The U.S. Army Natick Soldier Systems Center's new virtual reality dome, demonstrated 7 October 2015 at the U.S. Army Natick Soldier Research, Development and Engineering Center, Natick, Massachusetts, will enable researchers to assess the impact of the environment on soldier cognition, including decision making, spatial memory, and wayfinding. (Photo by David Kamm, U.S. Army Natick Soldier RD&E Center)

Strategic Acquisition for Effective Innovation

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This article reflects recommendations developed by a team from the Chief of Staff of the Army Strategic Studies Group (CSA SSG). The CSA SSG is a think tank that conducts independent research on topics selected by the CSA.[1] The team studied an essential strategic question: How can the Army make its acquisition process lead to effective innovation?

That the Army acquisition process is cumbersome is widely accepted, as several case studies and task forces established to improve it have clearly demonstrated. For example, in 2009, the Task Force on Defense Acquisition Law and Oversight recommended significant acquisition reform to increase unity of effort across all acquisition stakeholders, recruit personnel with business skills and experience, and focus on outcomes that would meet the needs of warfighters.[2] However, attempts such as this at improving the acquisition process have largely failed, and innovation has suffered for that reason.

The Future Combat System (FCS) exemplifies the task force's findings. The FCS originally was envisioned as a major Army innovation effort. However, FCS program managers failed across all acquisition functions to plan effectively, generate realistic requirements, and manage the complex program. Their failure largely was due to an unreformed acquisition process that did not include adequate analysis nor achieve technology readiness before the program was under way.[3]

A critical roadblock to innovative solutions reaching warfighters is the difficulty of introducing new ideas, technologies, and concepts from the scientific and research community into acquisition programs.[4] Acquisition programs offer minimal flexibility—with fixed requirements, schedules, testing protocols, and budgets that deter integration of innovative solutions. Furthermore, a key metric of success in research and development (R&D) efforts is the number of transitions from the R&D community to acquisition programs. This metric drives R&D investments toward existing acquisition programs, requirements, and funding lines, and away from effective innovation.

The team conducted extensive research before reaching its conclusions on how the Army can encourage the kind of acquisition process it needs to be ready for future conflict. However, the final recommendations are adapted primarily from a 2014 paper by Joseph P. Lawrence III, titled "A Strategic Vision and a New Management Approach for the Department of the Navy's Research, Development, Test and Evaluation (RDT&E) Portfolio."[5] Lawrence's proposals, while aimed at improving Navy acquisition, apply strategic principles relevant across the Department of Defense. Therefore, for the purposes of ensuring acquisition supports effective innovation for the force, the Army should adopt the following recommendations:

1. Separate research (technology development) from product development.
2. Establish an Army R&D corporate board to set Army acquisition priorities consistent with projected future conflict.
3. Realign acquisition management under Headquarters, Department of the Army (HQDA).
4. Increase competitive prototyping and experimentation.

These changes are necessary because the Army suffers from a kind of acquisition paralysis—a limited ability to get good ideas and effective new technology applications into the field rapidly, as evidenced by the number of ad hoc organizations that are created during times of conflict.[6] For example, during the conflicts of the past decade, the Army needed intelligence, surveillance, and reconnaissance (ISR) technologies for squad-level command-and-control systems, but attempts to integrate ISR programs into Army acquisition failed because of R&D stakeholder ownership issues and federal regulations on the use of frequencies.[7] The Army acquisition process, however, is not in need of broad-based acquisition reforms—these have been tried before. Nor is acquisition paralysis the result of underinvestment.

The problem stems from how the Army traditionally views and executes R&D, and from how it defines the word *innovation*. For example, the Army tends to focus on the near term. In addition, Army leaders sometimes pursue exciting new technology solutions rather than effective innovation. Some leaders use the word innovation narrowly, to mean inventing new technologies. However, innovation also can include exploiting an existing capability or resource in a new and clever way to solve a problem. Objective, data-driven analysis for understanding problems can inform creative thinking that leads to inexpensive or nonmateriel solutions.

