



FUTURE FOUNDRY

A New Strategic Approach to Military-Technical Advantage

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Foreword by the Honorable William J. Lynn, III
and the Honorable Sean O’Keefe

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About Future Foundry

The Future Foundry project seeks to develop and articulate a positive, 21st-century vision for sustainable collaboration between the Department of Defense and its partners from multiple industry sectors. The project builds on two years of research by the CNAS team describing the challenges faced by the global defense industry in “Creative Disruption” and considering DoD’s attempts to maintain military-technical superiority in “Beyond Offset.” Now, with widespread recognition that the existing defense industrial regime is optimized to cope with neither the rapidly evolving and varied threat landscape nor the decentralization of innovation and global proliferation of advanced technology, there is an opportunity to initiate meaningful change.

CNAS’ research focused on how DoD can capitalize on a more innovative, adaptive, and inclusive set of industries to support national security objectives, yielding two separate but related reports. “Future Foundry: A New Strategic Approach to Military-Technical Advantage” engages in a strategic-level analysis of what structures and processes would allow DoD to develop and acquire the capabilities necessary to generate military-technical superiority into the future. A complementary case study, “Leveraging Commercial Technology: Early Adoption of Emerging Mobility in the Pentagon,” explores the specific benefits of adapting DoD’s policies to take full advantage of commercial innovation in a particular area: mobile technology. These reports showcase how the Department of Defense can align strategy with available technologies and the variety of business models that support innovation.

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Foreword

William J. Lynn III & Sean O’Keefe

U.S. defense supremacy has always rested on the shoulders of the highest quality fighting men and women in the world and the vast technological and manufacturing prowess of American industry. When President Roosevelt during World War II called for the production of 100,000 aircraft in a single year, it wasn’t some random, outsized stretch goal to spur productivity. America responded to the commander in chief by flexing its 1944 industrial muscles like no nation ever before, churning out 96,270 military aircraft in an awesome display of manufacturing might.¹

Today, the diverse industrial capacity of the United States remains vital to our nation’s military at a time when America faces perhaps the widest array of threats in history. In parallel, technological progress is exploding across multiple global industrial sectors, often just at the edge of the Pentagon’s reach.

“Future Foundry” looks more deeply into the external forces that are driving change and the vital cooperating roles played by the Pentagon and a U.S. industry on the cusp of a major pivot to adjust to rapidly emerging market and technological forces.

To better understand the evolving implications for the U.S. industry segments that presently dominate defense contracts, it is helpful to track the industry’s origins. Before World War II, America built its weapons of war through a federally controlled arsenal and shipyard system. During the war, an aggressive revision to defense industrial policy was devised to rely on the nation’s huge commercial product suppliers, like Ford and IBM, to build the high volume of military systems required. This led to the first U.S. defense industrial pivot to an established corps of commercial-defense conglomerates that thrived long after the Second World War. But Cold War downsizing and global commercial manufacturing competition drove the second pivot, when America’s commercial brands sold off their defense businesses, yielding a more limited range of private sector weapons system platform producers with near exclusive activity and expertise in the defense market.

Alongside this shift to a targeted defense industrial sector dominantly concentrated on the global military markets, commercial innovation has once again transformed the world. From smartphones to renewable energy to nanotechnology, and with disruptive processes like 3D manufacturing, the wide range of and high commercial demand for interconnected technologies are now

reshaping daily lives. This occurrence shows no signs of abatement. Commercial R&D spending today dwarfs that of the top five U.S. defense contractors, who combined spend less than one-third of what Intel or Microsoft spend individually each year. And while defense programs have benefitted from disruptive technologies and continue to incorporate today’s high-tech capabilities, the once dominant market for defense programs now represents a significantly smaller fraction of the nation’s manufacturing and technology development capacity. The decreased demand, lower profitability, and high barriers to entry have made the defense market less attractive than at any time in modern history.

“Future Foundry” seeks to establish a new strategic approach to sustain and advance U.S. military advantage, while at the same time improving the health of the business ecosystem that the Department of Defense relies on to access critical technologies. Building on the findings of the 2014 CNAS report, “Creative Disruption,” this new report argues that the erosion of DoD’s technical advantages in critical areas stems from a lack of a coherent industrial strategy rather than simply failed acquisition reform efforts. The potential for a third defense industrial pivot demands that the Pentagon clearly establish and communicate a new investment strategy. The plan requires collaboration with industry to broadly access impressive and innovative technology, wherever its industrial or geographic source.

Foremost, “Future Foundry” calls for the Pentagon to adopt an “optionality” strategy for its defense industrial investments, and acquire a wider and more diverse mix of capability options to address a range of threats, whether from near-peer competitors or terrorists armed with commercially available hardware. A more flexible and adaptable approach is needed to more quickly prototype and test a broader array of systems, and help the DoD more rapidly field limited production programs at scale in times of war. An optionality strategy could also speed the DoD’s ability to respond to adaptation among smaller and often more nimble adversaries, who easily and fluidly assemble crude but lethal weapons that threaten our forces.

Working together, we believe the Pentagon and the U.S. defense industry should establish new corridors of entry for commercial technology. The reality is that the Pentagon, once a net exporter of technology like GPS or the early manifestations of the Internet, is today a net importer of technology, from IT to robotics. Clearly, some parts of the DoD recognize the need to better capitalize on the potential of commercial technology, as evidenced by the creation of the Defense Innovation

Unit Experimental and other outreach offices. However, despite these efforts a lack of systemic change persists. The DoD and industry should work together to establish clear pathways for “commercial systems adaptation” into military hardware and capabilities. But inclusion of the broadest range of technology developers will take a concerted effort to lower barriers to new partners and entrants into the defense industry. Alternatively, maintaining the status quo risks further isolation of the core defense industry and the prospect of a return to something resembling the arsenal state.

An optionality strategy could provide the basis for institutional change in defense industrial policy. Implementation will require revisions to the DoD acquisition process to create the right incentives for the U.S. defense industry to reinvest in R&D, and therefore its own future. In doing so, companies already supporting the DoD could stretch their technological reach and enhance their market boundaries and therefore business results, while strengthening their most essential mission – to build the best defense technology the world has ever seen.

Global business and technology change will take place regardless of DoD and industry action. Both entities must recognize the trends they face, and work to capitalize on the associated opportunities. If the Department and industry choose not to act, they will not only miss out on potential positive outcomes, but also contribute to the decline of US military-technical superiority.

Please share your thoughts on “Future Foundry.” Its overarching goal is to reignite a lively debate on how our nation’s governmental and industrial institutions can work together even better today than at any time in U.S. history to ensure that the world’s most powerful fighting force continues to be equipped with finest technology in the world.

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Executive Summary

In June 2014, the Center for a New American Security released “Creative Disruption: Technology, Strategy and the Future of the Global Defense Industry.” The paper argued that the United States military risks losing its technological advantage if the Department of Defense and its industry partners do not adapt to widely recognized strategic, technological, and business trends.

In the two years following that paper’s release, senior leaders in the DoD have sought to arrest the decline of U.S. technological superiority. Secretary of Defense Ash Carter has launched high-profile innovation efforts, reaching out to Silicon Valley and creating the Defense Innovation Unit Experimental (DIUx) and Defense Innovation Advisory Board. Deputy Secretary of Defense Robert Work has championed the Third Offset Strategy, which seeks to maintain the United States’ ability to project power against adversaries armed with significant precision munitions capabilities. It is apparent that senior leaders understand the challenges facing the DoD, but their efforts have yet to address the systemic issues outlined in “Creative Disruption.” Empowering new organizations such as the DIUx and the Strategic Capabilities Office (SCO) is a positive step, but it is ultimately insufficient for the DoD to innovate exclusively outside its core bureaucracy or attempt to force new technology efforts through an outdated system.

The Department of Defense must recognize that its military-technical challenges are a matter of strategy – the fundamental approach the department takes to generating technological advantage – not simply of acquisition policy. The DoD’s acquisition system requires constant improvement but functions reasonably well for its intended purpose and has improved in recent years, as reported by Under Secretary of Defense for Acquisition, Technology and Logistics Frank Kendall in October 2016.²

Accordingly, the DoD must develop and implement a new strategic approach to generate and maintain technological superiority – one that fundamentally shifts the basis of the DoD’s advantage by creating an elegant alignment among the nation’s strategic needs, available technologies, and the various business models through which the DoD develops and fields military capabilities. The source of that future advantage cannot depend on DoD investments alone, but must encompass the United States’ total technological capability, including civilian talent and resources.

The impending presidential transition offers the new secretary of defense a rare window to capitalize on opportunities created by current leaders in the Pentagon and Congress. A new strategic approach to military-technical advantage must be at the top of the next secretary’s agenda, and not simply as an end in itself or as a method to address rising costs and fragility in the defense industrial base. The next secretary must communicate a new vision within his or her first 100 days in office, and convince stakeholders from Congress, industry, and inside the DoD to take action in line with that strategic approach.

The DoD plays critical policy, intelligence, and trade roles across the government, but ultimately, it is the only department responsible for developing the military capability that underpins the nation’s foreign policy options. The erosion of U.S. military-technical advantages increases military risk, weakens the deterrent value of traditional capabilities, and undermines the DoD’s ability to generate nuanced military options to address the growing range of policy contingencies faced by the nation. The DoD must ensure it can support the widest possible range of policy choices for the commander in chief despite technological advances fielded by adversaries.

The DoD therefore needs to:

- Articulate a new strategic approach to military-technical advantage – an optionality strategy – in which the goal is to expand the range of military and technical options available via a diverse portfolio of capabilities and concepts.
- Use this new strategic approach to drive institutional and policy reforms that ensure DoD component organizations are able to field the full range of technologies required for military advantage.
- Develop associated industry policy to align incentives and collaborate with a wider range of industry partners in a more nuanced manner that yields both military and business benefits.

Under an optionality strategy, the DoD would build a diverse portfolio of capability options, with each investment designed to mitigate risks in other areas of the portfolio, and manage them dynamically to reflect changing threats and new technological opportunities. These technology investments would be matched by diverse concepts of operation (CONOPs). The resulting capabilities would leverage

the diversity and flexibility of this portfolio to impose intelligence and innovation costs on the nation's adversaries. The options provided in this portfolio would also allow the United States to rapidly respond to enemies' and competitors' adaptations.

An optionality strategy would shift the basis of technological competition from the features of specific weapons systems to the military's access to centers of industry and innovation and – more importantly – to the human capital of concept developers and military commanders. By widening the basis for technical competition and seeking to achieve advantage in aggregate, the DoD can exploit advantages, particularly human, in which the United States is expected to remain dominant for the foreseeable future.

The DoD's industry partners are integral to any new strategic approach to increase the department's technological edge. To facilitate more effective collaboration with industry, the DoD needs to adopt nuanced policy that recognizes it does business with four distinct industry segments, which produce:

- Military unique systems with constrained competition – such as aircraft carriers, submarines, and nuclear weapons.
- Military unique systems with viable competition – such as combat aircraft, armored vehicles, military-unique unmanned systems, or command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems.
- Military adapted commercial technology – for which the DoD currently does not possess a dedicated policy or acquisition process.
- Purely commercial technology – such as software, mobile devices, or all-terrain vehicles (ATVs).

For the traditional defense industry, an optionality strategy would provide more opportunities to innovate and to focus on rapidly fielding new technologies, thereby increasing investment, competition, and industry vitality. In parallel, a new defense industry sub-segment would emerge, based on policies and processes that support the development of military adapted commercial technology. This sub-segment could see vigorous competition between traditional American defense industry, global defense industries, commercial businesses, and startups. Such businesses could bring new technologies to market, creating business value while, more importantly, generating technological advantages of the U.S. military.

An optionality strategy need not increase the DoD's top line budget if it is implemented effectively. Under such a strategy, the DoD could leverage the almost \$2 trillion of global commercial research and development (R&D) more effectively, mitigate the risks of overruns and program cancellations (estimated from \$58 to \$116 billion between 1997 and 2015, not including classified programs), and better manage its operational and maintenance costs.³ Above all, this strategy will help the DoD avoid the incalculable costs of losing the nation's military-technical advantage.

