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ACQUISITION REFORM: NEXT STEPS

HEARING

BEFORE THE

COMMITTEE ON ARMED SERVICES
UNITED STATES SENATE

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ACQUISITION REFORM: NEXT STEPS

TUESDAY, DECEMBER 1, 2015

U.S. SENATE,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

The committee met, pursuant to notice, at 9:30 a.m. in Room SD-G50, Dirksen Senate Office Building, Senator John McCain (chairman) presiding.

Committee members present: Senators McCain, Inhofe, Wicker, Ayotte, Fischer, Cotton, Rounds, Ernst, Tillis, Reed, Nelson, McCaskill, Manchin, Shaheen, Gillibrand, Donnelly, Hirono, King, and Heinrich.

OPENING STATEMENT OF SENATOR JOHN MCCAIN, CHAIRMAN

Chairman MCCAIN. Well, good morning. The Senate Armed Services Committee meets this morning to discuss the next steps for reforming the Pentagon's broken acquisition system.

Last week, the President signed the National Defense Authorization Act [NDAA] for Fiscal Year 2016 into law, and that legislation marked the beginning of a significant revamping of the defense acquisition system that has been broken for decades. Schedule delays and cost overruns are par for the course. Complex regulations and stifling bureaucracy impede innovation and restrict access to critical commercial technologies. Worse still, it seems no one in the defense acquisition system is ever held accountable for these repeated failures. That's why in this year's NDAA, Congress sought to improve access to nontraditional and commercial innovation by removing barriers to new entrants into the defense market, adopting commercial buying practices for the Defense Department, and ensuring these firms are not forced to cede intellectual property that's developed at their own expense. The NDAA also expanded flexible acquisition authorities in the development of alternative acquisition pathways to acquire critical national security capabilities.

And perhaps most importantly, the NDAA took important steps to ensure accountability in the defense acquisition system. The NDAA gave greater authority to the military services to manage their own programs and enhance the role of the service chiefs in the acquisition process. Service chiefs, service secretaries, service acquisition executives and program managers will now sign up to binding management requirement and resource commitments. And if military services fail to manage a program effectively, they will lose authority and control over that program and be assessed an annual cost penalty on their cost overruns. This committee will be watching closely to ensure the Department implements these re-

forms in keeping with both the letter and spirit of the law. At the same time, we will continue to press forward to make lasting reform a reality.

It's been almost 30 years since the landmark Goldwater-Nichols Act and the Packard Commission. It's been 20 years since the Federal Acquisition Streamlining Act and the Clinger-Cohen Act. In recent years, the Pentagon has been given unprecedented authorities to bypass the existing acquisition system and access new technologies and innovative companies, yet today the defense acquisition system is more risk-averse, costly, inefficient, and less open to commercial solutions than it was 30 years ago.

This morning, we welcome a distinguished panel of witnesses to help us identify what else Congress can do to change the current incentive structure and culture to achieve improved acquisition outcomes that meet the needs of our servicemembers and taxpayers: The Honorable Jacques Gansler, Chairman and CEO [Chief Executive Officer] of The Gansler Group and Professor Emeritus at the University of Maryland. Mr. Gansler previously served as Under Secretary of Defense for Acquisition, Technology, and Logistics in the Clinton administration; Mr. Norman Augustine, founder of In-Q-Tel, former Chairman and CEO of Lockheed Martin, and Acting Secretary of the Army; Mr. Ben FitzGerald, Senior Fellow and Director of the Technology and National Security Program at the Center for a New American Security; and retired Air Force General—Lieutenant Colonel Dan Ward, a former Air Force acquisition officer who specialized in leading high-speed, low-cost technology development programs.

We simply cannot tolerate the vast management failure that is the defense acquisition system. All too often, programs are delayed, over budget, and underperforming. Worse still, the Pentagon has wasted billions on programs that produce no combat capability whatsoever: $20 billion spent on the Future Combat System, with little to show for it; over $1 billion spent on the Expeditionary Combat Support System; a failed attempt to implement a, quote, "commercial off-the-shelf logistics IT [information technology] system" that resulted in no usable capability for the Air Force; $3 billion in 15 years spent on the expeditionary fighting vehicle; and $3.2 squandered on the presidential helicopter without ever fielding a single helicopter. And to think we used to be able to field zero helicopters for free.

Still, the management failures and the colossal waste of taxpayer dollars may not be the worst of our problems. As the bureaucracy fiddles and fails to modernize our forces, our adversaries are catching up with us in the development of critical defense technologies. At the same time, the Defense Department struggles to incorporate advanced commercial technologies into its operations as they become more widely available to our enemies. Our national security cannot rest on the assumption that our adversaries will be as inefficient and clueless as we are about buying defense capabilities.

We've reached a critical inflection point. We are confronting an emerging technology gap with the commercial market in electronics, information, security, robotics, communications, and data analytics. Combined with budget cuts that prevent us from modernizing our forces or deploying them in sufficient numbers around

the world, such a gap will be disastrous, emboldening our adversaries and feeding instability. We must not allow any such technology and capability gap to grow. The United States has the greatest military in the world, but, make no mistake, protecting our military technological superiority is the urgent work of today, not tomorrow. For acquisition reform to be successful, we must change the current culture of inefficiency, risk aversion, and complacency. There is only so much that legislation can do to accomplish this goal. It will require changing incentives and focused and continuous leadership from Congress, the Secretary of Defense, and industry. Every year we fail to do so, billions more in taxpayers' dollars will be wasted, and our military will be left less capable of performing its missions. That is dangerously unsustainable, and that's what we must prevent. And that's why we must continue to press the cause of acquisition reform.

And finally, I'd like to say that the President, as we all know, signed the defense authorization bill, a product of which all of us, Republican and Democrat, can be proud of the bipartisan effort. Our constituents are very unhappy about our lack of achieving results here in Washington. And I think all of—every member who has been heavily engaged in this process can look with some satisfaction, the fact that, in a bipartisan fashion, we were able to craft legislation that is a beginning of reform and also continues our obligation to help train, equip, and defend the men and women who serve this Nation.

Senator Reed.

STATEMENT OF SENATOR JACK REED

Senator REED. Well, thank you very much, Mr. Chairman. And let me also echo your comments about the defense authorization bill and make it clear that, without your leadership, it would not have been a bipartisan and innovative and important piece of legislation. So, thank you, Mr. Chairman.

And, gentlemen, thank you for joining us today. You have a wealth of experience in acquisition and management in the Department of Defense. You will help us sort of look forward to the next steps that we must take to follow on the—what is included in this defense authorization bill to improve defense acquisition. Your experience, your insight, will be absolutely critical as we review additional steps that we will take, going forward.

The Pentagon's fundamental mission is the defense of our Nation, which requires that our military procure technologically advanced weapons platforms and invests in cutting-edge research and development. According to the Congressional Defense—excuse me—the Congressional Research Service, the Department of Defense obligated $285 billion in contracts in FY [fiscal year] 2014, which was more than all other Government agencies, combined. This amount included funding for high-end critical weapon systems, such as the Joint Strike Fighter and the *Ohio*-class replacement submarine, as well as service support contracts, which have much less visibility. In fact, the Government Accountability Office has stated that, within the Federal Government, the Pentagon has the largest share of all service contracts, totaling $156 billion in FY 2014. And many times, we overlook these service contracts, where, in fact, that's a

critical item, in terms of reforming and making more efficient the operation of the Department of Defense.

In an era of fiscal constraints, it's become more important to ensure that we spend every dollar wisely. While the Department has made progress in addressing cost overruns for some major acquisition programs, more work remains. For every dollar that is spent on the weapon systems that are underperforming, that is a dollar that we cannot spend on other important requirements of the military services, including other acquisition programs and important readiness activities, including flying hours for aircraft, steaming days for ships and submarines, and all training that supports the national military strategy.

The good news is that the acquisition procurement reforms undertaken by this committee, again under the leadership of the—Chairman McCain and, preceding that, under his leadership and that of Senator Carl Levin, such as the Weapon Systems Acquisition Reform Act, have been, I think, combined with the better buying power reform led in the Department by Secretary Carter and Under Secretary [of Defense for Acquisition, Technology, and Logistics] Kendall, have begun to make an impact on our ability to control costs and schedules of acquisition, but we can't sit back on our laurels; we've got to do much more. Programs, I think, are being run with more realistic cost estimates, more rigorous systems engineering, and with lower technological risk. Programs that have been initiated under the rules of these later reforms have experienced less cost growth and fewer schedule slips than we've seen previously. Fewer programs are breaking large cost-growth thresholds—in other words, Nunn-McCurdy [Act] breaches. We also seem to be making progress with halting the cost for increases for some major troubled acquisition initiated under the old rule.

Unfortunately, progress has been more elusive in other areas. The Department still struggles to develop and field large information technology systems and managed businesses processes, like personnel, pay, and accounting. DOD [Department of Defense] still does not have a good handle on how to control its spending on the lower visibility service contracts, as I mentioned before. DOD also finds it very difficult to compete with the private sector for world-class technical, engineering, and program management talent. We are rapidly losing important pieces of our defense industrial base through merges and consolidations. And, perhaps most importantly, the Pentagon is in the unfamiliar role of chasing global and commercial innovation, rather than acting as the technological leader that it has been in the past. And I hope our witnesses can help us shed light on all these different topics.

Thank you again for your service to the Nation. And I look forward to your testimony.

Thank you, Mr. Chairman.

Chairman MCCAIN. Dr. Gansler.

By the way, all of your complete statements will be made part of the record.

Dr. Gansler.

STATEMENT OF HON. JACQUES S. GANSLER, CHAIRMAN AND CEO, THE GANSLER GROUP AND PROFESSOR EMERITUS, UNIVERSITY OF MARYLAND

Dr. GANSLER. Thank you.

Well, I don't have to tell this committee that this is a critical period in the future security of the United States. Our defense budget is being cut significantly to help pay for the Nation's debt, and a significant share of these cuts are coming out of R&D [research and development], which, of course, Senator Reed, your statements there are in conflict with that, taking cuts in R&D as we are now doing to help balance the budget. I think the way this strikes me is, we're preparing for 20th century warfare, but not 21st century needs. And I think that's not what we should be doing.

Well, clearly, the world is not at peace today. We have concerns about ISIS [the Islamic State of Iraq and Syria], Syria, the Crimea, the South China Sea, nuclear weapons and ICBM [intercontinental ballistic missile] proliferations, terrorism, and cybersecurity. And, as we become more and more dependent on cyber, and as Senator McCain mentioned, things like robotics and other areas, we're becoming increasingly concerned about cyber—use of cyber—and therefore, this threat is becoming more and more real, the cybersecurity threat. And the recent OPM [Office of Personnel Management] cyber attack certainly alerted all of us to that.

The overall security problem is compounded by the rising costs of the current weapon systems and the high cost of their support. And I agree with Senator Reed's point about emphasizing the support, as well. And then, of course, the lengthening development times for the new systems—for example, the F-22 took 22 and a half years; during that 22 and a half years, technology changes rapidly, geopolitics changed rapidly, and so we have to be able to adjust more rapidly.

Without a question in my mind, significant change is clearly required in the way the DOD goes about the acquisition of goods and services. And, to achieve this, the historical data is very clear—in order to make change, to make significant change, two things are required: widespread recognition of the need for change, and leadership with a vision, a strategy, and a set of implementation actions.

On a positive note, the first of these is demonstrated by the current SASC [Senate Armed Services Committee] and HASC [House Armed Services Commitee] proposals, under the leadership of Senator McCain or Representative Thornberry, for significant defense acquisition reform. Now we need agreement from the executive and legislative branches on the specific actions required to address this need for greater security with fewer dollars.

In the past, the U.S. defense and economic competitiveness strategies for the Nation have been based on technological superiority. But, today, as shown in the first of my figures that I hope you all have copies of, it's very clear that, as was mentioned, the commercial world is now spending significantly more money on their R&D, and the global world is spending significantly more on R&D. And because there should be a correlation between R&D expenditures and results achieved, there are many critical national security areas in which the DOD is no longer leading.

For example, like when I got a briefing from the Army Night Vision Lab recently, the French are the leaders in night-vision devices. And also, when the DOD decided to armor the next-generation infantry fighting vehicles because roadside bombs were the number-one killer of U.S. soldiers and marines in Iraq and Afghanistan, so the DOD chose armor from Israel, and the foreign firm agreed to build the armor in the U.S. At least that's positive. Clearly, the congressional and DOD cutbacks and the share of the budgets going to R&D must be reversed in order for the DOD to achieve technological leadership in the 21st century.

Under Secretary Frank Kendall stated, in the—in his Better Buying Power 3.0, the removal of the barriers to buying commercial is an area that has to change. And in the figures that I gave you, Figure 2 shows the comparison that came out of the Packard Commission that Bill Perry certainly pushed hard when Bill was Secretary, for the difference between a commercial electronics item—in this case, semiconductors, and a MIL-SPEC [U.S. Military Standard] one—in this case, as you can see from the data, the commercial is more than an order of magnitude cheaper, and more than an order of magnitude more reliable, and even more advanced in technology. And so, why wouldn't we use them? It seems to me sensible to consider doing that.

And, in fact, on Figure 3, you'll notice, this is the code of Federal regulations today, and it's now up to 180,000 pages. I'm sure every one of you have memorized every one of those requirements.

[Laughter.]

Dr. GANSLER. And there's no question about—that is a barrier to using commercial——

Chairman MCCAIN. Say that again. How many pages?

Dr. GANSLER. 180,000 pages.

Chairman MCCAIN. Thank you.

Dr. GANSLER. And not only that, Senator, but every year——

Chairman MCCAIN. Yeah, I read them all the time.

[Laughter.]

Dr. GANSLER. Every—that's—look at the slope of that curve. Every year, we're adding another 2,000 pages of requirements that are coming from a combination of legislation and regulation. That's where they're coming from. And it has been independently estimated by OMB [Office of Management and Budget] and the Small Business Administration that the cost of that compliance is $1.75 trillion in 2008, when they did their analysis. So, it's not a trivial point that is—this is just one of the barriers that Frank Kendall was trying to identify. And clearly we have to address that.

And so, why, if you're a commercial firm, would you then want to go into the defense business? It's not expected to be a growth market. It's—as we're seeing, it—the dollars are shrinking. It's being used to pay for the Nation's debt. And we are legislating, in effect, a smaller profit than what the company would make in the commercial business. So, you know, if you don't have a growth market and you're guaranteed to get a lower profit, why is that a good business for you to go into? And this growth in the Federal regulations pages is killing the desire for any good commercial firm to get into this business.

So, in 2005, the test of desirability of using commercial parts to lower the costs of weapon systems, we tried, when I was Under Secretary, to apply this logic to the JDAM [joint direct attack munition] missile. The JDAM missile is converting dumb bombs into smart bombs. Precision-guided rather than simply gravity-dropped.

Chairman MCCAIN. Doctor, could you summarize, since we have three other witnesses and so we could move forward with the questions, please?

Dr. GANSLER. Sure.

Chairman MCCAIN. Thank you.

Dr. GANSLER. Okay.

Chairman MCCAIN. Go ahead.

Dr. GANSLER. Well, Senator Nunn once told me, "Jack, don't give me a lot of theory, give me some examples." So, this—the JDAM is an example, where it was independently estimated that, if you use MIL-SPEC parts for the JDAM missile, it was going to cost $69,000 each. They now—we allowed them to use commercial parts, and they're now building them for $18,000 each. So, there's a $50,000 difference there, times the 10- to 20,000 of dumb bombs that we had stored, that we wanted to now put into them, that we can now have precision delivery with. So, it makes a significant difference, not only in cost, but in reliability and performance, getting the combination of that out of it. So, we got the savings both ways, performance improvements and cost.

So, clearly, we should be using affordability now to drive our system. And the keys to affordability, it seems to me, are six items that—one of which is increased—let me summarize this—increased competition. And I—and in my paper, I've described some of those issues. For example, in a lot of these services that Senator Reed mentioned, we have a choice of doing public sector versus private sector. But, Congress has outlawed A–76 competitions. And when we had over 3,000 of those competitions, the average savings was over 30 percent. Why wouldn't we continue them? I understand what the political considerations were.

Second thing that you need to do in order to address more efficiency and effectiveness is greater civil/military, industrial integration.

Third thing, more emphasis on innovation. Cutting the R&D budget is, for example, not an emphasis on innovation, and people don't just—are resisting cultural change, or resist change. And that's one of the things that's happening.