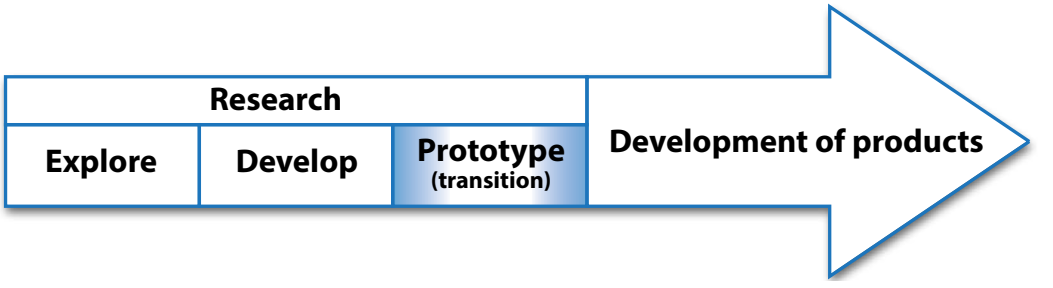
The Army is no stranger to innovation. Jeffrey J. Clarke, former director of the Center for Military History, frames the Army's rich innovation history

in the foreword to *A History of Innovation: U.S. Army Adaptation in War and Peace*:

> From the exploits of the Lewis and Clark Expedition at the beginning of the nineteenth century to the medical and engineering advances associated with the construction of the Panama Canal begun at its end, … [Army innovation also includes] military initiatives in weapons, tactics, organization, training, and other areas.[8]

requirements. Their objective is to transition developmental systems to production and then into fielding.

Frequently, product managers fund engineers from RDECOM's research, development, and engineering centers (RDECs)—usually the same RDECs that oversee the supporting technology. Figure 1 (adapted from Lawrence) illustrates the transition point of research and product development, where prototyping leads to innovations.[9] However, at this transition point, prototypes tend to be influenced by end users *before* product requirements are generated and locked in.



(Graphic adapted from Joseph P. Lawrence III)

Figure 1. Traditional Process Flow of Research and Development (with Transition Point Highlighted)

While the process sometimes works, there are some unanticipated consequences. For example, the Army tends to be focused on incrementally improving existing equipment and systems without adequate consideration of return on investment. This approach leads to a stove-piped, product-based culture instead of a solid strategy and a balanced investment portfolio that could address the most pressing Army problems. Alternately, by focusing on early prototyping of new capabilities and concepts rather than product-based programs for improving trucks, aircraft, and rifles, the acquisition community could become responsive to bigger-picture Army needs for accomplishing missions.

With the right changes to the acquisition process, the Army can make sure the force remains adaptable through effective innovation. The CSA SSG team's recommendations are designed to ensure Army innovation thrives within budgetary limits. They could help ensure R&D investments address both near-term and future needs.

Recommendation 1: Separate Research from Product Development

The Army needs to separate research (where technologies are discovered or created) from product development (where technologies are refined for use). A separation between research and product development would increase the discovery of innovative solutions. It would facilitate determining a technology's viability before significant resources were expended in product development.

Army researchers and scientists explore and develop technologies to solve the Army's capability gaps and maintain military superiority. They do this mainly as part of the Research, Development and Engineering Command (RDECOM). In contrast, program executive officers, and their subordinate project and product managers, undertake product development as part of formal programs of record guided by fixed capability

The intentional separation of research and product development would also prevent immature technologies from entering into formal programs where they are exposed to rigid processes and fixed requirements that can lead to high risk of failure, delays, and cost overruns. A 2010 review of Army acquisition, known as the Decker-Wagner report states, "even with this laborious [acquisition] process, new weapon systems continue to enter engineering and manufacturing development prematurely with technological risk, leaving a legacy of program cost overruns, reduced quantities fielded, and terminations."[10]

This same point is made in a report published by Business Executives for National Security (BENS). The report notes the Department of Defense effectively