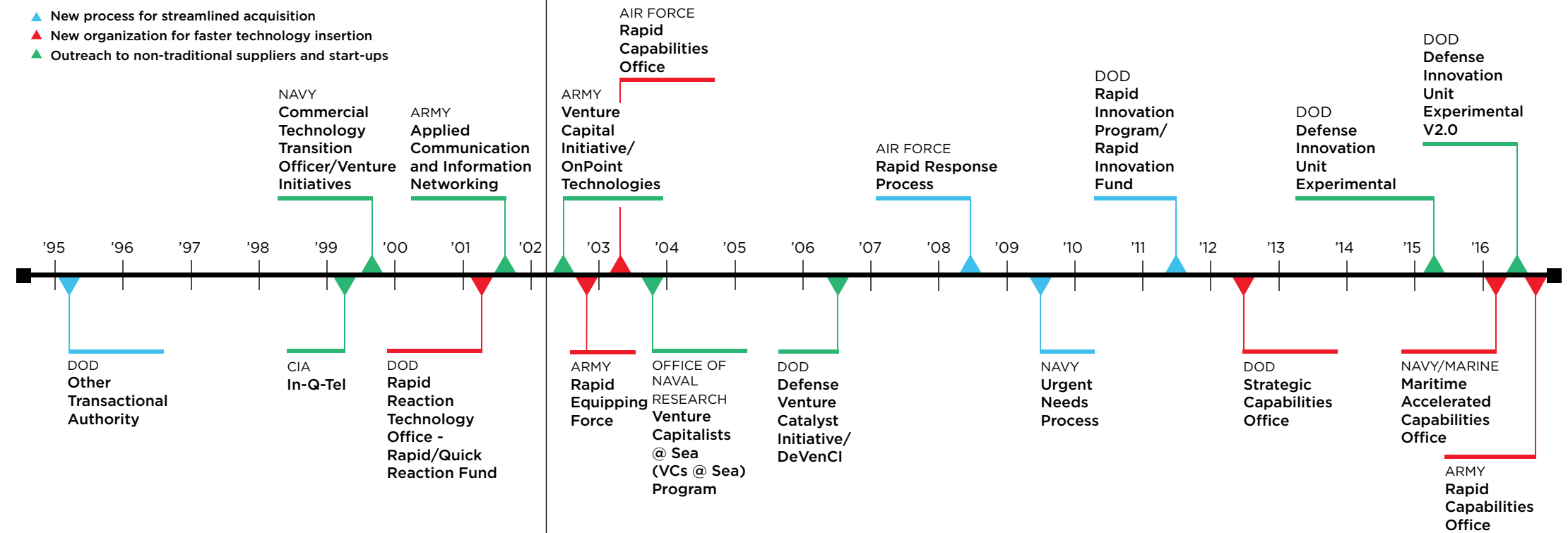
The United States possesses intellectual, financial, and institutional advantages sufficient to maintain its military-technical superiority, even in a world of democratized technology and rising competitors. The ability of the DoD and its industry partners to adapt to change will be the difference between success and failure. Unfortunately, recent history suggests that such change is unlikely. In the absence of institutional adaptation, the United States' historic military advantages will continue to decline, as will the industrial capability required to reverse such a trend. To allow such an outcome to occur due to a lack of leadership or failure to implement new ideas would be irresponsible.

Theory of Change

Concerns over the United States' military-technical superiority are not new, and criticisms of the Department of Defense's acquisition system are long-standing. As Senator John McCain (R-AZ), Chairman of the Senate Armed Services Committee, has noted, "Acquisition reform has been a perennial topic in defense circles for years."⁴ Despite near-annual attempts to address acquisition problems since the Packard Commission in 1986 – including recent reform efforts, such as the Better Buying Power initiatives launched by the Office of the Under Secretary of Defense for Acquisitions, Technology, and Logistics (USD (AT&L)) and major Congressional reforms through 2016 and 2017 National Defense Authorization Acts (NDAA) – there have been relatively few improvements to the system's outcomes. Clearly, this failure to change is not due to a lack of proposed solutions but is the consequence of inadequate political will and ineffective execution. Given broad acceptance among acquisition and industry professionals that the current system is flawed, endless recommendations for reforms, persistent bureaucratic intransigence, and a lack of meaningful change, how can the Department of Defense establish a reliable approach to generating and maintaining technological superiority in the 21st century?

Efforts to Work Around the Main Acquisition System

- ▲ New process for streamlined acquisition
- ▲ New organization for faster technology insertion
- ▲ Outreach to non-traditional suppliers and start-ups



RAPID OFFICES

Over the past 15 years, the DoD has created many offices intended to work around the traditional acquisition system. Each organization has its own mission and methodology, but most prioritize short development times and focus on working with nontraditional suppliers or providing access to commercial technology. While they often work with smaller programs and budgets, some have been involved in large, multi-year projects. Each organization has had varying levels of success, and many are still in a period of institutional uncertainty, having been championed by senior leaders without being successfully integrated into the DoD mainstream.

Rapid Equipping Force (REF)

Founded in 2002 to help counter the threat of IEDs, the REF is an Army organization tasked with rapidly providing military-off-the-shelf (MOTS) and commercial-off-the-shelf (COTS) systems to meet the capability gaps faced by Army units deployed worldwide. As of 2015, the REF fully reports to the U.S. Army Training and Doctrine Command (TRADOC). The REF has authorities for requirement validation, acquisition, and funding, and operates on 180-day turnaround time lines.

U.S. Air Force Rapid Capabilities Office (USAF RCO)

Founded in 2003, the USAF RCO is designed to rapidly develop new capabilities, and frequently prototypes and makes use of commercial equipment. The RCO reports directly to the USD (AT&L), the secretary of the Air Force, the chief of staff of the Air Force, and the assistant secretary of the Air Force for Acquisitions.

Asymmetric Warfare Group (AWG)

Created in 2006, the AWG is an Army unit linking TRADOC and the operational Army. The AWG's core functions include operational advising, identification of capability gaps, solution development, and doctrine, organizations, training, materiel, leadership, personnel, and facilities (DOTMLPF) integration assistance.

Strategic Capabilities Office (SCO)

Founded in 2012, the SCO seeks to rapidly adapt existing military systems for new use. Housed within USD (AT&L), the SCO effectively reports directly to the secretary and deputy secretary of defense, and the typical time line for its projects is under three years.

Defense Innovation Unit Experimental (DIUx)

Founded in 2015, the DIUx seeks to connect startups and technology companies with DoD challenges out of its offices in Silicon Valley and Boston its and hub in Austin, Texas. The DIUx reports directly to Secretary Carter but often works with individual services.

U.S. Army Rapid Capabilities Office (USA RCO)

Created in 2016, the Army's RCO will focus on rapid prototyping and initial equipping of capabilities for high-priority, threat-based projects. The RCO will tackle projects that last approximately one to five years, and will seek to inform DOTMLPF along with the creation of new systems. The Army RCO reports to a board of directors led by the secretary of the Army.

The DoD must view military-technical challenges as a strategic issue requiring fundamental change. Defining military-technical superiority in terms of acquisition reform, process, procedures, and organizational structure – even though those are critical elements for success – undersells the importance of the challenge and may fail to drive action at the highest decisionmaking levels. Moving

forward will demand sustained attention from the most senior leaders in the department, Congress, and industry, who must push change down into the middle levels of their bureaucracies while also enabling innovation to advance from the bottom up.

Ideally, senior DoD leaders, to include the secretary and deputy secretary as well as the chairman and vice chairman of the Joint Chiefs of Staff, will create and implement an integrated strategy for technological superiority. Such an effort must encompass warfighting concepts, adversary adaptation in warfighting and acquisition, global business trends, the DoD's investment strategy, and institutional reform. Senior leaders should use this strategic shift to justify and drive change within the Office of the Secretary of Defense (OSD), the military services, the acquisitions workforce, and the testing and evaluation community. In doing so, the DoD also must create the correct incentives to enable a range of partners – from traditional defense industry to commercial industry, startups, Federally Funded Research and Development Centers (FFRDCs), government labs, and universities – to collaborate, compete, and contribute new technology and ideas.

To execute such an ambitious strategy, the DoD must foster a high level of cooperation among DoD components,



Secretary of Defense Ash Carter speaks with Defense Innovation Unit Experimental employees. (Senior Master Sgt. Adrian Cadiz/Ash Carter, Flickr)

Congress, and its partners. The department must take the lead in creating the vision, strategy, systems, and incentives necessary for change, but it will require external support to implement and fully realize the benefits of a new strategy. If the DoD works in concert with its colleagues on the Hill, Congress will be able to remove political, legislative, and budgetary roadblocks. A joint effort between the DoD and defense industry will strengthen that market sector, allowing companies to plan for their futures in a way that is financially viable, shape their long-term planning and investment strategies, and make the case for change to their shareholders.

While a reframing of strategy is the optimal solution, there is no recent historical evidence to suggest it is likely. In the absence of effective DoD leadership, Congress likely will continue to act as a change agent, attempting to force reform through legislation as seen in the 2016 and draft 2017 NDAA bills. Such efforts will be better than no change at all, but Congress could better facilitate progress by dictating the outcomes it desires, rather than assigning specific solutions.

In the absence of effective change from either the executive or legislative branches of government, the defense industry must explore ways in which it can adapt independently. From new business models to mergers and acquisitions to production methods, industry arguably has more flexibility than the government to reshape itself

rapidly. In recent years, the defense industry has adapted to the Budget Control Act and efficiency initiatives by reducing costs.⁵ However, contractors should innovate beyond such efforts to support their long-term viability, position themselves as partners to commercial industry and startups, and help the United States maintain its technological advantages in the face of bureaucratic barriers.

Without action from the DoD, Congress, or the defense industry, the United States either will see the continued erosion of its advantages or pay an unsustainably high price to stay ahead. Following World War II, the United States followed strategies in which countering U.S. technology cost more than that technology cost the United States. Today, the United States is often on the wrong side of such strategies. In the fight against the Islamic State in Iraq and Syria the United States used aircraft that “cost nearly \$200 million apiece against pickup trucks costing virtually pennies in comparison.”⁶

The change in the global technology landscape cannot be halted, so the question is whether the DoD will be able to adapt to capitalize on external factors, or if change will be forced on the department and its industry partners in catastrophic ways. History tells us the likelihood of change is remote, but recent efforts in the Pentagon and on the Hill have shown a common recognition that change is required – even desired – and created a window of opportunity for real progress.

A New Technology Superiority Strategy

The United States' ability to generate decisive military-technical advantages in the 20th century was a function of DoD strategies that elegantly aligned strategic needs with compelling capabilities, via business models that capitalized on, and contributed to, the nation's unique natural strengths.

During the Second World War, the United States built the arsenal of democracy on the basis of American industrial might, a feat of mobilization and mass. The early Cold War saw the nation shift to the New Look, or First Offset Strategy, which leveraged the country's cutting-edge laboratories and technical talent (some of it of foreign origin) to limit Soviet ambitions through nuclear deterrence. Later in the Cold War, under the threat of mutually assured destruction and in support of the U.S. grand strategy of Soviet containment, the DoD developed the Second Offset Strategy, which strove to offset the greater mass of Warsaw Pact forces with qualitative military-technical advantages. The department achieved this objective by investing in information technologies such as the Global Positioning System (GPS), microprocessors, computer networking, software, and data compression, which in turn generated information-based force multipliers delivered through C4ISR networks and precision munitions.

American businesses, uniquely qualified to build these new technologies, developed the key technologies for both Offsets with government funding. Exclusive access to key technologies allowed the DoD to develop new CONOPs, such as AirLand Battle, and to lock in its advantages with tight export controls. Many of the industrial partners that supported these developments were part of large conglomerates, operating simultaneously in defense, industrial, and commercial marketplaces, allowing for the controlled transfer of breakthrough technologies into the U.S. private sector. This approach generated positive externalities, positioning the United States and American businesses at the forefront of the information technology revolution and laying the groundwork for the future successes of Intel, Qualcomm, Hewlett Packard, Apple, Google, Facebook, and countless others.

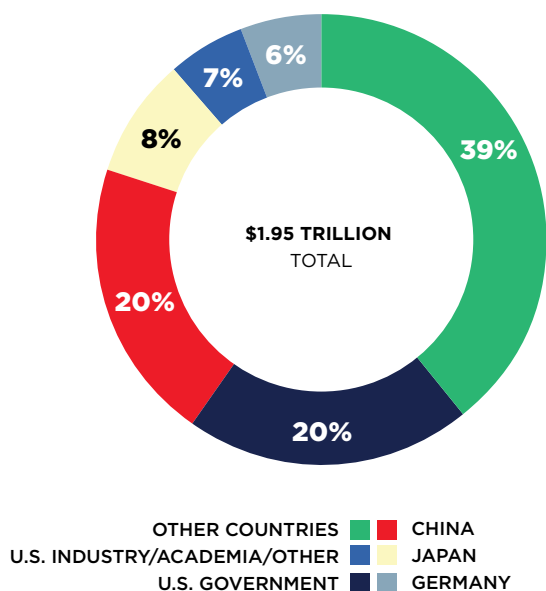
The Current Strategic Challenge

Today, the DoD no longer can exploit such an elegant alignment of strategic need, available technology, and effective business models. The nation faces multiple divergent threats, each with differing strategies and methods. Their capabilities range from nuclear weapons to conventional military platforms, and include high-end and low-end asymmetric technologies such as anti-satellite weapons and improvised explosive devices, as well as



Boeing B-17Es under construction at one of the Seattle, Washington, Boeing plants circa 1942. (Wikimedia Commons)

Global R&D Funding 2016



Source: "2016 Global R&D Funding Forecast" (Industrial Research Institute, Winter 2016).

cyber technologies and terrorism. Such diversity grants adversaries many opportunities to circumvent or attack the monoculture platforms of the DoD’s conventional warfighting regime. Adversaries’ variety challenges both the DoD’s capability planning efforts and ability to unify the executive and legislative branches of government in support of a new strategic approach.

The DoD must allocate its investment over a much larger array of advantage-generating technologies. In addition to the stated “building blocks” of the Third Offset Strategy – autonomous deep learning systems, human-machine collaboration, assisted human operations, human-machine combat teaming, and network-enabled semi-autonomous weapons hardened to operate in an electronic warfare and cyber environment⁷ – the DoD also might benefit from advances in directed energy, advanced manufacturing, quantum computing, material science, and biotechnology. This diversity further complicates the DoD’s decision calculus and investment methodology, especially in a forecasted era of tight budgets and an oncoming bow wave of modernization bills for nuclear and conventional deterrent capabilities.⁸

Moreover, the DoD no longer can direct nongovernment R&D and its ability even to influence it is declining. Most of the new technologies the DoD seeks to exploit are developed outside its direct control, unlike

computers in the 1950s or GPS in the 1980s. The proliferation of technology – notably information technology, which previously was a U.S. advantage – means not only that the United States does not have exclusive access to many capabilities, but also that its purchasing power in the global technology economy has diminished, together with the DoD’s influence in R&D spending.