And I think we also need to look at more innovative financing techniques. Other countries are now using leasing, for example. And I know we went through that once on a—the tankers, but we had to stop it because of the illegal action, but not because of the leasing. And it's important.

Okay. And the fifth area was overcoming the resistance to change, both in industry and in the DOD. And we have to—that takes leadership to do that.

And then the last item, that you did address, and they also addressed it in the House, which is the education and training of the DOD acquisition workforce. That's critical that we get these people with better education and training. And one of the things that at least I had noticed that was being cut out was graduate education

funding for the DOD. And strikes me that that's going in the opposite direction.

So, let me thank you, Senator McCain, and you, Senator Reed, for this opportunity to present this information.

[The prepared statement of Dr. Gansler follows:]

PREPARED STATEMENT BY HON. JACQUES S. GANSLER, PH.D.[1]

I do not have to tell this Committee that this is a critical period for the future security of the United States. Our defense budget is being cut significantly to help pay for the Nation's debt and a significant share of these cuts are coming out of R&D. Clearly, we are preparing for 20th century warfare, but not 21st century needs.

Yet the world is not at peace. We have to be concerned about ISIS, Syria, the Crimea, the South China Sea, nuclear weapons and ICBM proliferations, terrorism, and cybersecurity—as we have become more and more dependent on cyber, and as the threat capability becomes more real (as the recent OPM cyber attack alerted us).

The overall security problem is compounded by the rising costs of current weapon systems and the high cost for their support, as well as by the lengthening development times for new systems—for example, the F–22 took 22.5 years. This long cycle is counter to the rapid and continuing changes occurring today in the areas of both technology and geopolitics.

Without question, **significant change is required** in the way DOD does its acquisition of goods and services and, to achieve this, the historical data is clear. To achieve significant change, two things are needed.

1. Widespread recognition of the need for change; and
2. Leadership—with a vision, a strategy and a set of implementation actions.

On a positive note, the first of these is demonstrated by the current SASC and HSAC proposals, under the leadership of Senator McCain and Representative Thornberry, for significant defense acquisition reform. Now we need agreement, from the Executive and Legislative branches, on the specific actions required to address the need for **greater security with fewer dollars**.

In the past, the US defense and economic competitiveness strategies have been based on "technological superiority." But today (as shown in figure 1) the commercial and international worlds are greatly exceeding the federal government's expenditures on R&D. Since there is a correlation between R&D expenditures and results achieved, there are many critical national security areas in which the DOD is no longer leading. For example, the French are the leaders in night-vision devices. Also, when the DOD decided to armor their next generation infantry fighting vehicles (since road-side bombs were the No.1 killer of US soldiers and marines in Iraq and Afghanistan), they chose armor from Israel (and the foreign firm agreed to build the armor in the US). Clearly, the Congressional and DOD cut back in the share of the budgets going to R&D must be reversed in order for the DOD to achieve technological leadership in the 21st century.

Under Secretary Frank Kendall stated, in "Better Buying Power 3.0," the "removal of the barriers to buying commercial" is an area that has to change. Figure 2, from the Packard Commission, compares commercial semiconductors to military-specification semiconductors, and shows that the commercial parts are an order of magnitude cheaper, more than an order of magnitude more reliable, and more technologically advanced. But, there are significant "barriers" to commercial firms wanting to do business with the Department of Defense—it is not expected to be a growth market, the profit margins are mandated to be low, and the incredible number of regulations for doing government business drives up costs and also drives away commercial firms. In fact, Figure 3 shows that the Code of Federal Regulations is now around 180,000 pages (and growing by 2,000 pages a year). In 2008, OMB and SBA estimated the regulatory compliance cost to be 1.752 trillion dollars.

In 2005, to test the desirability of using commercial parts (to lower the costs of weapon systems), the Joint Direct Attack Munition, or JDAM (see Figure 4), which is a precision-guided weapon to convert "gravity bombs" into "smart bombs" was allowed to use commercial parts for electronics, sensors, and actuators. The result was greatly improved performance at dramatically lower cost. In fact, an independent cost analysis determined that by using military specified parts the cost would be

[1] Former Under Secretary of Defense Acquisition, Technologic and Logistics, 1997–2001. Currently, CEO The Gansler Group, McLean, Virginia, and also Professor Emeritus, School of Public Policy and Glenn L Martin Professor, School of Engineering, University of Maryland.

$69,000 each, while the actual price, using commercial parts, is $18,000 each. Since the DOD had tens of thousands of gravity-dropped dumb bombs to be converted to smart bombs, the use of commercial parts on JDAM resulted in very significant savings, and the performance greatly improved.

To achieve the required overall DOD objective of "greater capability for fewer dollars," the driving requirement must be **"affordability."** This can be achieved by six specific actions:

1. **Increased competition,** at both the prime contractor level and at the subcontractor level—for the acquisition of both goods and services—with awards based on "best value," not simply "lowest price."

   The benefits of competition, both in performance gains and in lower costs, have been demonstrated over and over—and is the basis of the American economy. Similarly, in over 3,000 examples of public/private competitions for non-inherently governmental work, the average savings has been over 30 percent; but these so-called "A–76 competitions" have been outlawed by Congress. Without a doubt, for all future acquisitions of goods and services, at both the prime contract and subcontract levels, competition must be considered.

2. Greater **civil/military industrial integration** in both hardware and software by removing the barriers to buying commercial

   The JDAM example clearly proves the value of civil/military integration. A second example I might note is the dramatic price increase that occurred when Boeing was forced, by the government, to separate the building of military and commercial transports. Boeing had been building both in the same production facility and achieving lower cost for both by taking advantage of the economies-of-scale from the higher combined volume.

3. Increased **emphasis on funding for innovation.** The fact that both Congress and the DOD have decided to cut the R&D budgets as the total defense budgets are declining, is a clear demonstration of the resistance to innovation (i.e. the resistance to change) and an indication that the US will no longer be able to lead through "technological superiority"—especially, since (as shown in Figure 1) both the US commercial world and other countries are significantly increasing their R&D budgets. However, the DOD must continue to focus on innovation investments in order to stay ahead.

   I might note, at this point, that recent data (as seen in Figure 5) indicates that the greatest source of significant innovation comes from government-supported small-business-innovative-research (SBIR). It is a no brainer that this should continue to be supported.

4. Greater use of **innovative financing techniques** such as leasing and public/private partnerships. Currently many other countries are using leasing as a way to spend less and still get the needed performance. This is a technique we all use regularly; for example, if we need a car somewhere across the country, we do not buy one, we just lease it when we need it.

   In fact, DOD decided to use leasing for the tanker. Unfortunately, there was a criminal personnel scandal (in 2002) which, by the way, had nothing to do with the concept of leasing, that killed the deal. I believe the potential benefits are sufficient to explore the concept again—especially when the leased items have dual-use value, both for commercial and military applications.

5. Greater emphasis on the need to **overcome the institutional resistance to change.** A critical change required is greater use of innovation, with a focus on higher performance at lower costs.

   To overcome the Congressional and DOD's institutional resistance to change, the literature is clear, it takes two things to implement successful change:

   - **General agreement on the need for change.** Today, the HASC and the SASC acquisition reform bills, show that there is widespread agreement on the need for change.
   - Therefore, what is required is legislative and executive branches' **leadership** pushing for the needed changes; specifically, to get more capability for the available dollars—with a focus on the six areas covered herein.

6. A focus on the **education and training of the DOD's acquisition workforce.** The last change required is reform of education and training for the DOD's acquisition workforce. This is clearly recognized in both the SASC and the HASC acquisition reform proposals.

   A 2009 Defense Science Board Task Force found that 55 percent of the DOD acquisition workforce had less than five years of experience and that most of

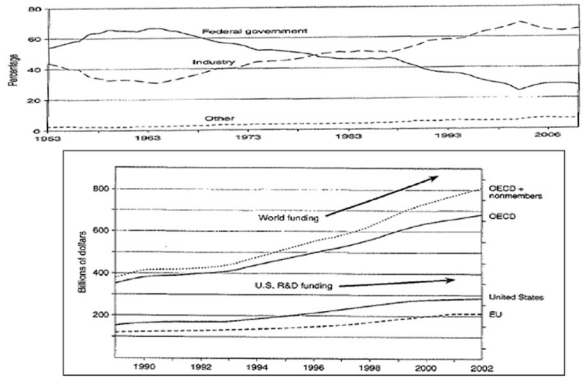
the senior, potential mentors, had retired. For example, in 1990 the Army had five general officers with contracting experience, while in 2009 it had none. Instead of educating the acquisition workforce on compliance with the 180,000 pages of the code of federal regulations, they should be taught about "best practices." Also, instead of solely case studies on the acquisition of prior weapon systems, they should learn with comparable examples of complex commercial acquisitions (faster and at lower costs).

Finally, the DOD acquisition workforce should be encouraged to attend relevant Graduate school classes (at government's expense). The cost is small but the potential benefits are significant.

Senator McCain and Senator Reed, thank you both for the opportunity to express my views on the needed defense acquisition reforms at this critical point in our Nation's security posture.

Figure 1

Research Funding Trends* (critical for Economic Competitiveness and Security Technological Leadership)



*Sources: Top Fig.: David Mowery " Military R&D and Innovation" (University of California Press, 2007); Lower Fig.: National Science Foundation, S&E Indicators 2006; OECD, Main S&T Indicators database, Nov. 2004

Figure 2

Historic Example of potential benefits: at the Parts level: Commercial Vs. Military Semiconductors

For Same Environment and Performance

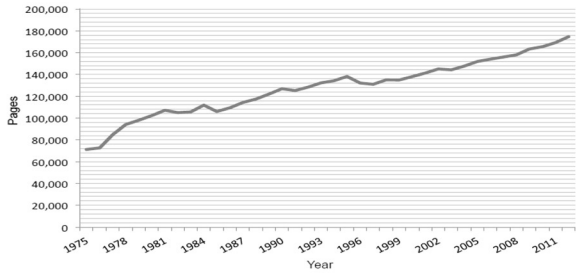
	COMMERCIAL	MIL SPEC
PART COST		
Bi-polar digital logic	$1.67	$15.78
Bi-polar linear	$0.42	$11.40
RELIABILITY FAILURE INDEX (ppm)	0.06	1.9 – 4.6
LEAD TIME NEW PART	1-12 months	17-51 months

After seeing this (and other comparable data) on the "Packard Commission", Defense Secretary Perry issued a Directive for DoD to "use Commercial Specs and Standards" (which has not been followed)

*Sources: "A Quest for Excellence"-"The President's Blue Ribbon Commission Defense Acquisition;" (from Packard Commission), June 1986

Figure 3

Problems in DoD DoD's Acquisitions Caused Increased Regulation and Oversight Increasing Costs and Driving Away Commercial Firms



OMB and SBA estimated Regulatory Compliance costs of $1.752 trillion in 2008 (up from $1.1 trillion in 2005 and $843 billion in 2001)**

Note 1: That the sum of corp. tax and individual taxes in 2011 was $1.402 trillion (far less than the estimated regulatory compliance costs).
Note 2: The TASC/Coopers and Lybrand study of the 18% "regulatory cost impact on DoD purchases" was done in 1994. A 2014 Air Force report said the regulatory cost increase is now 25%.

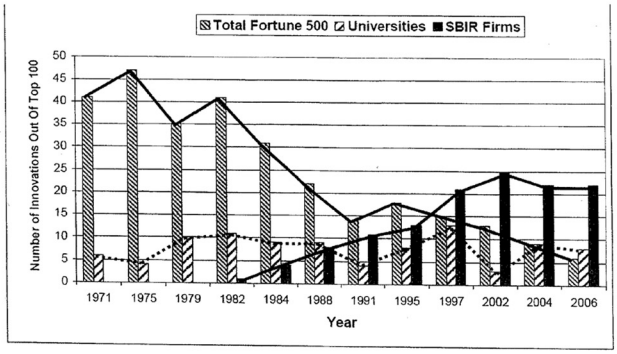
Figure 4

Unit Cost: Military Specification parts: $69,000 each;
commercial parts: $18,000 each

Joint Direct Attack Munition (JDAM)

Figure 5

Where Do Key Innovations Come From?



Source: Testimony of Robert Schmidt, National Co-Chair, Small Business Technology Council: Before the Committee on Small Business, UNITED STATES HOUSE OF REPRESENTATIVES, Washington, D.C. , May 21, 2014.

Chairman MCCAIN. Thank you, Doctor.
Mr. Augustine, welcome back.

STATEMENT OF NORMAN R. AUGUSTINE, COAUTHOR, THE DEFENSE REVOLUTION

Mr. AUGUSTINE. Thank you, Mr. Chairman—it's good to be back—Senator Reed, members of the committee. I appreciate the opportunity to share my thoughts on the defense acquisition process. And I have submitted a statement for the record, Mr. Chairman.

I need to emphasize that I'm appearing as a private citizen, and so the views I express are purely my own.

Chairman MCCAIN. It's never constrained you in the past.

[Laughter.]

Mr. AUGUSTINE. That's true, and it may not today. But, I probably should give a little bit of my perspective. I must confess that I've spent nearly 60 years now in the defense acquisition process, either in it or around it, both in government and in industry. And I've also had the opportunity to work with a number of commercial firms sort of on the side.

In the United States, as you know, we've chosen to have the private enterprise system provide much of our military equipment, as opposed to having it provided in government-owned arsenals and government-operated arsenals. That's not true of much of the world. From everything I've seen, our system works far better than the other alternative. But, the fact remains that there are many complications that go along with that decision that we've made. One of them is that the companies that provide most of our military equipment, not only compete with each other, they also have to compete for talent and for capital with all the other firms in the U.S., whether it's Google or IBM or Intel, or eBay, or whoever. Furthermore, our defense system is necessarily—defense acquisition system is necessarily not true free enterprise, because it's a monopsony. And the sole buyer is a very powerful buyer. That places a huge fiduciary responsibility, not only on the buyer, but on the seller. The buyer, to assure that short-term actions don't harm the long-term sustainability of the industry. And it places a huge responsibility on those who run the industry, because this is not an industry that makes video games or sailboats. We're dealing with the Nation's defense. We're dealing with the lives of our servicemen and -women. A huge responsibility.

Having said all that, arguably—and I think, strongly arguably—the defense equipment that we've had in the past has been such that almost any other nation would have traded theirs for ours. But, the fact remains that the process of producing that equipment has been far less efficient than it could be or that it should be, and that very often that equipment was produced in spite of the system rather than because of the system.

There's probably one fundamental problem that underlies most of this, and that is that we've tried to manage by regulation. Dr. Gansler mentions 180,000 pages. My experience is that the only way to manage is with talented, experienced, dedicated people, and to give those people the authority to make judgments. Yes, sometimes they will fail, indeed. But, the free market says, yes, that they fail far less often than does management by regulation.

In industry, we delegate responsibility. We place great emphasis on past accomplishments, past experience, placing people in posi-

tions of responsibility. And we fire people who fail to perform. None of these takes place in the government, to my experience. Furthermore, in the government, "risk" is considered to be a four-letter word.

How do you fix the acquisition process? Unfortunately, there's no silver bullet. There are a lot of very talented people who have tried in the past. You all know many of them. The—but, there are certain things I think that we've learned, and number one is that we have to have talented people in positions to make judgments, give them the authority to make those judgments, and to hold them responsible. That is, to have consequences.

Furthermore, we should take greater advantage of the immense power in the free enterprise system that's served this country so well in so many areas, whether it be industry or a higher education system or what have you. How do you do that? The fundamental basis of free enterprise is competition. And competition is not always possible, but it's usually possible to some degree. And to make it possible, one needs to have large buys, multiyear buys; one needs to rely, often, on competition at the subcontractor level if it can't be done at the prime level; one also can investigate such approaches as what was used at In-Q-Tel. Mr. Chairman, you mentioned my involvement in setting that up. And it addressed exactly the problem this committee is talking about. And I'm told that it's viewed by many as having been relatively successful.

We need to take advantage of the private sector, commercial sector, and the products that it produces, wherever we can, which would be to a far greater degree than we do. We need to be sure we use appropriate contracting methods. We need to provide funding stability. We need to shift authority from staff to line. That's extremely important, not only in the Defense Department, but in many other departments of the government. We need to totally revamp the requirements process. We need to provide contingency funding. We need to permit talented people, experienced people to move from government to industry, and back. And that could be done without creating conflicts of interest, in my view, but it's rarely done anymore. And I believe we've paid a price for that. People like Dave Packard probably couldn't serve in the government today. We should avoid these conflicts of interest. And I say I think we can. We should emphasize prototyping to a greater extent. We need to fund basic research far more than we do.

