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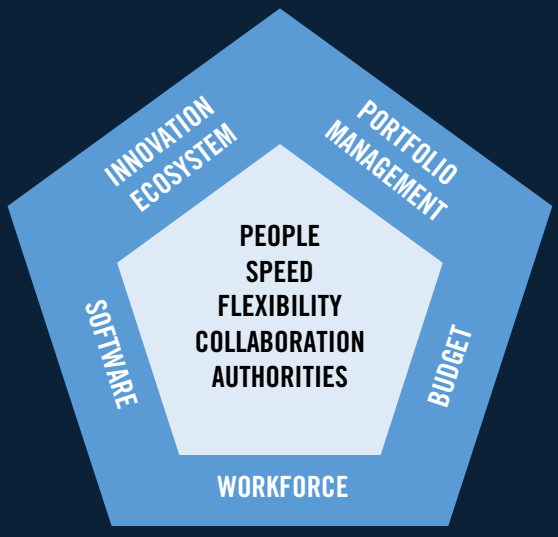
FIVE BY FIVE

Five Disciplines and Five Strategic Initiatives for the Pentagon in the Digital Age



by Pete Modigliani, Dan Ward, and Matt MacGregor

EXECUTIVE SUMMARY

The Department of Defense (DoD) embarked on a new era for Acquisition, with a relentless focus on accelerating the delivery of new operational capabilities. While much progress has been made in recent years, the new administration has an opportunity to build on the latest enterprise transformations and take them to the next level. The task ahead requires aligning and streamlining enterprise processes, shaping culture and incentives, and leveraging partnerships across DoD, Congress, industry, and our allies. This paper proposes a set of five key disciplines and five strategic initiatives to meet the challenge of accelerating and strengthening our national defense posture in the Digital Age.

The five disciplines listed below represent a shared commitment to a particular set of actions:

1. People	Putting people first and providing the necessary tools, training, autonomy, and accountability.
2. Speed	Minimizing the time to satisfy warfighter requirements.
3. Flexibility	Honing our ability to pivot in new directions and prevent adversaries from anticipating our moves.
4. Collaboration	Building strong partnerships with a wide range of diverse contributors.
5. Authorities	Developing a genuine and broad understanding of the full range of options available.

These disciplines support five proposed strategic initiatives, which the new administration, in partnership with Congress, should pursue. The **five strategic initiatives** are:

1. Instituting Portfolio Management	Breaking down stovepipes and accelerating the pace of action through integrated enterprises.
2. Budget Transformation	Improving alignment and flexibility of the resourcing process with investment priorities.
3. Building an Innovative Workforce	Improving skills, tools, and structure of the workforce.
4. Scaling and Streamlining for Software	Modernizing DoD's capacity and skillset for software.
5. Strengthening the Innovation Ecosystem	Understanding, expanding, and engaging with the wider innovation ecosystem.

The disciplines and initiatives in this paper constitute a set of actionable recommendations for DoD leadership and Congress to collaboratively partner around modernizing the defense enterprise. These require the new Deputy Secretary of Defense to champion, given the breadth of scope and senior leadership needed to drive change. They include:

Instituting Portfolio Management

1. Identify two portfolios within each military department and the defense agencies to pilot Mission Area Portfolios (MAPs). The goal would be to structure DoD capabilities via 40 MAPs.
2. Office of Secretary of Defense (OSD) Joint Staff, and Component leaders collaboratively shape DoD requirements and budget systems to align with the Adaptive Acquisition Framework.

Budget Transformation

1. DoD leaders and Congress hold a series of frank discussions to align perspectives on flexible resource allocations and acquisition authorities.
2. DoD leaders should work with Congress on increasing budget flexibility with controls by making key adjustments to new start rules, full funding requirements, reprogramming thresholds, and expanding software appropriation pilots.
3. DoD and Congressional Defense Committees should charter a Digital Age Defense Budget Reform Group to develop proposals for modernizing the defense budget system.
4. The new administration should push congressional leaders to consider transitioning to a biennial budget process that would improve agency planning and congressional collaboration.

Building an Innovative Workforce

1. Digitize the workforce: Increase digital literacy and training opportunities for personnel in all functional disciplines, such as requirements, budgets, and product support.
2. Expand the Adaptive Acquisition Framework (AAF): Update acquisition training to include new business models, best practices, and lessons learned from the field into the AAF curriculum.
3. Overhaul the acquisition education system: Incorporate modern pedagogy methods for learning, increase opportunities for experiments and exercises, and expand the range of providers.
4. Create Innovation Aggressor Squadrons: Run innovation proposals through simulated assessments, to identify and remedy any gaps, holes, or weaknesses prior to an acquisition.
5. Provide innovators on the front lines the resources to develop, deliver, and distribute dynamic training models.

Scaling and Streamlining for Software

1. Deputy Secretary of Defense (DEPSECDEF), Vice Chairman of the Joint Chiefs of Staff, and Service Chiefs/Secretaries should champion modernizing the DoD enterprise for software and hold senior leaders accountable to tailor and streamline requirements, cost estimating, budget, testing, and related processes to enable rapid and iterative deliveries of software capabilities.
2. DoD should scale software factories to provide enterprise platforms, services, and cybersecurity.

Strengthening the National Security Innovation Ecosystem

1. Services should allocate more resources for training and mentoring opportunities that scale current successes, and increase access to modern software development tools and maker-spaces.
2. Establish an independent Innovation Ecosystem Commission, to analyze all available tools to support commercial scaling, understand barriers and industry pain points, and identify where DoD should act.

3. The Under Secretary of Defense for Research and Engineering should identify two of their top priority technology areas to partner with the Service Acquisition Executives on, to identify and scale two non-traditional defense companies to serve as viable long-term providers.
4. Modernize the current export-control system rules through legislation and expand the initial cohort of the National Technology Innovation Base to include key countries.

While the new Pentagon leadership team won't all be in place on day one, there should be an urgency similar to the first 100 days when most administrations focus initial energy on their top priorities. Before defining the new buzzword initiatives with cool acronyms, key stakeholders must have a series of discussions to share perspectives, priorities, concerns, and ideas.

- Review past strategic initiatives across DoD, government, and industry that have worked and failed and understand why.
- Begin socializing the disciplines and initiatives proposed in this paper.
- Get active input and involvement by those on the front lines, outside the beltway, including program offices, operators, and other key organizations.
- Partner with congressional members and staff, as well as industry and academia. Establish goals for early wins in the first 100/200/300 days, then keep a steady pace for long-term performance.

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INTRODUCTION

The Department of Defense (DoD) recently entered a new era for Acquisition, introducing the most transformational changes the Department has seen in decades. Nevertheless, more work is needed to continually position the defense enterprise for success in the Digital Age.

A major theme in this new era is accelerating the delivery of new operational capabilities, as outlined broadly in the National Defense Strategy (NDS) and in Service-specific direction. For example, General Charles Brown published Accelerate Change or Lose to outline how the Air Force must accelerate change to remain the world's most dominant Air Force. General John Murray's Project Convergence is a multi-platform initiative for Army Futures Command to accelerate change in modernization efforts. The Navy's Project Overmatch aims to accelerate creating a naval battle network.

One of the first concrete steps to implement these acceleration strategies is delegating decision authorities to executives closer to program execution. In partnership with Congress, DoD's Acquisition Executive created new acquisition pathways for rapid prototyping, rapid fielding, and software acquisition. The new Adaptive Acquisition Framework (AAF) and the associated 5000-series policy updates transformed the decades-old acquisition models to enable acquisition professionals to rapidly exploit commercial technologies for military impact and balance speed with rigor. The new administration has an opportunity to build on these transformations and modernize other elements of the defense enterprise to enable DoD success in the Digital Age.

As senior leadership in DoD and the Intelligence Community transition in a new administration, our national security missions remain unchanged. Operational missions continue moving forward, along with efforts to develop and deliver new weapon systems and intelligence solutions. In the coming years, emerging technologies will redefine and expand modern warfare, and the pace of change is likely to be significantly faster than in the past. Cyber and hypersonic technologies will allow nations to achieve military effects in a fraction of the time previously required. New technologies will span commercial, economic, and military domains, creating new threats and new opportunities. Space will play an increasing role in influencing terrestrial conflicts. DoD cannot afford an acquisition enterprise that spends a decade to deliver a weapon system designed to last 30 years. As the pace of change of technologies, threats, and operations accelerates, development timelines and the operational lifespans of military technology are projected to shrink considerably. Indeed, that trend has already begun.

Accompanying this change will be a growing tension between the elements of DoD that historically focus on long-life platforms, large lifecycle costs, and reliability and the innovation-minded personnel more focused on experimentation, commercial applications, and exploiting new technologies for military advantage. These two groups have different incentives, priorities, and cultures, yet DoD needs both to be successful. DoD needs those on the cutting edge to rapidly prototype, experiment, and deliver initial capabilities, and the broader enterprise to scale, integrate, produce, and sustain these capabilities for potentially decades. Instead of a linear pendulum between speed versus rigor with DoD and Congress trying to drive the enterprise one way or another, DoD needs to understand it needs multiple avenues to achieve desired outcomes. Leadership needs to appreciate the competing incentives each group has and better align them to enterprise and mission outcomes.

As each administration and Congress focus on a new set of priorities and initiatives, we must never lose focus on the "WHY." We believe the purpose of DoD Acquisitions is to Deliver Better Capabilities Faster. Acquisition executives and professionals should internalize this mantra to shape decisions, investments, and initiatives at the enterprise or program level.

A BRIEF RECAP

From 2008 to 2016, Under Secretaries of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) Ash Carter and Frank Kendall implemented Better Buying Power 1.0, 2.0, and 3.0. This series of 30+ strategic initiatives was designed to control cost growth and improve affordability. Secretary Carter went on to create the Defense Innovation Unit – Experimental (DIUx, later renamed DIU) as an outpost in Silicon Valley to tap the latest technologies for military solutions. He also established the Defense Innovation Board (DIB) to advise DoD on how to infuse Silicon Valley innovations and culture, and established the Defense Digital Service, based on the successful U.S. Digital Service.

In 2017, per direction from Congress, the AT&L enterprise was broken into a pair of peer organizations: Acquisition & Sustainment and Research & Engineering, resembling focused enterprises of past generations. Furthermore, Milestone Decision Authorities for all but eight of the largest acquisition programs were delegated to the Services. Defense Acquisition Executive Ellen Lord developed the AAF transforming the monolithic "5000-series" acquisition model into six dynamic acquisition pathways. Ms. Lord established the Middle Tier of Acquisition (MTA) and Software Acquisition pathways, per congressional direction, to offer greater speed and flexibility to prototype, produce, and deliver capabilities.

The Air Force, under the leadership of Dr. Will Roper, reinvented the way it conducts acquisitions, launching efforts such as the Advance Air Mobility accelerator Agility Prime and a commercial investment arm AFVentures. Scaling the strategies from the Strategic Capabilities Office, it delivered innovative solutions by repurposing existing capabilities for new missions, integrating systems into teams, and harnessing commercial technologies. The Air Force used the new MTA pathway extensively to rapidly prototype and field capabilities. This enabled accelerated

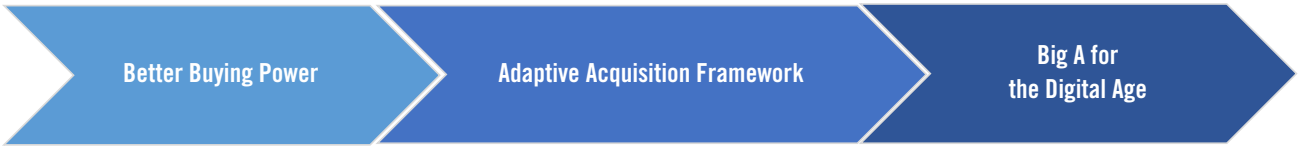


Figure 1. Acquisition Eras

learning and pivoting compared to the traditional acquisition model that often spends a decade or more to produce major weapon systems. The boldest initiative is the Digital Century Series, which demonstrates the digital trinity of digital engineering, agile software, and open architecture. It focuses on designing and delivering aircraft in a fraction of the time and flipping the decades-old model of spending 70% to sustain a system to instead continually invest in new capabilities. Dr. Roper hinted that the Next Generation Air Defense aircraft already flew and will accelerate the Advanced Battle Management System.

The Navy and Army also valued rapid acquisition experience in selecting their acquisition executives. Jim "Hondo" Geurts, a longtime champion of rapid acquisition at Special Operations Command (SOCOM), was selected to fuel the next wave of innovation for the Navy. He focused on bringing speed of relevance to Navy acquisition. Dr. Bruce Jette was the founding director of the Army's Rapid Equipping Force and founded a technology firm before shaping the Army's acquisition enterprise. The new administration should appoint executives with similar experience and drive for rapid and innovative acquisitions to take advantage of the momentum already present in the defense acquisition enterprise.

BIG A FOR THE DIGITAL AGE

Big-A acquisition includes DoD's three major enterprise systems: acquisition, requirements, and budget. DoD leaders struggle to align and integrate these three areas that have different stakeholders and often face different pressures. All, however, are subject to the forces of the prototypical "iron triangle." Even when Congress grants DoD exemptions from certain bureaucratic elements, either muscle memory takes hold, or the defenders of the status quo quickly sabotage new greenfield pilots. To position DoD for success in the Digital Age, the next cadre of Pentagon leaders must commit to modernizing these systems to more effectively spend hundreds of billions of dollars annually and rapidly deliver impactful warfighting capabilities.

The acquisition system has already undergone an overhaul but must evolve and improve as needed. The requirements system has gained recent attention with Congress directing DoD in the FY21 National Defense Authorization Act (NDAA) Section 809 to reassess its requirements processes, but true reforms will take leadership, patience, and perseverance. The budget process, likely to be the thorniest challenge, is the system most in need of change and one that will require political savvy, bureaucratic competence, and dedication. The new administration should focus on developing adaptive requirements and budget systems to align with the acquisition pathways. This enables tailored and streamlined pathways for DoD to rapidly deliver a range of defense capabilities. Figure 2 outlines a notional enterprise framework.