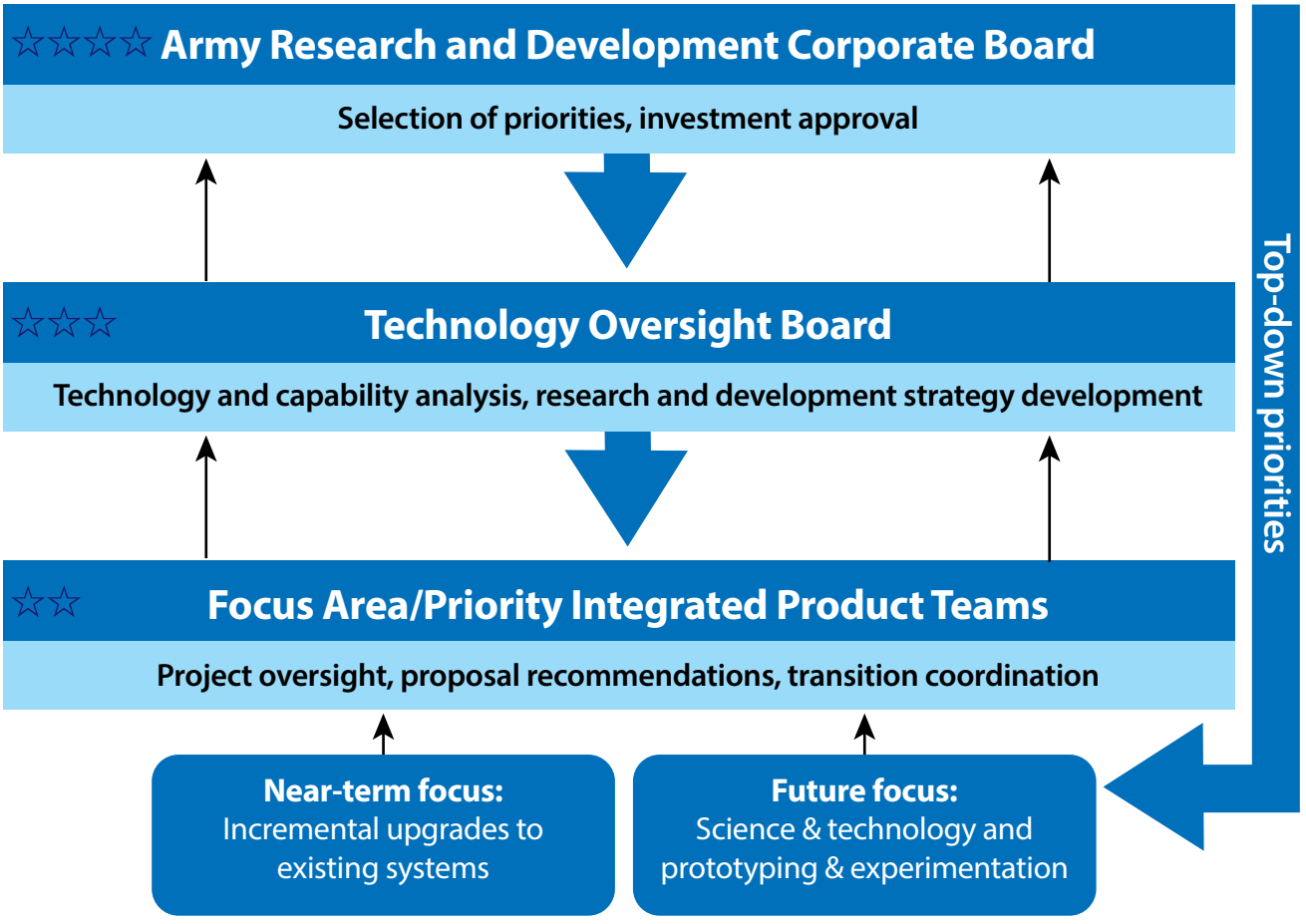
Deryck James, Army Research Laboratory (ARL), operates the Stream Line PRO Light Detection and Ranging (LiDAR) at the Parachute Operations Mishap Prevention Orientation Course 2016, Fort Stewart, Georgia, to demonstrate enhanced capabilities not available with current precision airdrop operations systems. In response to a request from United States Army Africa, ARL undertook a program to reduce the size, weight, and power of current commercial off-the-shelf Doppler LiDAR systems. The new system weighs less than forty-five pounds, is under two cubic feet, and operates on standard twenty-four-volt batteries with required power of less than one hundred watts. (Photo courtesy of U.S. Army)

encourages unnecessary risk in acquisition product-development programs with unproven technologies and uncertain requirements.[11] Demanding a high science and technology (S&T) transition success rate places the greatest S&T program risk where it does not belong—in product development.

According to Lawrence, the risk of failure should be mainly in the research phase of R&D.[12] The cost of failure during research is less than the cost of failure during product development. New ideas and theories can be expounded and tested, prototypes built, and experiments conducted apart from product development. Allowing researchers to explore ideas without having to perfect a specific product would provide the Army with tremendous value because it would allow the freedom to explore creative solutions to the Army's challenges prior to facing fixed requirements and acquisition processes. In contrast, to fail during product development leads to very different outcomes, with far greater costs, as noted in the Decker-Wagner report.[13] How, then, does the Army realign risk to the technology development phase and increase the rate of innovation in Army culture?