The DoD’s research development test and evaluation (RDT&E) budget has increased from \$37 billion to \$66 billion (Fiscal Year 2015 dollars), or roughly 175 percent, in the past four decades, but global R&D spending has increased more than ten times faster – over 1,875 percent – during a similar period.⁹ In such a global environment, both militaries and businesses must differentiate themselves through the innovative use of technology rather than pursuing unique access to it. At the same time, the traditional defense industry is under increasing pressure to develop military systems more quickly, more cheaply, or with greater complexity than ever before in a defense market in which the number of major defense acquisition programs (MDAPs) is decreasing, all while pleasing their shareholders.¹⁰

Maintaining Advantage Through an Optionality Strategy

Rather than pursuing a singular approach, or a classical strategy of defining end states then managing toward them, the DoD should embrace a strategy of options and diversity.¹¹ In this approach, the DoD would create more capability options across a wider, more diverse portfolio. These options should naturally address the range of military operations but also develop a true high-low mix of capabilities. This capability mix must encompass “exquisite” systems, such as stealthy, penetrating, unmanned strike aircraft, and lower-cost systems that can be deployed in mass, such as drone swarms. This approach would resemble the DoD’s technological development of and doctrinal development for submarines, aircraft carriers, and combat aircraft during the interwar period and World War II.¹² For example, between 1950 and 1960 the U.S. Air Force employed 14 different fighter jets, three times as many as today.¹³ The logic of an optionality strategy is best seen in this passage from Colonel John Warden:

We have just over 60 F-117s, but the world must react to those F-117s just as if we had many hundreds ... Our problem, though, is the F-117s operate in a fairly constrained, well known altitude and speed block ... Our answer must be an F-118 and an F-119. Maybe a little more stealthy, but more importantly, something that

operates in a significantly different speed and altitude regime; in a regime where the defenses developed against today's F-117s are unlikely to be effective. How many F-118s, F-119s, F-120s do we need? Not many; probably just a squadron or two ... How many different types should we have in the inventory? A lot, and all radically different. Maybe ten to fifteen substantially different air, space, information, kinds of platforms, each occupying a unique niche. Imagine trying to defend against this kind of a force.¹⁴

An optionality strategy also would allow the DoD to segment its technology needs and optimize its acquisition approaches and policy accordingly. The differences in markets, capital requirements, and development timelines for nuclear submarines and micro UAVs are painfully obvious, but the DoD pursues the same technology strategy for both. Instead, the department must recognize that it requires four different approaches: one for military unique capability development where competition is constrained, a second for military unique capability development where competition is viable, a third for military adapted commercial technology, and a fourth for purely commercial technology.

Within these segments, the DoD should maintain current classical strategies where appropriate – for example, for capabilities such as nuclear weapons and

large platforms that are capital intensive and demand long-term investments. But for newer systems, especially those reliant on commercial technologies, the department should pursue adaptive strategies, vary its approaches and investments, and select the most successful options to deploy in greater quantities when required.¹⁵ Additionally, the DoD should pursue opportunities to apply at scale the type of recombinant innovation¹⁶ currently being championed by the SCO, turning existing airframes into arsenal planes¹⁷ and modifying Tomahawk missiles to increase their range and scope of use.¹⁸

The Joint Staff and services then will be able to integrate these diverse capabilities through new and varied CONOPs. A more diverse portfolio with greater options will allow operational planners and commanders to develop unique, optimized force packages for specific operations, taking into account cost and political considerations and the enemies' sophistication. This diversity will exploit and empower the creativity and talent of U.S. military personnel, rather than relying on technical advantages in a few platforms. This approach will impose a significant intelligence burden on competitors and adversaries, as well as an innovation burden.

Under an optionality strategy, the DoD's ultimate objective will be to maintain advantage in aggregate based on the diversity, adaptability, and strength of the entire technological portfolio. At present, the United States retains the ability

to build superior technology on a system-to-system basis better than any other nation on earth. While there is no need to cede ground in any individual technological contest, this competition cannot ensure affordable, strategic military-technical advantage in an era of democratized technology. This is especially true at a time in which the U.S. military will likely be simultaneously engaged with irregular non-state actors, near-peer competitors, state-sponsored proxy forces, cyber-enabled adversaries, or terrorists. The pursuit of technological advantage via exquisite weapons systems introduces unacceptable risks of affordability, asymmetric responses, and business model viability.



A U.S. Air Force B-52 Stratofortress leads a formation of aircraft including two Polish air force F-16 Fighting Falcons, four U.S. Air Force F-16 Fighting Falcons, two German Eurofighter Typhoons, and four Swedish Gripens over the Baltic Sea, June 9, 2016. (Senior Airman Erin Babis/U.S. Air Force)



A sailor uses a 3D printer on board the aircraft carrier USS Harry S. Truman.
(Mass Communication Specialist 3rd Class B. Siens/U.S. Navy)

Enabling Technologies

An optionality strategy is an intentional departure from previous approaches that were premised on the development of game-changing or ‘leap ahead’¹⁹ capabilities to establish generational technical advantages.²⁰ It is certainly possible that such game changers could emerge from an optionality strategy, and in that case the United States should capitalize on them to the fullest extent. These rare achievements should not be a prerequisite for the nation’s military success, however. The costs, risk, and hubris associated with such an approach are unacceptable. Further, the diversity of future threats, combined with finite resources, means that the DoD cannot safely bet on a handful of technologies or optimize its technologies for a singular form of warfare.

Under the precept of advantage in aggregate, the DoD could use an optionality strategy to consciously assemble and manage the military equivalent of a software stack – a group of programs that work together to perform desired functions.²¹ Such a construct would provide the basis for generating and managing more and better military options, while providing the foundation for modernizing long-standing capabilities and exploring promising technologies iteratively.

The department’s challenge is not in identifying new technologies, but in bringing them to maturity, integrating them into the force, and converting them into military advantage. There is a set of technologies and

technology approaches that will prove critical to enabling an optionality strategy and military-technical superiority. System-of-system engineering principles, open system architectures, modern software design based on decoupling, software stacks and cloud architectures, and open source software will make the difference between an adaptive and interoperable force and a fractured set of advanced technologies. Advanced computer-aided design and engineering, 3D printing, robotic assembly, and other emerging manufacturing capabilities offer suppliers the opportunity to dramatically alter the cost profile of manufacturing complex systems, to prototype rapidly and more effectively than ever before, and bring manufacturing back or close to the continental United States.²²

Cold War-era military-technical competition relied on technological breakthroughs, from new high performance materials and long-range sensors to information-based force multipliers. Because of the democratization of technology and the speed of change, future competitions will be characterized by militaries’ ability to identify, integrate, and deploy available technologies at scale in advantageous ways. Sophisticated software and new manufacturing methods are differentiators in such an environment. Both technology areas were pioneered by the United States and are currently used within the DoD, but they have not yet been deployed to their full potential as contributors to the United States’ military-technical advantage.

Strategic Alignment

An optionality strategy would better align the department's technology strategy with its projection of a future operating environment that comprises well-understood trends, rapid change, and strategic uncertainty.²³ Moreover, it will shift the department's approach to generating military-technical advantage away from Cold War-era precepts as these are invalidated by trends in technology, economics, and warfighting.

A new strategic approach would allow the department to leverage not only its existing, sophisticated systems but also the talent and innovation of its military and civilian workforce and current industry partners, while attracting new partners from other industry sectors domestically and abroad. A segmented, strategic approach to industry collaboration will allow the department to remove bureaucratic inhibitors and capitalize on its natural advantages as an early adopter of technologies with downstream commercial applications. In this way, the department will be able to ride the wave of commercially funded R&D, while developing unique military advantage through integration and the work of its traditional industry partners.

Proposing a new strategic approach of options and diversity is most ambitious. Such an approach is open to critiques that the DoD will be incapable of managing or paying for more projects and programs, that it will be unable to work with new partners while supporting

traditional defense industry, that new business models are difficult to establish, and that data, software, and architecture integration on such a scale is unfeasible. These are all valid concerns; but it is worth keeping in mind that earlier military-technical strategies required, in one case, the mobilization of the entire U.S. industrial base to creating the first nuclear weapon, and in another, the invention of GPS and the internet.

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The United States is the only nation with the wealth, technical capability, capital, industry, and innovation base to support an optionality strategy. The Department of Defense is the only organization with the size, scope, funding, and management potential to implement such a strategy. And the U.S. military is the only force with the scale, sophistication, and human capital to take full advantage of the military opportunities that an optionality strategy provides. Pursuing this strategic approach will not only establish a military-technical advantage for the United States, but also provide a method by which to address endemic bureaucratic challenges within the Department of Defense.

The Role of the Department of Defense

The DoD’s outdated approach to technology strategy contributes to the diminution of U.S. military-technical advantage. Failure to adapt to global trends has led to capability monocultures and an ever-dwindling variety of weapons systems, procured at higher prices and in lower quantities than ever before.²⁴ This trend cannot be reversed simply through acquisition reform initiatives or attempts to acquire new “game changing” weapons systems, as evidenced by the many recent sensible yet unimplemented recommendations and the various programs canceled by former Secretary of Defense Robert Gates. Instead, success will be determined by reinforcing current technological strengths and acquisition methods while rapidly and flexibly developing new options using new or updated strategies, methods, and processes.

The department must establish a new strategic basis for developing and maintaining military-technical advantage. This approach should have five objectives:

1. Generate more and better military options for policymakers.
2. Provide principles, impetus, and incentives to drive the institutional change required to execute any technology strategy effectively.

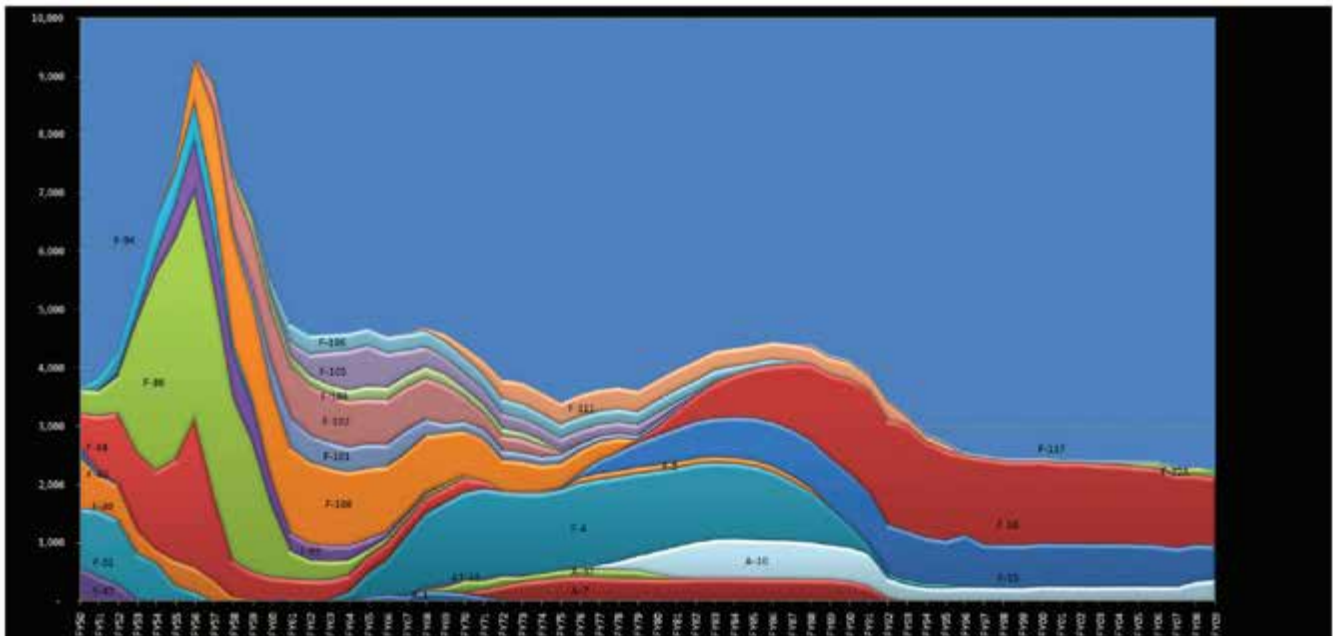
3. Ensure that speed, flexibility, and adaptability are built into standing organizations and process, not special, isolated offices.
4. Translate technological advances into military advantage through innovative CONOPs and improved adoption capacity.
5. Maintain access to relevant technologies through positive relationships with a range of businesses, including, but not limited to, traditional defense industry.

The primary impediments to achieving these objectives are not access to capital, markets, or technology. They are far more prosaic, involving deep-seated inertia, perverse incentives, and a belief that change is not possible. The DoD therefore must focus its attention and effort on altering its core bureaucratic elements, not as a routine reform exercise but as one of its highest priorities, a matter of strategy, and a vital prerequisite to effectively executing its fundamental mission.²⁵

An Acquisition System for Advantage

The current acquisition system functions as intended – it competently acquires military unique systems based on rigorous competition between defense specialist corporations. However, the DoD has new technology needs that must be met from sources that do not conform to that model. The DoD’s acquisition challenge is therefore

USAF Fighter Force Composition



During the 1950s, the U.S. Air Force employed up to 14 different fighter aircraft and employs only four today.

Source: Col. James C. Ruehrmund Jr., USAF (Ret.) and Christopher J. Bowie, “Study Arsenal of Airpower: USAF Aircraft Inventory 1950–2009,” (Mitchell Institute, 2010).

RISK

The DoD spends a great deal of time designing, implementing, and managing complex risk mitigation processes across its capability projects. While these systems are intended to address many risks, culturally and institutionally the department prioritizes the mitigation of three risk types: corruption, insufficient competition, and compromise of classified technical and operational information. The DoD cannot condone corruption, yet the bureaucratic, financial, and temporal costs of control measures likely outweigh the risks they seek to mitigate and divert energy and attention from strategic challenges.