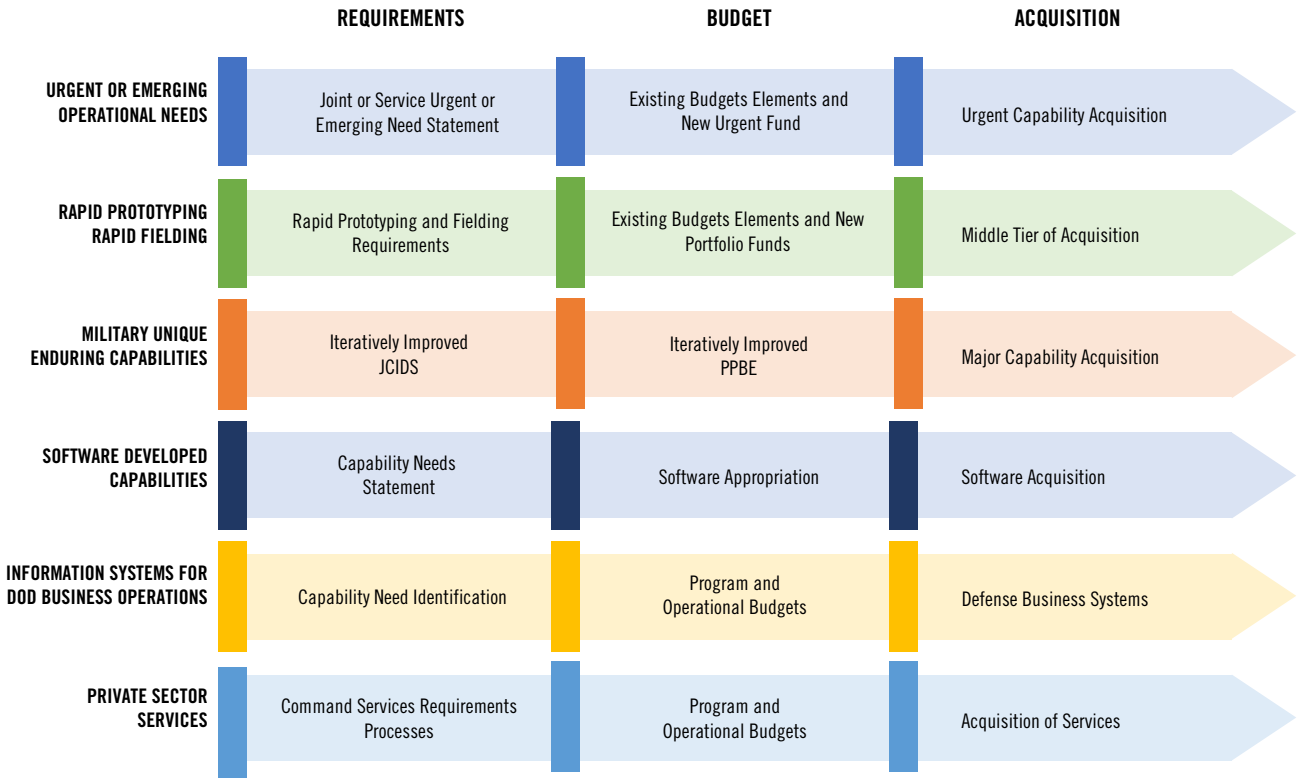


Figure 2. Notional Big-A Acquisition Framework

The foundations for the modernization and implementation of the Big-A Acquisition Framework for the Digital Age can be found in the following five disciplines and five strategic initiatives. The five disciplines provide the sets of behavior that are needed to enable a modernized enterprise. The five strategic initiatives identify the specific prescriptions that are needed to unbind the full potential of the innovation at our disposal. Together they can build the military force required to defend our nation, our allies, and our interests around the world.

FIVE DISCIPLINES

We propose five guiding disciplines to shape the defense enterprise for the Digital Age (Figure 3). The five disciplines represent a shared commitment to a particular set of actions in support of DoD's overarching goals. Each discipline contains a set of repeatable behaviors to be studied, practiced, and mastered.

A Discipline of Focusing on People

No policy or procedure can interpret, implement, apply, enforce, or improve itself. In order for a policy or procedure to have any effect, or for any improvement to happen, a person must make a decision and take action. Policies and procedures add value only when people understand and use them well, which means DoD must adopt a discipline of focusing on people.

Focusing on people encompasses a broad range of activities, from recruiting and retention to training and benefits. The government needs to have deep expertise in dealing with the complexity of new technologies and new development paradigms. This means taking steps to identify, recruit, train, enable, and support the people responsible for implementing and improving acquisition processes and policies. This includes unlocking the talent and creativity of the workforce, providing tools and opportunities to experiment, and increasing both autonomy and accountability.

"Successful operations and combat support in a contested environment demand maximum delegation, trust, and empowerment of Airmen before conflict starts."

– Gen. Charles Brown, Air Force Chief of Staff

PEOPLE	SPEED	FLEXIBILITY	COLLABORATION	AUTHORITIES
				

Figure 3. Five Guiding Principles for the Digital Age

Congress highlighted this in recent legislation, specifically in FY20 NDAA Section 230, which allows the Secretary to appoint a Chief Digital Talent Recruitment Management Officer. While OSD envisions this as a collective effort in conjunction with the Services, the official must be given the appropriate authority to effect the needed change.

DoD needs to reinvigorate the civil servant ranks more in line with the Defense Advanced Research Projects Agency (DARPA), which rotates more talent from the commercial sector into program offices. The talent rotation should include all related functionals (contracting, pricing, legal, product support, etc.).

A Discipline of Speed

The defense acquisition enterprise must take steps to keep up with the pace of change in military operations and in the technology environment. Like the rest of the military, the acquisition community must develop a discipline of speed and recognize that speed is an essential element of quality.

The acquisition community must make it a priority to minimize the time between identifying a requirement and satisfying that requirement. Failing to deliver capabilities at the speed of need reduces the quality and impact of the system, diminishes our nation's overall defense posture, and can lead to failed missions and lost lives.

An essential practice in a discipline of speed is to reduce decision latency. This involves recognizing that delaying a decision reduces the quality of the decision. Fortunately, decisiveness is a skill that can be learned, as Air Force Chief of Staff (CSAF) General Charles Brown explains in his Accelerate Change or Lose paper: "*Leaders at all levels must train to make quality decisions at the speed necessary for competition and combat timelines.*"

This disciplined practice must avoid the *superficial* appearance of speed, such as inappropriately cutting corners or unnecessarily sacrificing quality. This requires a nuanced understanding of speed, thoughtfully distinguishing between acting with genuine speed and merely being hasty. The former is a rigorous practice of identifying the fastest way to consistently deliver capabilities by reducing unnecessary delays. The latter is a sloppy approach characterized by an unsustainable pace, excessive and inappropriate risk taking, and shortcuts that ultimately undermine the system's performance.

A Discipline of Flexibility

The future will inevitably be surprising; however, the fact that the future contains surprises should not surprise us. The acquisition community must prepare for the unexpected by developing a discipline of flexibility, honing our ability to pivot in new directions as threats, technologies, and opportunities evolve. This applies across the spectrum of decision making, from requirements and budgets to acquisition strategies and system architectures.

A discipline of flexibility is closely related to a discipline of speed. Flexibility allows us to pivot away from dead-end ideas in a timely manner and reduces the tendency to stay locked in on systems, ideas, and decisions that have been overcome by events. As an unknown writer observed, "*The most dangerous thing you can do is pursue the only idea you have.*"

A discipline of flexibility also makes our future capabilities harder for our adversaries to predict and respond to. This gets us inside their OODA (Observe, Orient, Decide, and Act) loop – while they are responding to our last move, we've already made two more moves they didn't see coming.

As Dr. Roper pointed out on several occasions, *"There are too many possible futures for us to pick one and build a force that's geared to defeat it."* A discipline of flexibility aims to present our adversaries with "too many possible futures" for them to effectively respond.

This disciplined practice must avoid the *superficial* appearance of flexibility, such as constantly changing objectives and approaches for the sake of change or failing to make firm decisions in a timely manner. Instead, DoD must be credibly unpredictable in our capabilities, while also maintaining a reliable capacity to respond to our adversaries' unpredictable moves. This likely involves "*building more for the short term*," as Hon. Richard Danzig explained in Driving in the Dark, rather than locking in plans and budgets over the long term, which is how our current budget process is structured. A robust discipline of flexibility that is focused on building for the short term does not require sacrificing long-term objectives. In fact, the tactical ability to deliver new capabilities quickly and repeatedly is itself a strategic capability.

A Discipline of Collaboration

Innovation is a team sport, and the most effective change leaders are those who are able to build effective partnerships with a diverse set of allies. A discipline of collaboration aims to produce productive partnerships across functional domains, reaching out beyond the usual suspects, and a making a determined effort to remove barriers to participation. To once again quote the CSAF's Accelerate Change or Lose paper, "*Only through collaboration within and throughout will we succeed*."

A discipline of collaboration requires a nuanced understanding of the innovation ecosystem. It must go well beyond reaching out to Silicon Valley startups and must also work to identify and invite innovators within our own ranks to participate, creating space and opportunities for people to contribute. We must make a discipline of including voices not previously heard.

Looking outward as well as inward, DoD must build greater cross-governmental partnerships (with the Intelligence Community, Homeland Security, other State and Federal Agencies, etc.), creating opportunities to learn and to share our knowledge. There is also significant room for improvement in collaborating with the traditional defense industrial base. Too often, artificial walls are built between DoD and contractors, preventing more open collaboration that could facilitate better, more effective procurements.

Beyond our national borders, a discipline of collaboration would also lead to improved research and development (R&D) partnerships with allied countries and international companies, to expand DoD's access to talent, technologies, capabilities, efficiencies, and ideas.

This discipline makes previously untapped creative energy more readily available. It actively seeks out a wide range of perspectives and ideas, bringing new voices to the discussion and more hands to the work.

A Discipline of Leveraging Existing Authorities

The current policy environment provides a considerable amount of flexibility, autonomy, and opportunity for acquisition programs. Congress has been a great partner over the past five years to grant dozens of authorities in recent NDAAs, helping to enable greater speed and flexibility as it delegated authorities and established new pathways. The acquisition community should commit to understanding and using the authorities granted to it.

A discipline of leveraging existing authorities requires developing a genuine and broad understanding of the full range of options available to acquisition professionals today. It rejects the shallow mindset that views acquisitions as a one-size-fits-all domain with limited options and tight restrictions. Instead, this discipline adopts a creative and bold posture that is well informed and accepts both autonomy and accountability. For example, Part 1 of the Federal Acquisiton Regulation (FAR) explicitly authorizes pursuing a strategy in the best interests of the government and not addressed in the FAR nor prohibited by law. The acquisition leadership must make these authorities more visible. As one example of how to do that, in 2014 the White House Office of Science & Technology Policy (OSTP) and the Office of Management and Budget (OMB) published the Innovative Contracting Case Studies playbook. This was originally envisioned as "an iterative, evolving document that describes a number of ways Federal agencies are getting more innovation per taxpayer dollar – all under existing laws and regulations." It is clearly due for an update. The defense acquisition community should follow the OSTP/OMB example and produce a similar playbook, building on the earlier work and expanding it to include recent developments. This should then be incorporated into the acquisition training curriculum and disseminated across the community as a living document.

Following are five recommended strategic initiatives for the new administration, in partnership with Congress, to enable greater success across DoD with these five disciplines.

INSTITUTING PORTFOLIO MANAGEMENT

CHALLENGES

1. DoD's Requirements, Acquisition, and Budget Systems Are Stove-Piped
2. Enterprise Systems Are Slow and Rigid
3. Structures and Processes Are Designed for Programs, Not Integrated Capabilities

Robert McNamara established DoD's Planning Programming Budgeting and Execution (PPBE) system 60 years ago during the peak of the Cold War. Former DoD Executive and Senate staffer Bill Greenwalt describes DoD's five-year budget process as *"*One of the last bastions of Soviet style central planning.*"* Donald Rumsfeld introduced the Joint Capabilities Integration and Development System (JCIDS) in 2002 as a new way to manage requirements post-9/11. The Defense Acquisition System meanwhile has been in a perpetual state of reform. While there are periodic touchpoints between them, these three enterprise systems continue to operate independently. They lack the speed and flexibility to react to shifting operations, threats, budgets, and technologies, which risks missions and wastes tens of billions of dollars. In this new era, DoD needs new requirements and budget processes, and to ensure the budget and acquisition pathways are aligned to meet requirements.