Lawrence, an acquisition expert at the National Defense University, is a strenuous advocate of early prototyping and experimentation during technology development. He promotes "use of early experiments and/or demonstrations by SYSCOMs [systems commands] to resolve technology risks, prior to initiation of product development, reducing cost and schedule overruns; and use of early-fielded prototypes as a mechanism for achieving speed to the fleet/force."[14] Lawrence further notes that prototyping should be a mechanism for refining requirements, gaining customer expertise and buy-in on the value of the product, and reducing the risk otherwise inherent to introducing new technologies. Adopting an approach similar to what Lawrence describes would allow the Army to place and resolve risk early in the R&D process, where failures contribute valuable insights that inform the Army's future decisions—and where failures cost far less.

Furthermore, the separation of research from product development prevents the Army from over influencing S&T investments to support existing near-term technology and programs. Capability gaps, operational requirements, strategic direction, and space for innovative ideas



(Graphic by Innovation and Improved Acquisition Team, Cohort IV, Chief of Staff of the Army Strategic Studies Group, 2015-2016)

Figure 2. Recommended Research and Development Governance Structure

should direct focus areas, not existing programs of record. Essentially, the current investment strategy, which emphasizes continual incremental improvement of existing systems for today's threats and operating environments, closes an effective entry point into Army R&D that would keep pace with the Army's accelerating needs.

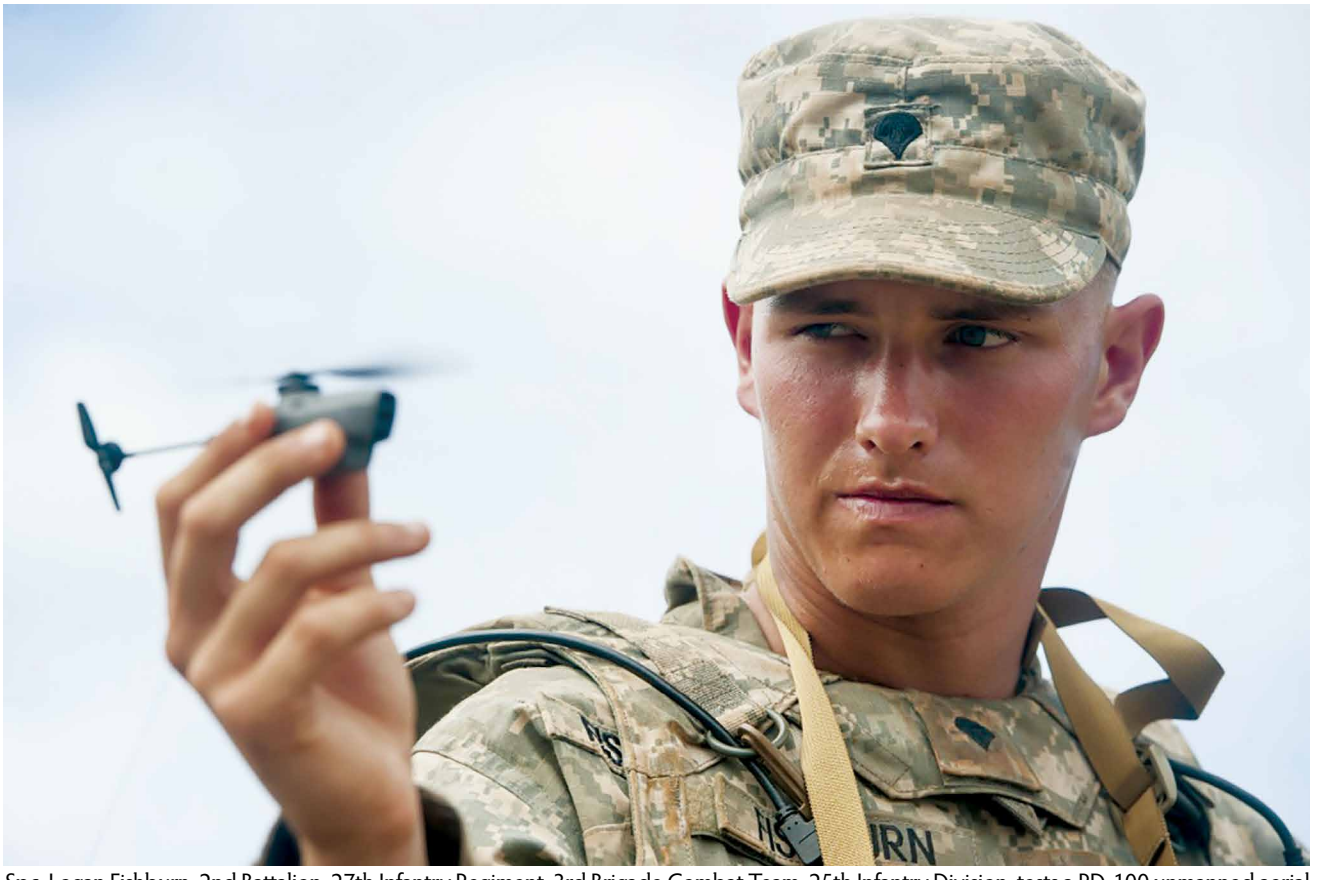
Before creating a program of record, there should be an iterative refinement of requirements for new capabilities by warfighters, technologists, sponsors, and the acquisition community. Scientists and engineers should be free to explore new ideas and move toward a larger strategic vision that would guide their work.