And I just would conclude by saying that none of this is rocket science. This is Management 101. We just have to have the will to go do it.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Augustine follows:]

PREPARED STATEMENT BY NORMAN R. AUGUSTINE

Mr. Chairman and Members of the Committee, thank you for this opportunity to share my views on the defense acquisition system. I should emphasize that I am appearing as a private citizen, representing only myself.

In the way of background, my perspective is that of one who has participated for sixty years in defense acquisition at virtually every level and has observed the process from both the industry and government standpoints. I have also participated in over 500 board meetings of Fortune 100 commercial firms concentrating in the energy, manufacturing and consumer products fields.

If one is to seek to improve defense procurement "while doing no harm," recognition of at least ten facets of the environment in which the process functions is essential.

The first of these is that in terms of capability no other nation on Earth would trade their defense equipment for that of the United States.

Second, there is an enormous number of dedicated, talented individuals both within government and in industry who somehow make the system work as well as it does.

Third, in America we have chosen, unlike many other countries, to rely largely upon the private sector, operating as a free-enterprise endeavor, to equip our armed forces; the alternatives being to have government arsenals entirely fill that role or to *de facto* nationalize the industry. Having traveled in some 112 countries around the globe, I have observed nothing that causes me to believe that either of the latter two approaches would in any way be superior. This conclusion of course carries many implications and consequences, perhaps foremost among these is that so-called "defense companies" must compete not only against one another but also must compete for talent and capital against Google, Amazon, Facebook and IBM. This in turn means that the industry's shareholders will demand a competitive return on their investments and that sought-after employees will demand to work in an innovative, creative environment where they have the freedom to excel and contribute.

Fourth, unlike virtually all the rest of U.S. industry, the defense sector operates in a monopsony. Its defense products have in essence but one customer, a customer that makes the rules, interprets the rules and enforces the rules. At the same time, the customer, in this case the U.S. government, occasionally, and sometimes unavoidably, finds itself dealing with a monopoly. If, for example, the government decided it needed one more B–2 bomber there was only one place where it could be practicably obtained.

Fifth, in most commercial businesses a "bad year" means the loss of two or three points of market share. In defense procurement, where major contracts come in rare but enormous quanta, it can mean going out of business. Consider the case of the iconic McDonnell Douglas Corporation being absorbed into Boeing shortly after the former lost the F–35 contract competition.

Sixth, unlike when I entered the industry, the leading edge of most technology no longer resides in the defense industry. The latter was where such things as commercial jet aircraft, satellite communications, nuclear power, GPS, robotics and the internet originated. That was where young scientists and engineers wanted to work. Today, the leading edge of the state of the art and innovation is often to be found in commercial firms, and many of those firms are not eagerly seeking the opportunity to participate in the defense acquisition process—or even with the government in general. A canonical example would be the situation that existed some sixteen years ago when the CIA recognized that the state of the art in its very lifeblood, informatics, had moved to Silicon Valley, Route 128, Research Triangle, Houston and other such environs, places where many of the leaders, probably most, wanted absolutely nothing to do with government procurement policies. Having at that time just retired from my job in industry, I was asked to help address this impasse that was increasingly becoming a danger to our nation's intelligence capability. This led to the establishment of an organization that we called In-Q–Tel, the concept of which was very simple: conduct business on behalf of the government with Silicon Valley and others as they would deal with any other commercial firms. I believe that it is fair to say that this has been an immensely successful endeavor from virtually every perspective.

Seventh, and again unlike when I first entered the industry and the average shareholder held a share of stock for eight years, today that period is four months—and declining. This implies that a firm's owners—including those firms supporting national defense—have little interest in what happens to the firm ten or fifteen years from now. And this, in turn, implies that the government must be particularly mindful of the fragility of the nation's overall defense enterprise and its long-term importance.

Eighth, the industrial foundation of national security is not the defense sector per se, as important as it may be. Rather, it resides in the nation's economy as a whole. Without a strong economy our nation will be unable to afford a strong military with modern equipment. That is a formula for greater casualties in warfare . . . or worse. Numerous studies, including one that formed the basis of a Nobel Prize, have shown that 50 to 85 percent of the growth in America's GDP during roughly the past half century are attributable to advancements in just two fields: science and technology. Yet, in recent years America has fallen from first to seventh place in basic research as a fraction of GDP and from first to tenth place in R&D by the same measure.

China is projected to outspend the U.S. in R&D in less than ten years, both in absolute terms and relative to the economy. The U.S. government now ranks 29th in the fraction of research performed in the nation that is federally funded. We rank 79th out of 93 nations in the fraction of all baccalaureate degrees that are granted in the field of engineering. The nation most closely matching us in this regard is Mozambique. Our 15-year-olds rank 21st in science and 27th in math among the 34 OECD nations participating in standardized tests. It is my view that these factors are far more consequential to our nation's defense than shortcomings of our defense acquisition process, as serious as the latter may be.

Ninth, those individuals and firms who work on projects supporting our nation's defense bear a special fiduciary responsibility that far transcends that of those who operate in the more conventional commercial marketplace. This implies that in some instances these individuals and firms must be prepared to accept special constraints.

Tenth, the defense acquisition process does not function nearly as well as it could or should.

Which brings us to the questions of what is broken and how can we fix what is broken without destroying the system's underlying strengths. I could of course offer a long list of specific actions and in fact have done so on a number of occasions. The problem is that there is no silver bullet—if there were it would have been implemented long ago. But if there is anything *approaching* a silver bullet it is to use wherever possible the power inherent in the free enterprise system that has made America's business, its universities and its innovative process the envy of the world.

But in doing so one is constantly confronted with paradoxes. Competition is the heart and soul of free enterprise, but where limited numbers of items are procured, as is often the case in defense procurement today, at what point does it no longer make economic sense to establish a second producer to maintain competition? When does it make sense to distort procurement policies to promote worthy social goals, such as aiding small businesses? Fixed price contracts make a great deal of sense under many circumstances, say performing serial production, but when applied to risky endeavors, say R&D, only the desperate, foolish or dishonest would bid other than an inordinately, and probably unacceptably high, fixed price. Where is the point in the continuum at which one type of contract or the other no longer makes sense? When relying on past performance to select contractors such as is widely done in the free market, what does one do when the CEO's of the two firms in a major competition suddenly switch jobs—as actually happened on one occasion? Or how does one evaluate a firm possessing no prior record that seeks to enter the market?

The answer to such questions resides in a single word: "judgment" . . . and judgment regarding complex issues is an attribute that can only be found in one place—competent, dedicated, experienced people who are given the freedom to exercise judgment.

This of course means that bad judgments will occasionally occur . . . judgments are made by humans. In the private sector, when particularly bad judgments are made people lose their jobs. In government, when bad judgments are made, nothing happens. Too often when good judgments are made, nothing happens either. In industry people are rarely placed in positions for which they have not accumulated years of relevant experience. This is often not the case in government. Further, there are few people in senior or relatively senior government line-positions possessing any experience in industry; and the converse is also true.

The essence of my message today is the compelling need for a personnel system that delegates authority, rewards success and penalizes failure. This is by no means an original idea. It has been espoused for a half-century by friends of mine such as Air Force General Bennie Schriever, Army General Bob Baer, Admiral Wayne Meyer, and industry executives such as Dave Packard and Kelly Johnson. Virtually every successful major defense program that I can recall has had as its leader an extraordinary individual such as these folks.

But today's policies strongly discourage leaders in industry from serving in government; military officers from going into acquisition; and government civilians from aspiring to hold senior positions in their organizations. (For example, today there are no fewer than 168 presidential appointees—not all Senate confirmed—in leadership roles in the Department of Homeland Security, not all of whom have experience in homeland security.)

If we are to make the acquisition process work more like a business, the first thing we must do is run the personnel management system more like a business. Only then can we get down to lesser matters such as fixing the requirements process, increasing prototyping, milestone budgeting, contingency funding, enhancing competition, shifting management authority from staff to line, providing funding

stability, and encouraging prudent risk-taking. Fortunately, none of this is rocket science . . . it is done every day in the free enterprise marketplace.

Thank you again for permitting me to share my views, and thank you for devoting your attention to this critically important topic.

NORMAN R. AUGUSTINE was raised in Colorado and attended Princeton University where he graduated with a BSE in Aeronautical Engineering, magna cum laude, and an MSE. He was elected to Phi Beta Kappa, Tau Beta Pi and Sigma Xi.

In 1958 he joined the Douglas Aircraft Company in California where he worked as a Research Engineer, Program Manager and Chief Engineer. Beginning in 1965, he served in the Office of the Secretary of Defense as Assistant Director of Defense Research and Engineering. He joined LTV Missiles and Space Company in 1970, serving as Vice President, Advanced Programs and Marketing. In 1973 he returned to the government as Assistant Secretary of the Army and in 1975 became Under Secretary of the Army, and later Acting Secretary of the Army. Joining Martin Marietta Corporation in 1977 as Vice President of Technical Operations, he was elected as CEO in 1987 and chairman in 1988, having previously been President and COO. He served as president of Lockheed Martin Corporation upon the formation of that company in 1995, and became CEO later that year. He retired as chairman and CEO of Lockheed Martin in 1997, at which time he became a Lecturer with the Rank of Professor on the faculty of Princeton University where he served until 1999.

Mr. Augustine was Chairman and Principal Officer of the American Red Cross for nine years, Chairman of the Council of the National Academy of Engineering, President and Chairman of the Association of the United States Army, Chairman of the Aerospace Industries Association, and Chairman of the Defense Science Board. He is a former President of the American Institute of Aeronautics and Astronautics and the Boy Scouts of America. He serves on the Board of Trustees of the National World War II Museum and is a former member of the Board of Directors of ConocoPhillips, Black & Decker, Proctor & Gamble and Lockheed Martin, and was a member of the Board of Trustees of Colonial Williamsburg. He is a Regent of the University System of Maryland (12 institutions), Trustee Emeritus of Johns Hopkins and a former member of the Board of Trustees of Princeton and MIT. He has been a member of advisory boards to the Departments of Homeland Security, Energy, Defense, Commerce, Transportation, and Health and Human Services, as well as NASA, Congress and the White House. He was a member of the Hart/Rudman Commission on National Security, and served for 16 years on the President's Council of Advisors on Science and Technology under both Republican and Democratic presidents. He is a member of the American Philosophical Society, the National Academy of Sciences and the Council on Foreign Relations, and is a Fellow of the National Academy of Arts and Sciences and the Explorers Club.

Mr. Augustine has been presented the National Medal of Technology by the President of the United States and received the Joint Chiefs of Staff Distinguished Public Service Award. He has five times received the Department of Defense's highest civilian decoration, the Distinguished Service Medal. He is co-author of *The Defense Revolution and Shakespeare in Charge* and author of *Augustine's Laws* and *Augustine's Travels.* He holds 34 honorary degrees and was selected by Who's Who in America and the Library of Congress as one of "Fifty Great Americans" on the occasion of Who's Who's fiftieth anniversary. He has traveled in 112 countries and stood on both the North and South Poles of the earth.

Chairman MCCAIN. Thank you.

Mr. FitzGerald.

STATEMENT OF BEN FITZGERALD, SENIOR FELLOW AND DIRECTOR OF THE TECHNOLOGY AND NATIONAL SECURITY PROGRAM, CENTER FOR A NEW AMERICAN SECURITY

Mr. FITZGERALD. Mr. Chairman, Ranking Member Reed, distinguished members of the committee, thank you for the opportunity to speak with you all today. It's a considerable honor. In fact, it's such an honor, I've taken the unusual step of putting on a tie, something I don't normally do.

I offer my remarks today from two perspectives, that of a researcher at a think tank, but also as the former managing director of a small business that worked predominantly for the Department of Defense.

It's a generally held article of faith today that the locus of technological innovation is now firmly rooted outside of the United States Department of Defense in the global private sector. My testimony seeks to unpack this bumper-sticker statement and explore the implications for necessary reforms to our R&D and acquisition systems.

The democratization of technology to a global user base is not new and has been underway since at least the early 1980s. The United States Government cannot arrest this trend. In fact, the Department's R&D budget is higher today, in constant dollars, than it was in the early 1970s. This trend is simply due to the growth of the global economy. Our challenge today is that, despite the efforts of this committee and others across the defense establishment, our implicit strategy and organizational methods for developing military capability remain optimized for a bygone era, and we continue to cling to the methods of past success in ways that unnecessarily disadvantage us.

At a high level, it is helpful to think about this challenge in terms of the alignment between our strategic needs, the technological environments, and our underlying models of doing business. The canonical case for what "good" looks like comes from the increasingly popular second offset strategy.

During the '70s and '80s, the U.S. faced a clear and singular threat, in the form of the Soviet Union. Concomitant with the strategic imperative, the DOD possessed privileged access to critical technical components—microprocessors, computer processing, networking, data compression, GPS, and software—that, when integrated, would yield the precision munitions, ISR [intelligence, surveillance, and reconnaissance] networks, and command-and-control systems that underpin our current military technical advantages. The positive alignment of U.S. strategy, technology, and business during the Cold War meant that the DOD could simultaneously establish a conventional deterrent to the Soviet Union, develop the most capable fighting force in human history, and lock in at the privileged access to enabling technologies through a series of export controls. As if this was not enough, those investments helped establish U.S. businesses that came to dominate entire global industries. We would not have Intel, Cisco, or Apple or the following generation of Internet businesses, like Google and Facebook, without those early investments.

In contrast today, we face a range of rapidly evolving threats and competitors from near-peer powers to nonstate actors, with no one capability providing game-changing advantages across likely contingencies. We face many more technological options to which we might apply our finite resources—AI [artificial intelligence] and automation, big data, additive manufacturing, hypersonics, and directed energy weapons, to name a few. And the U.S. no longer holds a monopoly on emerging technologies with military relevance.

Most importantly, while the DOD budget is still significant and influential, it is no longer compelling. Apple Corporation currently has $203 billion cash on hand, enough to buy Lockheed Martin, General Dynamics, Raytheon, Northrop Grumman, and BAE Systems without having to get a loan. In this environment, it is hard to convince many businesses to build technologies specific to DOD

requirements. Despite these many differences and the work of this committee and others, our acquisition system is still optimized for that prior Cold War environment, creating a misalignment between our strategy, technology, and business.

So, what do we need to do to address this strategic misalignment? Accessing technology, people, and capital from commercial markets will be vital to providing our military with advanced capabilities today and in the future. I commend this committee for its work on the 2016 NDAA, which will make it much easier for the DOD to acquire commercial technology, should it choose to make use of those authorities. The DOD has also undertaken smart initiatives, such as better buying power and establishing a presence in Silicon Valley with the DIUx [Defense Innovation Unit Experimental]. However, commercial technology is available globally, to our allies and our adversaries, alike. Our challenge, therefore, is not simply how better to acquire commercially available technology, but, rather, how to generate and maintain unique military advantage in a global marketplace driven by demand for increasingly powerful commercial technologies.

To achieve this objective will require a more nuanced and varied approach than we have in our current system, which operates on similar principles, regardless of whether you were developing an aircraft carrier or a microdrone. We cannot expect the same market conditions, product life cycles, export controls, or business models to create optimal outcomes for the full range of capabilities we require in our arsenal. We will need to create a business environment that incentivizes the best companies and individuals to help solve our hardest problems. This naturally conjures images of Silicon Valley, an important innovation hub, but we must also include other hubs around the country and the world.

Importantly, reforms to our acquisition system must also incentivize traditional defense industry to innovate and collaborate with nontraditional businesses. Traditional defense industry will be an important conduit to deploy new technology and ideas inside the DOD at scale. This committee can provide the legal basis and strong incentives for the DOD to adapt appropriately. Updated approaches to intellectual property, export control, our requirements regime, and contracting methods would help lay the foundation for a more competitive, innovative, and sustainable set of industries from which the DOD can generate unique military advantages.

Acquisition reform will never have the same urgency as the frequent international crises we face, or garner the same interests as decisions on new weapon systems. And yet, our ability to respond effectively to the crises of today and tomorrow, to generate unique military advantage, and to support healthy industries for the DOD require us to improve our acquisition system. While DOD's recent history does not provide much hope for our ability to change, I believe we have a small window within which we might make significant progress. The leaders of this committee, your colleagues on the HASC, and the current DOD senior leaders are uniquely qualified and willing to take action.