A key part of a modern Big-A system is to transform from acquisition programs of stove-piped systems to portfolios of integrated suites of capabilities. Portfolios should be the foundational structure for requirements, budgets, and acquisitions. Innovation pipelines from commercial and defense sources

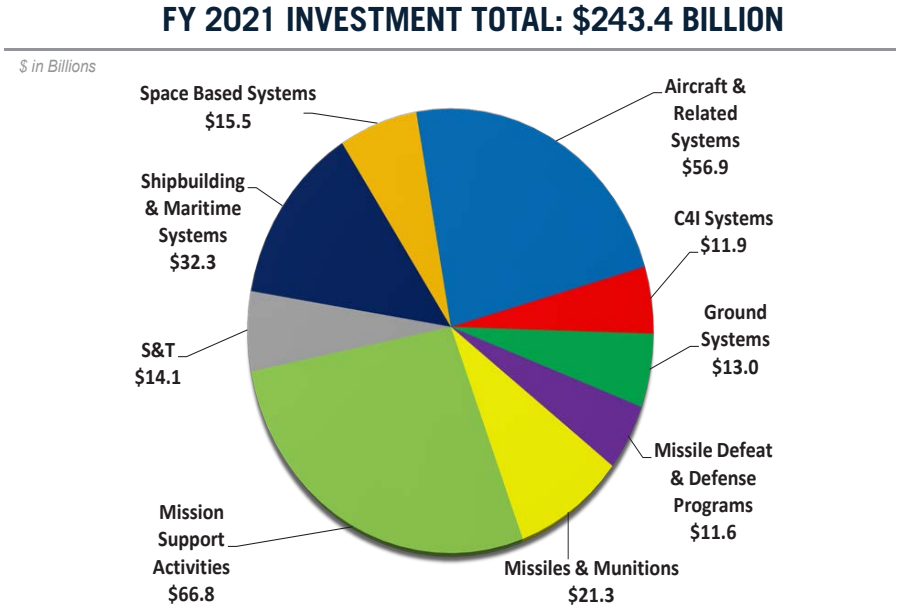


Figure 4. Strategic Capabilities in FY21 Budget

would regularly feed new technologies into each portfolio and work closely with mission partners to innovate on operational concepts to optimize mission threads. The portfolios would maximize use of open and modular systems, while providing opportunities for companies to provide proprietary elements to the capability portfolio. The business models within each portfolio would evolve to maximize competition and innovation opportunities. There would be the right balance where companies can maximize revenue and returns closer to commercial markets, while DoD increases holistic affordability and mission performance. Portfolios can host challenges for companies to regularly compete and offer solutions to address a portfolio's priority needs, risks, and opportunities.

DoD's FY21 President's Budget Request organizes major weapon systems via nine Mission Area Categories (MACs), which can also be viewed as **Strategic Capabilities** (Figure 4). These provide a sound enterprise structure for better capability portfolio management. In some areas, DoD breaks these MACs into sub-groups. In examining the budgets and major programs within each sub-group across the DoD Services and Agencies, some minor adjustments would provide a more viable portfolio structure than joint capability areas) for DoD to adopt to modernize the current PPBE process. Examining where the bulk of investments are made in each portfolio and Service can be the basis for breaking a newly reimagined **Strategic Capability Budget (SCB),** roughly aligned with the MACs, into a set of roughly **40 Mission Area Portfolios (MAPs)** for investment budget line items.

As an example, DoD could organize aircraft acquisition in 10 Aircraft MAPs that align to an existing Program Executive Officer (PEO) who oversees the specific acquisition efforts.

Aircraft MAPs	PEO
Air Force Bombers	PEO Bombers
Navy Combat Aircraft	PEO Tactical Air
Air Force Combat Aircraft	PEO Fighters and Advanced Aircraft
Joint Strike Fighter	PEO Joint Strike Fighter
Air Force Cargo Aircraft	PEO Mobility
Air Force Tanker Aircraft	PEO Tanker
Army Aircraft	PEO Aviation
Navy Unmanned Aircraft	PEO Unmanned Aviation and Strike Weapons
Air Force Unmanned Aircraft	PEO ISR and SOF
SOCOM Aircraft	PEO Fixed Wing and PEO Rotary Wing

Table 1. Aircraft MAPs Alignment to PEOs

This SCB construct would represent a strategic level starting point for DoD to negotiate with the Congressional Defense Committees in developing a budget structure that is aligned for the Digital Age. It also provides a structure for Joint Staff and the Components to manage requirements more effectively at a mission area versus a system level. Figure 5 shows the full set of potential MAPs.

In a Big-A for the Digital Age, each MAP would have a set of governing requirements and budgets to regularly deliver an integrated suite of capabilities. The governing requirements would outline the operational needs, threats, and priorities for the larger portfolio, not specific system performance requirements. The MAP resourcing would support a broader set of capabilities across multiple programs, services, prototypes, research areas, and more.

In 2020 MITRE published recommendations on Modernizing DoD Requirements. They include a new adaptive framework; warfighter essential requirements; revisiting boards, docs, and staffing; and an iterative approach driven by users and technology. Congress directed DoD to follow these recommendations in the FY21 NDAA Section 809. In discussions with senior officials in DoD and the Intelligence Community, some organizations are leveraging these ideas to shape new, streamlined requirements models.

Figure 5. Strategic Capability Budget with Proposed DoD Mission Area Portfolios (MAPs)

While DoD and Congress continually try to reform acquisitions, the reality is if the requirements aren't done right, the acquisition program is set up to fail. For software acquisition, Congress, in the FY20 NDAA Section 800, mandated DoD to establish a software acquisition pathway with streamlined acquisition, requirements, and budget systems to support rapid capability deliveries. Congress exempted software acquisitions from the complex, bureaucratic JCIDS requirements process, designed for major hardware systems.

DoD needs to break from the current model where major programs are scoped and defined up front based on preliminary requirements and cost estimates, which DoD rarely gets right given the many unknowns. DARPA, DoD labs, and Federally Funded Research and Development Centers (FFRDCs) develop great new technology research, but these technologies regularly fail to cross the "Valley of Death" to integrate into a new or existing acquisition program. Similarly, major programs, which can spend the first few years with studies and prototypes, are focused too much on a predefined solution and incentives to accelerate into development with immature technologies.

The modern approach enables PEOs and agencies to invest more in prototyping, experimentation, and pilots at a portfolio level to invest and shape research, apply commercial technologies in a defense environment, and explore new operational concepts and capability mixes to address operational needs. They can align and shape DoD, government, and commercial R&D to develop new technologies and apply leading technologies to enhance the performance of portfolio capabilities.

As DoD transitions from a program-centric model to a capability portfolio model, it should reconsider the value of baselining all acquisition programs without regard for the goals of the procurement. For instance, a formally baselined acquisition program in development is likely to be resistant to integrate novel technologies even if the program manager (PM) realizes the value and improved performance. The "lock-in" effect of having a fixed requirements document; an Acquisition Program Baseline (APB) of costs, schedules, and technical performance; a long-term contract; approved system designs; and an array of hard to update acquisition program documentation creates innovation barriers. A more dynamic approach would be to reconsider all the constraints on a program and allow greater flexibility within a capability portfolio.

What if the key performance parameters in a requirements document removed thresholds and only had objectives? What if programs were no longer locked to an APB? Programs would continue to measure and report on cost, schedule, and performance, yet acquisition and operational portfolio managers would have tradespace flexibility. If an 80% solution can be delivered sooner and resources shifted to higher portfolio priorities, they could do so. If inserting a new technology increases costs and schedule, but increases mission impact, the program isn't penalized. If a program is underperforming, functionality could shift to other portfolio programs. Removing some of the requirements and acquisition constraints would enable MAPs to be more responsive to changes in operations, threats, technologies, budgets, and system performance to maximize impact.

Today some programs are funded out of multiple Program Elements (PEs) and Budget Line Items (BLIs), and PEOs are responsible for the planning and execution of dozens of PEs with multiple appropriation types. The SCB budget structure would see MAPs possessing fewer PEs and BLIs to enable greater budget visibility, flexibility, and accountability. Each PE would have subordinate

program budget activity codes for visibility into individual development efforts while providing PEOs the flexibility to shift funding within the PE to maximize mission impact. This simplified budget structure makes developing, reviewing, and executing Service budgets more effective for DoD and Congress.

In the Digital Age, DoD needs to balance strategic, long-range investments in major platforms with short-range flexibility to rapidly harness leading technologies for current operations and threats. As the Navy is reconsidering having aircraft carriers as the centerpiece of its force structure, DoD needs to reconsider focusing most of its capability developments around major weapon systems. While DoD will continue to have billion-dollar major programs for aircraft, ships, ground vehicles, and space systems for the foreseeable future, it needs to complement them with a growing array of lower cost, higher quantity, shorter lifespan, and expendable systems. DoD needs to accelerate investments in designing and delivering new autonomous systems to complement manned systems. As Chris Brose captures in his book The Kill Chain: *"DoD should be a military defined less by the strength and quantities of its platforms than by the efficacy, speed, flexibility, adaptability, and overall dynamism of its kill chains."* Future wars will be won and lost not by applications of major systems, but rather by integrated capabilities of systems and services operating as force multipliers and force magnifiers. Similarly, future wars will not be won by the most advanced technology, but the most effective incorporation of technology into doctrine, strategy, and operations.

RECOMMENDATIONS

1. Identify two small portfolios within each military department and the defense agencies to pilot Mission Area Portfolios. This modern portfolio management approach will include a portfolio-level structure for requirements and budgeting, aligned to current acquisition PEOs.

2. OSD, Joint Staff, and Component leaders collaboratively shape DoD's requirements and budget systems to align with the AAF pathways. This will ensure tighter alignment and effectiveness of the Big-A Acquisition enterprise based on what capabilities are needed and deliver at the speed of relevance.

BUDGET TRANSFORMATION

CHALLENGES

1. DoD and Appropriators Not Aligned on Use of Rapid Acquisition Authorities

2. Budget System Hinders DoD's Ability to Plan, Respond to Threats, and Exploit Tech

3. Funding Movement Restrictions Lead to Billions Wasted and Reduced Capability

Aligning Priorities and Authorities

For the past few decades, DoD and Congress marched in lockstep that the appropriate way to maintain military superiority was using a disciplined and methodical process that predicted the long-term capabilities that would be needed, developed extensive plans that would be used to execute an effort, conducted numerous assessments against those plans, established program baselines, and monitored performance against those baselines. The Weapon Systems Acquisition Reform Act (WSARA) passed in 2009 established the core tenets for acquisition programs to execute in that fashion. WSARA required acquisition professionals to consider and address factors that might impact meeting requirements and help ensure delivery of affordable, highly capable, and reliable systems. The Government Accountability Office (GAO) credits it with influencing the Army to reduce requirements on a key combat vehicle by 25% and giving contractors more flexibility in designing solutions.

However, by 2015, a quorum of congressional defense authorizers, led by the late Senator John McCain and Representative Mac Thornberry, began recognizing that the pace of technology development by our competitors was accelerating and that the U.S. military was at risk of losing its historical edge. Sen. McCain published Restoring American Power to capture his vision, which included the creation of a better defense strategy and a rapid modernization of the force with improved adoption of commercial technology advances. This thought process led to the passing of the new MTA pathway and the expansion of Other Transaction Authority.

Since that time, DoD and congressional defense authorizers have continued to expand their view beyond the tenets of WSARA in pursuit of implementing a modern defense strategy and gaining faster and more responsive capabilities that can meet current needs but also grow and adapt to meet future threats. This mindset led to authorization of the Software Acquisition Pathway that was designed to accelerate delivery of digital capabilities into warfighting weapon systems.

While DoD and congressional authorizers embraced this new paradigm in defense acquisition, congressional defense appropriators appear to resist this shift and the reduced control it affords when compared to monitoring execution against clear, long-term program baselines. This mindset was reflected by FY21 House Appropriations Committee bill language demanding more discipline when it comes to programming, budgeting, and transparency despite the FY21 President's Budget (PB) investment exhibits submitted to Congress exceeding 28,000 pages. It is also displayed in the antipathy toward the Air Force's novel approach for its Air Battle Management System, noting the need for increased discipline and greater internal controls while making a huge cut to requested funding. The Senate Appropriations Committee has adopted a critical stance toward MTA pathway usage particularly in using RDT&E to deploy operational prototypes since it "obfuscates costs and limits transparency and visibility." The committee demands an array of documents and senior official

certifications for rapid prototyping and fielding programs from which prior statutory authorities were designed to provide relief. These provisions kneecap the flexibilities Congress granted DoD to pursue innovative solutions, discourage program managers from employing key flexibilities, and impose new requirements that drive delays to delivering critical capabilities to warfighters.

DoD will be challenged to provide the nation the military it deserves if the resourcing process continues to be misaligned with defense investment priorities and processes. As Senator James Inhofe and Rep. Thornberry, leaders in the Armed Services Committees, noted in an op-ed last year, the U.S. "will not win this competition with a strong military alone but we will lose it without one [and] these are the stakes for the NDS: revitalizing American military power so that America can achieve its vision of a safe, prosperous, and free world."

Congress and DoD need to communicate more often, in greater detail, and synchronize on the strategies required to obtain the military fighting force that is needed to counter the influence and power of our competitors. These agreed-on strategies would be used to guide congressional resourcing allocations as part of the new Strategic Capability Budgeting system. Complementarily, Congress and DoD need to have broad agreement on the authorities that will be used to implement those strategies, minimizing year-to-year shifts that cause disruption in modernizing the defense acquisition system.

Budget Cycles

While aligning budget allocations to mutually agreed-on defense priorities is critical, there are also budget processes and rules in place that make it very challenging for DoD to be responsive

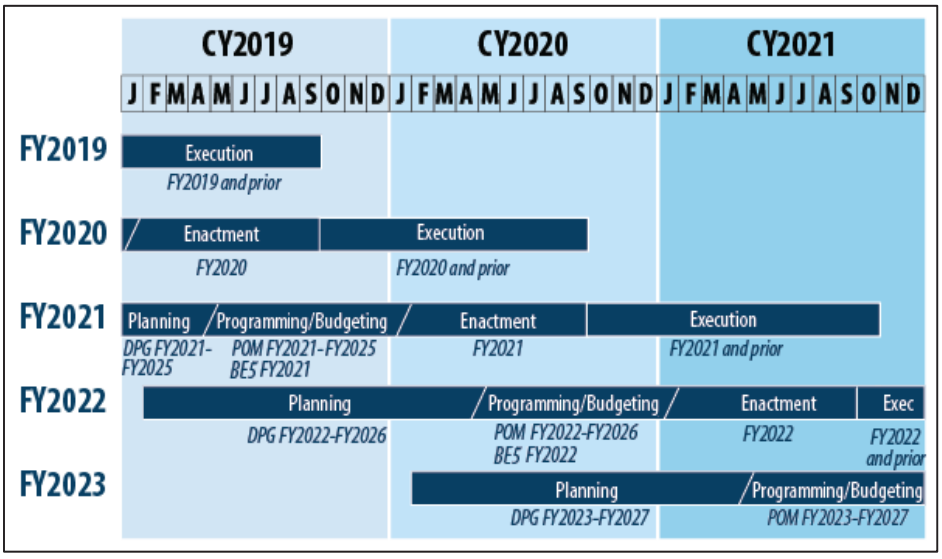


Figure 6. The Complexity of Managing DoD's Budgets Each Year

in a way that is needed in this dynamic digital and technological age. The current budget process is highly concurrent and demands significant time and energy from congressional and DoD leadership and staffs that impairs insight and leaves little room for strategic planning (Figure 6).