While existing risk management processes are effective at ensuring bureaucratic compliance, they do less well at mitigating higher-order strategic risks, both for individual programs and the portfolio at large. Examples of strategic risk may include leaving capability gaps unmet, like the need for mine-resistant armor-protected vehicles; creating a capability monoculture, as with the F-35; or allowing cost and schedule overruns to preclude the acquisition of needed new capabilities, as in the case of the Future Combat System. All these can occur while complying with bureaucratic risk mitigation processes.

The department must ensure procedural compliance, but it also must find ways to mitigate strategic risks through strategy, portfolio management, and process. For example, in pursuing an optionality strategy based on a greater number of programs of more diverse types, each with fewer requirements and a lower cost for each program, the DoD would distribute risk across its broader portfolio. In addition to reducing strategic risk, this approach would also allow issues of corruption or competition to be caught earlier and on a much smaller scale.

The DoD and the government at large likely have no accurate estimate of the costs imposed by secrecy. Although individual programs report (in secret) their direct security costs, there is no sign that the cost of duplicative effort has been taken into account.

less a question of the capacity of the system than one of its design and appropriateness. The result of creating an additional acquisition pathway would be an acquisition system that supports the nation's traditional military advantages, while also allowing the DoD to build on its military-technical superiority in new and innovative ways.

A PORTFOLIO OF OPTIONS AND DIVERSITY

An optionality strategy would require the DoD to build a much wider portfolio of capabilities than it does today. This portfolio must be designed and actively managed so as to mitigate the risks of each investment with

another. Importantly, the department must diversify its portfolio based on factors beyond operational needs articulated in formal requirements, to include cost, time lines, alternate futures, deterrence, adversary adaptation, allies' capability needs, and undoubtedly many others. For example, developing a portfolio of high-end manned combat aircraft, inexpensive manned combat aircraft, stealthy unmanned combat aircraft, and swarms of inexpensive drone systems would be better than putting resources into a smaller range of capabilities. The DoD currently invests in all of these systems in some form, just not in sufficient variety.

The DoD already possesses many of the analytic tools, methods and organizations required to oversee the wider portfolio associated with an optionality strategy. OSD, including both the assistant secretary of Defense for Strategy, Plans, and Capabilities and the Office of Cost Assessment and Program Evaluation, and the Joint Staff within the Forces Structure Resources and Assessments Directorate (J-8), already provides strong oversight over DoD technology investments.

An optionality strategy will require the department to dynamically manage its portfolio: Projects should be sped up, slowed down, expanded, shrunk or canceled based on the needs of the overall portfolio, not simply program performance. The DoD practices portfolio management in theory, but a 2015 GAO study found that the DoD "is not effectively using portfolio management to optimize its weapons systems investments."²⁶ Portfolio management is inhibited by a stovepiped investment process, lack of involvement from top-level leaders, and political impediments to canceling programs. While insufficient for a future strategic approach, the DoD's existing structures around portfolio management can serve as a baseline from which to build.

DIVERSE APPROACHES FOR DIVERSE CAPABILITIES

The DoD's core acquisition challenge is not that its current system is fundamentally flawed, but that the department has many technology needs that the system is not designed to meet. The DoD is structured to acquire military-unique capabilities through open competition between specialized defense contractors. It is possible to acquire capabilities outside of this model, but that means overcoming entrenched bureaucratic norms and values – an expensive and time-consuming endeavor well illustrated by the ongoing issue between the U.S. Army and Palantir. (Recently, Palantir has successfully sued the Army for excluding it, and other commercial software providers, from competing for the Distributed Common Ground System contract.²⁷) The DoD cannot afford to alienate providers of differentiated technology.

In order to acquire the diverse sets of capabilities the U.S. military requires, the DoD must develop tools and systems to manage four segments of capabilities. These four segments must all be established as equally valid and regular practice, which will allow the department the flexibility it requires to acquire everything from aircraft carriers to cyber capabilities and micro UAVs in an optimal manner.

Military Unique Systems With Constrained Competition. The United States relies on certain systems such as aircraft carriers, submarines, and nuclear weapons for which there are declining numbers of competitors globally²⁸ and for which international competition is largely ruled out for political reasons. These capabilities are characterized by long development time lines, low production quantities over long timespans, high barriers to market entry, and very high restart costs associated with any break in production. These enduring features, coupled with budgetary constraints, lead to constrained competition and even favor monopoly suppliers.

Failure to accept this market reality leads to the unhelpful application of OSD (AT&L)'s principle that "competition and the threat of competition are the most effective incentives."²⁹ Forcing competition on these capabilities may undermine the viability of the businesses that build these systems. Counterintuitively, competition in these areas may inhibit innovation and limit the opportunity to attract investors to businesses with erstwhile long-term stability.

The acquisition system can be improved for these capabilities but is structurally sound. The DoD must explore new policy approaches to ensure the cost and innovation outcomes they require through means other than prime contractor competition. This should include additional methods to ensure competition among

The DoD's core acquisition challenge is not that its current system is fundamentally flawed, but that the department has many technology needs that the system is not designed to meet.

sub-contractors and sub-system providers, as well as a formal policy of selecting "national champions"³⁰ or removing competition requirements for these capabilities. This would preserve U.S. advantages in these capability areas, while ensuring cost control and innovation via alternate means such as new production methods, increased investment in R&D, commercial consolidation, or broadened adoption of open architectures.

Military Unique Systems With Viable Competition. These systems include most other military-unique capabilities, such as combat aircraft, armored vehicles, C4ISR systems, or military unmanned systems, that are generally built specific to military needs and purchased in larger volumes. These are the programs for which the current acquisition system was designed. Multiple defense companies have the ability to build to these requirements and therefore can compete for each contract.

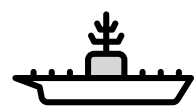
Much of the traditional debate surrounding acquisition reform is focused on the systems within this segment, and many challenges remain. While the DoD can still improve policy and process, its fundamental structure is appropriate, requiring change of the type recently articulated by the Under Secretary Kendall: "What we need, always will need, is professionalism, hard work, attention to detail, and flexible policies and incentives that the data show align with the results we desire."³¹ A move toward a larger diversity of systems in this category – dictated by changing threats and enabled by advances in engineering design and manufacturing technology – would be a healthy change but would not require a new procurement process.

Military Adapted Commercial Technology. The DoD currently does not possess a viable, standardized method to acquire commercial technologies, adapt them for military purposes, and incorporate them into CONOPs, doctrine, and training at scale. Many of these technologies are still emerging and may come from unconventional roots, as did the crowdsourced combat support vehicle known as the FLYPmode.³² Notable organizations including the AWG, REF, and DIUx all have attempted to fill this gap with greater or lesser success.



The aircraft carrier USS Ronald Reagan under construction, March 2000. (U.S. Navy)

Four Capability Segments



MILITARY UNIQUE SYSTEMS - CONSTRAINED COMPETITION

- Low production quantities
- High barriers to market entry
- Significant capital intensity requirements

Existing acquisition is appropriate but could be improved.

SUPPLIER

Government Arsenal, Shipyard, or FFRDC

Defense Specialists



MILITARY UNIQUE SYSTEMS - VIABLE COMPETITION

- Built to specific military needs
- Purchased in larger volumes than military unique systems with constrained competition

Existing acquisition is appropriate but could be improved.

Defense Specialists

MILITARY ADAPTED COMMERCIAL TECHNOLOGY

- Leverages emerging commercial technologies
- Developed and deployed on a rapid and routine basis

There is no existing acquisition structure: new processes and leadership support are required to develop and deploy these capabilities.

Opportunity for New Entrants



PURE COMMERCIAL TECHNOLOGY

- Purchased directly off the shelf from commercial supplier

The DoD insufficiently uses the existing acquisition structure that include authorities for the purchase of purely commercial capabilities.

Commercial Businesses

THINGS ONLY MILITARIES BUY

TAILORED VERSIONS OF WHAT OTHERS BUY

COMMERCIALY AVAILABLE TECHNOLOGY

The United States’ ability to maintain its military-technical edge is tied to its ability to leverage advances in commercial technology, including for high-end warfighting. Many of the Third Offset Strategy technology areas currently are led by purely commercial businesses such as Google, Facebook, and Tesla.³³ At the same time, the DoD will need to access commercially available technology to respond quickly to its adversaries’ adaptation at the low end of the conflict spectrum, as seen in the fight to counter IEDs.

Theoretically, the DoD possesses the legal authorities and acquisition regulations to procure these systems.³⁴ In reality, the lack of a dedicated workforce familiar with these types of procurement, the nature of the current requirements system, and a lack of support from mid-level leadership mean that commercially adapted military technologies remain stuck as prototypes or are acquired in the same way as military unique systems. This practice consumes time and money and discourages innovative businesses from supporting the DoD. The department must create new processes and provide leadership to ensure that these systems can be developed and deployed quickly and routinely.

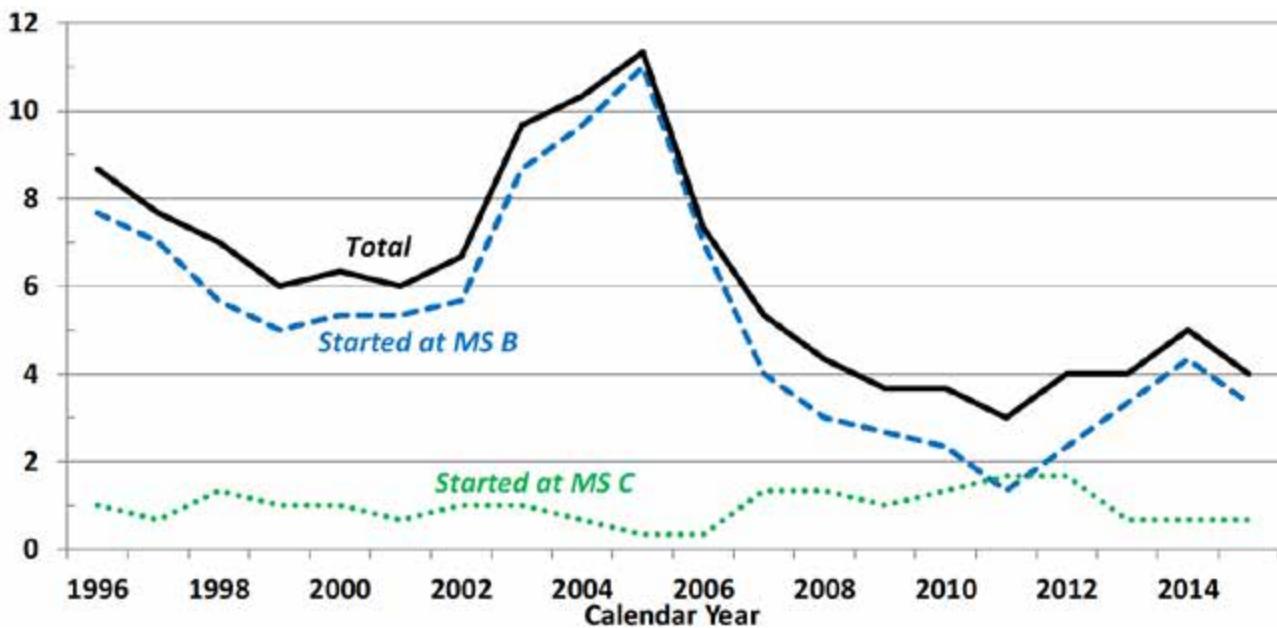
Purely Commercial Technology. Finally, there are many capabilities the DoD can purchase directly off the shelf from commercial suppliers, such as software, mobile devices, or ATVs. Significant authorities for the

purchase of commercial capabilities already exist within Part 12 of the Federal Acquisition Regulation (FAR) and were enacted in the 2016 NDAA.³⁵ Additionally, the DoD has a reasonable process for these acquisitions, but should make better use of it, rather than generating military unique requirements out of habit or an assumption that the commercial market cannot support DoD needs.

BEYOND REQUIREMENTS

In order to invest in technology that generates advantages, the DoD must be able to identify what it needs, but the requirements process is optimized for the development of large-scale, long-term, military unique systems. The department cannot continue to rely solely on highly formalized requirements, enshrined through capability-based analyses and the Joint Capability Integration and Development System (JCIDS) process. This process takes months or years and hundreds of thousands, or even millions, of dollars to produce a requirement. This deters the services from starting new programs, contributing to a decrease in the number of new MDAPs. That in turn creates an incentive to load many requirements on a single program, adding complexity, extending time lines, and increasing cost, contributing to the so called “death spiral” of defense capability and industry.³⁶ In this way, a process that is intended to reduce risk through intense

Frequency of New MDAP Starts: 3-Year Moving Average (CY 1996-2015)



Since the mid-1990s there have been fewer new starts for MDAPs.

Source: Under Secretary of Defense, Acquisition, Technology, and Logistics, Department of Defense, Performance of the Defense Acquisition System: 2016 Annual Report (October 24, 2016), Figure H-18, pg. xlv.

scrutiny of requirements actually increases it by causing many new needs to be piled onto a single program. Worse, this regime makes it very difficult to purchase available solutions without a formal requirement, a common complaint from innovators and a frequent excuse from the establishment when it does not wish to acquire something.

The DoD and armed service branches must provide multiple onramps to bring a wider range of technology into their portfolios. In addition to the JCIDS process, the DoD must establish agile methods by which validated experiments, challenge grants, competitive wargaming, emerging combatant command considerations, and prototypes can be used by the services and OSD to establish needs and start new acquisition projects.³⁷ The department and services should actively scout and support innovative concepts from within their ranks. From the Marine Corps' hobbit databases to drone rifles, U.S. military personnel have a proven track record of actively contributing to military-technical advantage.³⁸ These onramps could be used to support their endeavors.