So, in closing, I thank the committee for its work, and I encourage you to continue on your current path of investigation and reform.

Thank you again for the opportunity to speak with you all today.
[The prepared statement of Mr. FitzGerald follows:]

PREPARED STATEMENT BY BEN FITZGERALD

It is a generally held article of faith today that the locus of technological innovation is now firmly rooted outside of the United States Department of Defense (DOD) in the global private sector.

This testimony seeks to unpack this bumper sticker statement to establish its historic context, frame the impact it has on the DOD and, most importantly, explore the implications for necessary reforms to our research and development (R&D) and acquisition systems.

The democratization of technology to a global user base is not new and has been underway since global R&D spending outgrew DOD spending in the early 1980s. There is little the U.S. can do to arrest this trend and this is not an issue of declining spending on the part of the DOD. In fact, the Department's R&D budget is higher today, in constant dollars, than it was in the early 1970s when many of the investments that underpin our current technological advantage were made. Rather, this trend is a function of the global economy and, indeed, there are many benefits to the U.S. in terms of global prosperity.

Our challenge today is that, despite the efforts of this committee and others across the defense establishment, our implicit strategy and organizational methods for developing military capability remain optimized for a bygone era and cling to the methods of past success in ways that unnecessarily disadvantage us.

STRATEGIC ALIGNMENT AND MISALIGNMENT

It is helpful to think about this challenge in terms of the alignment between our strategic needs, the technological environment, and underlying models of doing business. Considering this alignment in the context of the Second Offset Strategy offers a case study in a positive relationship between these factors.

During the 1970s and 1980s the U.S. faced a clear and singular threat from the Soviet Union in the context of the Cold War. In an era of mutually assured destruction, the U.S. required a qualitative technological advantage to 'offset' the numerical superiority of Warsaw Pact forces. Concomitant with this strategic imperative, the U.S. possessed privileged access to the technical components that would enable so called 'information based force multipliers' that would manifest themselves in precision munitions, intelligence, surveillance, and reconnaissance (ISR) networks, and command and control systems. During this period the DOD was the overwhelmingly dominant provider of funding for technology including: microprocessors, computer networking, data compression, global positions system (GPS), and the software required to tie these elements together.

The positive alignment of these various factors meant that the DOD could establish a conventional deterrent to the Soviet Union, develop the most capable fighting force in human history, and lock in its privileged access to the enabling technology through a series of export controls. As if this was not enough, these investments helped establish U.S. businesses that came to dominate entire global industries. We would not have Intel, Cisco or Apple or the following generation of internet businesses like Google and Facebook without these early investments.

In contrast, today we face a range of rapidly evolving threats and competitors from so called near peer powers to non-state actors and terrorists. We also face many more technological options to which me might apply our finite resources: artificial intelligence and automation, big data, additive manufacturing, hypersonics, and directed energy weapons to name a few. The U.S. no longer holds a monopoly on emerging technologies with military relevance. And, while the DOD budget is still significant and influential, it is no longer compelling in the way that it used to be. Samsung corporation's R&D budget is larger than that of DARPA. Apple Corp. currently has $203b cash on hand, enough to buy Lockheed Martin ($70b), General Dynamics, ($45b) Raytheon ($38b) Northrop Grumman ($34b) and BAE Systems ($16b).

But despite the many differences in our strategic and technological environments the DOD largely operates today as though the conditions of the early 1970s still prevail – especially regarding the acquisition of major weapons systems. We establish formal requirements, competitively select a contractor from a relatively small number of businesses, develop and test it over a period of years or decades, and then control access to that technology through a regime of export controls.

This committee is well aware of the myriad implications of this lack of adaptation. I will offer a short example from the world of drones. We are currently unable to

sell armed Predator drones to our ally Jordan due to the provisions of the Missile Technology Control Regime—with China now seeking to take our natural place and sell their drones to Jordan instead. In a prior era, keeping this technology in the hands of the U.S. alone may have prevented proliferation but today, many nations compete in the global drone market.[1] In fact, Israel has supplied over 60 percent of the world's drones since 1985, with the U.S. only supplying 24 percent.[2] This policy decision does not just adversely impact the revenue of U.S. businesses, it makes us less competitive technologically. This was seen in July of this year when the Indian Army rejected the U.S. Raven drone, currently in use by the Army and Marine Corps, as being insufficiently 'futuristic' for its needs.[3]

Yet, the U.S. military and defense industry have been pioneers in the use of drones—no other nation has a stealth drone that can land on an aircraft carrier. This is clearly a problem of law and policy not of military, technical, or business acumen. In a world of rapidly proliferating drones other nations have many avenues by which they can acquire these systems. By choosing not to sell drones to our allies we risk making U.S. businesses less competitive, allowing strategic competitors to establish arms sales relationships with our allies, diminish interoperability, and have less influence over how drone technology is used by others.

THE ADVANTAGES OF COMMERCIAL TECHNOLOGY

The driving force behind this (not so) new reality is the spread of powerful technologies, particularly information technologies, from a handful of government customers to thousands of business customers and now, most potently, to billions of individual users around the globe. Operating at vast scale has rapidly driven down prices while increasing the capability of systems that were highly classified mere decades ago. The global availability of these technologies creates a number of challenges to the U.S. from highly capable non-state actors to competitor nation-states able to proliferate their own military technologies. However, commercial technology is also fundamental to generating and maintaining our military-technical advantage. Specifically:

- **Efficient resource allocation**—Commercial technology is increasingly able to meet demanding military requirements. For information technology (IT), the Department of Defense frequently seeks commercial solutions, ranging from Apple and Galaxy smartphones to enterprise email, rather than developing proprietary systems for basic functions. This trend is increasingly moving from the back office to the battlefield. The government should enhance this approach beyond IT and think creatively about how to quickly adapt a broader range of technologies to various military environments. While the market will not yield a stealthy, armed drone, commercially available drones may be utilized for tactical applications at a fraction of the cost of military models. An effective division of labor that utilizes cheap and readily available commercial products can save the department time, personnel, and money to devote to more challenging, military specific endeavors.[4]
- **Effectively incorporating commercial components in unique military systems**—The Department of Defense, as a long-time user of commercial components in major platforms, is seeking to better incorporate emergent commercial technologies by designing modular military systems. Designing and fielding exquisite platforms and systems is expensive and time-intensive, as evidenced by the long and costly history of the F–35. To accelerate this process, the Better Buying Power 3.0 procurement initiative will focus on agile development and modular, platform-agnostic technologies. Modular design facilitates modernization and avoids situations like the F–22 processor, where software components are rendered obsolete by the pace of technological advances. Analyzing what components can be developed using existing technology can reduce lifecycle costs and ensure the military is positioned to take advantage of technological developments. These initiatives can be taken further by adopting commercial practices, for example in the areas of user experience design or development practices. Updating DOD procurement practices will be the difference between

[1] George Arnett, "The numbers behind the worldwide trade in drones," *The Guardian,* March 16, 2015.

[2] Rania Khalek, "Sixty percent of global drone exports come from Israel—new data," *electronicintifada.net*, March 24, 2015.

[3] Rajat Pandit, "Army rejects US offer of Raven mini-drones for its foot-soldiers," The Times of India, July 18, 2015.

[4] Ben FitzGerald and Katrina Timlin, "Time for a Private-Sector Pivot On Military Technology," WarOnTheRocks.com, May 14, 2015, *http://warontherocks.com/2015/05/time-for-a-private-sector-pivot-on-military-technology/*.

a U.S. military that benefits from commercial innovation and one that is superseded by it.

- **Applying military grade engineering to wholly commercial components**—Commercial components are rarely deployed prima facie as military hardware, but integrating commercially available technology can produce cost-effective systems and platforms quickly. Integrating commercial technology affords U.S. armed forces with advantages in rapid fielding, adaptation, and more varied force mixes, as well as the ability to easily export weapons systems to allies. The Textron Scorpion fighter jet uses only commercial technology, leading to an inexpensive aircraft, that used no DOD research and development funding but is still appropriate for routine missions. The Air Force has additionally integrated multiple PlayStation 3 consoles to build a supercomputer that is not only cheaper, but more energy efficient. Such approaches allow the department to manage cost, innovate rapidly, and stay connected with allies—especially for contingencies with less technologically advanced adversaries—while preserving exclusivity around unique high-end military systems.
- **Commercial tech as a force multiplier for military systems**—Commercial technology can also be deployed in combination with military systems to expand their scope of use. One program that has adapted commercial technology for military purposes is DARPA's Persistent Close Air Support System (PCAS). Using Android tablets, PCAS enables closer coordination between ground and air troops and provides enhanced situational awareness by integrating various data streams and lines of communication for close air support. While currently deployed on the MV–22, DARPA is looking to expand to other air platforms, which is possible due to the modular, software-based PCAS system. This approach extends the utility and lifespans of existing military systems but also imbues commercial systems with military advantages. Anyone can purchase an Android tablet, but they can't use it to call for precision fires in a secure communications environment. The Qinetiq robotic applique kits are another example of imbuing traditionally commercial platforms, in this case a Bobcat truck, with functionality for military applications and missions. Adapting common applications for a military purpose allows the Department of Defense to leverage a tested, functional product in the private domain and adapt it to a military environment.

DOD'S PUSH FOR COLLABORATION

It is in this context that the Secretary of Defense Ash Carter is seeking to improve DOD's relationships with Silicon Valley and other hubs of innovation around the country. This is absolutely the right instinct but for the DOD to benefit in any meaningful way from this collaboration will require policy, legal and ultimately cultural changes in the way we do business. In the period from the 1960s to today, the DOD has gone from being *the* customer for technology to a customer for technology and has not adjusted accordingly. With global R&D spending topping $1 trillion and with abundant venture capital available to startups, the Department's roughly $60 billion R&D budget remains large but far from the only option available.

In an era with ready access to capital, doing business with the Department of Defense often represents too great an opportunity cost for many new and innovative businesses. The Pentagon's investment and purchasing model operates on sales cycles measured in years. Contracts run even longer—the F–22 fighter took more than two decades to develop—with some engineers working their entire careers on a single project. Rigid requirements and testing regimes designed to mitigate risk also mitigate innovation, often to the extent that a company's product would not be competitive or desired by non-DOD users. Worse, these businesses would then have to suffer through prescriptive accounting and compliance requirements, frequent audits and arcane contract vehicles that lock in prices and even profit margins. It is therefore natural for commercial businesses, including startups, to focus on other markets despite the DOD's, and particularly military professionals', burning desire for collaboration.

Without realigning the incentive structures for collaboration the DOD will be unable to take advantage of partnerships with innovative commercial businesses. Worse, the Pentagon's early investments and new technology opportunities will continue to be acquired by Silicon Valley companies, denying DOD the chance to fully capitalize on its own investments. Boston Dynamics, DARPA's leading robotics provider; Skybox, a provider of micro satellites and data analytics; and much of the driverless car technology generated by DARPA's Grand Challenge have all found a more welcoming and sustainable home at Google.

Despite this gloomy outlook, significant potential remains for healthy collaboration between the DOD and commercial businesses. Indeed, smart businesses should want to collaborate because the DOD:

- Remains on the leading edge of technical challenges and has early access to compelling problems. Businesses able to help solve those problems will find themselves in advantageous technical and market positions.
- Is willing to invest in and experiment with immature technology that commercial investors would be unwilling to consider.
- Can provide access to a large, singular user base, particularly active duty military personnel, comfortable with testing and adapting to new technology.
- Owns significant testing facilities and ranges that can provide rare and discreet opportunities to test new technologies.
- Is willing to pay above commercial rates for new technology.
- Can provide capital to startup and small businesses that does not dilute their equity in the ways that seed or venture capital would.
- Provides a sense of purpose, mission and meaning greater than most other industries.

However, for commercial businesses to invest their time and capital into collaboration with DOD they will need to be able to transition their product from a national security context to a commercial one. If we look to aerospace, a related field experiencing similar dynamics, companies like Space X and Blue Horizon are applying innovative practices to the business of private space launch. There are a number of national security benefits to their work but the end game for these businesses is commercial space flight not military satellite launches. If we stifle their ambitions, that capital and innovation will go elsewhere, leaving the U.S. with insufficient launches to justify a robust domestic market for rocket engines and an ongoing need to purchase these engines from Russia.

Without reforming our current laws, policies and acquisition culture create many impediments for commercial businesses that might otherwise wish to capitalize on the natural advantages of collaboration with the Department of Defense.

BEYOND COMMERCIAL TECHNOLOGY

Accessing technology from commercial markets will be vital to providing our military with advanced capabilities today and in the future. However, commercial technology is widely available and therefore cannot provide the U.S. with unique military advantage. In this context, our challenge is not simply how to better acquire commercially available technology but rather how to generate and maintain technical advantage in a global marketplace driven by demand for powerful commercial technologies. This will require an acquisition system that can integrate a mix of military and commercial technologies in compelling ways.

Achieving this objective will require a more nuanced and variegated approach than we have in our current system, which operates on similar principles regardless of whether you are developing an aircraft carrier or a micro-drone. We cannot expect the same market conditions, product lifecycles, export controls, or business models to create optimal outcomes for the full range of capabilities we require in our arsenal.

Additionally, in seeking to take advantage of commercial technology, we must not overlook the important role of defense industry. DOD reforms to compete more effectively in commercial marketplaces is just as important for defense businesses to enable them to innovate and reorient their organizations to focus on growth and technology investment. Defense industry will also continue to play an important role integrating technologies—commercial and military—into capabilities that our services can use. Accessing non-traditional sources of defense technology will be good for traditional defense industry as well.

Left unchanged, our current regime will continue to provide the DOD with strong control over the technology acquired for its own personnel but will make it almost impossible to build technology compelling to a global user base—the key area of focus for the best technology companies.

Ultimately, our acquisition and R&D challenges are strategic, organizational, and cultural in nature and we do not have a strong track record of updating these factors over the last thirty years. That said, I commend this committee for its work on the National Defense Authorization Act of 2016, particularly for the contributions made in providing additional authorities to the DOD for purchasing commercial technologies. These authorities, should the DOD choose to make use of them, provide an excellent basis for purchasing commercial off the shelf technology, a critical aspect of maintaining our technical advantage.

However, to truly and effectively compete in the global market for technology, talent, and capital will require further action. This committee can provide the legal basis and strong incentives for the DOD to adapt appropriately. Most significant will be updated approaches to intellectual property, export control, as well as our requirements regime and contracting methods.

CONCLUSION

Improving our acquisition system will never have the same urgency as the daily crises we face or garner the same interest as decisions on new weapons systems. And yet, our ability to respond effectively to the crises of today and tomorrow, to create compelling options for weapons systems, and support healthy industries for defense require us to improve our methods for developing military capability.

While our recent history does not provide much hope for our ability to change, we have a small window within which we might make significant progress. The leadership of this committee and your colleagues on the House Armed Services Committee combined with the leadership from Secretary of Defense Carter, Deputy Secretary Work, and Undersecretary Kendall are uniquely qualified and willing to take action. I encourage you to do so.

Chairman MCCAIN. Thank you, Mr. FitzGerald. It's a nice-looking tie.

Mr. FITZGERALD. Thank you. I bought it specially.

Chairman MCCAIN. Thank you.

[Laughter.]

Chairman MCCAIN. Thought maybe you had borrowed it. Thank you.

[Laughter.]

Chairman MCCAIN. Colonel Ward.

STATEMENT OF LIEUTENANT COLONEL DAN WARD, USAF (RET.), CONSULTANT AND AUTHOR OF F.I.R.E.: HOW FAST, INEXPENSIVE, RESTRAINED, AND ELEGANT METHODS IGNITE INNOVATION

Colonel WARD. Good morning, everybody.

Mr. Chairman, Ranking Member Reed, and distinguished committee members, thank you for the opportunity to be here this morning and to share some thoughts.

My perspective on acquisition reform can be summed up in two words: constraints work. That perspective is based on my 20 years of service as an Air Force acquisition officer and my research over the past decade. I've observed that small teams who embrace constraints tend to outperform large teams who adopt an expansive mentality of "take your time and spare no expense." It may seem counterintuitive, but, beyond a certain point, there is an inverse relationship between how much we spend on a project and the value of what it produces. I contend that if we want the acquisition community to deliver world-class, affordable systems at the speed of need, we need to establish small teams with short schedules, tight budgets, and a deep commitment to simplicity. We should resist the urge to launch big, slow, expensive programs which inevitably cost more, take longer, and do less than promised.