Congressionally, there are a number of activities such as "concurrent resolutions on the budget, reconciliation measures, tax measures, public debt measures, authorizations, regular appropriations, continuing appropriations, and supplemental appropriations" to contend with year to year in addition to normal legislative and political activities.

On the DoD side, planning, programming, and execution occurs concurrently while awaiting enactment on the current PB. OSD, Service, and combat leaders develop planning guidance to inform the next Program Objective Memorandum (POM) while working the programming process for the current POM often without full knowledge of the congressional position on the previous PB. These concurrent processes occur in conjunction with execution of the previous budget, which demands attention as well.

DoD leaders need better insight and more time to engage with congressional members to share their long-term plans in greater detail, address concerns, and work collaboratively toward the best possible outcomes. Congressional leaders need more time to understand new strategies, planned changes to operations, capability details, readiness issues, new threats, emerging technology opportunities, and other nuanced aspects of the defense budget that currently get addressed mostly through sparsely attended posture hearings, delegation visits, questions for the record, and staffer briefings.

The idea of a biennial budget has been proposed for years but never adopted. Now is the time for a strong reconsideration of those proposals. A recent Congressional Research Service report detailed adoption options. The adoption of a biennial budget cycle would provide the space and time for both DoD and congressional leaders to engage in more detailed information sharing. Off years would allow for collaboration on the Strategic Capability Budget makeup with early congressional feedback on proposed allocations. During the budget year, the focus could shift to refining the off-year proposals with more open communication and regular feedback loops.

Full Funding Requirements

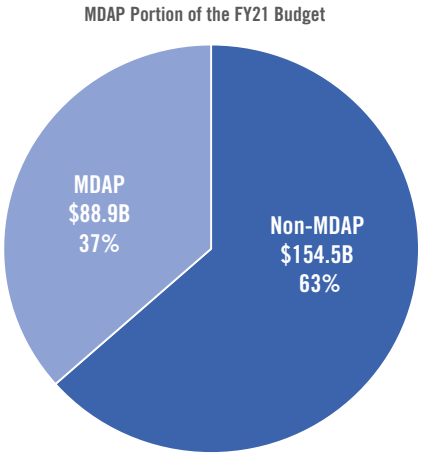


Figure 7. MDAP Portion of the FY21 Budget

Full funding requirements currently impose a significant restriction on DoD's ability to allocate funds to the highest priorities. With the original intent of providing Congress visibility into the total weapons systems costs and enabling easier tracking, this rule has now become a means of locking down a significant portion of the defense investment budget in perpetuity. It requires Component Acquisition Executives and Chief Financial Officers,

as part of 10 USC 2366a, 2366b, and 2366c requirements, to certify at every major program milestone that the program will be funded to its cost position across the Future Years Defense Program and that each Major Defense Acquisition Program (MDAP) program be budgeted in separate, dedicated budget lines. See Figure 7.

In the FY21 President's Budget request, over a quarter of investment funding was dedicated to MDAPs. This requirement was understandable in decades past given the relative stability of the threat environment and the expected life of systems. However, technological advances of competitors over the past decade have driven the need for DoD to adopt a more responsive and iterative defense acquisition model with greater use of rapid prototyping, digital engineering, modular open systems architectures, and agile software development to develop, field, and upgrade systems at the speed of relevancy. The Air Force is moving to a different paradigm for aircraft procurement that focuses on procuring smaller lots of aircraft with a greater number of spirals. This approach allows funding typically allocated to sustainment to instead be fed into developing the next set of capabilities. It also eases the Department's ability to retire systems that lose relevancy. Today, it is very challenging to cancel an MDAP without a long phase-down period. While MDAPs represent important capabilities, defense and congressional leaders need flexibility to fund efforts, whatever their size, proportional to the priorities that they represent not merely because they have crossed an artificial threshold.

Congress should relax full funding rules to allow DoD to allocate less funding than predicted in the latest cost estimate and not have to sequester it in a single budget line item if DoD could certify that the program was viable at the current funding levels and able to provide the required capabilities on an operationally relevant timeline. Alternative means should be devised to provide Congress with the transparency that might be perceived as lost due to this change. This change is critical to implement with the Strategic Capability Budgeting approach since funding locked down in single budget line items would dramatically reduce the efficacy of the portfolio construct.

New Starts

Another area that severely restricts defense leaders from pursuing technology opportunities is current new start rules. Flexibility in the form of congressional letter notification is limited only to very small efforts ($10 million for an entire RDT&E effort over its life). Any efforts beyond this require processing of an Above Threshold Reprogramming (ATR) package or awaiting the next budget cycle. ATRs routinely take months to process and the entire budget cycle can take more than two years from request to receipt of funds. If a DoD lab successfully demonstrates a new capability such as a novel unmanned system that is ready for integration or transition into a program of record, the Department is unable to begin that process until the budget cycle catches up or an ATR is requested. Within the past year, DoD submitted 17 new start requests as part of ATR packages that included numerous technology transition, prototyping, and limited procurement efforts for special forces capabilities, in-theater troop tasking hardware, cyber operations planning software, counter unmanned aircraft systems, high-demand electronic warfare aircraft, and 5G experimentation. Sixty-five percent of the new start requests required funding within Below Threshold Reprogramming (BTR) thresholds, which with slightly more relaxed new start rules would have allowed pursuit of these important

capabilities without delay.

In a Digital Age where new technologies and threats emerge quickly and systems can be used in new domains, national security demands cannot afford lengthy new start processes to rapidly exploit new technologies. As DARPA, labs, and commercial companies demonstrate viable solutions, all barriers to speeding those critical solutions into warfighting capabilities must be eliminated. This is especially true regarding software capabilities. As the Department becomes more digitally nimble, there will be many opportunities to exploit commercial software products and quickly integrate them to meet current mission needs. Congress recognized this potential in the FY20 NDAA and required DoD in Section 255 to develop new tools and approaches to allow rapid software insertion into defense systems. These opportunities will likely drive new starts under the current rule structure. A delay of four months for an ATR approval or two years for the budget cycle may well translate into day-for-day slips in deploying the capability and resulting diminished operational effectiveness.

Having increased flexibility to initiate efforts within the same previously approved mission area is incredibly important for DoD to pursue innovation opportunities as they present themselves in the year of execution. This flexibility would be an important accompaniment to the adoption of the Strategic Capability Budget construct since current new start restrictions would limit the portfolio's ability to only move funds across existing programs and not support the core need of increasing DoD's responsiveness to new opportunities. A more prudent approach would be to use the current congressional letter notification with the same thresholds ($10 million for RDT&E efforts and $20 million for procurement) but remove the restrictive language that constrains it to the "cost of the entire effort." This is in lieu of providing additional details on the expected total cost of the effort in the notification and annotating the funds used in budget documents submitted later for the remainder of the requirement.

Software Budgeting

Greater flexibility in funding software development is needed as more acquisition efforts adopt modern software practices. The DoD Financial Management Regulation makes "expense" and "investment" distinctions that determine whether software can be funded using RDT&E, Operations and Maintenance (O&M), or Procurement appropriations. The primary distinction between using RDT&E and O&M for software development is whether the effort is intended to reach "objective system performance" or whether it is "iterations on the basic release and not involving significant performance improvements or extensive testing." The challenge is that these distinctions for programs employing modern commercial software development practices such as Lean, DevSecOps, and Scrum drive inefficiencies into their streamlined and continuous deployment cycles. Smaller, iterative releases should be planned based on the priorities of the user and on what technical sequence of events is most efficient for delivering software capability, not what appropriation is currently available due to budget planning conducted years before. Modern software development is in many ways a "build to budget" approach. As scope and requirements are flexible, initial estimates can provide only a broad range, which will be refined over time as more is known on the productivity and scaling of development teams.

The congressionally chartered DIB, as part of its Software Acquisition and Practices Study, conducted numerous interviews with program managers, financial managers, and other acquisition professionals and found that funding was a

major issue in effective software development. The DIB's recommendation was to "create a new appropriations category" that would enable software to be funded as a single budget item, with no separation between RDT&E, production, and sustainment. To that end, Congress has authorized the creation of Budget Activity 8 (BA-8) pilots for FY21 where all software costs would be executed out of the RDT&E account to experiment and inform any long-term solutions such as a dedicated software appropriation. However, the pilots are limited to eight programs and there are indications in FY21 appropriations language that Congress views most restrictions on software development as being driven by DoD internal accounting guidance. There is a request for more objective quantitative and qualitative evidence to prove otherwise, and limitations on any additional pilots being approved. Whatever the solution, there needs to be a recognition that software *"is uniquely unbounded and flexible, having relatively few intrinsic limits on the degree to which it can be scaled in complexity and capability"* and that the application of legacy accounting rules aligned to multiple appropriations, particularly when using modern software development approaches, is antiquated and restrictive.

Instead of software programs having to scrutinize every dollar to assess where they can legally be applied for individual software features, DoD and congressional appropriators need to collaborate on ways to increase flexibility in this area. Initially, DoD needs to reevaluate its current multi-thousand-page Financial Management Regulation to identify language, such as expense and investment definitions, that might be modified to relax software restrictions and work with appropriators on drafting new guidance. Congress needs to approve more BA-8 pilots in the next cycle to increase the data set of programs using this experimental appropriation and avoid adding cynical requirements such as those in the FY21 appropriations that only make it more challenging for DoD to increasingly deliver high-quality and more timely software deliveries. After a reasonable set of BA-8 pilots have been demonstrated and the conclusions reached, Congress should consider establishing a permanent software appropriation.

Budget Structure and Flexibility

Article I, Section 8 of the Constitution grants Congress the power "to provide for the common Defense…of the United States" but does not mandate "any specific structure or process for making appropriations" nor does it limit the flexibilities that can be granted to the executive branch. The current approach has been influenced by historical practice, specific events, and political considerations rather than a deliberate methodology designed to maximize military effectiveness. Some of the challenges have been noted in terms of initial funding allocations, budget planning constraints, limited flexibilities to initiate new efforts or terminate current efforts, and the issues facing modern software development execution. In addition to those challenges is the highly restricted ability to reallocate funds once they have been budgeted, authorized, and appropriated.

Congress appropriates funding at the BLI level, which for RDT&E captures the Major Thrusts (or major activities) within a Program Element, and for Procurement captures the quantities of items to be produced and fielded. The BLI justification documents submitted as part of each President's Budget include highly detailed execution information. Challenges with new starts arise when attempting to use appropriated funding for activities not adequately captured in budget justification documents. However, even when the work is adequately captured but the needed level of funding shifts, programs have little recourse to correct. So,

two efforts that contribute to a common mission but are budgeted in two different Program Elements cannot share more than $10 million without using the ATR process. This dramatically limits the ability of PEOs and PMs to manage budget execution across multiple efforts or surge needed resources to high-performing efforts. Conversely, it also means that funding on an effort that is experiencing long contract delays cannot repurpose those funds for higher value activities, which results in wasted opportunities and massive inefficiencies. As the congressionally mandated Section 809 Panel found, program managers had double the reprogramming flexibility in the 1960s than they do today. This has been exacerbated by language in recent Appropriations Acts, which halved the BTR threshold for Procurement accounts from $20 million to $10 million. This language was sustained in the 2021 Consolidated Appropriations Act.

To account for the fact that programs have such little flexibility to self-correct, congressional appropriators maintain hypervigilance on budget execution rates, and the bulk of marks against the investment lines is for anticipated under-execution. In the FY20 Appropriations Act, there were over 370 under-execution-related marks comprising $5.2 billion just within the RDT&E accounts. It is possible that appropriators were accurate in predicting which efforts would under-execute but a better approach is to provide more flexibility so that small congressional staffs do not have to prognosticate to that level of detail. Their skill at doing so may not be as accurate as desired – a GAO analysis showed DoD returned more than $80 billion to the Treasury in expired funds from 2013 to 2018. Those were resources the Department could have used to

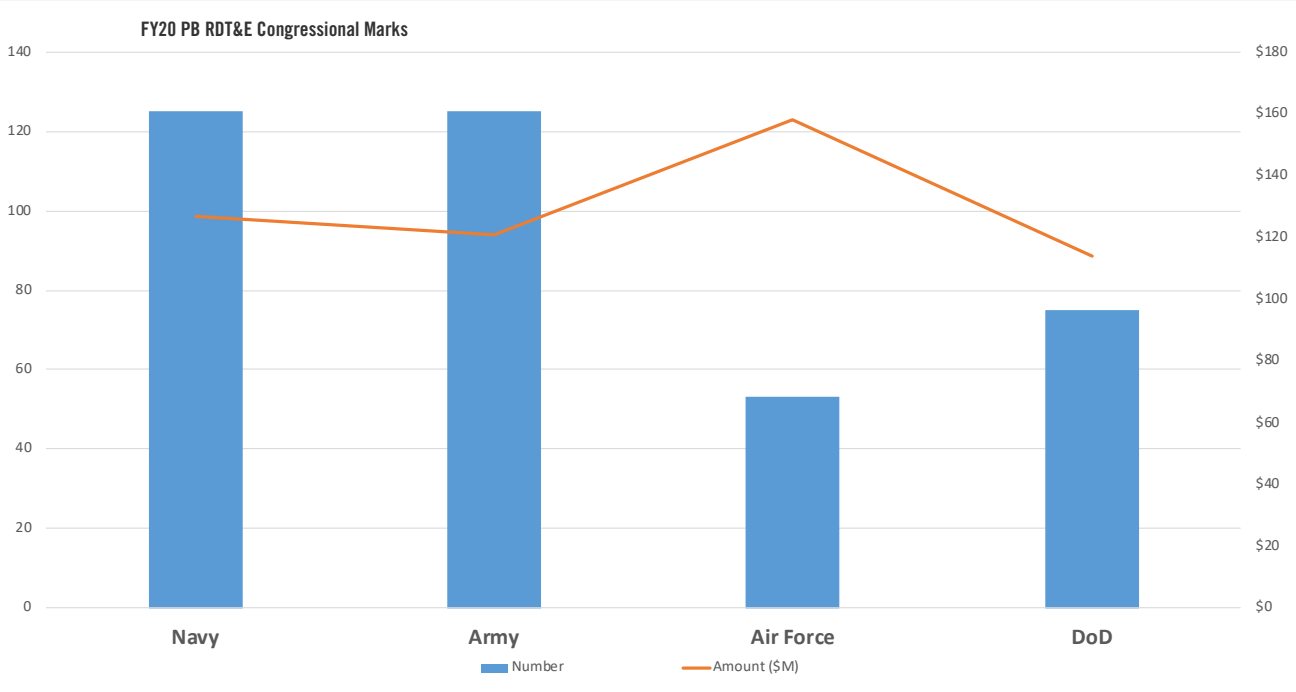


Figure 8. FY20 PB RDT&E Under-Execution Marks

improve readiness levels and develop or acquire critical warfighter capabilities. To achieve the needed levels of disruptive innovation, programs need more flexibility to use funds that are approved for generally the same purpose to pursue new technology opportunities, whether from DoD-sponsored research projects, internal research and development conducted by defense primes, or the commercial sector (see Figure 8).