Recommendation 2: Establish an Army Research and Development Corporate Board

An Army senior leader R&D corporate board would bridge the gap between technology development and product development. It would ensure the CSA and Army secretariat could identify the Army's problems and set priorities to guide the acquisition community to align its R&D investments. It could increase the direct participation of uniformed military personnel in setting acquisition priorities and guiding R&D investments. Without that participation, the CSA's ability to influence acquisition to meet future threats and operational needs will be stymied by a lack of synchronization across military, civilian, and congressional stakeholders.

The board would not be a new governance body. It would be a repurposing of existing four-star general-officer-level and senior civilian-level boards such as the Army Science & Technology Assessment Group or the Army Requirements Oversight Council (AROC). It would achieve unity of purpose across the Army's senior leadership by reinvigorating corporate R&D governance and development of an Army R&D strategy.

In early 2016, CSA Gen. Mark A. Milley took charge of the requirements process by convening four-star



Spc. Logan Fishburn, 2nd Battalion, 27th Infantry Regiment, 3rd Brigade Combat Team, 25th Infantry Division, tests a PD-100 unmanned aerial vehicle 22 July 2016 during the Pacific Manned-Unmanned Initiative at Marine Corps Training Area Bellows, Hawaii. (Photo by Staff Sgt. Christopher Hubenthal, U.S. Army)

commanders to participate in frequent AROC forums.[15] By reinvigorating other senior-leader groups in a similar manner, senior leaders could set priorities for the current and the future force, balance the R&D portfolio, and establish an Army R&D strategy built on an analytical foundation. An Army corporate board (illustrated in figure 2) would operate as a governance team, directing R&D resources toward the Army's most pressing near- and far-term needs, and promote unity across Army labs, combatant commands, and networks of industry and academia. A four-star corporate R&D board could establish a single Army R&D strategy and exercise substantial influence to cut through bureaucratic processes and organizational stovepipes.[16] To be effective, the corporate board would require access to valid analysis to enable thoughtful decision making.