As I explained in an article about technology lessons from Star Wars, we need to build droids, not death stars. Droids work, death stars keep getting blown up. And this doesn't just happen in the movies, it happens in real life, too. The opening story in my first book, F.I.R.E.," is about a supercomputer developed by the Air Force Research Lab in 2010. At the time, it was the fastest supercomputer in the entire Department of Defense. Remarkably, it cost

less than a tenth of what a typical supercomputer would cost. How did AFRL produce a best-in-class technology on a shoestring budget? They built it out of 1,760 Play Station IIIs, which makes it an interesting story and a funny story, but also an important story.

If the scientists and engineers at the Air Force Research Lab had a large budget for that particular project, what would they have done? They would have bought a standard, typical supercomputer, which would have cost more and performed more slowly than the system they actually developed. Their small budget forced them to pursue a different path, which not only saved money, it also—and I can't emphasize this enough—outperformed every other supercomputer in the Pentagon's inventory. And that is a key point. A constrained approach can help save money, yes, but that's a secondary objective. The primary objective is to ensure we deliver best-in-class capabilities so that our men and women in uniform continue to enjoy unsurpassed technological advantages. As a person who has strapped on body armor and carried a loaded weapon into a combat zone, I take this very seriously. And the data is overwhelmingly consistent. We get better acquisition outcomes, programmatically and operationally, when we take a constrained approach. That's what I mean when I say "constraints work."

So, the question is, How do we build a culture that incentivizes constraint? And the first is to recognize that constraint is not a foreign concept. The Armed Forces are full of people who embrace constraints, who take pride in doing the most when they have the least. And I had the privilege of leading one such team during my final year on Active Duty. There were six of us in uniform, along with a handful of civilian partners. Our $84 million project was one of the smallest in our division, so constraints are relative. $84 million is a lot of money. But, outside experts said this project should take 7 years. My predecessor wisely decided to do it in 2. I took over for the last year. Our first test flight was a month ahead of schedule. We flew twice as many test flights as originally planned. And, when the program ended, I was able to go into my commander's office and report that we were $8 million under budget.

Now, this is not a typical outcome, but it's more common than you might think. And if we want more projects to look like this—world-class technologies, ahead of schedule, and under budget—my suggestion for—is for leaders to seek, support, and celebrate such teams. Take steps to find these high-performing innovators, and support them, and tell their stories. If prominent leaders tell the world, "This is what right looks like. This is us at our best," that will help provide incentives for others to move in that direction, as well.

Look, the U.S. military is fantastic at achieving its goals. Give us an objective, and we will do whatever it takes to satisfy that objective. Military innovators have proven we can deliver world-class capabilities ahead of schedule and under budget when that's the goal. But, acquisition programs run into problems when that's not the goal, when concepts like speed and thrift are dismissed, when they're viewed skeptically or written off as impossible. Acquisition programs run into problems when big budgets are treated as signs of prestige, when long timelines are treated as signs of strategic genius, and when high degrees of complexity are treated as signs of

sophistication. We need to set better goals and incentivize the right things.

If we're going to reform the acquisition system, we must take steps to measure and incentivize three things: speed, thrift, and simplicity. And we need leaders who will seek, support, and celebrate the teams who pursue these goals. And we need to do these things for a very, very simple reason: constraints work.

Thank you.

[The prepared statement of Colonel Ward follows:]

PREPARED STATEMENT BY LT. COL. DAN WARD

Constraints work.

Earlier this year a *study in the Oxford Journal of Consumer Research* looked at the way "resource availability" affects behavior and concluded that scarcity promotes creativity. That is, when people have fewer resources, they tend to exhibit more creative behaviors. The researchers explained that having *less* helps to foster a "constraint mindset," which leads to more innovative outcomes. Abundance on the other hand is correlated with less creative behaviors. The implication is that if we want to foster creative, innovative approaches, we should start by restricting resource availability.

The results of this study match my own experience serving for more than 20 years as an Air Force acquisitions officer, where I observed that limited resources tend to drive innovative outcomes. This study and my experience are also consistent with large body of data on the effectiveness of technology development programs in general and defense acquisition programs in particular. This data shows that small teams with short schedules, tight budgets, and deep commitments to simplicity—in other words, teams with a constraint mindset—are not only more creative but also more effective. Small teams consistently outperform large, unconstrained teams who pursue complexity and adopt a "take your time, spare no expense" mentality.

In other words, we tend to do the most when we have the least.

This is particularly true in the Defense Department. Time and again, military program offices working under tight constraints reliably hit their budget and schedule targets while the technologies they produce contribute significantly to achieving operational objectives in the field. In fact, the military's most important, impactful, and innovative systems tend to come from these small, thrifty, speedy teams. In contrast, when a cast of thousands spends billions and decades, the result inevitably costs more, takes longer, and does less than promised.

It bears repeating: constraints work. They help acquisition professionals deliver affordable world-class technologies that are available when needed and effective when used.

Despite overwhelming evidence that focusing on speed, thrift, and simplicity leads to positive programmatic outcomes *and* outstanding operational performance, the DOD continues to foster an environment where expansive budgets and long timelines are rewarded, pursued, and valued. The predominant culture treats budget overruns and schedule delays as inevitable attributes of advanced technology development programs, if not desirable attributes. This is a flawed belief, based on incorrect assumptions rather than actual data. The truth is that constraints are an important precursor to creativity and innovation. This also means that fiscal responsibility and technical excellence are not incompatible goals.

Specific examples of these dynamics within defense acquisition programs are easy to find and well documented. While this statement does not aim to provide a comprehensive summary of the data, I will briefly refer to a handful of examples while primarily focusing on the overall trend, then provide a specific recommendation for an initiative that would encourage and incentivize a constraint mindset.

Let's begin with a brief look at how constraints work:

1. **Constraints foster creativity.** When time and money are limited, status quo solutions are off the table. Program teams must instead pursue alternative solutions. For example, in 2010 the Air Force Research Laboratory built a 500 TFLOPS supercomputer named the Condor Cluster. When it was delivered, it was the fastest supercomputer in the entire DOD. Remarkably, it cost less than one-tenth the price of a comparable machine and used one-tenth the electricity of a traditional supercomputer. How did AFRL manage to produce a best-in-class technology on such a shoestring budget? They built the Condor Cluster out of 1,760 PlayStation 3's.

The reason they took this approach is clear: they had no other option. They were operating under strict financial constraints. If the scientists and engineers at AFRL had a large budget, they would have simply bought a standard, expensive supercomputer . . . which would have been less capable than the system they actually developed. Instead, their small budget forced them to pursue a different path—which not only saved a significant amount of money, it also outperformed every other supercomputer in the Pentagon's inventory. And that is key. The fact that a constraint mentality helps us save some money is only a secondary objective. The primary objective is to ensure we deliver best-in-class capabilities.

2. **Constraints foster focus.** When time and money are limited, a program team is forced to prioritize and restrict their requirements. They simply cannot afford to do everything and are unable to accommodate requirement creep. This leads to a more focused approach on requirements that matter the most and have the largest impact on operations. There is less clutter (organizationally, procedurally, and technically), less passive engagement, and less social loafing.

   For example, the JDAM famously had *just three requirements* from the Air Force Chief of Staff ("It should work; it should hit the target; and it should cost under $40,000 each."), an approach that provided a very useful sense of priorities and focus to the development team. The resulting system performed admirably and ended up costing approximately $17,000 each, well under the $40,000 requirement.

   Feedback from the field shows that simple, focused systems tend to do more than they were designed to do, while complicated systems with long lists of features tend to underperform. Simple systems tend to be more reliable and less fragile, easier to use and easier to maintain.

3. **Long timelines increase exposure to change.** Over time, new threats emerge and old threats go away. New technologies are developed, new political and economic situations unfold, and new leadership comes on the scene. All of these changes contribute to increase the odds that the product under development will be operationally irrelevant, technologically obsolete, or both by the time it is delivered.

   For example, the F–22 Raptor was intended to counter the Soviet Air Force. However, the USSR collapsed 15 years before the Raptor program declared its Initial Operational Capability (IOC). Because so many things in the world changed between program inception and IOC, the final product was ill-suited for the military's actual combat needs and the F–22 did not fly a single combat mission in Afghanistan, Iraq or Libya. It was even declared *"not relevant"* by the Secretary of Defense himself.

   In contrast, shorter timelines increase the odds of a close alignment between the state of the art and the user's needs. For example, an ISR aircraft known as the MC–12W Project Liberty flew its first combat mission *a mere 8 months after receiving funding,* then went on to fly thousands of missions in Iraq and Afghanistan.

   By constraining the development timeline, programs present a smaller target to the forces of change and increase the likelihood of alignment between what the system can do and what the users need it to do. Long timelines, in contrast, rely on long-term predictions about future needs and amplify any predictive errors.

4. **Delays foster delays.** Extending a program's development schedule or slipping the delivery date creates a vicious circle that necessitates additional delays, because the more time a program spends in development, the more changes it is exposed to (see #3 above). It takes time to respond to these changes, but the world does not stand still while the program office responds. The net result is that *delays cause delays,* and the program ends up presenting a larger target to the forces of change. This ends up adding to the cost and complexity of the system as well as adding to the schedule.

   In contrast, speed fosters speed, and programs which set aggressive delivery timelines have a remarkable tendency to deliver ahead of schedule. For example, the US Navy's Virginia Class Submarine program set an aggressive goal of delivering two submarines for $2B each, every two years (referred to as "2 for 2 in 2"). These firm constraints helped shape the program office's behavior across the whole spectrum of decision making, and the result is that the Navy consistently delivers Virginia submarines months ahead of schedule and tens of millions of dollars under budget. Specifically, in 2008 the USS *New Hampshire* was delivered 8 months early, $54 million under budget. In 2011 the USS

Mississippi was a year ahead of schedule, $60 million under budget. In 2014 the USS *North Dakota* continued the trend, delivering on time and under budget. This is a remarkable achievement and a stark contrast to the previous Seawolf program, which was terminated in 1995 after delivering only three of the planned 29 submarines, each of which cost $4.4B.

Given this reality, why do so many defense programs continue to operate in an unconstrained manner? In large part this is caused by the presence of perverse incentives and an absence of positive incentives. The defense acquisition community tends to be skeptical of constraints rather than guided by the idea that constraints foster quality. The prevailing mindset views complexity as a sign of sophistication, long timelines as a sign of strategic genius, and large budgets as signs of prestige. Quick, simple, low-cost solutions are dismissed as simplistic, hasty, and cheap.

The result is an acquisition environment where large budgets and long timelines are viewed as inevitable attributes of advanced technology programs, and adding time and money to a program is a common problem-solving strategy. While some organizations within the military take pride in accomplishing a lot despite minimal resources (e.g. SOCOM), they are a distinct minority.

Further, the acquisition environment does very little to reward program offices for delivering under budget or ahead of schedule. If a thrifty program ends up with unspent funds, either at the end of the fiscal year or at the end of the program, these dollars are generally transferred to some other project (usually one that is overspending). The team who worked hard to save money receives virtually no benefit aside from a single line in an annual evaluation. The team which is overspending ends up receiving more money.

The good news is that we can improve this situation without having to completely recreate the entire enterprise. In a broad sense, congressional and military leaders can make a concerted effort to seek, support, and celebrate the organizations, programs, and individuals who exhibit this constrained mindset. Find the teams which are already delivering ahead of schedule and under budget, encourage them to continue along that path, and celebrate their achievements in public. Point to them as an example of what right looks like, hold them up as exemplars for other programs to follow, as viable and valuable alternatives to the status quo. Identifying these teams as the top performers can provide a strong incentive to the rest of the acquisition community to follow suit.

Let's look at one specific way to do this, which is entirely allowable within the current regulations. A few small policy adjustments would be sufficient to get things started, and a minor legislative effort could boost it considerably.

GIVE PROGRAM OFFICES "A TIP"

I propose creating an Acquisition Thrift Incentive Program (A TIP), through which Pentagon leaders give program offices a "tip" for good performance. This could be initially implemented on a small number of programs, then expanded to the wider enterprise if proven successful. Here is how that would work.

When a program office delivers a new capability under budget, a portion of the saved funds (nominally 10 percent) would be formally set aside for the team to spend on a project of their choosing. They would be granted considerable freedom and autonomy in deciding how to invest these funds. The available options would vary depending on how much money is involved, but might include the following:

1. Establish an incentive prize on Challenge.gov to fund a relevant technology contest
2. Fund a Small Business Innovation Research (SBIR) effort at SBIR.gov
3. Sponsor a small research project with a university
4. Purchase the necessary hardware (3D printers, etc) to set up and maintain a Maker Space on their local base

The A TIP initiative would grant top performers an opportunity to do more of what they are good at and would equip front-line practitioners the freedom to explore alternatives which might otherwise be overlooked. It would also reward speed, because the longer the program takes to complete, the less likely there will be money left over and the less likely the people involved early in the program will still be involved as the program ends. Focusing on speed, thrift, and simplicity (i.e. adopting a constraint mindset) would maximize the team's odds of receiving A TIP funds. Any funds spent on an incentive prize or SBIR award would likely produce additional low-cost solutions to important needs and would help fill gaps in current plans.

It would be difficult to game this system by inflating initial estimates and budgets, because all the existing incentives would still apply (i.e. low bidders tend to win,

etc). The A TIP concept directly incentivizes the desired outcomes (not merely the desired behavior), as it encourages program teams to deliver capabilities under budget and ahead of schedule.

One important aspect of A TIP is not to add new reporting requirements or excessive restrictions on how the funds will be spent. The mechanisms, reporting requirements, and controls already in place for managing government incentive prizes or SBIR programs should be sufficient. Senior executives should refrain from dictating exactly which program, technology, or endeavor to fund. The idea is to allow the front-line practitioners to decide as a team which areas to pursue.

This is a sensible position to take because if the team was efficient enough to come in under budget in the first place, it is reasonable to suggest that they would be similarly efficient and effective with the A TIP funds. The program will still comply with all the accountability requirements associated with the particular contracting vehicle or channel, but should be given wide latitude within those boundaries.

Let's consider an actual example. From January through November of 2014, I was the program manager for the Dismount Detection Radar (DDR) program, an $84M effort to develop a new radar system. When we finished the effort and closed out the contract, our thrifty approach meant we had $8M in unspent funds to return to the government. Under an A TIP initiative that provides 10 percent of the savings to the program office, the DDR team would receive $800,000 to invest and manage (approximately 1 percent of the program's original budget), while the Air Force would retain $7.2M. This is the very definition of a win-win-win situation.

With $800,000, my team could have funded several small experiments via SBIRS, as well as a handful of incentive prizes at Challenge.gov. There would likely have been money left over to send the whole team to a technology conference or to pay for formal training at a place such as the University of Tennessee's Aerospace and Defense division or Georgia Tech's Contracting Education Academy.

The benefits of this program include:

1. Increased incentives to adopt a constraint mindset.
2. Increased incentive to complete programs under budget and ahead of schedule.
3. Increased morale among program offices as they are granted autonomy to experiment with the A TIP funds.
4. Increased training opportunities for the workforce with no additional funds needed.
5. Increased opportunities to pursue disruptive innovations and alternative technologies, suppliers, and methods via SIBR.gov and Challenge.gov.
6. Increased access to innovative solutions (incentive prize winners and SBIR awards).

One potential barrier to implementation is the legislative restriction based on "color of money" and fund expiration dates, but this is easily overcome. For starters, there are plenty of opportunities to use the saved funds within the original funding category and timelines. A team that saves R&D funds could simply put their 10 percent towards an additional R&D effort, staying within the category of the original budget. The fact that they are not allowed to spend those funds in a completely unrestricted manner would likely have a minimal impact on the incentive nature of the A TIP initiative. However, it would also be possible to establish a simple mechanism to convert the A TIP funds (which will inevitably be a small portion of the original program budget) into "colorless money," which does not expire and could be used in a wider range of situations.

CONCLUSION

There are many ways for military and congressional leaders to provide a strong, creative, empowering incentive to encourage acquisition professionals to adopt a constraint mindset. The A TIP idea is one such method that seems particularly promising. It is designed to help our best performers do more of what they are good at and is likely to convey a rich benefit to the acquisition workforce and the armed forces as a whole.