Having the ability to reallocate funds is critical for program managers to respond to operationally driven changes and real-world events that could not have been mitigated with better planning. It plays a critical role in integrating new commercial technologies as they become available. Budget constraints also continue to hamper the Department's ability to quickly fund Joint Urgent Operational Needs, which currently require Above Threshold Reprogramming activities in most cases. The adoption of the Strategic Capability Budgeting process, with certain rules, would solve many of these funding flexibility issues.

Finally, as part of shifting to a more strategic budget formulation, DoD and Congress should work to redefine congressional oversight of the budget process with a greater focus on ensuring insight into DoD activities without the minute dictates of the current process. As one analyst has noted, "*Oversight should be in what is and what was, not casting speculative judgment on what will be*." One potential model to explore is the relationship between investors and venture capitalists in the private capital world, in which congressional authorizers and appropriators should expect to see a return on investment and military value creation but provide the flexibility for Senate-confirmed officials to direct the means in how to achieve overall military goals.

The timing is right for budget reform as Congress and the Department embrace the digital revolution and are actively pursuing new avenues for innovation. Congress has clearly realized this as the House recently reorganized its committee structure to include a more targeted focus on digital technology, with the Cyber, Innovative Technologies, and Information Systems subcommittee under the Armed Services Committee. Congress also noted in Section 1075 of the FY21 NDAA the need to modernize current budget exhibits and directed DoD to devise a new approach. DoD should take advantage of this opportunity to propose a new digital budget reporting approach while also tackling the larger need for expanded budget reform. While there are near-term, high-impact reform measures to be proposed, OSD should focus on convincing congressional leaders to form a Digital Age Defense Budget Reform Group to modernize the defense budget system. This independent group should be chaired by experts from the think tank, academic, and FFRDC communities and supported by OMB analysts, congressional staffers, and DoD officials. This group should incorporate defense and congressional feedback from the MAP pilots (proposed earlier), assess use of the proposed Strategic Capability Budgeting System, and reimagine budget oversight structures that enable the appropriate insight into DoD activities to validate alignment with jointly agreed-on and desired strategic outcomes.

RECOMMENDATIONS

1. **DoD leaders and Congress should have a series of frank discussions to align perspectives on flexible resource allocations and acquisition authorities.** While priorities for individual systems, missions, and technologies will vary, there needs to be a common understanding of strategies and on balancing speed and flexibility with rigor and oversight to achieve NDS objectives.
2. **(Near-Term) DoD leaders should work with Congress on immediate budget flexibility options.** This includes providing greater flexibility with sufficient controls with new start rules, full funding requirements, reprogramming thresholds, and expanding software appropriation pilots.
3. **(Long-Term) DoD and Congressional Defense Committees should charter a Digital Age Defense Budget Reform Group.** This group would develop proposals for modernizing the defense budget system incorporating feedback from the MAP pilots (earlier paper recommendation), exploring use of a Strategic Capability Budgeting System, and reimagining current oversight structures.
4. **As a complement to these defense-focused recommendations, the new administration should implore its congressional leaders in the Budget and Appropriations committees to reconsider proposals for transitioning to a biennial budget process.** This would enable better agency planning and improve congressional collaboration in the off-budget years.

BUILDING AN INNOVATIVE WORKFORCE

CHALLENGES

1. Unfamiliarity with Practical Innovation Principles and Practices
2. Lack of Digital Literacy Across the Workforce
3. Acquisition Education Slow to Adopt Modern Professional Development Approaches

Acquisition leaders must create a culture where innovation is understood, practiced, and encouraged, rather than being used as a vague buzzword or dismissed as a meaningless slogan. The first step in building this culture is to establish a shared understanding of what innovation means in the context of defense acquisition.

We suggest defining innovation as "*novelty with impact*." This definition expands the scope of innovation beyond technology, and includes new processes, organizational structures, communication methods, and other types of creative approaches under the umbrella term "novelty." This definition also emphasizes that innovation is not just about a new idea, it must also be impactful – solving a problem, creating value, making an improvement, etc. Further, this definition provides a very simple quality check in the form of two questions: *What is novel about the effort*? and *What impact will it have*?

Acquisition leaders can use this definition to clearly explain what innovation means in their domain, by identifying the specific *novelty* and *impact* for each initiative, project, or proposal. Further, this definition can help people understand that innovation is everyone's job. Each contributor can look for new ways to add value, whether through small incremental changes that make operations more efficient (*sustaining* innovations), or large changes that fundamentally change the landscape by displacing previous approaches (*disruptive* innovation).

Finally, acquisition leaders can use this to establish a high standard of clarity related to innovation, and help their teams avoid vague, unspecified, imprecise goals and behaviors. Toward that end, leaders should establish organizational metrics that measure both novelty and impact.

In addition to helping their teams understand *what* innovation is, leaders must also ensure people know *how* to do it. The acquisition community must make investments to provide training, tools, tactics, and techniques that enable innovation. We recommend placing particular emphasis on experimentation as a way to test ideas, generate validated data, and demonstrate the viability and potential impact of an innovation proposal. For more specific guidance on the role of experimentation in innovation, which includes a set of actionable recommendations, download the National Academy of Sciences report titled The Role of Experimentation Campaigns in the Air Force Innovation Lifecycle.

An experimental approach to innovation will inevitably result in some failures. This should not be a surprise nor a cause for alarm. Instead, DoD must establish mechanisms that help the workforce collect, study, and learn from the experiments and initiatives that did not deliver the expected results. This learning-based posture ensures that failures lead to improvement, rather than punishments, and contributes to a climate where people are encouraged to take action, try new things, and take thoughtful risks.

Digitize the DoD Workforce

Most of the major technological breakthroughs of the coming years will be driven by software (Artificial Intelligence [AI], autonomy, 5G), so DoD must take steps to ensure the entire workforce is digitally literate. In the Digital Age, this competency is not only the realm of computer engineers or DevSecOps experts on an acquisition program. People responsible for requirements, budgets, product support, and other functionals all must have a basic level of digital literacy. Congress may also need some assistance here, and DoD can play a role in advising and briefing legislative leaders about the military implications and opportunities in software, as well as the way modern software development methods differ from previous processes.

While pathfinder programs like Kessel Run were an important early step, it is time for DoD to move away from reliance on small elite acquisition units to solve the toughest problems and instead shift toward upskilling the larger workforce. DoD should increase opportunities for defense acquisition professionals to do rotations with leading tech companies, so they can develop practical, first-hand experience with the principles and practices of modern software developers.

Enterprise services need to be available for everyone and not funded program by program. Services like the Air Force's Platform One and Navy's Lighthouse need to be treated like commodities. Units at the edge need to be able to solve more of their own problems, and low-code/no-code development skills need to exist at all levels on the provided infrastructure to enable open architectures, ensure secure apps, and improve accessibility.

Scale the Adaptive Acquisition Framework and Contracting Cone

As Ellen Lord has frequently observed, the AAF – and the related Contracting Cone – are "*the most transformational acquisition policy change we've seen in decades*." By providing new pathways, the AAF helps to accelerate acquisition programs and enables a greater degree of critical thinking within the acquisition enterprise. There is room now to add new pathways to the AAF, such as a Space Acquisition Pathway. This is particularly timely and relevant, given the recent establishment of the U.S. Space Force.

Building on the AAF, DoD should also introduce new business models for partnering with non-traditional vendors, and infuse the new models into Service acquisition policies, guidance, and processes for integrated solutions for the acquisition workforce. The AAF should provide further iterations of guidance across acquisition-related functional areas, as well as infusing more best practices and lessons learned into the AAF-related curriculum.

Ultimately, the AAF should scale to be an enterprise platform for the Digital Age. It should evolve from a centrally curated model with limited contributions from a small group to one with thousands of contributors across the acquisition enterprise.

Overhaul Acquisition Education

DoD must move away from the outmoded model of students spending weeks in a classroom risking Death by PowerPoint, and fully move to a modern, dynamic approach to professional education. The Department must bring new thinking and methods to how acquisition professionals are trained. The issue is not simply in-person versus virtual classrooms, although that shift should have happened long before the COVID-19 pandemic

hit. DoD should also incorporate better pedagogy methods for adult professional learning, such as more experiments and exercises, and must expand the range of offerings beyond the current slate of existing providers.

Many of the challenges in the defense acquisition community come from people's inability to communicate clearly and work together. Accordingly, the training and education curriculum should shift its focus away from the current policy and compliance topics and introduce a greater focus on topics such as critical thinking, decision making, communication, and collaboration. These topics require interactive, participative classroom activities, rather than formal lectures. Prioritizing these skills and providing practical, experience-based instruction in communication and collaboration would be a big step forward.

For example, in September 2019 an Air Force major developed a course called PMT-X, in partnership with a few professors from Defense Acquisition University (DAU). It stemmed from the major voicing frustration in a LinkedIn post, which quickly involved acquisition innovators, executives, and DAU's president to champion a new model. This course brought a fresh, experimental approach to acquisition education and training. More of this please, across the whole enterprise.

As another example, the Air Force recently established the Acquisition Instructor Course (AQIC), in conjunction with the Air Force Weapons School. The AQIC Commandant, Col. Steve Smith, says "*We've designed the course … to educate our workforce in the skills required to look forward and tackle emergent technology. Scaling a workforce to adopt a digital, or software mindset, is how we will truly change the Service's approach to acquisition and make a difference*." Scaling up this approach beyond the currently small capacity is essential and will determine whether AQIC merely produces a small cadre of experts or has a substantial impact across the acquisition enterprise.

Similarly, the Air Force's Digital University aims to use modern training models "*to transform the way the Air Force trains and recruits digital talent*." These innovative experiments in acquisition training and education provide models that should be expanded quickly.

Steve Blank, Raj Shaw, and Joe Felter developed a national security class at Stanford: Technology, Innovation, and Modern War, which includes amazing guest speakers (Ash Carter, Michelle Flournoy, Chris Lynch, Gen. Raymond, Lt. Gen. Shanahan, Will Roper, Chris Brose, Ellen Lord, and Gen. Mattis) and provocative, practical lessons. Steve Blank shares summaries on LinkedIn and publishes most of the course videos, readings, and lessons on his blog. This too is a great model to follow.

The acquisition community should also establish a curriculum around the concept of FICINT or "useful fiction." Coined by author August Cole (Ghost Fleet, Burn-In), FICINT is short for Fictional Intelligence, and refers to using imagined narratives, science fiction in particular, to explore issues with military applications and implications. The Army's Mad Scientist Lab has already begun to put this into practice, hosting several writing contests. The Marine Corps' Krulak Center published a graphic novel titled Destination Unknown for the same reason. While these stories can help operators and strategists think through the implications of future conflict, few domains within DoD would benefit more from FICINT-based training than the acquisition community. The curriculum might include both reading and writing, as a way to examine, define, and refine issues related to national defense.

Create Innovation Aggressor Squadrons

Fighter pilots test their aerial combat techniques by flying against "aggressor squadrons," which are trained in the tactics and techniques of opposing forces. Defense innovators in other domains should have a similar opportunity to test their ideas by going up against an Innovation Aggressor Squadron (IAS). These simulations could be incorporated into the standard acquisition training curriculum as well as offered as stand-alone experiences.

Members of the IAS would study the organizational and bureaucratic barriers that prevent innovative ideas from progressing. They would use this knowledge to serve as red teams in virtual testing grounds, playing the role of status quo defenders and new idea killers to test real-world innovation proposals in simulated assessments. Just like an aerial aggressor squadron, the value of this experience is directly proportional to its realism. Thus, the proposals under evaluation should be "flight-worthy" concepts, ready to be put forward in an actual organization. Similarly, the IAS members should do more than simply say "that's not how we do business around here." Instead, they would identify the actual gaps, holes, incorrect assumptions, and other weaknesses in proposed innovation plans, to help innovation advocates strengthen their positions and present the best possible version of their idea.

RECOMMENDATIONS

1. **Digitize the workforce:** Increase digital literacy and training opportunities for personnel in all functionals, such as requirements, budgets, and product support.
2. **Scale the Adaptive Acquisition Framework:** Expand acquisition training and education to include new business models, and bring new best practices and lessons learned from the field into the AAF-related curriculum.
3. **Overhaul the acquisition education system:** Incorporate modern pedagogy methods for adult professional learning, increase opportunities for experiments and exercises, and expand the range of offerings beyond the current slate of existing providers.
4. **Create Innovation Aggressor Squadrons:** Run innovation proposals through simulated assessments, to identify and remedy any gaps, holes, or weaknesses prior to their formal entry into the acquisition process.
5. **Provide the resources for innovators on the front lines to develop and scale innovative training models:** This includes Congress and DoD allocating a portion of Defense Acquisition Workforce Improvement Act funds to these new models.