Recommendation 3: Realign Acquisition Management

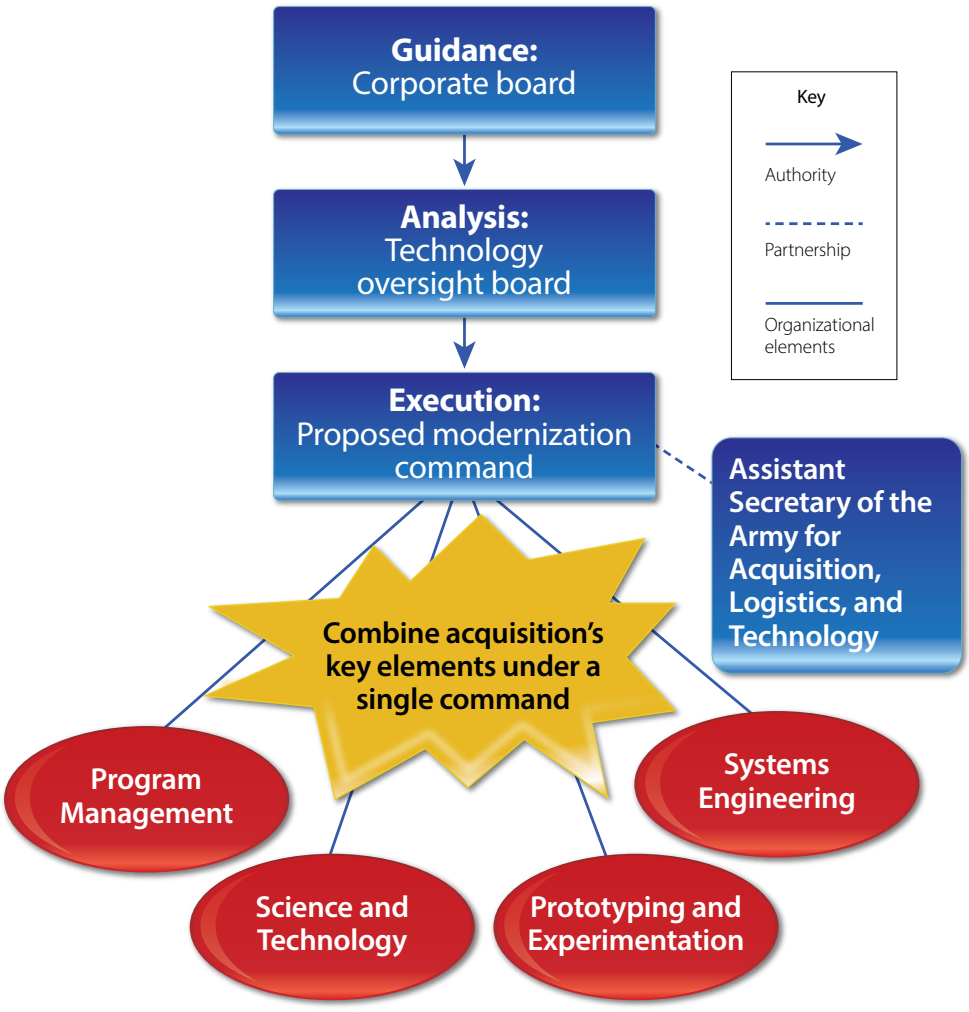
The third recommendation is focused on aligning R&D, program executive officer programs of record, and systems engineering functions under a single chain of command. A misalignment between S&T (far term) and product development (near term) has created counterproductive incentives that lead to integrating immature technologies into Army systems and investments in nonprioritized efforts.

Figure 3 (next page) depicts a realignment of acquisition stakeholders that would enhance their ability to respond to guidance from the corporate board, as refined from the CSA's guidance and priorities. Existing Army labs, RDECs, program executive officers, and program managers would provide formal analysis and S&T, R&D, and systems integration within a proposed technology oversight board. Most important, an execution command (i.e., a proposed modernization command) could unify and integrate R&D organizations to execute well-founded programs that are in line with the needs of the Army.

This realignment would calibrate the technology development and product development efforts to help solve tough Army problems and inform the corporate board on potential courses of action. This would be

especially important when the corporate board and the CSA needed to make tough decisions such as redirecting program efforts and funds.

The proposed HQDA organizational structure would develop strategic approaches around Army problems by balancing investments through cost-benefit and trade-off analyses. An analysis-based R&D strategy—grounded in shared views of future operational environments and supported by data from operational prototyping and experimentation—would coalesce around shared Army goals and objectives. Combined with a technology- and capability-vetting process led by RDECOM, the R&D strategy would be integrated with operational test venues to inform the corporate board and the executing acquisition organizations on how to accelerate innovation and reduce program-of-record risk. Test venues integrated with that R&D strategy would include the Rapid Equipping Force, the Asymmetric Warfare Group, combat training centers, and U.S. Army Training and Doctrine Command battle labs.



(Graphic by Innovation and Improved Acquisition Team, Cohort IV, Chief of Staff of the Army Strategic Studies Group, 2015-2016)

Figure 3. Recommended Organizational Alignment of Army Acquisition

By placing R&D, prototyping, program executive officers and product managers, and systems engineering funding under a single HQDA priority schema, in partnership with the assistant secretary of the Army for acquisition, logistics, and technology, the CSA can better execute a streamlined, need-driven R&D program. This realignment also would provide the added benefit of creating a more flexible, focused, and responsive culture among the Army RDECs, program executive officers and product managers, and centers of excellence.