Launching such an initiative would be a matter of issuing a Department-level policy, as the majority of the actual mechanisms necessary are already in place. The first step is to launch A TIP as a small pathfinder program, available to a select group of programs. If it succeeds in delivering the desired results, it could then be rolled out on a larger scale. The initial A TIP programs might focus on leveraging existing legislative mechanisms, and over time additional opportunities could be introduced through the legislative process (i.e. changing color of money).

Lt Col Dan Ward, USAF (ret) is the author of The Simplicity Cycle: A Field Guide To Making Things Better Without Making Them Worse and F.I.R.E.: How Fast, Inexpensive, Restrained, and Elegant Methods Ignite Innovation. He holds three engineering degrees and served in the U.S. Air Force for over two decades as an acquisition officer before launching Dan Ward Consulting LLC. He is a Cybersecurity Fellow at the New America Foundation and a Senior Associate Fellow at the British Institute for Statecraft.

Chairman MCCAIN. Thank you.

Silicon Valley seems to be a place where innovation and quick turnaround and quick progress on their products is the order of the day. And we continue to see new products, new advances in information technologies, new ways of communicating. And therefore, many of us, including the Secretary of Defense, have tried to involve and engage Silicon Valley more in the issue of acquisition. And also, the attempts, at least, have been made to help us with this challenge of cyber. And that part, we seem to be at somewhat odds, but—so, we formed up In-Q-Tel. That was a CIA [Central Intelligence Agency] operation, and seemed to be very successful. It provided funds for startups, which have—many of which have been successful. And I think it's quite a—really remarkable progress in the area that we are looking for and engaging Silicon Valley, who I think we all know are not particularly interested, because of the constraints which the witnesses just described. But, then we had DIUx, and that seems to be a tour guide for government officials that visit Silicon Valley and matchmaking—and vastly different from what In-Q-Tel has done.

So, I guess my overall question to you is, How do we engage Silicon Valley? How do we really adopt some of the practices, which obviously have astounded and led the world, and employ some of those, at least in our reform—our efforts to reform the acquisition process?

I guess we'd begin with you, Dr. Gansler.

Dr. GANSLER. Well, the——

Chairman MCCAIN. And what role does Silicon Valley play in that effort?

Dr. GANSLER. I think what Secretary Carter started there was the right thing to be considering, is to try to come up with some innovative, nontraditional approaches, you know, because clearly we've had some great success with the Small Business Innovative Research Program. And that probably, right now, is being emulated around the world. Other countries are trying to copy us, because we've had such success with the SBIR program. And the same concept is behind the move toward Silicon Valley. And what we're trying there to do is to, again, think about, How do we get disruptive things done? I mean, you mentioned, earlier, unmanned systems. And that's an example of where there's enormous cultural resistance to introducing some of these new ideas. And we have to continue to fight that.

I mean—I'll give you an example again. I like to use examples wherever we can. The Global Hawk is an example of that, where, if you remember, for 2 years in a row, while I was Under Secretary, the Air Force refused to fund the Global Hawk, because it was an unmanned airplane, and that was countercultural to the Air Force culture of pilots. And so, the—we—I actually had Bill Cohen send a note to the Air Force saying, "Fund the Global Hawk." And they

did fund it, but then they got back at me by saying the person sitting at a desk in Las Vegas flying an airplane over Afghanistan must be a rated pilot. So, what we had to do was to spend a million dollars to get that person to be trained as a pilot, each—you know, for each person. And then, when you realize it, those people didn't want to sit at a desk anymore, they wanted to fly airplanes, so we had trouble trying to get them to stay as the remote piloting systems.

Chairman MCCAIN. Could——

Dr. GANSLER. And there's an example, it strikes me, that what we need is something like the innovation that comes out of the Small Business Innovative Research Program.

Chairman MCCAIN. Thank you.

Dr. GANSLER. It's a self-sustaining program. It—by the way, it often has this—the people from the universities involved in that. They're, in many areas, ahead of the technology.

Chairman MCCAIN. Thank you.

Mr. Augustine.

Mr. AUGUSTINE. Yes, I think there are two characteristics of Silicon Valley that are particularly important. One is the willingness to take risk, and the other is that young people getting out of college today, where do they want to work? They want to work in Silicon Valley; whereas, when I first got out of engineering school, where you wanted to work was in the Defense Department, because the latter was where the state-of-the-art was, the excitement was.

You mentioned In-Q-Tel. I—my experience with that was in 1998. George Tenet was head of the CIA, and George called me. I had just retired from my other job. The—George said that they were having a terrible problem at the CIA because they were totally dependent on the information industry, that it was their—their lifeblood, obviously, is information. But, the state-of-the-art had moved from defense contractors to Silicon Valley. And the Silicon Valley wanted absolutely nothing to do with the government, particularly the CIA—and asked what we might do. And, anyway, a group of us got together, and we decided maybe what we should do is form In-Q-Tel. And I was the first chairman of that. And the model is extremely simple. What——

Chairman MCCAIN. But, DIUx has not followed that model.

Mr. AUGUSTINE. I'm sorry?

Chairman MCCAIN. But, the Department of Defense, DIUx, has not followed in the In-Q-Tel model.

Mr. AUGUSTINE. No, it's totally different approach. And the In-Q-Tel model was simply to deal with Silicon Valley as other commercial firms——

Chairman MCCAIN. Right.

Mr. AUGUSTINE.—deal with each other not as the Defense deals with you—Department—deals with you. And so, through great courage of the people at the CIA, we created an outside organization in the private sector, not for profit, and we were given the authority to grant contracts, to give grants, to take equity positions, and to make decisions overnight without competition, whatever we thought was the best interest of the government. And we did it.

And I might add, sir, we spent the first 2 years being investigated by every IG [inspector general] in the world, but——

Chairman MCCAIN. Could——

Mr. AUGUSTINE.—once they became convinced that we were sincere in our belief, In-Q-Tel, I think, has been an enormous success. And I would think, just maybe there's some prototype of In-Q-Tel that could be adopted by the DOD. I wouldn't suggest you could develop aircraft carriers with In-Q-Tel, but I think there are a lot of things you can. And I would encourage thinking about a prototype version of it.

Chairman MCCAIN. Thank you.

Mr. FitzGerald.

Mr. FITZGERALD. Senator, I think that the way to engage Silicon Valley is by solving hard problems with mutual benefit. If we're able to align our interests and Silicon Valley interests, help them kick off new work on new ideas and hard problems, let them innovate rapidly, and then if we have the ability to purchase those solutions commercially later and allow them to pursue a global commercial market, things will line up neatly.

I agree—I almost always agree, unfortunately, with Mr. Augustine, we're not going to see a Google aircraft carrier or the Apple iBomber. The Department of Defense shouldn't try to become Google. It's not—that would not work, and it would be a bad idea. But, if we align——

Chairman MCCAIN. But, in the area of cyber, which is a major challenge, it's seems to me that we could have some alliance there.

Mr. FITZGERALD. Absolutely, we can, although I note that Silicon Valley thinks about information security and information risk in very——

Chairman MCCAIN. I know.

Mr. FITZGERALD.—different ways. So——

Chairman MCCAIN. I'm very aware.

Mr. FITZGERALD. But, we can—but, I think that we can line that up. I think a good model for what "good" looks like here is if we think about SpaceX. So, SpaceX, in the aerospace industry—and I have some writing about this in my written statement—they're supporting NASA [National Aeronautics and Space Administration] through commercial spaceflight. They're not interested in going after ULA's satellite launch business. They want to do commercial spaceflight. But, in the interim, NASA can benefit from commercial practices, and the United States will develop—will redevelop a healthy space industry. If we don't allow organizations like SpaceX and BlueOrigin to get into this environment, we're not going to have a sufficiently healthy space industry to build our own rocket engines, and we're going to have to keep buying them from the Russians. So, we can't—despite the fact that I agree with—that we need constraints, we can't constrain Silicon Valley to a purely DOD market. We need to find common interests and leverage those, and then let them go do their thing outside of that.

Chairman MCCAIN. Thank you.

Colonel Ward, briefly. I'm way over time.

Colonel WARD. Yes, sir. When I was on Active Duty, I actually had a very successful engagement with a nontraditional company from Silicon Valley. The reason they were interested in working

with us is that we had a—an interesting series of small, quick, rapidly developed and rapidly delivered new capacities. Look, Silicon Valley looks at the big traditional acquisition programs, and they get uninterested because the pace is so slow and the bureaucracy so heavy. They want to deliver something quickly, not just because they are interested in speed, but because they know speed works and they know that long timelines increase the risk of delivering something that's operationally irrelevant, technologically obsolete, or both. And that's the type of risk that we don't want to pursue. So, by keeping the timelines short, we can make ourselves more interesting and more engaging to the Silicon Valley folks.

Chairman MCCAIN. Thank you.

Senator Reed.

Senator REED. Well, thank you very much, Mr. Chairman.

Let me start with Colonel Ward and go down. And the general topic are the service contracts. You know, usually when there's a front page story, it's about overrun on a system—a land-based system, an aircraft, or something. But, there's so much money being devoted to service contracts—and Mr. Gansler referred to one of the constraints already—but your insights about how we can get our handle on these service contracts to be more efficient, more effective, and hopefully free up dollars for other higher priorities. And, Colonel Ward, you start, and we'll go right down.

Colonel WARD. Yes, sir. So, a couple of years ago, the Air Force announced that they were spending more money on service projects than they were on, you know, traditional R&D and technology-type things. So, it is a huge amount of money. I think one of the first steps is to not treat service contracts that same as we treat contracts to build an aircraft, for example. However, I think a lot of the similar constraints can apply. Rather than assembling a cast of thousands, I think we're better off with smaller teams. And I think if we sort of modularize these service contracts—again, this idea of centralized—centralizing everything in one big service contract to rule them all—the economies of scale that were promised never seem to emerge, the efficiencies that are supposed to come along with those never quite happen, because the bureaucracy just gets so heavy when we're managing that. Large numbers of small teams have their own challenges, and none of this is easy. But, large numbers of small teams, I think gets you better results than a small number of really large teams.

Senator REED. Thank you.

Mr. FitzGerald, please.

Mr. FITZGERALD. Senator, I don't have much more to add on top of Colonel Ward's excellent points. The only thing that I would add is: shorter duration allows for continued competition; and we need to ensure that there are strong incentives for these companies to continue to compete for that business. They can't view them as an annuity business which just allows them to generate revenue in perpetuity.

Senator REED. Very good.

And Mr. Augustine.

Mr. AUGUSTINE. Senator, everything I have seen with regard to service contracts or hardware contracts is that the successful ones always have somebody at the leadership position who has author-

ity, who has the willingness to put their career on the line, who has experience at what they've been asked to do. And I think it comes down to leadership, with people.

Senator REED. And that leadership would be in the company or in the Department of Defense, or both? I agree with you.

Mr. AUGUSTINE. I—it's obviously both, but the real issue, I think, is in the Department of Defense. The way we've filled many of the leadership positions really discourages people from joining the Department of Defense today.

Senator REED. There's another aspect of this, too, I think, in terms of—sometimes you have to plug the gap at the middle and lower level with contractors, because of the reason you point out. You cannot attract, as you did 30 or 40 years ago, you know, the very best to go in for a career in the Department of Defense. Is that another problem we have in—we have to deal with?

Mr. AUGUSTINE. I think it is absolutely a problem. And in my mid-career, when you—it was during the Cold War—when you were asked to take a position in the government, even if it meant a huge pay cut, you took it. Today, I know of jobs that a dozen people have turned down, senior positions in the government. And I think we pay a great price for that, sir.

Senator REED. Thank you.

Dr. Gansler, please.

Dr. GANSLER. Well, the most obvious place where I think this would be applicable to your point about services is in the information technology area. I mean, the example that I think would be appropriate here is a comparison between FedEx, UPS, and Department of Defense logistics systems, where FedEx and UPS have total asset visibility, but the DOD doesn't have that. That's inexcusable. It seems to me that we should be learning how to take advantage—I mean, right now, our IT systems tend to follow the same rules as building a tank. And that's not sensible. I mean—and that's one of the main areas I think we have to address, is the information system technology acquisition, and how to take full advantage of what commercial technology is doing in the IT area today; for example, that logistics case I just gave you.

Senator REED. Just one follow—a quick point—is that, you know, we've come to realize that information technology is a double-edged sword. It moves things around very quickly, but if you can get into that system, you can stop everything in a moment. So, part of what we're—we want to do is emulate what they do, but also make sure it's invulnerable to penetration, I would presume. Is that fair?

Dr. GANSLER. Correct. No, that's—right now, we're becoming increasingly vulnerable, and that's the danger in the system. And it's been demonstrated with that OPM attack recently. And it's very clear that—when people were talking, a few minutes ago, about supercomputing, that the number-one supercomputer in the world today is actually the National University of Defense Technology in China. And it's obvious that they are focusing on the software aspects of that. And, by the way, when I toured that facility, those were all American parts in there. There's a globalization of parts. And—but, it's clear that their focus is on the software side of that. And so, other countries are going to be—not just countries, but people—are going to increasingly be attacking our systems. And it

makes them more vulnerable as we become more dependent on cyber.

Senator REED. Thank you.

Thank you, gentlemen, very much.

Thank you.

Chairman MCCAIN. Senator Inhofe.

Senator INHOFE. Thank you, Mr. Chairman.

I've been waiting for the right panel to come along for several years now. So, I'm going to only ask one question, and I'm going to carry you through. And it's something that's very personal to me, because I was elected to the Senate in 1994. My first year was 1995. In 1995, they came up with the idea that we've had the old Paladin system for many years. It's old World War II technology. And we needed to have something that would really be substantial, really protect our kids out there. And they came out with the Crusader. That was 1995.

In fact, let me get the timeline down here so I'm accurate on it. In 1995, it's when they approved the—to commence the program. And the first prototype—this is the Howitzer—was—and you're all familiar with this, of course—was in the year 2000.

Then, in 2002, after some $2 billion had been spent, it was terminated. Now, I'm a Republican, I'm conservative, but I can't blame the Democrats on this, because this was done with Rumsfeld in the Bush administration. In fact, it was so seriously considered that one of—you remember the Congressman, J.C. Watts, he actually retired from the House of Representatives because he was so upset with spending 7 years on a program and then dropping the thing. And at that time, $2 billion seemed like a lot.

Well, then we go through with this thing, and carry it through. And they say, "All right, we need to have something that's lighter." The Crusader started out at 65 tons, ended up at 40 tons. They went into bringing it down to 18 tons. They said, "No, that's not heavy enough to offer the protection that's necessary, so let's"—we dropped that program, started the NLOS Cannon, none-line-of-sight cannon. That was one that was—they brought down to 18 tons because they wanted to make sure they could transport it on a C-130. And so, we went through this—all of this program. And finally, at the end of a period of time, they went into—that was part of the FCS program, then they dropped that one. As the Chairman mentioned in his opening remarks, that was a $20 billion program that we had already spent on that.

Now, the interesting thing is, they brought the weight down. We're now going back to a part of an improved Paladin, the PIM system. And what's the weight of that? It's right back up to where the Crusader was. It's 40 tons.

Now, what I'd like to ask you—and I know you can't do it in here—I'd like to have your opinions on the record, later on, getting around to it, as to how we went through that chronology, that transition.

Senator INHOFE. Because you start a program, the requirements really didn't change that much, because the requirements were, "It's got to be transferable, it's got to be mobile, and it's got to offer the protection." And other than the fact that we had different systems down there, we're going right back to one that offered essen-

tially the same protection that—in the final years of the Crusader. Do you have any comments now about just that one combat vehicle that we've gone through in that period of time? In your—and in your opinion. Is it because requirements changed and then didn't we end up where we started?

Dr. GANSLER. Well, I think one of the things we should start to think about is making affordability a requirement. Because it's very clear, if you think about Lanchester's Law, that—you know, of total force effectiveness is proportional to individual weapon effectiveness times numbers squared.

Senator INHOFE. Yeah.

Dr. GANSLER. And so, the question is, Are—is it affordable to get the numbers we need? And therefore, that's the unit cost. Why isn't that a requirement?

Senator INHOFE. Yeah. Well, let me do this. Because I'm out of time anyway. If you all wouldn't mind tracing that through, that little history through for me. And I'd like to be—very much to have your comments on how we ended up in that situation.