SCALING AND STREAMLINING FOR SOFTWARE

CHALLENGES

1. Culture and Unfamiliarity with Modern Software Practices Impedes DoD Adoption

2. Processes Designed for Major Weapon Systems Delay Rapid Software Deliveries

3. Workforce Training and Education on Software and Digital Acquisition Is Limited

Software is THE most important factor in our national security. Software poses the greatest threats and opportunities. Software is central to every major weapon system and operational mission. Nothing moves without software. Software can drastically increase the lethality of our weapon systems and defeat billion-dollar platforms at a fraction of the time and cost. Leaders across the U.S., China, and Russia recognize AI, autonomy, and cyber are gamechangers spanning military, economic, and political domains, and each country is investing heavily to exploit these technologies. As Chris Brose wrote in The Kill Chain: *"the future force must be defined more by its software than its hardware. It must be, in every way, a digital force. This is a total inversion of how military power has forever been conceived."*

The DIB, comprised of technology experts and leaders across Silicon Valley and academia, reported that DoD's approach to software development is a huge risk and must take bold steps to catch up to the commercial world. It stressed catalyzing innovation in AI and machine learning, leading to the development of the Joint AI Center. It highlighted the urgency to address critical cyber vulnerabilities across our weapon systems and networks, a growing mission for U.S. Cyber Command. Furthermore the National Security Commission on Artificial Intelligence stresses DoD needs to organize, train, and partner for AI and emerging technologies. Former Senate Armed Services Chairman Sen. Inhofe highlighted *"software is foundational to military capability, yet has failed in countless DoD programs. It must continue to invest in talent, tools, development and delivery processes."*

Over the past few years, DoD has made great progress in how it acquires, develops, and operates software. The Air Force has demonstrated great success so far in establishing software factories to exploit leading tools and methodologies, and disrupt the culture. The Air Force's Platform One has DoD's centralized repositories for source code and artifacts. The Navy and Army have followed suit with software factories of their own. Yet DoD is not moving fast enough or scaling these approaches wide enough. Many areas are a decade or more behind the commercial sectors in software, wasting billions of dollars, and most important, putting our warfighters and their missions at increased risk.

From an acquisition perspective, Ms. Lord issued an interim Software Acquisition policy in January 2020 and Department of Defense Instruction DODI 5000.87 Operation of the Software Acquisition Pathway in October 2020. These policies implement the direction from Congress in the FY20 NDAA Section 800 and the DIB recommendations of a new acquisition pathway for software. Ms. Lord stressed the Software Acquisition Pathway "represents a substantial departure from the department's usual way of doing business." It enables acquisition professionals to deliver software via small, frequent releases using commercial best practices of Agile, Lean, and DevSecOps. It drives human-centered design with active end-user

involvement throughout development. Dozens of software acquisition programs are adopting these key practices and transitioning to the newest pathway. DoD's Chief Information Officer (CIO) and Acquisition Executive directed DevSecOps is the preferred approach for DoD software. DoD CIO also published DoD's Enterprise DevSecOps Reference Design to describe the DevSecOps lifecycle, pillars, ecosystem, and tools to guide the defense enterprise on adoption.

Yet these early adopters, including the congressionally directed Agile pilots started a few years earlier, continue to struggle with the DoD bureaucracy designed for large, hardware-centric weapon systems. Implementing modern software acquisition practices requires a radical rethinking of most DoD processes, documents, and, most important, culture. These include new approaches to requirements, budgets, cost estimation, contracting, testing, security, sustainment, engineering, program management, metrics, oversight, and operations. DoD, with congressional direction in recent NDAAs, is moving out on digital and software training and career field development for both acquisition professionals and software developers. Investing in training and career field development for DoD software acquisition professionals and software developers is critical to scaling software success.

Congress exempted programs using the software acquisition pathway from using the JCIDS requirements processes. Many organizations are starting to define new, streamlined approaches to capture, approve, and manage requirements. Some organizations are beholden to JCIDS and still mandating programs develop outmoded legacy documents and be subject to extensive reviews, contrary to statute and commercial best practices. DoD can no longer afford to spend up to two years to approve software requirements via legacy documents and processes.

In 2021, DoD Services and Agencies need to aggressively move out to define a new, streamlined requirements model and finally abandon the fallacy of defining software requirements up front. The new software acquisition policy outlines a high-level capability needs statement and iterative program roadmaps and backlogs. Requirements organizations need to better understand these commercial best practices and identify how to effectively balance speed with rigor in software requirements. The Air Force's Kessel Run program uses the term hypothesis to define initial needs, then based on Minimum Viable Products and early releases will iterate on the "requirements" via prioritized user stories and roadmaps planning upcoming functionality. Active user engagement throughout software development is paramount.

Software also drives a new paradigm on assessing value. It's not about testing against key performance parameters in a legacy JCIDS document defined years ago. The new model includes active sponsor and user engagement throughout development and value assessments to ensure recent and planned releases provide maximum mission impact and provide needed returns on investment. DoD has taken steps to integrate cybersecurity early and throughout software development, and to ensure more secure supply chains. Yet more is needed to automate security and testing to streamline reviews and accelerate software deliveries. DoD needs to aggressively modernize and disseminate a tool

chain that permits more seamless compliance with the Risk Management Framework and enables programs to achieve a Continuous Authority to Operate within a highly mature DevSecOps environment.

RECOMMENDATIONS

1. DEPSECDEF, Vice Chairman of the Joint Chiefs of Staff, and Service Chiefs/Secretaries champion modernizing the DoD enterprise for software and hold senior leaders accountable to tailor and streamline requirements, cost estimating, budget, testing, and related processes to enable rapid and iterative software deliveries.

2. DoD scale software factories to provide enterprise platforms, services, and cybersecurity.

STRENGTHENING THE NATIONAL SECURITY INNOVATION ECOSYSTEM

CHALLENGES

1. Internally Driven Innovation Opportunities and Edge Solutioning Not Maximized

2. DoD Not Effectively Scaling Promising Commercial Technology into Defense Solutions

3. Technology Cooperation from Allies and Partners Dramatically Underexploited

The competition between the U.S. and its allies against the revisionist powers of China and Russia will occur across many domains, such as economic, financial, diplomatic, cultural, legal, geopolitical, informational, intelligence, and military. While numerous drivers will be at play across these domains, none is likely to be as powerful as the competition for technological superiority. The ability to mobilize the full innovation potential of the respective nation-states will determine the winner and likely determine the future rules of the global world order.

Innovation to drive military technological superiority comes in multiple forms. It can be major scientific innovations derived from basic and applied research in the laboratory or academic environment that result in completely new capabilities. It may be novel solutions derived from existing technology but integrated in ways that form a unique capability. It may also consist of low-scale innovations where current capabilities and processes are improved in important ways. The ability to win the global competition will require a synergistic effort of all these forms (see Figure 9).

Sources that can deliver these forms of innovation also vary (Table 2). The national innovation ecosystem is a complex network that goes by different names with nuanced definitions but is viewed by key figures as comprising federal agencies, national laboratories, FFRDCs, University-Affiliated Research Centers (UARCs), university research centers, defense prime contractors and major subcontractors, commercial industry, and the corollary entities of U.S. allies and partners. A listing of the key government innovation ecosystem entities can be found here. Overall innovation

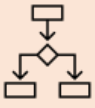
	RADICAL INNOVATION: A major technological breakthrough usually achieved by teams in a laboratory environment that transforms current modes of operation.
	DISRUPTIVE INNOVATION: A technological upgrade or novel integration of existing technology that dramatically improves the success rate of an operational mission by replacing or displacing a previous solution.
	INCREMENTAL INNOVATION: A series of small advances driven by a continuous process improvement mindset usually by those very close to a particular problem.

Figure 9. Major Technological Innovations that Drive Military Superiority

sources can be generally summarized into six main groups each with their own strengths, challenges, and potential areas of improvement.

Innovation Source	Definition
Government	Innovation driven by the efforts of organic operations and acquisition personnel as well as research centers such as Service labs and DARPA
Academic	Innovation driven by university-funded efforts, agency funded projects, nationally funded grants, and the work conducted through UARCs
Defense Contractors	Innovation driven by traditional U.S. prime contractors or subcontractors, by government funded independent R&D, or by internally funded R&D
U.S. Commercial	Innovation developed for commercial sale with dual-use applicability or non-traditional defense vendor solutions developed initially for DoD use
Interagency	Innovation driven by a collaborative group of federal stakeholders leveraging joint resources, sharing ideas, and developing new capabilities
Allies/Partners	Innovation driven by organic, contracted, or commercial entities of an ally or partner nation

Table 2. Innovation Sources

Maximizing Internally Driven Innovation Opportunities and Edge Solutioning

The military has approximately 1.3 million active-duty troops, 592 thousand reservists, 443 thousand guard members, and 677 thousand government civilians in its workforce. Collectively, that is a force of over 3 million trained professionals that represent enormous innovation potential. Too often innovation is viewed only through the lens of major weapons platforms. Everyone marvels as a fighter jet roars through the sky, an aircraft carrier takes to the high seas, or a tank rolls over a battlefield. However, innovation can also occur in small- and medium-scale ways that collectively represent very meaningful advances that contribute to or even significantly improve operational effectiveness.

The Services have done an admirable job creating venues for those at lower ranks to get the appropriate training, contribute to the idea pool, have concepts funded, and in some cases be directly involved in the implementation of those ideas. The Navy stood up the NavalX Center for Adaptive Warfighting, which offers agile and design thinking classes and support to provide the naval workforce, including those at the lowest levels, with the tools to ideate and solve complex problems that increase productivity of the fleet. The Air Force established AFWERX Spark, which is focused on "empowering innovation at the operational edge" by providing resources and training and connecting intrapreneurial military members to commercial innovators. Spark cells can be established at any base across the Air or Space Force by any enterprising member to expand the military network of change agents.

One example of small-scale innovation with big impact is the creation of a cable tester for the F-15's avionic system. Usually 400 individual pins had to be individually inspected but an Airmen-designed tester eliminated that need and

drove a task that normally took 24 hours of effort down to 5 minutes with improved accuracy. The Army also operates an Army Ideas for Innovation platform that offers an avenue, including a mobile app, for submitting good ideas and promises to "unleash the creativity, ingenuity and adaptability" of the Army workforce. The Army hosts various innovation communities on the National Security Innovation Network including the 18th Airborne Corp's Dragon Innovation Program, which has executed 76 high-powered ideas to date. One project was a mission planning application that "automates analysis, visualization, and sharing" of formations in large-scale combat operations that dramatically improved planning efficiency. Funding for the Dragon program is provided through regular funding streams and soldiers are rewarded with extra leave and commendations.

The Army Future's Command Software Factory, the Navy's iLoc Development Team, and the Air Force's Airmen Coders have also undertaken identifying top digital talent in their ranks, and providing additional training and experience so experts can be deployed to software factories or to operational units. Efforts like these will be crucial in developing the digital talent of the force and enabling units to solve more of their own issues locally rather than relying on a less timely formal acquisition system.

While important progress has been made to maximize the innovation of the organic workforce, there is much more untapped potential. As the next generation of "digital natives" enters the workforce, that potential will only grow. A Georgia Tech study concluded that only countries with the highest number of digital natives (the U.S. ranks sixth) will be "positioned to define and lead the digital age of tomorrow."

The Department should proactively prepare for that growth by devoting more resources to developing the talent that is already or will be closest to operations using training and mentoring, and by establishing an infrastructure that allows any member access to digital tools to directly contribute to their mission. The Department should also expand the rewards system to provide incentives in various forms to those not already motivated to contribute their talents. The Department should view its internal talent as much of an incredible source of military capability as manufacturers of planes, tanks, and ships, since in the Digital Age they may collectively contribute similar value when fully utilized.

Harnessing Promising Commercial Technologies

Over the past decade, the Department has shifted dramatically to the commercial sector (often termed non-traditional defense contractors) as the key source of innovative solutions to solve the Department's toughest problems. This was a much-needed shift as small startups bring an influx of fresh ideas and top technical talent to devise new solutions the Department was unlikely to solve using its current antiquated processes. They also bring access to the latest advances in dual-use technologies that are needed for the future fighting force, such as artificial intelligence, robotics, 3-D printing, augmented reality, autonomy, quantum computing, resilient networks, swarming, human systems, space, and cybersecurity. For years, DARPA created successful collaborations between industry, academia, and government to integrate novel technologies into warfighting capability. The Defense Innovation Unit (DIU), launched in 2015, showed the DoD community how non-traditional defense contractors (NDCs) could be enlisted to solve major defense challenges like counter-drone systems, predictive maintenance, and missile detection radar upgrades. DIU also showed the Department how to maximize the use of acquisition authorities to accelerate contract awards using Other Transactions and Commercial Solutions

Opening sometimes in as little as 60 days. The Defense Digital Service (DDS) demonstrated how to employ commercial digital expertise to solve key military software challenges. While these innovative organizations attract top talent and have had notable success, they are too small to rely on to scale the commercial innovation needed for DoD.

The challenge in scaling the successes of DARPA, DIU, and DDS has been the Department's inability to attract enough NDCs into the defense space that they could become a reliable source of innovation for acquisition programs. The bureaucracy of the traditional defense acquisition system was a key reason that promising companies with dual-use technologies opted not to do business with the U.S. military. Another driver was the culture of the acquisition community. Acquisition professionals have been trained that the best way to obtain a military solution is to, after conducting some basic market research, draft an all-encompassing request for proposals with exhaustive requirements, explicit deliverables, and detailed evaluation criteria and then go into an extended source selection and emerge with a vendor that will deliver what is needed. The challenge is that the cash flow for many startups was so minimal that this timeline becomes immediately untenable. There were also few companies, which mostly had their eye toward the commercial market, willing to deal with government requirements like the Truth in Negotiation Act that requires exposure to detailed costs, Cost Accounting Standards systems that require very intrusive government certification, restrictive intellectual property provisions, and scores of contract clauses too burdensome for most small companies to justify accepting.