Once this alignment was achieved, the work of identifying and analytically vetting technologies and capabilities could begin. Prototyping and early experimentation would be key to this process.

Recommendation 4: Increase Competitive Prototyping and Experimentation

How can the Army senior leaders influence the acquisition process to maximize the benefit it has on R&D? The final recommendation is to strategically manage prototyping and experimentation as a distinct

portfolio that progresses toward the Army's strategic vision. This is akin to seizing key terrain in battle.

The CSA has limited influence over the current force, as the budget investments are set through 2025. However, with these recommendations, Milley could align Army R&D to meet the needs of the future force as he realigned Army capability requirements when he reenergized the AROC. The CSA has significant influence on the future. Milley has indicated he welcomes opportunities to guide R&D for the success of the future force. In his view, the future must be informed by analysis derived from prototyping and experimentation, and inspired by networks of expertise.[17]

As of 2016, most prototyping funds are executed by program executive officers, in a process that does not allow for early, unconstrained prototyping and experimentation that could positively influence multiple capability solutions. The CSA, as the uniformed leader of the R&D corporate board, should strategically oversee prototyping efforts and strategies. This would assure Army priorities were met, and it would provide the capabilities needed for the current and future force.

Through prototyping efforts, the CSA receives user needs from two primary sources: first, from the current force (through FORSCOM) and the combatant commands, and, second, from the projected future force, as influenced by the S&T technology communities and future operating concept data. The outputs from these data are strategic requirements, priorities, and funding for both forces.[18] For the current force, the corporate board and the CSA can identify the equipment needed for incremental capability enhancements. For the future force, they can identify critical technologies for the S&T portfolio. The CSA would have the means to manage R&D strategically so that Army innovation could thrive even during downsizing.

The Boeing–Sikorsky RAH-66 Comanche prototype made its maiden flight 4 January 1996 at West Palm Beach, Florida. The program was canceled in 2004 just before mass production. (Photo courtesy of Wikimedia Commons)

Sunk Costs on Terminated Acquisition Programs

The Army spends more unrecoverable money—sunk costs—on more terminated acquisition programs than any other entity in the Department of Defense (DOD): "The Army has both the largest number of canceled programs and the largest percentage of sunk RDT&E [research, development, test, and evaluation] costs [compared to DOD and other services]. The amount of funding lost was relatively constant for the Army from 2004 through 2010, coming down sharply thereafter. The majority of the Army's sunk funding problem through this period was due to the cancellation of the Future Combat System (FCS); however, every year from 1996 to 2010, the Army spent more than $1 billion annually on programs that ultimately were canceled."[1]

According to Patrick Clowney, Jason Dever, and Steven Stuban, the Army's sunk cost for the failed FCS is estimated at $20 billion.[2] Another example of a sunk cost for a failed acquisition program is the estimated $6 billion spent on the RAH-66 Comanche helicopter.[3] Helicopters exceed their budgets more frequently than most other major defense acquisition programs.[4] A third example is the sunk cost of the failed Joint Tactical Radio System, estimated at $11 billion.[5]

Notes

1. Under Secretary of Defense, Acquisition, Technology, and Logistics (USD[AT&L]), *Performance of the Defense Acquisition System, 2013 Annual Report*, (Washington, DC: USD[AT&L], 28 June 2013), 13. The annual reports on the performance of the defense acquisition system are available at http://www.acq.osd.mil/news.html.

2. Patrick Clowney, Jason Dever, and Steven Stuban, "Department of Defense Acquisition Program Terminations: Analysis of 11 Program Management Factors," *Defense Acquisition Research Journal* 78, July 2016, table 1.

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4. USD(AT&L), *Performance of the Defense Acquisition System, 2015 Annual Report*, (Washington, DC: USD[AT&L], 16 September 2015), 28.

5. Clowney, Dever, and Stuban, "Department of Defense Acquisition Program Terminations: Analysis of 11 Program Management Factors," table 1.

Conclusion

The Army can create space for innovation to thrive within the acquisition process. It can do this by (1) separating research (technology development) from product development, (2) establishing an Army corporate board to direct R&D for unity of effort, (3) realigning acquisition management under HQDA, and (4) strategically managing prototyping and experimentation to nest within the strategic vision for the Army's current and future force.

