the Navy's Newest Carrier's Problem-Plagued Weapons Elevators Appears to Be Over," *The War Zone*, December 23, 2021, https://www.twz.com/43652/navys-newest-carriers-problem-plagued-weapons-elevators-saga-appears-to-be-over.

204 "Directed Energy Weapons: DoD Should Focus on Transition Planning," GAO, April 17, 2023, https://www.gao.gov/products/gao-23-105868.

205 Cheung and Mahnken, *Decisive Decade*, p. 32.

are aggressive but still within reasonable bounds of feasibility in terms of technology and timeline. Five years may not be a magic number, but such deadlines may be a good starting point for major innovation efforts.

Finally, public–private partnerships are foundational to U.S. defense innovation. Significant examples include the Atlas ICBM program, in which Schriever's WDD partnered with Ramo-Wooldridge Corporation to orchestrate an army of additional industry partners, and the F-117A stealth fighter, a product of the partnership between the Lockheed Skunk Works's Ben Rich and Under Secretary Perry's five-man program team.[206]

By contrast, China's private sector remains "confined to a secondary supporting role" relative to its government.[207] In the near term, China will likely forego the innovative potential of private companies that partner with, rather than take orders from, the state. This should, in principle, confer an advantage to the United States.

DoD, however, has developed a reflexive tendency to "hold the defense industry at arm's length."[208] Interactions are more likely to be combative than collaborative, a far cry from the era in which future Air Force Chief of Staff Larry D. Welch sat down, as a colonel, with Rich and Kelly Turner of Lockheed's Skunk Works to calculate the cost of the "revolutionary tactical fighter" that would become the F-15. "Ben and Kelly worked out the figures on a piece of paper.... The overall cost they predicted per airplane would be $7 million," Welch said. "The day we delivered that airplane the cost came out to $6.8 million per plane in 1971 dollars."[209] Today, in contrast, defense programs developed through highly structured management processes with detailed oversight from OSD routinely increase in cost by billions of dollars from one year to the next, sometimes exceeding original estimates by as much as 50 percent.[210]

Additionally, DoD's focus on rigid bureaucratic compliance drives a procedural wedge between public–private partners—an ironic mirror image of China's institutional shortcomings. This fact persists despite U.S. efforts to improve mission-oriented defense innovation. In 2020, DoD adopted the adaptive acquisition framework (AAF), which "recognizes that

206 On the close partnership between Skunk Works and Perry's program team, see, for example, Janos and Rich, *Skunk Works*, pp. 41–42.

207 Cheung and Mahnken, *Decisive Decade*, p. 7.

208 Ibid.

209 Janos and Rich, *Skunk Works*, p. 42.

210 By law, programs exceeding the 50 percent threshold (a "critical Nunn-McCurdy breach") must be cancelled unless the secretary of defense certifies that they are essential to national security. According to DoD, 37 programs incurred critical breaches between 2007 and 2016. "Nunn-McCurdy Breach," Warfighting Acquisition University, https://www.dau.edu/glossary/nunn-mccurdy-breach; DoD, *Updates to Selected Analyses from the Performance of the Defense Acquisition System Series* (Washington, DC: DoD, 2023), p. 5; "The Nunn-McCurdy Act: Background, Analysis, and Issues for Congress," R41293, CRS, https://www.congress.gov/crs-product/R41293; "Fact Sheet: Amend Nunn-McCurdy Act to Improve Defense Acquisition Oversight," Project on Government Oversight, March 20, 2025, https://www.pogo.org/fact-sheets/fact-sheet-amend-nunn-mccurdy-act-to-improve-defense-acquisition-oversight.

different procurement strategies, with varying levels of process, review, and paperwork, are necessary to match the characteristics [risks] of the capability being acquired."[211] Yet, the Government Accountability Office (GAO) has found that the AAF has not meaningfully improved cost or schedule outcomes. Innovation remains hobbled by the defense acquisition process, despite the creation of new acquisition pathways.[212]

The bureaucratic gap imposed between government and industry has an especially destructive impact on DoD's attempts to benefit from the momentum of commercial-sector advances, such as drone technology. Adoption of commercial technology entails many legitimate challenges, including supply-chain security and counterintelligence risk. Because of DoD's preference for process-oriented solutions, which may take years to develop and implement, not enough attention is paid to individual opportunities to select specific pieces of technology to shepherd through the development and fielding process.

Another speedbump is DoD's post–Cold War swing toward being a late adopter rather than a driver of technological innovation.[213] Many commercial technologies could prove valuable on the battlefield, and DoD should pursue partnership and commercial-to-military transition strategies. But there is no guarantee that private sector innovation will produce solutions to the most pressing military operational problems. Federally funded basic science, research, and development were critical elements of U.S. World War II and Cold War strategy.[214] They could be just as powerful today in combination with private-sector innovation. Today, however, the U.S. federal budget has slashed spending on R&D, with reductions in fiscal year 2026 estimated at nearly 40 percent.[215] Moreover, U.S. defense R&D spending as a percentage of global R&D investments has declined from its 1960 peak of 36 percent to less than 4 percent, making DoD a late adopter out of choice, not necessity.[216] Meanwhile, by 2009 China had overtaken every nation except the United States in overall R&D spending; it is expected to surpass the United States by 2026 (and may have already done so).[217]

211 Defense Business Board, *Industry Partnerships for Crisis* (Washington, DC: Defense Business Board, 2025), p. 42.

212 GAO, *Weapon Systems Annual Assessment: DOD Leaders Should Ensure That Newer Programs Are Structured for Speed and Innovation*. GAO-25-107569, (Washington, DC: GAO, 2025); and "Weapon Systems Annual Assessment," GAO, June 2025, https://www.gao.gov/assets/gao-25-107569.pdf.