Encouragingly, the Services responded to this challenge with help from Congress and new leadership. In 2017, AFWERX was created by the Air Force to improve commercial outreach using Small Business Innovative Research (SBIR) funds typically allocated to labs and program offices along with greater use of Other Transaction Authority recently expanded by Congress. AFWERX demonstrated an approach for attracting more startups with the promise of small pots of funding (up to $50,000) to help vendors build out concepts, test feasibility, and identify potential customers while trying to minimize the typical contractual burden. The SBIR program also helps preserve small business intellectual property rights. If an initial vendor solution seems promising, AFWERX may award a SBIR Phase II contract worth up to $1.5 million to demonstrate capabilities more fully with potential customers. This model seems to be working as the Air Force alone issued 1,300 awards in less than 2 years to vendors, 70% of whom had never worked with the Air Force before. However, to ensure greater odds that seed funding results in technology transitioning to a program of record or operational capability, the Air Force requires sponsor commitment for Phase II and sponsor funding to progress to Phase III to be joined with SBIR and private capital matching funds.

DoD and Private Capital Infusions

The infusion of private capital is a major shift in the way the Department has historically done business. Bringing a hybrid mix of private, SBIR, and program funding helps spread the risk for all parties and offers vendors more avenues if its project is successful, namely, to receive a government contract to scale its product offering for the defense world, become commercially viable, or hopefully both. Some claim that a startup receiving private capital "accelerates by up to 10 times" its ability to build and deploy that technology. Phase III SBIR awards, while rare (the Air Force anticipates only up to 20 a year), offer substantial benefits such as the right to sole-source follow-on contracts and

exemption from Small Business Administration size standards. The Air Force is not alone in adapting its SBIR model to drive improvements in accessing commercial tech and in establishing collaboration hubs to mentor and connect promising new entrants; there are many more organizations working toward this goal using tech accelerators, incubators, connectors, and challenges.

However, while there have been numerous Phase II and III awards and the Air Force claims over $2.2 billion in post-award private and government investments, the success of SBIR in turning startups into viable DoD suppliers or new major defense contractors is still unclear. The SBIR program claims that over the past 25 years, Phase II companies generated $28 billion in sales of new products to the military (from roughly $16 billion invested) but it is unclear if initial sales were sustained long-term or if these NDCs were purchased by larger defense contractors. What is clear is that private investors investing in promising SBIR companies today are not seeing the value proposition in becoming a supplier to DoD. Thirteen top venture capital investors, Steve Blank and Raj Shah among them, highlighted concerns that if DoD doesn't buy more commercial products, then the private investment that has been forthcoming will dry up. There are also congressional representatives who feel that SBIR companies that clear the hurdles to make it to Phase III and are ready to scale are often left to hunt for government sponsors on their own and experience the DoD "entrepreneurial death spiral." One expert, whose firm specializes in helping high-tech companies do business with DoD, may have identified the key problem: DoD is measuring success through the lens of contracts awarded and funds obligated instead of "evaluating how many start-ups actually moved to [a] program of record." AFWERX Prime was established in specific response to this challenge. Its first effort, Agility Prime, a flying car, will be the test case for whether DoD has the long-term processes in place to transition such novel technologies successfully. AFWERX says they have other technology candidates being lined up, such as "secure microelectronics, quieter supersonic travel, quantum communciation, [and] more-recyclable space systems."

DoD leaders need to establish new metrics to measure the true progress of SBIR and private-capital matching efforts in achieving defense goals. There are national economic considerations at play when commercializing technology through these DoD mechanisms but there should be more understanding of whether DoD efforts are making their way into operational defense systems so that adjustments can be made as needed. Private capital should continue to be encouraged while recognizing that the long-term viability is likely dependent on how DoD exploits currently available commercial technologies.

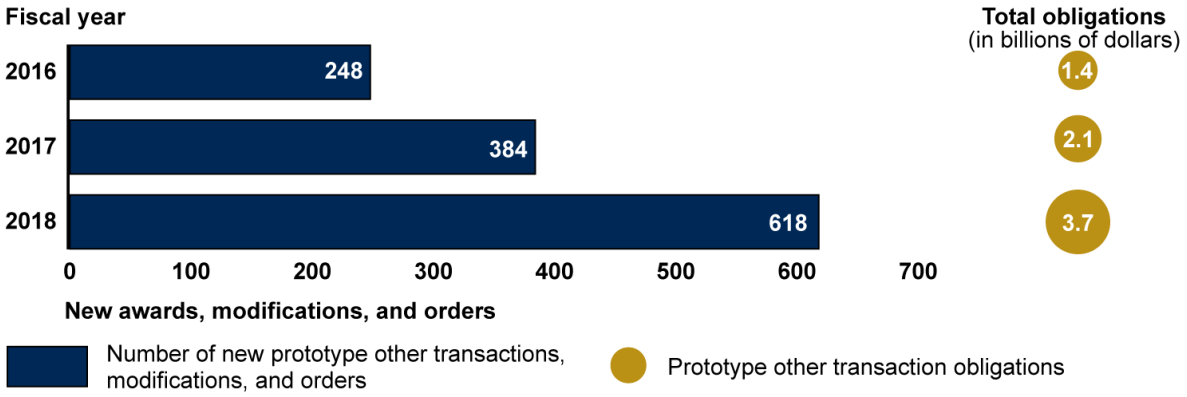
Inaugural efforts such as AFWERX Prime should be monitored and learned from so that best practices can be shared, or hard lessons conveyed to other similarly minded innovation organizations. Defense primes should also be surveyed to assess the impact of the SBIR program on their product offerings.

Apart from using SBIR funds more creatively, DoD also worked to expand the use of Other Transaction Authorities or Other Transactions (OTs) to attract NDC innovation. However, while OT awards have seen exponential growth, there are indications that the bulk of the funding may not be going to the NDCs. GAO found that from 2016 to 2018, the top five recipients by obligations were either consortiums or traditional defense primes. While the original intent of OTs was not for them to be used exclusively for a particular provider class, the authority does provide DoD with the ability to award efforts that better "reflect commercial

industry standards and best practices," which makes them a more appropriate contract vehicle for use with NDCs. There is nothing inherently wrong with using OT Consortia, but there are however some drawbacks that make it challenging for small vendors. For one, they are often comprised of many members (some over a thousand) and the requirements directed to consortia are often highly specific, which may create a "luck of the draw" situation where companies must await the perfect request that fits their niche. This may also explain why larger vendors are gaining more awards, since they have broader enterprises that can pursue more opportunities. Further analysis is needed to demonstrate whether this is a positive feature that shows defense primes are upping their innovation game or whether it shows that they followed the money and have a found a way to use a new vehicle to their advantage. See Figure 10 for the rapid growth in prototype OTs in DoD.

Whatever conclusions are reached on how SBIR and OT awards are currently contributing to innovative military solutions, DoD needs to ensure that it is continually knocking down barriers to attract these new ideas and not allowing bureaucracy to seep in and impose unnecessary time penalties. One assessment found that it currently takes roughly two man-months, or 320 hours, to adequately prepare an SBIR proposal, which can represent a significant burden to a small startup operation. A GAO analysis of government data found that OT award timelines can range from a sprightly 45 days to a ponderous 370 days, which is a wide range for a vehicle designed for efficiency. Of the 244 OTs the GAO analyzed, only 4 were OTs for Production, showing a dramatic underuse of a tool that could be used to rapidly procure commercial products in greater numbers. Specific data is sparse but the Procurement for Experimental Purposes (10 USC 2373) authority also appears

Department of Defense Use of Prototype Other Transactions: New Awards, Modifications, Orders, and Obligations, Fiscal Years 2016 through 2018



Source: GAO analysis of Federal Procurement Data System-Next Generation data. | GAO-20-84

Figure 10. DoD Use of Prototype OTs

to be underutilized as an avenue for procuring and testing commercial items to demonstrate their ability to satisfy operational capability gaps. This underuse is likely due to 2373 authority not being more widely delegated. DoD should conduct a Department-wide assessment to identify the barriers that may be precluding program offices from taking greater advantage of these tools and explore ways to minimize burdens on SBIR entrants.

Security has also taken on a new focus in DoD and various initiatives formed the past few years serve to address concerns that the U.S. defense supply chain is being compromised and DoD investments being harvested by our competitors. To address gaps in industry cybersecurity practices, DoD initiated the Cybersecurity Maturity Model Certification (CMMC) construct with tiers of cybersecurity process maturity that must be achieved prior to award of a DoD contract. There are planned pilots for this FY with an extended rollout to the larger acquisition community by FY25. DoD should closely assess results from CMMC pilot programs and pay particular attention as to how these requirements are imposed on NDCs. PMs are required in the newly released DoDI 5000.90 to conduct greater Supply Chain Risk Management (SCRM) by identifying all companies in their supply chain that may be subject to foreign influence or control and, depending on risk tolerance levels of the system, implement countermeasures such as procuring critical parts from an assured supplier. PMs should comply with new SCRM guidance but be judicious in applying severe mitigation steps and do so only when system criticality truly demands it. Due to an influx of foreign capital into small technology firms, the Committee on Foreign Investment in the United States (CFIUS), which investigates business transactions between U.S. and foreign entities, had its scope expanded in recent legislation to include certain non-controlling investments in U.S. businesses involved in critical technologies. This has led to over 440 investigations in the past 3 years, a dramatic jump from years past. CFIUS should continue its work taking great discretion in when to initiate probing investigations. While all these efforts are needed and currently strive for a balanced approach, DoD and Congress will need to maintain cognizance that expanded focus in these areas does not result in overreach by well-meaning program offices or security officials that disrupts the work done to date to attract commercial entities to the defense space.

A better approach than mandating rules or merely restricting vendors is to come up with more secure, but equally viable, alternatives that commercial vendors and the acquisition community can turn to. DoD is attempting that with the rollout of the Trusted Capital Marketplace to connect promising suppliers with private capital providers that will promote a more secure and robust supply chain for DoD's critical technologies. DIU also launched a program for buying secure small Unmanned Aerial Systems (sUAS) as an alternative to Chinese-made drones, called Blue sUAS, that will give DoD access to highly capable but trusted drone technology. Initiatives like the Trusted Capital Marketplace and Blue sUAS should be expanded and promoted while recognizing that capital providers and trusted vendors, like those participating in Phase III SBIR efforts, will want to see their investments gain solid returns and see their fledgling companies scaled.

There is no easy answer for shifting the defense acquisition community from a mindset that more often admires commercial innovation than fully exploits its potential. The solution is myriad and probably best reflected in Safi Bahcall's book Loonshots where he concludes the driver of innovation is structure. DoD is arguably not currently structured to support commercial innovation at scale. As CSIS noted in a recent report, "The entire acquisition, R&D, testing, and contracting

bureaucracy has been built up to support the model in place, a model predicated on internal development, monopsony market control, and a captive industry." Transitioning and scaling commercial technology, especially any requiring experimentation and maturation, to a program of record requires a supporting structure. There are still chasms between those who understand the potential (the incubators and accelerators) and those on the government side who can fulfill the potential (the program offices). There may not be enough connectors to bridge all the gaps, so greater visibility is required for program office personnel to recognize all the available opportunities and enabling structures put in place that make it easier for acquisition programs to scale commercial technology. As Michael Horowitz captures in his adoption-capacity theory, military innovation happens when financial intensity and organizational capital coalesce to permit the assimilation of that technology.

There are barriers to execution even when the potential is realized. A promising commercial solution may be unable to fully meet a set of defense requirements, leaving a PM to weigh the risks of taking a vendor new to DoD and still small in size into a development/integration effort against the more well-known path of going with an experienced defense prime. A PM may be up for the challenge of scaling a vendor but not have the knowledge to structure a solicitation that allows a non-traditional vendor to successfully compete for a major procurement action. A PM may be aware of a promising commercial solution that would meet requirements but may already be locked down in a program baseline and contract, deviation from which would drive a breach and current contractor disruption or termination. A savvy operational user may notify the acquisition community of a commercial solution that meets a key capability gap, but without budgeted funding or new start approval, the defense acquisition system is unable to move to procure that system until years later, if ever.

DoD needs to continue its commercial sector outreach efforts using the multiple avenues currently being pursued while clearly communicating its technology priorities that enable greater unity of effort toward the highest potential areas. DoD needs to maximize the effect of innovation organizations like DIU, DDS, and DARPA by instituting its proven methodologies to field cutting-edge solutions from the commercial sector. DoD needs to continue creatively using SBIR funds in conjunction with private capital to mature promising technologies for commercial viability. DoD needs to create visibility tools for acquisition offices beyond the current Army, Navy, and Air Force SBIR trackers that provide program managers with greater situational awareness of what efforts are funded and their maturation status. DoD needs to incentivize and train program managers on ways to scale commercial solutions, including making use of early transition agreements and structuring solicitations appropriately. DoD needs to conduct more in-depth analysis into the limited use of OTs for Production and 2373 Procurements to understand what additional training and motivation can be applied to make better use of all available tools. For vendors, DoD must strive to keep all barriers low and demystify DoD acquisition and contracting for industry, recognizing that non-traditional vendors will take different paths through the innovation ecosystem, with some becoming regular sub-tier suppliers, some commodity vendors, hopefully a few becoming new defense primes, and many becoming viable commercial entities.