Requirements officials should use tabletop exercises, experimentation, prototyping, capability improvement, and upgrade opportunities to identify and define problems, developing technologically informed requirements before proceeding to production. The system should support the repurposing of existing platforms and technology to address emerging needs in the manner being championed by the SCO.³⁹

Reform in this area would not simply improve the requirements process but also increase the impact of DoD investments in organizations like DARPA, ONR, DIUx, AWG, REF; defense labs such as the Naval Research Lab, U.S. Army Research Laboratory, and Air Force Research Laboratory; military school houses, such as the Army's Maneuver Center of Excellence and the Marine Corps' School of Advanced Warfighting; and the RCOs recently established, or being considered, by all of the services.⁴⁰ At present, the innovative work undertaken by these organizations is just as likely as a solution from a commercial business to perish in the "valley of death" between a new idea and a funded program.

Establishing more ways to rapidly identify and validate diverse capability needs is something the United States must do to maintain its military-technical advantage. The DoD and services possess the tools they need to undertake these activities, but they must develop the process and leadership to do so with speed and at scale.



U.S. Army officers developed their own counter drone weapon, the Cyber Capability Rifle. (Bill Roche/Army Cyber Flickr)

ACQUISITION PROCESS

FOR DIVERSE CAPABILITY OPTIONS

Acquisition challenges and their putative solutions have been identified for decades.⁴¹ Despite many years of analysis and hard work by acquisition professionals to address these challenges, the system remains dysfunctional, and indeed an inhibitor of U.S. military-technical advantage. While most institutional-scale reform efforts have failed, the department and services have created workarounds to the core acquisition system, most notably through organizations such as the DIUx, AWG, REF, SCO, and RCOs. Given that the traditional acquisition system appears impervious to change, the DoD must establish methods to institutionalize these innovations.

One way to do this would be to create an additional acquisition pathway, designed specifically to prototype new systems and adapt COTS and MOTS technologies into deployable, limited-production programs. This

would allow the current acquisition system to remain optimized for military unique programs, either with or without significant competition, while creating new mainstream methods to allow the DoD and services to benefit from commercial innovation and recombinant innovation with existing military technology. While it is well recognized that the acquisitions system needs improvement, it is important to avoid removing or altering parts of the existing system that function well for certain capability types.

An additional acquisition pathway would be in tension with the current system. That tension should be viewed as healthy, providing a reliable, institutional home and political support for the type of work now done by organizations such as the AWG, REF, and RCOs. Ultimately, this either would justify the need for the additional acquisition pathway or drive reform in the original system, if it seeks to adapt to compete.

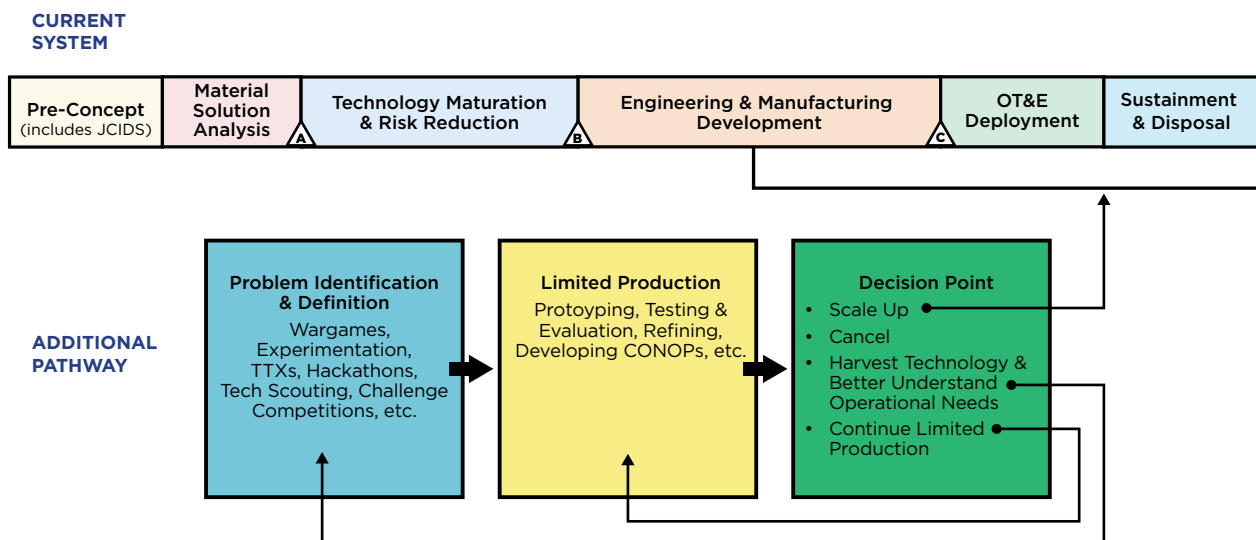
This pathway would capitalize on the lessons, methods, and processes that have proven by the organizations as established workarounds to the mainstream acquisition process. It would in many ways mirror the current acquisition system, particularly the period from Material Solution Analysis (prior to Milestone A) through Engineering and Manufacturing Development (post-Milestone B).⁴² However, a program in this new pathway would essentially be in a limited production, build-test-build phase. Potential users could test and engineers could refine the capabilities, mirroring on a smaller scale the steps in the current system that precede initial operating capability.

Limited production goes beyond current concepts of prototyping to allow services the option to field or deploy systems in small numbers or groups. At the end of a limited production run, the services would make a decision about each program: Most often, they would harvest some of the technology or ideas for a new program or run an additional limited production cycle, but they also could scale the program up to full production, or end it if necessary. The purpose of this process is not to winnow down each capability area to a single platform. Rather, this additional pathway will be most effective when there are multiple programs running continuously at each stage of the pipeline, allowing for transitions from limited to full scale production. This will enable the DoD and services to make informed decisions for each program based on broader technical needs, threats, and budget constraints.

New engineering and manufacturing technology would help make this system work. Model-based system engineering, an evolutionary development of computer-aided design, has shown that it can speed detailed design and minimize errors and rework. Additive manufacturing reduces the non-recurring cost of changes and flattens the learning curve, avoiding cost penalties for short production runs.

Further, in the additional acquisitions pathway, developmental and operational testing and evaluation could be more easily integrated into earlier stages of production. Not only would this save time, but it also would better allow engineers and program managers to assess

An Additional Acquisition Pathway



the suitability of their platform and address concerns earlier in the development process. Historically, early integration of testing and evaluation in capability development has proven critical to the success of innovative or unprecedented systems.⁴³

Most of the legal authorities required to support an additional acquisition pathway designed for commercial and recombinant innovation exist within the FAR. However, their dispersion fosters uncertainty and debate over when these authorities may be used and, sometimes, ignorance that they even exist.⁴⁴ This is particularly true in the case of decisions surrounding the use of FAR Part 12 (Acquisition of Commercial Items) over FAR Part 15 (Contracting by Negotiation). To institutionalize an additional acquisition pathway, it may be necessary to write a new part into the FAR – not to grant new authorities but to make unequivocally clear the legitimacy of tailored acquisition and adaptation of commercial technology for military use. It is the failure to address this lack of clarity that has preserved the built-in prejudices of the system, resulting in the blanket application of traditional acquisition methods across all segments of capabilities.

MANAGEMENT AND GOVERNANCE

Organizationally, each service would need to create its own additional acquisition pathway to augment its current systems. This would look different in each service, requiring relatively simple changes for the Marine Corps but more substantial changes for a large and technology-heavy service like the Air Force. Having a more diverse portfolio likely will exacerbate existing opportunities for mission overlap within and between the services. Such overlap is acceptable in the concept and limited production phases, and to the extent that it is required, de-confliction could occur in later stages when budgetary and quantity decisions are made and when technical and programmatic risk has been retired. Most of the supervision of limited production cycles and requirements generation would happen within the services, with each service headquarters managing its portfolios in alignment with its needs.

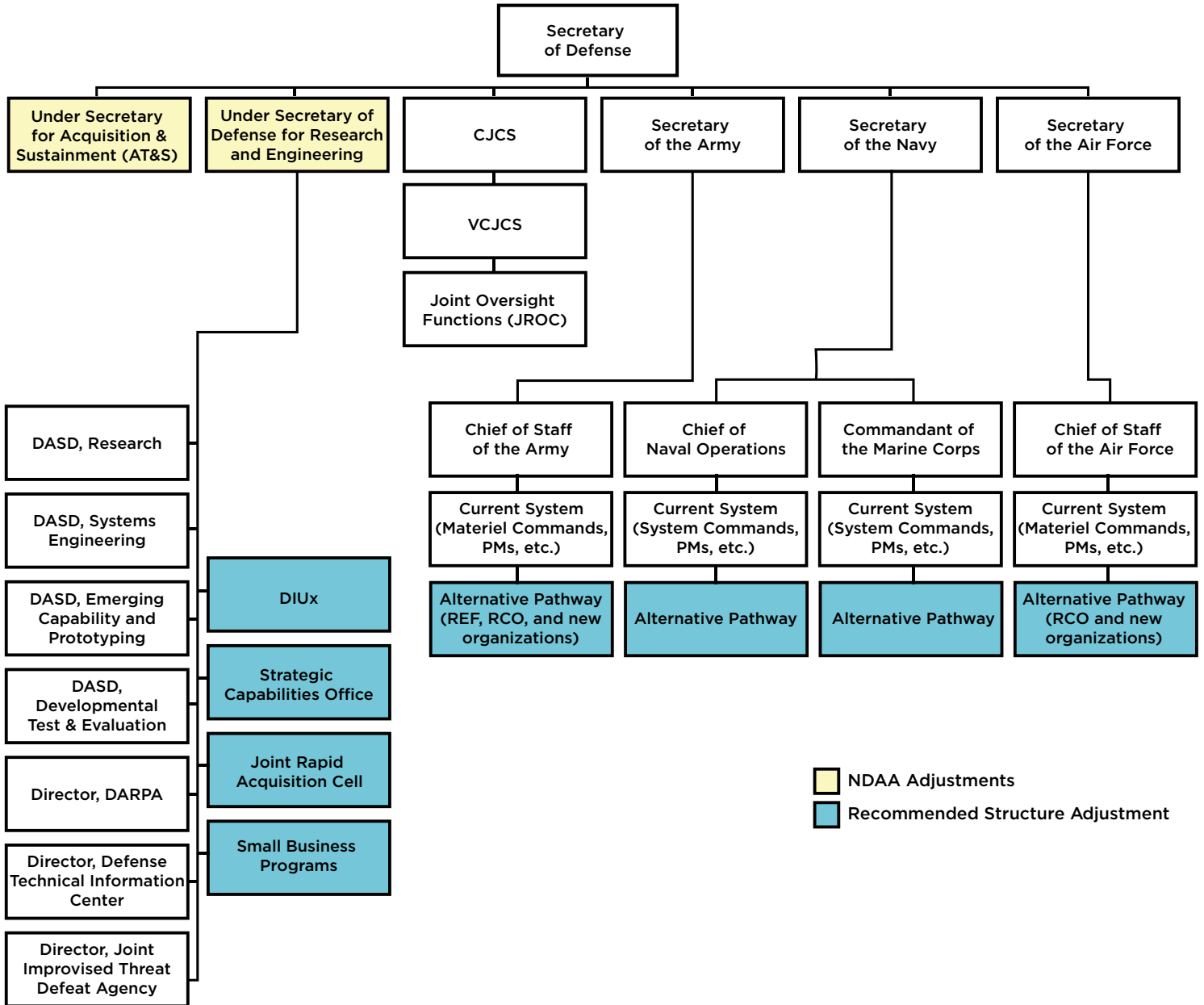
This additional acquisition pathway will require its own organization, leadership, and staff. When the pathway is at a mature operating capability, it should not represent a net growth of acquisition personnel, as fewer staff will be required to manage the current system. While the development of the additional pathway likely will require an initial increase in personnel, any rise in head count would be significantly lower than the 24 percent increase in the acquisition workforce from 2009 to 2015, totaling some 30,000 people.⁴⁵

In many ways, the people and structures of the additional pathway should mirror those in the current system, with officials in charge of limited production programs ultimately reporting to their service headquarters. They also would have administrative reporting responsibilities to their services acquisitions executive, the Joint Staff, and OSD in the same way that current programs keep senior leadership informed. In this way, the deputy secretary and vice chairman will receive inputs from both the standard system and the additional pathway, allowing them to manage their respective department-wide portfolios comprehensively. It also will require the authority and political capital of leadership at that level of seniority to provide top-cover for decisions and adjudicate complaints between the two systems.

The OSD and Joint Staff would need to provide oversight for the entire department's portfolio to ensure that the capability needs of the Joint Force are met across domains. This would involve responsibility for identifying gaps, advocating that the services address those gaps, and funding them at the enterprise level when necessary. The OSD should create the analytic environment in which the services can compete, and ultimately make budget decisions according to the outcomes of that competition. To the extent that services and the department are unable to establish agreement on concepts and resourcing, Congress will play an active appropriating role. The OSD also would articulate policy and manage incentives for its four capability segments, likely increasing responsibility and resources for the role of deputy assistant secretary of defense for Manufacturing and Industrial Base Policy.

The 2017 National Defense Authorization Act requires the DoD to establish a new position, the under secretary for research and engineering (USD (R&E)).⁴⁶ The DoD should embrace this action as an opportunity to create permanent, and supportive, homes for the DIUx and SCO, alongside existing organizations like the Joint Rapid Acquisitions Cell (JRAC), and Small Business Programs. The ensuing entity will be very large, and this size should provide the under secretary with sufficient influence to effectively advocate for and support his or her organizations. Additionally, these offices would be under the same leadership as those with adjacent missions such as DARPA and the DASD for Emerging Capabilities and Prototyping, allowing for easier collaboration. This under secretary position should also be empowered to create and advocate for an additional acquisition pathway.