213 Cheung and Mahnken, *Decisive Decade*, p. 8.

214 Ibid., pp. 4–5.

215 Chris Borges, *Innovation Lightbulb: Visualizing Proposed Cuts to Federal R&D Funding* (Washington, DC: Center for Strategic and International Studies, 2025), https://www.csis.org/analysis/innovation-lightbulb-visualizing-proposed-cuts-federal-rd-funding

216 Cheung and Mahnken, *Decisive Decade*, p. 5.

217 Harry Du, "Is China a Global Leader in Research and Development?," ChinaPower Project, January 31, 2018, https://chinapower.csis.org/china-research-and-development-rnd/; and Robert D. Atkinson and Meghan Ostertag, *Congress Should Fully Fund NSF's TIP Directorate to Make America More Competitive Versus China* (Washington, DC: Information Technology & Innovation Foundation, 2025), https://itif.org/publications/2025/06/30/congress-should-fully-fund-nsf-tip-directorate/.

In sum, while China seeks to fuse its military and civil sectors for speedier and more effective defense innovation, the United States continues its decades-long practice of maintaining strictly formal, procedural relationships between military and industry. It is increasing its reliance on the private sector to produce defense innovations while reducing its ability to influence the direction of private-sector research. If these trends continue, China is likely to compound its military advantage in the Asia–Pacific region while the United States falls farther behind.[218]

The delegate-to-innovate principle is the missing link between America's vast potential for rapid defense innovation and its current entrapment in the innovation valley of death. Neither authoritarian control nor loosely managed bottom-up innovation is the answer; rather, the greatest U.S. successes have been produced by empowered leaders with a sole focus on delivering a specific solution to an operational problem. As Rickover himself put it, the secret of success for any single innovation is to combine "centralized decision-making and responsibility—which enables us to move just as fast as would be possible in a totalitarian state—but with private industrial ingenuity and with democratic processes."[219]

That said, empowered innovators cannot make up for a strategic deficit in research and development investment, and U.S. reduction of federal science and R&D spending may accelerate Chinese military ascendancy in the Asia–Pacific region. Nevertheless, specific innovations are microeconomic, not macroeconomic phenomena. Schriever, for example, kept the Atlas ICBM program on track despite years of defense budget cuts under the Eisenhower administration, cuts that were only reversed after the Soviet Union launched Sputnik in 1957.[220] To ensure that the United States makes the most of every dollar spent on defense capabilities, DoD must delegate to innovate.

Innovation, by definition, entails things that are new: new ways of thinking; new ways of operating; and new ways of designing, building, and producing. It follows that military innovation is likely to require new ways of operating within the U.S. defense ecosystem—ways that do not necessarily correspond to the processes and authorities embodied in existing organization charts and bureaucratic rules. Successful innovation is likely to require fluid movement across organizational boundaries in ways that trespass on proper lines of authority. From the vantage point of a rules-driven organization, innovation is very likely to look like insurgency. Delegating to innovate captures that insurgent spirit and puts it to work.

218 On China's first-mover advantage in the 21st century techno-security competition, see Cheung and Mahnken, *Decisive Decade*, p. 32.

219 Rickover, "Remarks."

220 Sheehan, *Fiery Peace in a Cold War*, pp. 364–365.

LIST OF ACRONYMS

AAF	Adaptive acquisition framework
AEC	Atomic Energy Commission
AMC	Air Materiel Command
CDAO	Chief Digital and Artificial Intelligence Office
CNO	Chief of Naval Operations
CRs	Continuing Resolutions
CRS	Congressional Research Service
CSBA	Center for Strategic and Budgetary Assessments
CTP	Commercial technology pipeline
DARPA	Defense Advanced Research Projects Agency
DFARS	Defense Federal Acquisition Regulation Supplement
DIB	Defense industrial base
DIU	Defense Innovation Unit
DoD	Department of Defense
DRPM	Direct-Report Program Manager
EDO	Engineering duty officer
FAR	Federal Acquisition Regulations
GAO	Government Accountability Office
ICBM	Intercontinental ballistic missile
JCAE	Joint Committee on Atomic Energy
JCIDS	Joint Capabilities Integration and Development System
JROC	Joint Requirements Oversight Council
OSD	Office of the Secretary of Defense
OSRD	Office of Scientific Research and Development
PPBES	Planning, Programming, Budgeting, and Execution System
R&D	Research and Development
USD (A&S)	Under Secretary of Defense for Acquisition and Sustainment
USD (R&E)	Under Secretary of Defense for Research and Engineering
WDD	Western Development Division

CSBA
Center for Strategic and Budgetary Assessments

1667 K Street, NW, Suite 900
Washington, DC 20006
Tel. 202.331.7990 • Fax 202.331.8019
www.csbaonline.org