Fundamentally, however, DoD must create the structure that enables commercial innovation to scale. There must be a common understanding of how a successful SBIR or prototyping effort can

transition to a production contract. Headquarters and operational communities must have more flexible and timely requirement processes that are influenced by available technology and based more on requirements pull than push. This will enable the defense acquisition community to respond to commercial opportunities more adeptly. The acquisition community must explore all AAF pathways and make the most judicious use of one or multiple paths. Acquisition professionals must tailor them to the needs of the acquisition and not become prey to the legacy checklist mentality. For commercial solutions, the MTA Rapid Fielding pathway should become a go-to pathway to scale, given it was designed for that very application. There must be reform of budget processes and overall flexibility for program managers to make optimized decisions based on technical feasibility and speed to the warfighter. Finally, leadership must play a critical role. Exploiting available commercial technologies at scale is not a sharply honed skillset that most program managers possess. There must be considerable mentoring and incentivizing by OSD acquisition offices, Service Acquisition Executives, and PEOs to generate the motivation and enthusiasm to shift in this direction. These same leaders must also be willing to provide top cover, as failures will occur and they must be willing to support learning and moving on to the next opportunity in hopes of better success. As the Deputy Secretary of Defense has noted, "A sustained focus on innovating requires a culture invested in true experimentation, which seeks rather than punishes small failures to make big gains [noting that] the sum of these efforts—from tech hubs to wargaming—will add up to less than the parts if they are not translated into timely delivery of operational solutions to the warfighter."

DoD should establish an Innovation Ecosystem Congress, comprising thought leaders from relevant think tanks, FFRDCs, academia, and industry, to analyze barriers to transitioning and scaling commercial technology and make cogent reform recommendations to congressional staff and OSD/Service officials on how to best organize and resource the Department's innovation ecosystem. This body should document best practices across the acquisition enterprise, identify barriers limiting use of key tools, collect industry pain points in working with DoD, and propose new metrics to measure the success of the SBIR program and private-capital matching efforts in achieving defense goals.

Concurrently, the Under Secretary of Defense for Research and Engineering (USD(R&E)) should also identify dual-use technology areas and partner with each of the Services to scale a non-traditional defense company that can serve as viable long-term provider and competitor in that key technology area.

DoD Not Effectively Exploiting the Innovation Potential of Allies and Partners

While the U.S. has a robust national and commercial innovation ecosystem that when properly employed can meet many of its current defense needs, allies and partners have also developed military research and procurement complexes that can vastly help accelerate the modernization of the U.S. military. The 2018 NDS had "Strengthening Alliances and Attracting New Partners" as a key theme, noting that "By working together with allies and partners we amass the greatest possible strength for the long-term advancement of our interests [and] when we pool resources and share responsibility for our common defense, our security burden becomes lighter." While its focus on diplomatic initiatives in this area was detailed and cogent, its technology strategy seemed limited to prioritizing Foreign Military Sales and ensuring interoperability. There is much greater opportunity space that should be explored. Given

the NDS objectives were based on a 3-5% real annual increase in the defense budget, which has not come to pass, it is even more imperative that we leverage technological advances of our allies and partners. As a recent CSIS report noted, the global innovation base is expanding rapidly and DoD has less influence in technological advancements; therefore, limiting its focus to U.S.-funded R&D dismisses 95% of global R&D activity.

In the FY17 NDAA, Congress expanded the National Technology and Industrial Base (NTIB) from the sole historic cooperation with Canada to also include the United Kingdom and Australia. It also directed the Secretary of Defense to develop a plan that reduced current barriers between the countries and allowed a seamless integration between the persons and organizations comprising the NTIB. As Bill Greenwalt, a former Senate Armed Services Committee (SASC) staffer and OSD political appointee, noted in his Atlantic Council study on the NTIB, the intent of the statute designed by the late Sen. McCain was "to establish an innovative, trusted community within which new concepts of technology sharing and international cooperation could be tested in order to meet the emerging threats that face the U.S. and its allies." While the NDAA directed plan is not accessible, we know that this effort has not lost focus with Congress given that the former SASC Chairman, Sen. Inhofe, wrote an op-ed some months ago noting that *"we do not have to make a false choice between investing domestically and in our allies — we can do both [and that] It's in our best interest to ensure our allies can leverage our technological advantages and we can leverage theirs."*

The biggest long-term challenge in countering competitors such as China will be the sheer numbers of their population. As education levels rise in the rural areas and millions are brought into the economy, the U.S. and its allies will be increasingly disadvantaged. Including the NTIB countries in the U.S. defense industrial base and innovation ecosystem based on their population numbers would represent a 40% plus-up in innovation potential. Of course, there are other countries with whom the U.S. is aligned that would be important partners in this competition too. The annual Bloomberg Innovation Index analyzes dozens of countries using seven metrics, including research and development spending, manufacturing capability, and concentration of high-tech public companies (Table 3). Many of these countries (e.g., South Korea, Singapore, Israel, Denmark, Japan, and the Netherlands) are active participants in the U.S.-led F-35 program, showing that while there are likely many challenges to overcome in technology cooperation, they already have experience working with the U.S. defense acquisition system and its personnel. While Germany, Sweden, Finland, Switzerland, and Austria have not had the close connections of F-35 partners and may not have had interest in sharing military technology secrets in years past, they have a highly compelling reason now in the form of a resurgent Russia, which has mastered hybrid warfare and has shown aggressive intentions toward its neighbors.

As reported in Defense News, allied and aligned countries such as the UK, Netherlands, France, South Korea, Turkey, Finland, Belgium, Germany, Canada, Switzerland, India, Italy, Israel, Sweden, and Singapore represent significant R&D potential and have defense companies in the World's Top 100, which in 2019 generated over $139 billion in sales. Apart from just being innovative and having weapons to sell, our allies and are also investing "significant R&D in specialized areas, from AI and cyber to space and anti-access area denial." Some suggest that initial focus of improving international technology cooperation should start with the newly minted NTIB members, given their aligned values, history with the U.S., common language, and

already established intelligence sharing cooperation. However, there is good reason to branch out further as part of a renewed U.S. push to garner the collective benefits of shared international technology cooperation.

2020 Bloomberg Innovation Index			
Rank	**Economy**	**Total Score**	**R&D Intensity**
2	South Korea	88.16	2
5	Sweden	85.50	4
6	Israel	85.03	1
7	Finland	84.00	10
9	U.S.	83.17	9
12	Japan	82.31	5

Table 3. 2020 Bloomberg Innovation Index

The U.S. should consider adding Israel, Sweden, Finland, South Korea, and Japan to the NTIB list. Israel is a strong ally, a major recipient of U.S. military aid, and one of the U.S.'s most technologically advanced allies. The U.S. also just signed late last year a science and technological (S&T) cooperation agreement that promises to "elevate and facilitate" research, collaboration, and innovation. Sweden and Finland should be included given they consistently top the charts in innovation, recently signed a joint letter pledging to increase the national security relationship with the U.S., have an S&T cooperation agreement in place, have a Security of Supply Arrangement with the U.S., are strategically located, and are highly motivated to cooperate given Russian land and maritime threats. Both countries were also found in recent exercises to be strategically imperative in deterring a Russian attack on the Baltic states. South Korea, also a top innovator, already has a mutual defense treaty with the U.S., spends 4.5% of its Gross Domestic Product (GDP) on R&D, has an overwhelming segment of its populace who see China as the country's biggest threat, and is strategically situated. Japan, also in the top 15 most innovative countries, already has an S&T cooperation agreement with the U.S.; acquires more than 90% of its defense imports from the U.S.; has expertise in unmanned weapons systems, AI, hypersonics, and space; is motivated due to growing threats from China; and is strategically situated. This expanded NTIB presents the ability to work out easier reforms with our closest allies while also working to remedy collaboration pain points with our Israeli, Northern European, and Asian allies that may be more challenging.

The consensus from multiple knowledgeable sources is that the key reason there is not already extensive collaboration with these countries, many of whom are incentivized to work closely with the U.S., is that our export-control system discourages collaboration. One estimate has the UK spending "more than $500 million each year just to navigate the compliance obligations of doing business with the United States [which] equates to roughly 1 percent of the UK's annual defense budget." That is overly burdensome regulation and will continue to be a limiting factor in expanding government partnerships abroad and in our partner's procurement of U.S. commercial technology. An Atlantic Council report noted that current rules "impose burdensome restrictions on technologies widely available to American adversaries while dis-incentivizing R&D and commercial-market cooperation with allies." This needs to be rectified at the earliest opportunity to improve access to fresh sources of innovation while also ensuring our defense solutions are available to key allies.

Corrective recommendations articulated very well in both the Atlantic Council's report titled "Leveraging the National Technology Industrial Base to Address Great-Power Competition" and the Ronald Reagan

Institute's report titled "The Contest for Innovation: Strengthening America's National Security Innovation Base in an Era of Strategic Competition" should be strongly considered by the next Congress for inclusion in the next NDAA and be encouraged by the new administration.

RECOMMENDATIONS

1. Service Secretaries allocate more resources to develop internal talent with training and mentoring opportunities that scale current successes; and Service Acquisition Executives create a digital environment with software development tools that can be accessed by any DoD member and expand availability of maker-spaces on all military bases. This would reflect that the Department values its internal talent as a key source of military innovation.

2. Establish an Innovation Ecosystem Commission, comprising acquisition professionals from OSD staff, DoD Components, think tanks, FFRDCs, academia, and industry, to analyze all available tools to support commercial scaling, understand the barriers for why they are not being employed, assess industry pain points and where DoD can minimize burdens, and collect best practices from those effectively employing them today. Based on the recommendations formed from the commission, the Undersecretary of Defense for Acquisition and Sustainment should direct the newly formed Acquisition Innovation Research Center to develop a detailed implementation plan that includes the key stakeholders.

3. USD(R&E) as CTO, identify two of the top 10-13 priority technology areas to partner with the SAEs to identify and scale two non-traditional defense companies to serve as viable long-term providers and competitors in that key area. This would enable the birth of new defense unicorns in key modernization areas that would inspire greater private investment in defense solutions and grow an array of new U.S. businesses that serve U.S. defense needs, grow our economy, and strengthen national security.

4. Modernize the current export-control system rules through legislation and expand the initial cohort of the National Technology Innovation Base to include key countries.

5. Maintain robust levels of SBR funding to groom up-and-coming companies despite declining defense budgets.

SUMMARY/FIRST STEPS

While the new Pentagon leadership team won't all be in place on day one, there should be an urgency similar to the first 100 days when most administrations focus initial energy on their top priorities. It will take time to confirm key appointees, align thinking with career defense leaders, and get organizations and strategies in order.

Before defining the new buzzword initiatives with cool acronyms, DEPSECDEF should have a series of discussions with key stakeholders to understand their perspectives, priorities, concerns, and ideas. DoD leaders should internalize a broad range of inputs and identify key priorities, similar to our five disciplines. While achieving consensus is admirable, it is not realistic in the Pentagon, so the will of key leaders will drive the key priorities. What do you value? What do you want to achieve over the next four years?

The five strategic initiatives proposed in this paper address Department-wide challenges that span beyond any individual Under Secretary of Defense. The new Deputy Secretary of Defense (DEPSECDEF), as Chief Operating Officer for the DoD, is the right linchpin to drive these reforms to modernize the Pentagon. The new DEPSECDEF, as Chief Operating Officer for the DoD, is the right linchpin to drive these reforms to modernize the Pentagon. DEPSECDEF Kathleen Hicks championed defense innovation in a series of discussions and a podcast last year.

The DEPSECDEF should review past strategic initiatives across DoD, government, and industry that have worked and failed and understand why.

The Pentagon has seen many noble strategic initiatives fail due to poor implementation.

1. Don't set out with a new 25-point plan as a strategic framework. Keep it to a handful (like the five recommended in this paper), each with a clear set of objectives – a destination most can envision and are motivated to collectively work toward. Then identify a set of initiatives and metrics for each to track impact.
2. Get active input and involvement by those on the front lines, outside the beltway, including those in program offices, PEOs, operators, and other key organizations. Crowdsource solutions.
3. While experience matters, limit the involvement of managers who have been overseeing the current processes for the past decade. While they become experts with great insights and good intentions, they are biologically resistant to disruptive innovations and incentivized to defend the status quo. Bring in some fresh blood with the vision and drive for radically new approaches. While this will lead to creative tension within the teams, it is needed for enterprise transformation.
4. We must recognize that to achieve Loonshot transformational changes, the incentives of those within the Pentagon bureaucracy don't align with the innovators and warfighters on the front lines who have the greatest stake in the outcomes.
5. Bring in those experienced in enterprise change management to complement each team to ensure key elements like communication, stakeholder buy-in, and iterative versus big-bang solutions are warranted. This is critical given the abolishment of the chief management officer.
6. Consider using techniques like those from MITRE's Innovation Toolkit to accelerate the process of generating ideas, seeking consensus, making strategic plans, and managing complexity. This freely available

set of field-tested methods is designed to help teams work together effectively and find innovative solutions to hard problems.

7. Balance initiative teams with full-time and part-time team members. A major reform effort can't simply be an "additional duty" for overworked Pentagon staff battling the daily fires, meetings, and paperwork.
8. DoD must partner with congressional members and staff. Beyond scripted hearings, establish a series of frank discussions with appropriators and authorizers to understand each other's values, priorities, and concerns. Look to align incentives toward a common set of outcomes.
9. Congress needs new reform champions to emerge following the retirement of Rep. Thornberry and passing of former Sen. McCain. The House's bipartisan Future of Defense Task Force should pick up the mantle and continue its efforts to strengthen the national security innovation base by increasing public-private partnerships.
10. Focus on early wins in the first 100/200/300 days. Scope the wins small, like Minimum Viable Products, to get some early momentum and enable learning to make constant adjustments to place energy behind bigger bets. Keep a steady pace for consistent, long-term performance.

As DoD is no longer fighting two major wars, it must take this time to position the defense enterprise for success in the Digital Age. It must take steps to ensure we maintain a competitive advantage over our adversaries to deter conflict, win future wars, and respond effectively to national and global emergencies. The Digital Age requires greater speed and flexibility to achieve these goals and a relentless drive to modernize the world's biggest bureaucracy.

About the Authors

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