Notional Organizational Chart



ACQUISITION CULTURE AND PERSONNEL

New strategy and processes will have limited impact if the culture of today's defense acquisition organizations persists across new acquisition pathways. It is understandable, even appropriate, that a bureaucratic and risk-averse culture would flourish given the personal consequences, including jail time, for failing to comply with regulations. The DoD needs to find new methods to balance compliance, program risk, the delivery of necessary technologies, and the business needs of its industry partners.

The DoD must take significant steps to ensure that the culture of its acquisition workforce, both military and civilian, aligns with pathways and capabilities required for technological advantage. While SOCOM's acquisition successes are often ascribed to its legal authorities, the culture and command climate of the organization are what truly allow them to use authorities, regulations, and processes in effective ways.

There are no easy solutions for transforming culture. Senior leaders, including the secretary of defense, must speak directly to the acquisition community, such as giving speeches at the Defense Acquisition University or industry conferences. Managers must establish incentives – for example, within staff performance reviews – to encourage timeliness and flexibility. The department

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must commit to education and training for its acquisition workforce,⁴⁷ allocate personnel in sufficient numbers, increase industry placement fellowships, and work with Congress to facilitate entry into the DoD for executives and staff with deep industry experience. The DoD has made significant improvements in the acquisition workforce, particularly under the Better Buying Power initiatives, increasing personnel, heightening levels of certification, and removing training bottlenecks.⁴⁸ At the same time, however, Congress removed \$875 million of unspent DoD funding from the Defense Acquisition Workforce Development Fund in the 2017 NDAA.⁴⁹

But as is so often the case with other defense reforms, cultural changes are well known, long advised, and rarely executed. The department and services therefore should populate an additional acquisition pathway with new, dedicated personnel, establishing an effective culture and workforce from the outset. Many of these personnel would need to be drawn from the existing acquisition workforce, but only with rigorous vetting and training. In this way, the department could build a workforce suited to the types of programs that are stymied by the current acquisition culture, such as software and military adapted commercial technology. If successful, this specialized workforce not only would help field critical technologies more effectively, but also demonstrate the potential of reform to the rest of the acquisition community.

FINANCIAL VIABILITY

Any strategy advocating for more programs will be viewed immediately as unaffordable. Because of the fluid nature of a future portfolio, it is impossible to predict the cost of such a system. This approach is financially viable, however, through an alteration of the ways in which the DoD executes its budget, rather than an increase in the top line:

- Changes to the acquisitions system provide an opportunity for the department to leverage global commercial R&D. In doing so, the DoD could take advantage of the close to \$2 trillion of global commercial R&D spending in 2016 alone.⁵⁰ This would allow the department to cut down on duplicative internal research and redirect its finite resources toward defense-specific concerns while increasing the productive output associated with the \$140 billion it spends per year on R&D.⁵¹
- Fewer requirements, shorter time lines, and integrated testing and evaluation will help rein in cost growth within each program. By failing faster and smaller, cancellations will become significantly less painful and more likely to happen before costs balloon. The scale of these losses varies. OSD (AT&L) calculates \$58 billion of “sunk costs” between 1997 and 2016.⁵² The combined losses of cost overruns of scaled back or canceled programs including Comanche, the Expeditionary Fighting Vehicle, Future Combat System, Littoral Combat Ship, and the F-22 exceed \$100 billion over the past two decades.⁵³ An analysis of costs for all programs terminated or cut short from 1980 to 2015 totals \$186 billion.⁵⁴ Avoiding even half of these costs would more than justify an alternate strategic approach.

- Deploying replaceable systems with intentionally shorter lifespans offers the DoD the opportunity to radically reduce maintenance and logistics costs. After a certain period of time, the cost associated with massive upgrades may inhibit the development of new and more efficient replacements – as is apparent, for instance, in the Air Force’s fleet of large surveillance aircraft. Opting to replace systems instead of maintaining them past the point of cost efficiency eliminates the need to invest in the infrastructure, personnel, and spare parts supply chain for decades-old systems. This would allow a redirection of funds from maintenance and logistics to higher-return areas such as capability development and acquisition.
- An optionality strategy would enable the DoD to more rapidly field existing limited production programs at scale in times of war, particularly in the face of adversary adaptation. Increasing production on existing systems would minimize the need for costly brute-force efforts such as the department’s \$45 billion MRAP program⁵⁵ or the \$19 billion spent by JIEDDO,⁵⁶ not to mention the incalculable human, strategic, and tactical costs associated with slow adaptation.
- A diverse portfolio will also allow the department to manage its cost profiles over time, building and employing assets according to mission profiles dictated by likely adversaries’ sophistication. Such management could significantly reduce production costs as well as operational and maintenance costs. For example, an F-35 will incur over \$42,000 in flight costs per hour,⁵⁷ compared to \$3,000 for Textron’s Scorpion jet,⁵⁸ or only \$600 for the propeller-driven Super Tucano.⁵⁹ In addition to minimizing costs, this approach would allow the DoD to preserve exquisite systems for truly high-end threats.

The DoD almost certainly will need to increase its RDT&E budget in order to implement an optionality strategy. But in addition to mitigating technical risks and accruing downstream cost savings, this up-front investment will produce better technical outcomes, spur innovation, bring in new industry partners, and generate positive externalities for the U.S. economy. The short-term challenge will be reestablishing priorities and funding allocations, particularly in the Program Objective Memorandum (POM).

Finally, it is important to consider the costs of maintaining the DoD’s current approach. What costs will the department incur should it lose its military-technical advantage? What are the strategic costs of the long-term decline of the U.S. defense industry? And what is the cost of military defeat or the inability to secure our vital national interests due to the absence of a variety of necessary hard power options?

From Acquisition to Advantage

Identifying, investing in, and developing compelling technology and capabilities are vital but insufficient aspects of guaranteeing military-technical advantage. In addition to buying the technology itself, the DoD and services must implement those capabilities in advantageous ways, ensure ongoing access to technology through positive relationships with a vibrant supplier ecosystem, and make wise choices regarding the provision or denial of U.S. capability internationally.

CONCEPTS AND ADOPTION CAPACITY

Acquiring technology is pointless unless the services are able to adopt those capabilities in ways that generate military advantage. Initially, this will require the U.S. military to update its concepts to exploit new technologies and avoid missed opportunities from using such technologies in old ways. The demand for new concepts will extend from theater-level equivalents of AirLand Battle to tactical-level concepts for urban combat.

The United States already is blessed with talented and creative military and civilian personnel, and possesses much of the intellectual and organizational structure required to develop and adopt new concepts. An optionality strategy will enable, and require, this system to move more quickly and be more willing to challenge the status quo. Adopting newer techniques such as internal competitions to crowdsource ideas, hackathons, Hacking for Defense methods, and collaborative experimentation

Acquiring technology is pointless unless the services are able to adopt those capabilities in ways that generate military advantage.

efforts like the U.S. Army’s CoCreate project⁶⁰ would allow the services to develop concepts more rapidly and effectively, particularly those that deliver tactical innovation in a bottom-up manner. The services will need to ensure that concept development efforts are integrated with capability development processes to ensure that concepts



An Operational View 1 diagram depicting DARPA's system-of-systems integration technology and experimentation program. (DARPA)

and technology each inform each other. The proposed additional acquisition pathway is designed to support such collaboration.

Ultimately, leadership will be the key enabler for the rapid development, adaptation, and re-development of the diverse range of concepts required for future military success. This will be particularly true for joint and operational level concepts, which require collaboration and negotiation between disciplines and services. Flag officers must provide an amenable command climate, but field grade officers will be primarily responsible for the development, staffing, and implementation of the concepts that turn novel technologies into military advantage.

Assuming the services are able to develop compelling concepts and technology, they also will need to be able to adopt these new approaches rapidly in order to stay ahead of competitors with access to similar technologies. As Michael Horowitz explains in *The Diffusion of Military Power*, “adoption-capacity theory argues that, once states have the necessary exposure to an innovation, the diffusion of military power is mostly governed by two factors: the level of financial intensity required to adopt a military innovation, and the amount of organizational capacity required to adopt an innovation.”⁶¹ Generally, the greater the amount of financial intensity and organizational capacity required to adopt an innovation, the longer adoption will take.⁶²

The DoD and services must increase their adoption capacity in order to maintain their technological edge. This will be more true in the future than it is today. The United States’ ability to adopt capability more rapidly than its adversaries can be a major differentiator in a future, highly contested military-technology race. While it is fashionable to bemoan the perceived slow rate of change in the services, the United States possesses a much higher adoption capacity than its competitors. Indeed, part of the DoD’s decline in military-technical advantage is due to other nations adopting capabilities pioneered by the United States decades ago.

Increasing adoption capacity is a complex undertaking that goes beyond the scope of any technology

strategy, touching on matters of culture, career progression, and the full range of capability factors across DOTMLPF. From a technology strategy perspective, constant prototyping, limited production programs, and recombinant innovation can drive down both the financial and organizational barriers to adoption. When change is routine, each individual adjustment becomes less painful. A well-implemented optionality strategy would promote the rate of adoption of new capability across the services.

INDUSTRY COLLABORATION AND POLICY

The DoD does not wield the influence it once did over its industry partners. Commercial technology companies prefer to pursue other markets, commercial companies with defense elements are encouraged to divest those business units by activist shareholders,⁶³ and many defense specialists face an uncertain future.⁶⁴ However, while the DoD may not be able to influence particular technologies such as microprocessors or mobile phones that have proliferated into commercial marketplaces, it still possesses many advantages (see “Why Non-Defense Companies Should Work with the DoD” on page 39) beyond its \$560.4 billion annual budget for 2015.⁶⁵ These strengths mean that the DoD can shape outcomes in certain market segments and benefit from trends in others if it organizes itself appropriately, creates the right incentives, and behaves as a decent customer.

In order to capitalize on global technology trends, the DoD also must collaborate with a wide range of partners within and beyond the traditional defense industry. This can only be achieved by creating tailored strategies and policy for different segments of the department's supplier ecosystem. While in some cases, such as military-exclusive markets, the department may best be served by pursuing a classical strategy and influencing via policy and compliance,⁶⁶ in most instances the DoD should encourage industry behavior with strategy, incentives, and partnership. This is especially true for commercial companies on the leading edge of next-generation technologies like artificial intelligence and unmanned systems.

Further, the department must take advantage of the greater flexibility it would have under a dual-path acquisition model to create the right incentives to secure access to necessary technologies. For example, it may be worth running a limited production program for an emerging technology, such as robotics, in order to invest in the health of the sector that makes it, help advance that field of technology, and ensure that businesses in that field remain interested in working with the DoD. Encouraging innovation among defense specialists and broadening DoD access to commercial technology also will require the department to rethink its intellectual property (IP) strategy. Current contracting practices, updated as recently as 2014, often require companies to turn over IP to the DoD in the name of competition, imposing an opportunity cost that both deters internal investment in R&D and causes commercial suppliers to walk away from DoD contracts.⁶⁷

The DoD cannot hope to maintain its technological advantage if it drives its partners away or out of business.

The DoD cannot hope to maintain its technological advantage if it drives its partners away or out of business.⁶⁸ For the DoD's industry partners, acquisition policy always will be articulated by what the department buys and the terms by which it buys, rather than the prose of policy documents. In collaborating with suppliers, the DoD must create outcomes that are mutually advantageous. Contract officers and program managers must be as concerned about the health of DoD industry partners as they are about protecting taxpayer funds if the department wishes to retain access to the technology required for success.

INTERNATIONAL COLLABORATION

The United States undertakes virtually all of its military operations as a member of a coalition. Common or interoperable military systems, provided through foreign military sales (FMS), foreign military financing, defense trade cooperation treaties, and co-development, serve as the physical representation of these alliances. The DoD requires a technology strategy that can support and benefit from the alliances that will play a crucial role in future operations and deterrence.

Maintaining a high leverage position and injecting compelling technologies into foreign military markets will be critical for U.S. global alliance strategies. This was clearly demonstrated when Turkey initially chose to purchase a \$3.4 billion missile defense system from the Chinese, which offered less interoperability with NATO systems than that of an American competitor.⁶⁹

The greater breadth of an optionality strategy's capability portfolio would provide the United States with increased opportunity to provide allies with systems that better match their budgets, technical sophistication and adoption capacity. While the United States is at risk of losing its technological advantages, it often uses systems that are ahead of even advanced allies.⁷⁰ This approach would also allow the United States to support greater interoperability among coalition forces and more easily address alliance technology demands while retaining exclusive access to certain high-end systems.

However, technical features are not the only factor in allies' military capability decisionmaking. The United States continually will need to weigh elements such as technology transfer and capacity building (key factors in the Turkish missile system decision), which help win business in the short term but complicate proliferation and future competition.

The United States also will need to make increasing use of technologies from its allies' defense industries. An additional acquisition pathway designed to support the military adaptation of commercial technology also would facilitate DoD acquisition of international MOTS technology more effectively. Increased access to these systems, especially components such as remote weapons stations, missile propulsion, communications equipment, and software, could significantly contribute to the DoD's technical edge.

Better leveraging the global defense industry will allow the United States to benefit from the R&D of other nations but also will help maintain the vitality of allies' defense industries, which is critical for those nations' self-defense. Further, these business ties will solidify and deepen alliances beyond the one-sided export of U.S. military systems.