Senator INHOFE. Thank you, Mr. Chairman.

Chairman MCCAIN. Senator Heinrich.

Senator HEINRICH. Thank you, Mr. Chairman.

I want to return, if I could, to something that both Mr. FitzGerald and Mr. Augustine have brought up a couple of times now, and it's just how much things have changed since even I got my engineering degree, back in the early to mid-'90s, where people really tracked to working in DOD, working in our National Labs, because of the attractiveness particularly of the problems. It was seen as the place to be. And I saw that change very quickly as I left and went to work as—for a contractor at Air Force Research Labs, how quickly Silicon Valley and other innovative tech clusters around the country became the place to be for the talent coming out of our engineering schools, in particular.

Some of that is based on the problems that are being put forth. People want to work on the things that really make them excited, that are difficult, where they feel like innovative solutions are going to emerge. Some of that's also cultural. And you see this anytime you—you know, if you go and tour some of the innovators at Silicon Valley, and the culture of workplace is so dramatically different than, you know, what I experienced at Air Force Research Labs. And that is something that has an enormous draw for engineering and STEM [science, technology, engineering, and mathematics] talent coming out of our universities today.

What can we learn, in terms of inserting some of those cultural elements into what is obviously a slow-to-change and rigid and, in many cases, for a reason, culture of DOD?

And, Mr. FitzGerald and Mr. Augustine, in particular, I'd like to get your thoughts.

Mr. AUGUSTINE. Well, it's a great question. And I think there are examples within DOD that do exactly what you describe. DARPA [Defense Advanced Rsearch Projects Agency], ARPA-E [Defense Advanced Rsearch Projects Agency-Energy], In-Q-Tel could attract the very best people coming out of college today. Whereas, many of the more established, rigid organizations can't. And I think the difference is the culture or the freedom to do things. And I'll cite the

example of my son, who is an engineer. Went to work for a company—not the one I was involved with—and was working on a defense contract. And he and these young engineers were told how very important this was. They worked through the Thanksgiving holidays. He went to work on Christmas Day. Early in January, the customer decided they really didn't need this after all and canceled the program. Well, those kids all got out of the defense business and headed to Silicon Valley. And so, it's a cultural issue. And this issue of the lack of stability is something that costs us a great deal.

Mr. FITZGERALD. I agree, this is a great question.

I'd come back to how we frame the problem. Part of the challenge is that we frame problems in really boring or esoteric ways. So, if I give a short example. The Secretary of Defense, when he was in Silicon Valley, talked a lot about GPS, and rightly so. If I described the problem to you in military technical speak, I would say, "We face an ongoing challenge of, How do we maintain persistent precision timing in navigation in A2/AD [anti-access/area-denial] environments against a near-peer threat specifically in the South China Sea?"—at which point most people under the age of 30 are in a microsleep. If we say, "I'm talking about the future of GPS that does not require expensive satellite technology, that would revolutionize how every mobile handset on the planet operates, and then all the opportunities that come from the apps that you'll build on top of that," that's a compelling and interesting problem to go after. So, we need to frame it, and then we need to let people go directly to the problem.

Most of the folks I speak to in Silicon Valley would love to work on an actual military problem. If they get to hang out with marines in a quonset hut in the desert, that's a good time. What they don't want to do is sit in an office park somewhere in Northern Virginia and do a capabilities-based assessment for 3 months. So, if we can keep things—if we can operate on short timeframes, I think we can make it more interesting. Overall, I think that this is one of those sort of addition by subtraction. Remove constraints, in terms of unnecessary bureaucracy, let people go at the problems, and they'll want to do it.

Senator HEINRICH. Thank you both.

I want to, with the remainder of my time—and this is for anyone on the panel—How much of these challenges just result from sort of an inherent bias towards sort of exquisite one-off solutions at the cost of off-the-shelf solutions as a result of the sort of regulatory process that we've created?

Mr. AUGUSTINE. Well, your question, really, I think, points to the requirements process, which, in my view, is a fundamental part of the problem that we face. The requirements process is very sterile, very formalized, lacks feedback, lacks financial input. And I think that—I won't take a lot of time, because we don't have it, but I—the first thing I would start doing would be to change the way we do requirements.

Senator HEINRICH. That's very helpful.

Thank you very much, Mr. Chair——

Dr. GANSLER. My comment on the——

Senator HEINRICH. Oh. Hello.

Dr. GANSLER.—GPS—I didn't realize I was going to turn the lights off, but—I mean, it's—but, your example of GPS is an interesting one, in the sense that one of the things we might look for is dual-use capability in some of these innovative ideas.

Senator HEINRICH. Right.

Dr. GANSLER. I mean, it's very clear. At the time when GPS was started, I was responsible for electronics R&D. And what was interesting about that is, both the Navy and the Air Force separately came to me and wanted their own satellite navigation system. I suggested to them they're using the same earth. You know, it doesn't seem to me it makes much sense, because it was so expensive. And why do you need a separate one? You know. And—but, it—obviously, it had lots of commercial application. So, if you were thinking about what career you want to go into, you would want to go into something that had both dual-use. And a lot of the things we've talked about today are dual-use kinds of things. And so, you might think about it in that model rather than simply saying something that's unique for defense. In the past, where defense was always ahead, it's no longer the case.

Chairman MCCAIN. Senator Rounds.

Senator ROUNDS. Thank you, Mr. Chairman.

Gentlemen, I'd just—what I would like to do is a little bit of an exercise. Based on a series of premises, I'd like you to rate and suggest to us, as policymakers, better ways to provide specific guidance.

Let me just lay this out. I'd—the old comic strip story of, "We have met the enemy, and the enemy is us." It sounds as though, in this particular case, when you have laid out for us the challenges that you've seen, it comes back down to the policy that has been established. And let me just work my way through this for just a second.

Dr. Gansler, in your testimony, you've noted the incredible number of regulations for doing government business. You've indicated 2,000 more pages are being added of regulations, 180,000 already in place. I think currently the total cost for regulatory compliance to the United States is up to about $1.9 trillion today, and climbing.

Mr. Augustine, you talk about the fact that, in the private sector, when particularly bad judgments have been made, people lose their jobs. In government, when bad judgments were made, nothing happens. You've also identified, earlier in our conversations today, the fact that there was a time, when someone asked someone to go to work in a government agency to help, people said yes. Today, we have those positions open, and we're having a tough time filling them. There's a reason for it.

When we talk—Colonel Ward, in your testimony, you comment that, time and again, military program offices, working under tight constraints, reliably hit their budget and schedule targets while the technologies they produce contribute significantly to achieving operational objectives in the field. And then you lay out the fact that constraints work.

It looks to me, though, that when we sit back and we look at the actual products that have been established, whether you talk about an F-22, where you talk about the total number of dollars invested

in the development of the program, and then, midstream, we end up with less than 200 aircraft operational when we're all done. Look at the F-35, where the challenge of developing it is one thing, and yet we're going to debate how many we actually build. We have an LRSB, which is under development today, and yet the cost of it will go up unless we commit to the number of aircraft that we're actually going to build.

At some stage of the game, when we look at all of these different issues, they all point back to policy, which is either being changed in midstream or there is not accountability demanded, or it appears as though, when we do see something wrong, the first thing we do is, is we jump back into this thing to say there ought to be a law to stop it from happening again, none of which seems to be working very well.

So, if I could, would you each just, in—briefly as you can—lay out for us one or two items that you think would be critical as we move forward that we could do, as policymakers, specifically to help the Department of Defense to actually be able to comply and to become more efficient, things that we could either stop doing or things that we should be doing as policymakers.

Colonel WARD. So, a program with a long timeline presents a larger target to the forces of change, whether it's legislative change, changes in the threat environment, changes in the technology environment, changes in the economics or the politics of the thing. So, anything we can do to incentivize and reward shorter timelines will help provide that stability, in terms of requirements, legislative requirements, all these things. So, we start sort of by measuring it. And if we're really legislatively, you know, saying, "We must measure not just how much time we're—we spend, but how much time we plan to spend"—because a lot of times, when we plan to spend a long time, we end up spending even more; when we plan to spend a short amount of time, we end up spending even less.

One of my favorite examples is the *Virginia*-class submarine. My friends in the Navy have done a fantastic job with the *Virginia*-class subs. I have some numbers here. The—in 2008, the USS *New Hampshire* delivered 8 months early, 54 million under budget. In 2011, the USS *Mississippi* was a year ahead of schedule, 60 million under budget. So, on the order of a year ahead of schedule, on the order of tens of millions of dollars under budget for something as large and expensive and complicated as a nuclear-powered sub. The reason they did that, they set a goal: two for two in two. Two subs, $2 billion every 2 years. And then they said, "Not a day more, not a dollar more. In fact, we expect you to beat these timelines." And $2 billion is a lot of money, but compare that to the Sea Wolf submarine, which was $4.4 billion—that was the one that came before and was canceled—it's less than half the price of the Sea Wolf. It can be done, even on something as big and complicated as that, by setting these tight constraints. Things like two for two in two, which is a nice, handy bumper-sticker, but there was deep engineering beneath it, as well.

Senator ROUNDS. Got it.

Mr. FITZGERALD. I'll pick two things. The first would be export controls. I think that we should blow the current system up and

start again. It made sense in an era when we had access to unique technology that we needed to protect. But other people have this technology already. The great example is our desire to sell drones to Jordan, an ally of ours. We sell them F-16s. Thanks to MTCR [Missile Technology Control Regime], we can't sell them drones. In the past, that would have meant they didn't have any. Now they're buying, or they have the opportunity to buy, Chinese drones that look suspiciously like our drones, and we have fewer means by which we control—we can influence the way that the Jordanians use them. And, at the same time, our businesses are not as competitive globally because they're not able to sell drones as frequently. I think that's a huge—one way we can just start again.

I would also—while it's not legislative, I would encourage the committee to establish incentives whereby we can start many more programs, each of which is smaller and shorter. That will mean that we have less risk in each program and we can shoot things earlier, and they won't be trying to move requirements onto one big megaprogram, as we've seen with all of the failures that we've been talking about today.

Senator ROUNDS. Thank you.

Mr. AUGUSTINE. Two things that I think the Congress could do to address the issue you raise. One would be to provide the Defense Department with a 10-year planning budget that you update every year, and require that all new starts fit within that budget. One of the problems is that we start out approving programs one by one, in isolation, and we don't fit together the total cost. And so, we start out to build a—I've forgotten how many B-2s, but we wound up building 21 of them and then wondered why they cost so much. So, if the Congress provided a planning budget, kept it up to date, that would, I think, be very helpful.

The second is to make it very much harder to start new programs and very much harder to change them once they're started. When I worked in the Pentagon, I was an aerospace engineer, they put me to work in the Army because they thought that was where the biggest problem was, I guess, or that's what I was told. And, at that time, there had been five—the Army "big five" had just started. And whether I agreed with them or not, I said, "By golly, we're going to stick with them to avoid the Crusader problem. We're going to stick with them, and we're going to make them happen." Well, those five programs today were the Apache, the Black Hawk, the Patriot, and Abrams tank, and the combat vehicle. Those are the systems we're fighting with today, and that was in 1973. And so, if we just stick with these things and make it—don't start them. Let's keep track of how many we finish, not how many we start.

Senator ROUNDS. Thank you.

Chairman MCCAIN. Got to move on to——

Senator ROUNDS. Thank you, Mr. Chairman.

Chairman MCCAIN. Yeah.

Senator Manchin.

Senator MANCHIN. Thank you, Mr. Chairman.

Thank all of you all for being here today and your service to our country.

Mr. Ward—Colonel Ward, I was—I checked your bio and everything. I was very impressed. And you went over the numbers again, 8—was it $8 billion under budget?

Colonel WARD. Million with an "m."

Senator MANCHIN. Eight million, oh, okay. I was giving you a little bit more credit. Anyway, time constraints. You know, we hear an awful—I want to hear all of your—the sequestering and budget caps. You're talking about time constraints. It seems like Congress has to—you want us to micromanage, since the Department of Defense can't put time constraints on themselves? Where should it come from? This committee? From Congress, telling how quick these programs should be—come to fruition? If not, then you move on. But, how did you get to where you all—the "two for two for two" you just mentioned, how did that come about?

Colonel WARD. I think that was Navy leadership who made that decision. And, again, I wouldn't recommend—I'm a big fan of decentralized decisionmaking and pushing——

Senator MANCHIN. Yeah.

Colonel WARD.—decisions down to the lowest possible level and as close——

Senator MANCHIN. Okay.

Colonel WARD.—to the action as possible. The challenge is, though, that what gets rewarded and incentivized is managing a program that—you know, if you want to get promoted, work on a long, big, expensive, complicated program.

Senator MANCHIN. There's schools of thoughts here, because some people think that we throw so much money, and it's just wasted, and there's no time, and there's no accountability and responsibility. And then others say that we basically have strangled with budget caps and sequestration. Give me all—give me your all thoughts on those real quick.

Colonel WARD. Sure. I think that there's a widespread belief that spending more money and spending more time is a good problem-solving technique and a good way to get us better outcomes. And the data just doesn't support that. In fact, we tend to get better results with short timelines and——

Senator MANCHIN. What's your thoughts on sequestration?

Colonel WARD. I think there's a way to do budget constraints that's intelligent and thoughtful, and then sequestration tends to be more of a broad——

Senator MANCHIN. Hammer down?

Colonel WARD. Yeah, more of a hammer than the scalpel.

Senator MANCHIN. Gotcha.

Colonel WARD. So, we can do it well, we can do it, you know, more of a brute force.

Senator MANCHIN. Do you think there's enough money in the system right now to defend our country?

Colonel WARD. I do. I do.

Senator MANCHIN. Just not using it wisely, right?

Colonel WARD. Right. Right. And the idea is not that we spend less money overall, but that we spend it on smaller individual projects. And we could have a portfolio of programs which distributes the risk, distributes the learning, and increases accountability.

Senator MANCHIN. Mr. Augustine, I'd like to hear your thoughts on that real quick.

Mr. AUGUSTINE. Yes. I think that not only is the amount of money important, but the stability of the amount of money is extremely important. And with regard to sequestration, everything I've seen, looking from the bottom up, is that it's been very damaging.

Senator MANCHIN. Mr. Gansler?

Dr. GANSLER. I think the one thing we've got to do is gain better confidence in the stability of the budget. And if—for planning purposes, that's going to be absolutely critical, in terms of how much you can afford for each individual system and how many of those you can buy.

Senator MANCHIN. Mr. Augustine, real quick, do you think there's enough money in the system right now, as far as our budget in—if we chose to spend it differently or, basically, appropriate it differently?

Mr. AUGUSTINE. I suspect I'm not in a position to really answer whether it's an adequate amount, but I do think that we could get a great deal more for what we have.

Senator MANCHIN. Efficiency.

Mr. AUGUSTINE. Through efficiency. And I'm talking about probably 25 percent or something like that, a big number.

Senator MANCHIN. Oh, boy.

Mr. FitzGerald.

Dr. GANSLER. But, it also depends upon how many more new regulations and legislation you write, because if those are driving the costs up and the—and stretching——

Senator MANCHIN. Well, you all have been very clear in your testimonies about, basically, the regulations. Almost—more than a trillion dollars of cost has been added because of regulations that have been sent from us, from Congress, or is it developed within the Department of Defense?

Dr. GANSLER. Some of each.

Senator MANCHIN. Some of each.

Mr. FITZGERALD. Senator, when I was running a small business, the majority of government input was about my reporting and my accounting and the audits that I had to go through to get paid, rather than, "Did I do good work? Were my ideas strong? Did they impact the Department of Defense in a positive way?" So, we're putting—we're strangling on the wrong things, not strangling on the right things.

I strongly agree with the point Mr. Augustine made, in terms of sequestration and budget clarity. I almost went out of business twice because of continuing resolutions. I had Department of Defense customers who wanted to purchase my services for things that mattered, but there were new starts during a CR [continuing resolution], and we couldn't do it. That meant that I had to keep significant cash on hand just to keep the business going. I couldn't invest that in new ideas. It was a very inefficient way of running a business.

Senator MANCHIN. Makes all the sense in the world.

Thank you.