The Army can apply analytical rigor to determining how it will invest in discovering technologies that can ensure the Army is successful in future conflicts. The Army can begin to overcome acquisition inflexibility and provide interdisciplinary solutions to complex issues; this does not require overhauling of the system through reform. The goal should be to identify long-lasting and impactful improvements to the acquisition system that will survive the frequent change of leaders in senior positions. ■

Biographies

Lt. Col. Rafael Rodriguez, U.S. Army, formerly served as a Chief of Staff of the Army fellow in the Strategic Studies Group. He holds a BS from the U.S. Military Academy, West Point, New York, and a master's degree in defense analysis from the Naval Postgraduate School. He has served in multiple airborne and Special Forces command and staff assignments, where he deployed routinely on overseas contingency operations.

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Maj. Justin Barnes is a U.S. Army judge advocate and formerly served as a Chief of Staff of the Army fellow in the Strategic Studies Group. He is a summa cum laude graduate of the University of St. Thomas School of Law and a graduate of Indiana University. He was an assistant professor in the administrative and civil law department and editor of the Military Law Review *at the Judge Advocate General's Legal Center and School. He has served in a variety of Army staff judge advocate assignments.*

Karen Burke is an acquisition professional in the U.S. Army Research, Development and Engineering Command (RDECOM). A Chief of Staff of the Army fellow in the Strategic Studies Group, she has over twenty years' experience in defense acquisition in positions across Army science and technology and joint program management. She holds an MS in engineering management from Western New England College and a BA from Framingham State College. She holds Level III certification in program management and systems engineering and is a member of the Army Acquisition Corps.

Notes

1. Chief of Staff of the Army Strategic Studies Group (CSA SSG) website, accessed 21 June 2016, http://csa-strategic-studies-group.hqda.pentagon.mil/SSG_Index.html. The authors were members of the Innovation and Improved Acquisition Team, Cohort IV, 5 July 2015 through 10 June 2016.

2. Task Force on Defense Acquisition Law and Oversight, *Getting to Best: Reforming the Defense Acquisition Enterprise* (Washington, DC: Business Executives for National Security, July 2009), accessed 30 June 2016, http://www.bens.org/document.doc?id=12. Other acquisition studies include Office of the Under Secretary of Defense, Acquisition, Technology and Logistics, *Performance of the Defense Acquisition System* (Washington, DC: Office of the Under Secretary of Defense, Acquisition, Technology and Logistics, 2013), accessed 30 June 2016, http://www.defense.gov/Portals/1/Documents/pubs/PerformanceoftheDefenseAcquisitionSystem-2013AnnualReport.pdf; Government Accountability Office (GAO), *Defense Acquisitions: DOD's Research and Development Budget Requests to Congress Do Not Provide Consistent, Complete, and Clear Information*, GAO-07-1058 (Washington, DC: GAO, 5 September 2007).

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4. Thomas Russell, technical director of the Army Research Lab, interview by Karen Burke, Rafael Rodriquez, and William Shoemate on Army Research Lab initiatives, 21 January 2016, Adelphi, Maryland.

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6. Army Science Board, FY 2009, *Institutionalization of Innovation in the Army* (Washington, DC: Army Science Board, December 2009), 11–14.

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11. Task Force on Defense Acquisition Law and Oversight, *Getting to Best*, 28.

12. Lawrence, "A Strategic Vision," 10.

13. Decker and Wagner, "Army Strong," 92.

14. Lawrence, "A Strategic Vision," 6.

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16. Joseph Lawrence, "Prototyping and Experimentation for Improved Acquisition: Setting the Stage" (lecture, National Defense University, Washington, DC, 14 September 2015).

17. *Report to Congress on Chief of Staff of the Army Acquisition Authorities, In Response to Section 801 of the National Defense Authorization Act for Fiscal Year 2016 Pub. L. 114-92* (March 2016) (statement of 39th Chief of Staff for the U.S. Army Gen. Mark A. Milley). See also Jen Judson, "US Army Chief Moves to Center of Acquisition Universe," Defense News online, accessed 30 June 2016, http://www.defensenews.com/story/defense/land/army/2016/03/10/us-army-chief-moves-center-acquisition-universe/81588944/.

18. Ibid., 16.