EXPORT CONTROLS AND FOREIGN MILITARY SALES

Export controls are intended to limit other nations' ability to use technology in ways that are unfavorable to the United States. They were effective when the United States had privileged access to many military technologies, but today this is by no means always the case. Export controls also worked better when the United States had one primary adversary. In the post-Cold War environment, where many militarily relevant technologies are widely available, outdated export control policies merely hamper U.S. efforts to partner with other nations, support industry, and engage in technological competition. Further, they create a vacuum in which competitor nations can do all of those things, such as when Jordan, one of America's partners in the fight against the Islamic State, looked to China to buy armed drones following a White House decision not to permit the sale of MQ-1 Predator drones.⁷¹

The Departments of Commerce and State have taken significant steps since 2010 to reform the export control process.⁷² However, more reform is needed so that U.S. commercial and military technology may be exported more rapidly and transparently, opening better opportunities to businesses.⁷³ In addition, the Departments of Commerce and State should undertake fundamental reform of export controls, updating the structure and nature of export lists rather than just editing what items are on a given list. Senior political decisionmakers need to revise their calculus for the appropriate interpretation of the policy objectives of export controls, balancing counterproliferation in the 21st-century technology environment with the need to support American businesses and the defense base.

Because many militarily relevant technologies are broadly available, the United States needs to go beyond current reforms and establish an updated policy approach to support its fundamental policy rationale. Rather than achieving its objectives through denial, the United States will need to export its technologies and shape behaviors through alliances, education, and the establishment of normative frameworks. Undoubtedly, there is potential for American technology to be used unfavorably, but the risks of such events are lower than the risks of ceding alliance building and business opportunities to competitors and adversaries.

To be clear, the U.S. government should continue to seek to limit the proliferation of sensitive military technology to plausible adversaries as much as possible. Denying them access to new capabilities via export controls remains a more effective method than shaping behavior, and the current export control regime is still appropriate for a range of high-end military unique systems, most notably nuclear weapons, advanced precision munitions, and other sensitive technologies.

But in cases where technology is accessible from other sources, commercial or military, the United States should lower export barriers. It also should consider the availability and state of proliferation for given technologies, and not just what the technology is, when developing export policy.⁷⁴

The Departments of State and Defense must also improve their ability to facilitate FMS transactions. While the FMS system itself is arguably fit for its purpose,⁷⁵ it is slow,⁷⁶ opaque, and unpredictable. FMS issues decrease the U.S. defense industry's ability to compete in an ever-tougher international market. Under an optionality strategy, the DoD would have a much more diverse portfolio at its disposal, providing the U.S. defense industry the opportunity to export a wider range of systems while retaining exclusive access to high-end or differentiated capabilities.

Effecting Change

The principal challenge associated with enabling any change in strategy for the DoD is overcoming bureaucratic inertia. Many of the solutions outlined above look similar to current practice. This is because the flaws of the current system relate less to its theoretical design than to the bureaucracy that has grown around it.

Regardless of whether it attempts to force change within the current system or create an additional acquisition pathway, the department must establish, as a matter of the highest priority, a system that can identify and invest in a diverse set of programs. To achieve this, the department must be able to make wise decisions about portfolio management, incorporate these technologies into military advantage, and maintain access to these technologies, while regulating their proliferation in ways that support U.S. strategic interests.

It will take years to plan, build, and implement portfolios with the diversity that the DoD needs. Much of the DoD's budget is already committed to programs in ways that cannot easily be altered, so new concepts will not be realized until later POMs and future financial years. This natural latency means that the DoD must establish necessary processes now, in anticipation of future budgetary flexibility.

If the department can make improvements in these areas, it will be well positioned to capitalize on the advantages associated with being the world's largest, most diverse, and best-funded military, situated in one of the world's most technologically advanced and innovative countries. However, if the department remains on its current path without seeking to change, it denies itself the benefits of these opportunities and will continue to see its military-technical advantage diminish.

The Role of Congress

Recognizing the need for reform and witnessing insufficient action on part of the DoD, Congress has sought leadership in rebuilding the defense acquisition system. The House and Senate Armed Services Committees, under the respective leadership of Representative Mac Thornberry (R-TX) and Senator John McCain (R-AZ), are attempting to drive change through the budget, organizational structures, and authorities provisioned by the annual NDAA. An updated strategic approach articulated by senior leadership in the Department of Defense, however, will require and enable Congress to take new kinds of action, in addition to traditional budget and oversight obligations, while retreating from its self-appointed role as change agent.

With an optionality strategy in place, the DoD will be mainly responsible for reform, but Congress will be a critical partner in the realization of the department's stated strategic goals. Congress must work alongside the DoD to support the implementation of an additional acquisition pathway and address dysfunctional political, legislative, and budgetary obstacles that worsen military-technical outcomes.

Congress must be willing to assist DoD efforts to develop a diverse capability portfolio. An optionality strategy will depend on the DoD's ability to act with more agility, investing in more capabilities while simultaneously cutting more programs with ruthless efficiency. The department will need political support from Congress to take more acquisition risks as some investments inevitably will not pay off. Congress should reduce its resistance to program cuts or cancellations – if the DoD cannot quickly discontinue programs when required, the portfolio will be filled with unnecessary capabilities. Additionally, Congress must not impede regular acquisition of international systems that contribute to American military-technical advantage. Political support will provide the DoD with space to adapt its acquisition behavior to the rapidly evolving threat landscape and capabilities of U.S. adversaries.

Beyond political support, Congress also must address issues of the categorization of “colors of money” in appropriations, which rigidly allocate funds to specific accounts. An optionality strategy likely will see a shift between the appropriation categories of RDT&E, Procurement, Operations and Maintenance (O&M), Military Personnel, and Military Construction.⁷⁷ Congress should provide funding flexibility between

accounts to the greatest extent possible and commit to re-tasking funds in support of new technological opportunities, such as using services funds for cloud computing, instead of spending more O&M funds for server farms that perform the same function. Similarly, the Air Force and industry have proposed retrofitting the B-52 bomber with commercial off-the-shelf engines, leased on a “power by the hour” basis, but budget rules make this difficult.⁷⁸

Ultimately, Congress' most important role in maintaining the United States' military-technical advantage is to remove the threat of sequestration and pass budgets in a timely manner to provide stability for both the department and its industry partners.⁷⁹ Over the past three administrations, the average delay in the passage of a defense appropriations bill has risen to almost four months, or a third of the fiscal year.⁸⁰ These delays, combined with Budget Control Act caps, severely burden the department's ability to manage and fund major contracts from one year to the next and obscure the long gaze required to invest across the Future Years Defense Program. Further, the lack of budgeting clarity has an outsized impact on the defense industry and is particularly damaging to the small, innovative businesses that the DoD must work with to preserve military-technical superiority.

Congress must work alongside the DoD to support the implementation of an additional acquisition pathway and address dysfunctional political, legislative, and budgetary obstacles that worsen military-technical outcomes.

While these actions certainly will have a greater impact in concert with an optionality strategy, there is no reason that Congress should wait for the DoD to act first. Even under current conditions, Congress is well suited to incorporate DoD risk-taking, funding flexibility, and budgetary stability into its existing agenda. Yet, the House and Senate Armed Services Committees should be wary of assigning specific solutions to acquisitions challenges. Instead, these congressional committees could better facilitate progress by dictating outcomes and providing the DoD with enough flexibility to implement internally researched solutions with stronger support from leadership and higher chances of success.

The Role of Industry

The United States' defense industrial base is in the midst of a slow, well-managed decline. Revenues are stagnant (even among the top five defense companies of 2016), firms are restructuring themselves, consolidating, or exiting from the defense market to manage shrinking DoD acquisition budgets, and both company and DoD expenditures on R&D are in decline.⁸² In order to return value to shareholders in such an environment, defense specialists are spending large portions of their free cash flow on share buybacks instead of investing in growth opportunities.⁸³ While these are rational short-term business choices, their long-term impact on national security is profound: where commercial underinvestment in R&D mortgages the future of a business, defense sector underinvestment in R&D mortgages the future technological superiority of the U.S. military.

In what is effectively a single-buyer market, adopting these types of business practices is the only rational way defense specialists in the United States can maximize revenue and cope with the tension between DoD incentives and Wall Street expectations – especially during down cycles in military spending. High compliance and

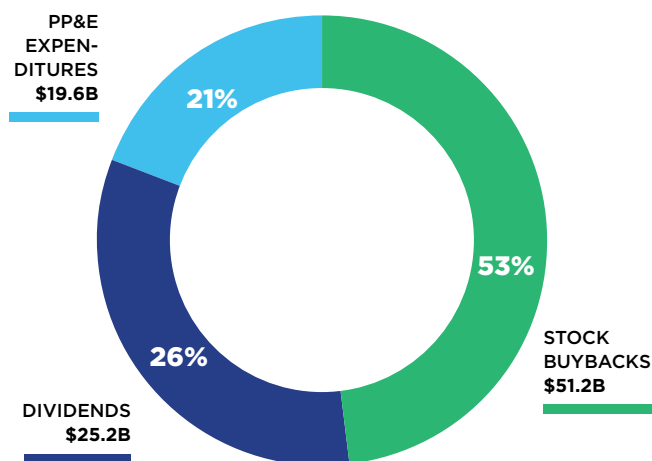
oversight costs, limited profits, and significant uncertainty about future contracts discourage new entrants from doing business with the DoD. Despite rhetoric that supports innovation, the department's purchase history and extensive acquisition regulations shape industry behavior to limit business risks and align practices with a lowest price, technically acceptable (LPTA) model of procurement.⁸⁴

The clash between defense market incentives and private business interests is, over time, reducing the number of DoD suppliers and creating a capability monoculture.⁸⁵ Repeated cycles of consolidation have left fewer than 20 of 1991's top 100 defense companies intact.⁸⁶ As dictated by the DoD, competition between the surviving companies is centered first on cost. Thus, innovating beyond DoD requirements is a risk that is hard to justify with diminishing opportunities to win new contracts.

These trends are reshaping the composition and capacity of the defense base in a way that compromises the United States' national security. The United States cannot sustain technological superiority over its adversaries without a healthy and dynamic ecosystem of businesses supplying the Department of Defense. But the defense industrial base today is neither positioned to meet the DoD's diversifying and expanding strategic and technological needs, nor to take full advantage of U.S. or global talent and capital. If the United States' future superiority rests on creating an advantage in aggregate, the DoD will need the support of an innovative defense base that capitalizes on diverse businesses, models, and production methods to efficiently acquire goods and services ranging from mobile phones to nuclear submarines.

The United States has the full extent of industry and commercial partners needed to create an advantage in aggregate but, instead of capitalizing on these assets, the DoD disincentivizes new entrants to the defense market and the pursuit of capabilities that transcend stated requirements. Reimagining technological superiority to include a broad portfolio of capabilities, spanning from purely commercial technology to sophisticated, military unique systems, will require not only the implementation of a new acquisitions pathway, but also a shift in the components and structure of the defense base. If the DoD can carve out new pathways and incentives for suppliers, it can drive the creation of a dynamic defense base that supports U.S. superiority, a feat that no other nation can achieve.

**Use of Cash from Operations
by Major Defense Suppliers**
from 2006 to 2015



Data includes five large U.S. defense specialists: Lockheed Martin Corporation, Northrop Grumman Corporation, Raytheon Company, L-3 Communications Holdings, Inc., and Huntington Ingalls Industries, Inc. Note: data for HII is for last seven years only.

Source: Martin J. Bollinger (data analysis, unpublished digital copy, 2016).

The Foundations of a Dynamic Defense Base

The U.S. defense market is unique in that the Department of Defense shapes its structure and composition as both the sole buyer and regulating authority.⁸⁷ Defense businesses are fundamentally rational actors and will respond to the incentives DoD enacts. Without DoD leadership, the realignment of strategic objectives, technology needs, and business interests to establish a broader defense base is significantly more difficult. However, if the department does adopt an optionality strategy, implement an additional acquisition pathway, and initiate associated reforms to policies regulating industry behavior, it would create new market conditions in which a diverse and dynamic ecosystem of businesses could better support national security objectives.

Articulating a broad portfolio of capability options and establishing an additional acquisition pathway both introduces more certainty into the defense market and creates more opportunities for a wider range of companies to do business with the DoD. Given department-led reform and related changes to market conditions and incentives, defense specialists will need to adapt to work alongside and partner with new entrants and capitalize on emerging opportunities.

NEW ENTRANTS

Removing high barriers to entry into the defense market will provide nontraditional defense companies and international defense industry new opportunities for business with the DoD, shifting the composition, and consequently the structure, of the defense base. Where defense specialists have a distinct advantage in producing complex, military unique systems, commercial companies entering the market can offer fast production cycles and innovative, leading edge technologies ready to deploy off-the-shelf or be adapted for military use.

Fewer restrictions limiting international acquisitions will open the U.S. defense market to MOTS and commercial technologies from international suppliers. The greatest opportunities for the international defense industry will be in capability areas where companies can leverage technical expertise based on unique operational experiences. For example, Norwegian industry has particular proficiency developing unmanned systems to support operations in a harsh maritime environment.⁸⁸ There always will be some limits on international success in the U.S. defense market, especially on MDAPs. The earliest and most realistic opportunities almost certainly will be for smaller systems and components. However,



A crew chief with Marine Light Attack Helicopter Squadron (HMLA) 269 uses a tablet to mark friendly and enemy targets. (Lance Cpl. Andrew Huff/U.S. Marine Corps)



The HUGIN 4500 AUV in the water. (Wikimedia Commons)

international and U.S. businesses alike will benefit from increased competition and the potential for new partnerships and business models.

Leveraging the full scope of defense specialists' and commercial companies' strengths is essential to sustaining military-technical superiority. To achieve the full benefits of expanding and diversifying the defense base, however, industry and commercial businesses also must adopt production methods that facilitate collaborative innovation and seamless systems integration.⁸⁹ The application of open systems architecture and principles of modularity to design and manufacturing will be key to the integration of the capabilities developed by a wider variety of suppliers, optimizing the DoD for adaptability.⁹⁰

COMPETITION & INNOVATION

DoD pursuit of a portfolio of capability options will generate more opportunities for companies to win a wider variety of contracts, stimulating healthier and more meaningful competition. More programs, each with a smaller share of the budget, mean fewer "must-win" challenges for companies and, consequently, lower incentives to "buy-in" or underbid. In addition, revision of industry policies, such as minimizing DoD control of IP and eliminating unnecessary export controls, will create new incentives that encourage innovation and support more sustainable business practices. Strategic movement away from a capability monoculture will allow the industrial base to develop new capabilities and pitch them to the DoD, generating demand instead of responding to the buyer's requirements. For much of the technology the department will acquire, this shifts the focus of competition from price and performance to underlying concepts and technology, rewarding innovation among businesses competing for DoD contracts.

WHY NON-DEFENSE COMPANIES SHOULD WORK WITH THE DOD

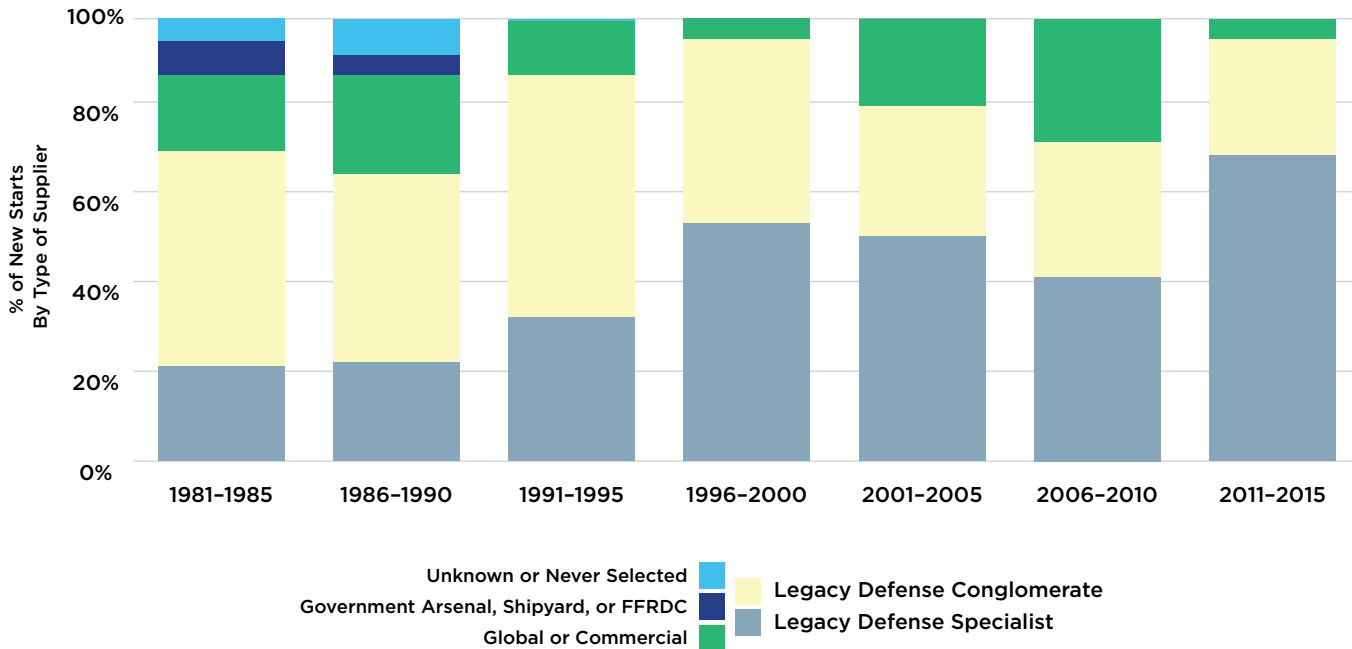
The DoD has a fundamental under-appreciation of the value it represents as a customer to important and interesting new businesses, often assuming that its sole value is in the provision of contracts. In fact, the department has many assets that make it a compelling partner for forward-leaning companies.

- The DoD is in close proximity to captivating and challenging technical problems in difficult operational environments, such as precision timing in navigation or self-patching cybersecurity systems. In addition, the department has both a need and desire to solve these problems before a commercial market does.
- The DoD is willing to pay for R&D, as well as for a high per-unit cost relative to commercial markets. Importantly for startups, this revenue is all non-dilutive, because the DoD does not want any stake in a company in exchange for its investment.
- The DoD often awards multi-year contracts, which give startups long-term stability and a better, more convincing story to tell potential investors.
- The DoD can provide access to testing ranges that are private, specially regulated, instrumented, or otherwise unique, such as cyber ranges.⁹¹ In addition, the department has tech-savvy users that are well versed in testing new technologies and providing structured feedback to developers and engineers.
- The DoD has technology talent and platforms that are unavailable commercially at the same level. For example, the National Security Agency cryptologic community is unparalleled, and the Naval Postgraduate School is doing cutting-edge work on drone swarms.⁹²
- The DoD has unique legal authority to operate or maintain access to certain important technologies, such as with space launches or certain cyber operations.

Each of these incentives could be interesting to innovative companies in isolation. But when considered in combination, they would provide businesses the ability to access a new market or product before its competitors, fund the development of that product, create a technology proven in tough environments, and position itself for a new market opportunity at its inception. In this way, the DoD can act as a "teacher-customer" for interested companies, and provide commercially oriented businesses the opportunity to refine and enhance their capabilities in an environment more complex than that which the average consumer will face.

Industry Shares of New Major Programs

By year when line item funding appeared for the first time



This chart tracks the number of major programs reported annually to Congress and identifies those appearing as funded line items for the first time. Some classified programs are not included. Data for 1989 are excluded due to inconsistencies resulting from changes to reporting formats. Base data captured from DoD Budget, "Program Acquisition Costs by Weapon System," annual reports to Congress 1991 to 2017, and DoD Annual Report to Congress, 1987 to 1990.

Source: Martin J. Bollinger (data analysis, unpublished digital copy, 2016).

Furthermore, frequent competition and contract opportunities add stability to the defense market, creating the conditions for more even and predictable revenue. The loss of a single contract will not put the future of a defense company at risk if they have more confidence in competition for future contracts.⁹⁴ Greater certainty allows businesses to plan ahead, take more calculated risks, and invest more in R&D and other future growth opportunities.

Additional investment in agile production methods will further enhance companies' ability to rapidly switch or scale production, further reducing the risks typically associated with competing for government work.⁹⁵ The right production methods will make it faster and easier to switch production from defense to commercial or vice versa and will facilitate rapid increases in production volumes if necessary. A more opportunity-rich defense market encourages investment in the infrastructure that creates conditions for innovation and agile production.

Another benefit resulting from more programs and more agile procurement is that more people in government and industry will acquire experience in leading

programs, and do so earlier in their careers. The prospect of early leadership positions also will help defense contractors compete for new recruits.

The major challenge in deviating from requirements-based competition will be the assumption of more front-end financial risk on the part of defense companies. Yet, with greater certainty surrounding returns on investment, the defense industry should be able to identify and secure other sources of capital investment.

NEW OPPORTUNITIES

By establishing a dedicated method for acquiring military integrated commercial technology, the DoD also will generate a new sub-market within the defense ecosystem. This market will create space for new entrants and an opportunity for defense specialists to conceive smaller, more agile programs. The ensuing competition will drive innovation not only in technology, but also, more importantly, in business models to include sub-contracting and joint ventures between defense and commercial businesses. These models may help the traditional defense industry capitalize on downstream revenue opportunities associated with the commercial

application of formerly military unique technologies, a business line that has eluded defense specialists in recent decades.

Relaxed export controls will expand U.S. defense companies' access to foreign markets, allowing them to compete more effectively for global business and stabilize their revenue by reducing their dependence on DoD contracts. A more diverse portfolio of capabilities also will allow industry partners the means to provide more tailored offerings to international customers.

Although DoD leadership is key, establishing a dynamic defense base requires equally smart and intentional action, particularly from traditional defense industry leaders.

Carving out the right pathways for new entrants into the defense market and realigning incentives to support viable businesses will create the conditions to achieve military technological superiority. Although DoD leadership is key, establishing a dynamic defense base requires equally smart and intentional action, particularly from traditional defense industry leaders.

Opportunities for Industry to Innovate Absent DoD Reform

In the absence of considerable department-led reform, traditional defense industry cannot significantly alter the status quo. Yet this does not mean the defense base is without opportunities for action. As they face fewer bureaucratic impediments, defense specialists are arguably freer than the DoD to take steps to initiate change. While industry will continue to be constrained by misaligned strategic and business incentives, it can take action in the absence of DoD leadership to create more ideal market conditions that support viable businesses and technological superiority.

Industry can act as a conduit for commercial and international military technologies and components to the department. Traditional defense companies can leverage their familiarity with the DoD as a customer and their capacity to do business with the department to bring new entrants into the defense market. Where new entrants lack the organizational infrastructure to comply with extensive regulations and international companies are barred from competing in the U.S. defense market, industry can serve as a value-added middleman. Raytheon, for example, hired the Norwegian company, Nammo, to

provide rocket motors for their advanced medium-range air-to-air missile.⁹⁶ Industry partnerships with commercial and international companies would allow the DoD, by proxy, to take advantage of commercial assets in technology areas, such as software, that do not often require unique military specifications. Defense manufacturers might perceive a conflict of interest in undertaking such a role, but defense service providers could formalize such partnerships as a service offered to international industry and commercial businesses.⁹⁷

Industry can employ new production methods to further reduce costs, improve productivity and efficiency, and enhance their competitive edge in a LPTA market environment. To an extent, defense companies already are exploring new methods, taking advantage of process automation in manufacturing and computer-aided design.⁹⁷ Production methods that prioritize modularity can be employed to support increased agility and adaptability in the face of high speeds of technological change and the demands of varied threat environments. Defense specialists can further benefit from capitalizing on systems-of-systems engineering methods, digital manufacturing, cloud services, and open source software.⁹⁹

Industry can apply new business models that support more predictable revenue streams and growth in a stagnant defense market with limited opportunities to win new contracts. Traditional defense companies can learn from unsuccessful attempts to exploit market adjacencies and instead search out joint ventures and partnerships with businesses or startups optimized for a commercial marketplace. Airbus Group, for example, in 2015 established a venture capital fund and technology business innovation center in Silicon Valley to “enhance its ability to identify and capitalize on innovative and transformational technologies and business models.”¹⁰⁰

Successful change must start with the senior leadership of traditional defense companies, who can create compelling roadmaps and investment plans that appeal to shareholders. Institutionalizing forward-thinking practices about how to operate in the contemporary defense market will require companies to take risks and implement changes that are likely to conflict with existing DoD incentives. While it may be tempting to assume that a short-term increase of spending related to military operations will improve economic outcomes for traditional defense industry, these increases in revenue from heightened demand only mask the underlying fragility of the defense industrial base. Industry leaders will face a choice either to take the risk of challenging the status quo and accepting the consequences or to continue managing the slow and steady decline of their core business.

Getting Started

Successful implementation of a new strategic approach for developing military-technical advantage will require action from the DoD, Congress, and industry. However, change must start at the top of the DoD. The incoming secretary of defense will need to establish from the outset that developing a new strategic approach is a priority. The secretary should announce from his or her confirmation hearing that he or she strongly believes in the need to establish a new strategic approach and intends to work closely with Congress to develop and implement changes.

The topic of acquisition reform almost certainly will arise in any hearing, as evidenced by comments and questions from Chairman McCain and Ranking Member Jack Reed for Secretary Carter,¹⁰¹ and through points raised by Reed and Senator James Inhofe at Deputy Secretary Work's confirmation hearing.¹⁰² It is important for the new secretary to signal to Congress that the issue is deeper than one of process reform, and to do so from the beginning of his or her tenure in order to get their support for the strategic approach early.

The secretary also must ensure that the president's choices for deputy secretary and USD (AT&L), or USD (AT&S) and USD (R&E), have a common vision and are empowered to implement a change agenda. Once confirmed, the secretary must continue to set the tone and own this agenda, while empowering his or her deputy secretary and USD (AT&L), or USD (AT&S) and USD (R&E), to execute on implementation in close collaboration with the vice chairman of the Joint Chiefs of Staff and vice chiefs of service.

The next secretary of defense has a rare opportunity to implement change that will improve the DoD's ability to compete effectively for military-technical advantage.

Specific actions within the first 100 days of a new administration should include:

- Formally announcing and branding the strategy in a public speech with an audience including leaders from the traditional defense industry, commercial industry, and startups from innovation hubs across the country.
- Assembling a cross-functional team from the OSD, Joint Staff, services, and acquisition community to develop a detailed implementation plan.
- Following the model of Secretary Gates at the outset of the Obama administration and make clear, declarative statements through immediate budgetary decisions.¹⁰³ These decisions should endorse and appropriately fund important new organizations like the DIUx and SCO while also making clear the future of the DoD capability portfolio in areas like the Third Offset Strategy.
- Communicating publicly an intent to provide greater institutional support to organizations like the DIUx, SCO, RCOs, AWG, and REF, articulating tangible actions where possible, to include establishing a formal and feasible bureaucratic home for the DIUx.
- Publicly rewarding a specific organization, program, or project, and showcasing its work as a role model or, alternatively, canceling an underperforming program or office and explaining the justification.

The next secretary of defense has a rare opportunity to implement change that will improve the DoD's ability to compete effectively for military-technical advantage and establish the correct framework and incentives to capitalize on the technological prowess and latent innovation of all its industry partners. Failure to act early will enable other critical exigencies to steal focus, allowing this moment to pass and the gradual decline of the U.S. military's technical edge to continue unabated. The department, and the nation, cannot afford such an outcome.

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