Chairman MCCAIN. Some feel that a meat axe approach, which is sequestration, is the wrong approach. And I don't know of many experts who disagree with that. I am proud of this committee's reductions in excess spending, fact I can name it in the billions. But, to have a meat axe approach, it takes—throws the baby out with the bath water. And every military—uniformed military leader who has testified before this committee has said that sequestration is harming their ability to defend the Nation. And if the attack on Paris doesn't wake us up, then nothing will. And so, to somehow allege that we're spending enough money right now in the right way is, in my view, sheer fallacy and ignorance of the threats that we face. Total ignorance.

Senator Ernst.

Senator ERNST. Thank you, Mr. Chair.

Gentlemen, thank you for being here today.

Colonel Ward, just thank you. You shared some great examples there of servicemen and -women that have really taken that extra step and exhibited some great ingenuity. So, thank you for doing that for us today.

Gentlemen, we do have a substantive budget allocation that's directly dependent on our program management, our program project management being done right. I mean, it must be done right. However, we don't have a fully standardized workforce leading those programs with a baseline of people and processes and the culture, which we've talked about today, how we need a culture that works a little differently than it has in the past, that culture that's necessary for predictable outcomes—on time, on target, on budget.

And the Defense Acquisition Workforce Improvement Act was a great first step in this process. However, it only deals with weapon systems, it doesn't deal with the service contract side that we've discussed about earlier.

So, just very briefly, if each of you could comment on your assessment of DAWIA. And is it providing the necessary program management across the whole of our acquisition process? And just some brief thoughts on that.

Colonel Ward, if we could start with you, please.

Colonel WARD. Yes, ma'am. So, I think there's a lot of good things that happened with DAWIA, in terms of the emphasis on education. I think there's certainly more room for improvement. One thing that I've done recently is, I kind of—I went through and I read the FAR [Federal Acquisition Regulation], or as much of it as I could, and I collected a series of the phrases, the clauses, the sections of the FAR that I could really hang my hat on, that moved us in the direction of speed, thrift, and simplicity, flexibility, agility, and these types of things. So, I mean, granted, the FAR is too long and too complicated and difficult to comply with, but there's a lot in there that does tell us to do the right things and do good things. And so, if we can kind of include that type of analysis. And I wrote a little booklet on it, and it'll be coming out in the new year, that says, "Here are the simplifications, the opportunities, and the agilities that the FAR not just allows us to do, but encourages us to do." A greater awareness of those types of things, I think, would go a long way to improve the quality of decision-making at the practitioner level, which is sort of my area.

Senator ERNST. Certainly. Thank you.

Mr. FitzGerald.

Mr. FITZGERALD. I agree with you. I think that the legislation is a good first step, that that needs to be followed up with strong management and getting the incentives right at the individual level. So, celebrating success, when required, and, without being indelicate, punishing failure. It's—all of this legislation will be immaterial to the practitioner if they can't see the implications for themselves. So, I would encourage this committee to engage in that sort of management, and also to encourage the Department of Defense to do that, as well.

Senator ERNST. Very good, thank you.

Mr. Augustine.

Mr. AUGUSTINE. Yes. My experience has been that, where you really develop managers for very, very complex undertakings, whether it's software or hardware or services or what have you, is really in industry, not in the government. And I think the reasons for that are that, in industry, you're given authority, and you're held accountable. And one of the things that's changed during the period of my career is that it used to be quite common for people to—in industry who have been trained to manage big projects, they serve in government for a period of time and manage those projects, and then can go back and have a career in industry. They have to disqualify themselves for many things to avoid conflicts of interest. And that's important. But, today it's so hard to go back and forth. And many would say it—you shouldn't go back and forth. But, I truly believe that if we don't have some of the industrial experience managing major projects in our government, we're losing an opportunity.

Senator ERNST. Very good, thank you.

Dr. Gansler.

Dr. GANSLER. I agree with Norman, it's highly desirable to have both experiences to understand—but, the incentives in industry, from the government side—that that's absolutely critical. And to the extent that maybe you can get that in business school, or something like that, it would be highly desirable to have that understanding. I also think that we should have a promotion system within the government, based upon success, achievements, you know, meeting schedules, meeting cost, meeting performance, things like that, that we need to evaluate the incentive systems, both ways. And, of course, it wouldn't hurt to have some salary compensation, either. I mean, twice I've gone into the government—first time, I took an 80-percent cut, and the second time, a 90-percent cut. That's not bad.

Senator ERNST. Right.

Well, I thank you all very much for your testimony today.

Thank you, Mr. Chair.

Chairman MCCAIN. Senator Hirono.

Senator HIRONO. Thank you, Mr. Chairman.

Our acquisition process is highly complicated, and yet we are stuck in a bygone era, from not just the testimony from today's hearing, but from other hearings that the Chairman has called.

I was very intrigued, therefore, by Colonel Ward's focus on "constraints work," where speed, thrift, and simplicity are the areas

that we ought to be looking at. And I'm interested to know from the other three panelists whether you think that this approach, the attitude, "constraints work," whether that would be applicable to the acquisition process in—for example, in our space systems, in the building of aircraft carriers, to our cybersecurity area. Would this be a good approach for us to move toward: "constraints work"?

Mr. AUGUSTINE. Well, I'll comment. And the Colonel makes a very important point. I think there's a real semantics hazard here. And the 180,000 pages that Jacques mentions are constraints. And I'm sure those are not what the Colonel is referring to. And so, I would probably use the word "freedom" instead of "constraints." But, I understand his point, and I think his point is correct.

Dr. GANSLER. Yeah, I would think that the—I agree with Norman—the concept of removing the constraints would be highly desirable, in the sense of the regulatory aspects of them. You know, the—right now, with the—one of the problems, I think, that we have is in the training of our acquisition officials in the Department of Defense. They learn all the constraints, but they don't learn to think about whether those constraints are good or bad, and how they could be modified.

So, I think what we probably do need is something like another Packard Commission, in effect, that—I mean, we didn't take advantage of what came out of the Packard Commission, in terms of how to use commercial stuff. That was one of the main things that Bill Perry was trying to do in the chart that I showed of the comparison of mill standard parts with commercial parts, is an example of where we could be more flexible in our judgment of how we apply commercial things. We talked information systems, for example, in the support functions.

Senator HIRONO. So, I think that if we define "constraints" as, really, speed, thrift, simplicity, I think that's what we're getting at, not, "Let's add another 100,000 pages of requirements." So, if we use those kinds of words to define what we mean, and then I think that's when you get a decision such as "two for two in two." And I think that that's perhaps where we need to go.

There's one more person who I'd like to hear from.

Mr. FITZGERALD. Yeah. So, I'm slightly biased. I'm a Dan Ward fan. I actually reviewed his first book. So, I agree. But, this is about putting constraints in the right areas, not through regulation, but through management. I'd also say that we can't have one system to build everything. So, building aircraft carriers requires a different system to building—to integrating ISR [intelligence, surveillance, and reconnaissance] systems and to acquiring commercial technologies. Building an aircraft carrier, you can still create constraints. It's a series of small projects, not one 50-year project.

We can also benefit ourselves by not building stuff. This version of the NDAA encourages or, I think, mandates that the Department of Defense look more at the persistent close air support project, which I think is an excellent project by DARPA and the Marine Corps. They build new software that they put on top of an Android tablet. We didn't have to build the Android operating system. We didn't have to build the tablet. That's a great way of constraining your project. Just don't build that. Focus on the hard

stuff that you need the military unique advantage. I think it's a great approach.

Senator HIRONO. Some of you have talked about the competition that exists between, for example, the engineers wanting to go and work at—in Silicon Valley, as opposed to the DOD. And as we look at the need of our country for STEM—people with STEM backgrounds, are we—how do you see us, vis-a-vis the rest of the world, in terms of our ability to have people with STEM educations? How are we doing? And what do we need to do? Very briefly. I'm running out of time.

Mr. AUGUSTINE. Well, I'm so glad you asked that question, because, I think, in the long term, that may be the biggest hazard we face in defense. And today—there was a recent study of 93 countries, as where they looked at what percentage of the baccalaureate degrees were awarded, were awarded in science of engineering. The United States ranked 79th out of the 93. The country we were closest to was Madagascar. If you look into the scores on standardized tests of 15-year-olds in this country, of the OECD [Organization for Economic Co-operation and Development] nations, 34 nations, the United States ranks 21st——

Senator HIRONO. So, we're not doing well. What—do you have any thoughts on what we can do to improve this situation?

Mr. AUGUSTINE. The first thing to do is to fix the K- through-12 system, and second is, don't have the States starve our great research universities.

Senator HIRONO. Anyone else?

Dr. GANSLER. Also——

Senator HIRONO. Yes, Colonel Ward.

Dr. GANSLER.—funding advanced research would certainly be one of the ways of doing it.

Senator HIRONO. Colonel Ward.

Colonel WARD. So, I was at a technology conference out in Silicon Valley, and Todd Park, from D.C., went out there and spoke to a big room of people, and basically said, "Your government needs you." We have important challenges to help serve our veterans—VA [Veterans Affairs] healthcare and—and he laid out a number of interesting challenges. And he said, "I'm going to be in that room over there. If you want to come talk to me about coming to D.C. and working, you know, give me your card." He was mobbed. The line was out the door. I couldn't even get—and I was still in uniform at the time, so I was already there. But, people want meaningful challenges. And I was listening to people talk, and it's like, "This is a chance to go—I'm doing—designing video games, which is fun, but I could be helping to save lives. That's what I want to go do." And the just simple outreach of, "Hey, I'm here. Here are some of the problems. Come talk to me"—seemed to have a huge impact.

Senator HIRONO. Thank you.

Chairman MCCAIN. Senator Ayotte.

Senator AYOTTE. Thank you, Chairman.

I want to thank the witnesses.

In Secretary Gates' books, he discusses the extraordinary measures he had to take to get the MRAPs [Mine-Resistant Ambush Protected Vehicles] fielded to our troops to save lives. And I think

that's one of—that's not the only story we have of where we've needed to really go around the entire system to get to our men and women in uniform, lifesaving equipment and the best, so that we could make sure that they're protected and we're able to address what we needed to do to fight the enemy on the ground. So, what do you all take from the MRAP experience? And how do we—especially as we think about our engagement in conflicts, and we're still, obviously, engaged in Afghanistan, we're fighting this war against ISIS [Islamic State of Iraq and Syria]. And we've been notably bad at predicting what our next conflict will be. How do we avoid this? What lessons do we take from that, from what he described he had to do for—to get the MRAPs to the troops?

Colonel WARD. Sure. I have sort of two observations on the MRAP. The first is that the defense acquisition system and all the requirements and things are super important for us to all comply with them, unless we have an important and urgent need in where it really matters to deliver it, and then we sort of throw that out the window and we come up with a new rapid approach. And so, this idea that, you know, we can only be fast when we have to be, is sort of a weird perverse incentive that goes on.

With the MRAP, the leadership made it very clear, "This needs to be quickly and spend as much money as you need to." So, what happened? It was done quickly, and we spent a lot of money. I wonder what would have happened if they had said, "Needs to be done quickly, and it needs to thrifty, and we need to plan for future upgrades." But, again, those goals weren't as clearly emphasized as——

Senator AYOTTE. Do you think that that's what distinguishes the *Virginia*-class success? Where we had a measurable, "It has to be done in this period, this amount of money, and this is how much we have produce"?

Colonel WARD. I do. I do. And I think that the tendency—again, to hit the goals that we set is very strong. We've got a great track record of doing that. And again, with the MRAP, they said, "Hey, speed matters. Cost doesn't matter so much." So, we got it fast, and it was expensive. But, the idea of "faster, better, cheaper, pick two," that's the one conclusion that the data absolutely doesn't support. It's possible to simultaneously improve all three dimensions—the speed, the quality, and the performance, and the cost. We can only pick two. And if we do only pick two, it becomes a self-fulfilling prophecy, but it's possible to pick all three. And the *Virginia,* I think, is a great example of when we've done that.

Mr. FITZGERALD. Senator, I think that the MRAP example shows that our system is geared for crisis. The thing that really concerns me is that we're getting to a point where the size of the crisis required to drive change is greater than the crisis we're trying to respond to in the world, at which point we've lost. We didn't just lose that conflict, we've lost all conflicts. So, it also shows that the only way to succeed in crisis is to go around the system. We saw that with the MRAP, we saw that even in the 1970s and '80s, with the second offset strategy. That was Bill Perry managing around the system. It's a call for the action that you guys are already taking. So, I get incredibly frustrated. The answer is always, "Change the system." And the one thing that we don't seem to be able to do is

change the system. We can't afford to—in the current environment, we can't assume that we're going to be able to jam through one or two capabilities——

Senator AYOTTE. Right.

Mr. FITZGERALD.—to get us out of a jam in the future, given the range of threats that we face.

Senator AYOTTE. I want to—before my time goes up, Dr. Gansler, I want to ask you about something that you—which I think is related to this, as well—in your written statement, you emphasize the importance of utilizing best value. And one provision that I've—got included in the defense authorization this year is to really focus on—in particular, on the personal protective equipment that are critical to life or death for our troops, of making sure that it's not—that it's best value. I mean, obviously, best value, in terms of best equipment and best cost, looking—doing it both. So, I wanted to get your thoughts on that since you included that in your——

Dr. GANSLER. Yeah, I've been very shocked by the fact that we've been drifting towards low pricing settings to be acceptable as a source selection criteria. I mean, you and I don't buy that way. You know, that's cheap.

Senator AYOTTE. Well, especially when it means bullets are coming at us and we——

Dr. GANSLER. Exactly.

Senator AYOTTE.—want to make sure that we're protected.

Dr. GANSLER. Yeah. I mean, it's—it just doesn't make any sense.

Senator AYOTTE. It's like when you're going cold-weather hiking. You know, do you get the cheapest thing you can find, or you get the thing that keeps you warm and so that you don't get frostbitten?

Dr. GANSLER. Exactly. I mean, well, I—we don't use best choice—combination of performance and cost. That's the way I think the DOD should be buying today.

Senator AYOTTE. So, my time is running up. So, I've got 10 seconds here, Mr. Augustine. You talked about In-Q-Tel. I've been very impressed with their success. What can we learn from that experience, from In-Q-Tel and that?

Mr. AUGUSTINE. I think that it—put very shortly is, it—it's going to take a long time to fix the system. And, in the meantime, for those things that are really important, take them out of the system, treat them separately.

Senator AYOTTE. Yeah. The irony, of course, the fact that we have to, like, essentially, go around the system to get something so important to our men and women on the ground, and to our warfighters, is that it's supposed to be set up to be warfighting and defend the Nation.

Mr. FITZGERALD. And then, once that contingency is over, we shut down the system that we created to go around——

Senator AYOTTE. It's unbelievable, because there's always going to be another contingency, and that's what we need to be dynamic enough to address.

Colonel WARD. My proposal is, sort of, shift the default. We have the rapid method that we only use in emergencies, and we have the big, expensive, complicated one. How about the rapid be the default

approach, and you only do the big, expensive, complicated one when you have to?

Senator AYOTTE. Sounds great.

Thank you.

Dr. GANSLER. You might also think about the distinction that Clay Christensen points out between disruptive technology and traditional incremental technology. And we're having trouble funding the disruptive technologies, the new innovation stuff. And that's the direction that we should be moving, because the world is changing rapidly. Technology is changing, geopolitics are changing rapidly. But, tradition constrains us to thinking that what we've been doing for the past, you know, 30 years is the right thing to continue doing.

Chairman MCCAIN. Senator King.

Senator KING. Thank you, Mr. Chairman.

Mr. Ward—Colonel Ward, I'm fascinated by the concept of constraints. Reminds me of when Edward Bennett Williams fired the general manager of what I refer to as "the team which plays its home games in Washington." He said, "I gave him an unlimited budget, and he overspent it. I gave him infinite patience, and he exhausted it." And it's common sense what you say, and yet, it's so rarely thought about that—of course we can't put a cap on this, because we don't know what it's going to cost, and "Take all the time you need," and, by definition, the work expands to fill the time available. I would love to see further thoughts from you. You said you have a book coming out. As—I hope it touches on this point.

Colonel WARD. I—my first book came out in May of 2014, and it goes into this in a good amount of detail.

A great example, though, is NASA's "faster, better, cheaper" missions during the 1990s. For the total cost—they launched 16 missions under this "faster, better, cheaper" initiative, and the idea was low cost, high-speed access to space. The amount of money that they spent on all 16 missions was less than what we've spent on Cassini. Now, Cassini is a huge success. I love Cassini. We're getting great science and great arc out of Cassini. But, for that amount of money, we got 16 other missions. Only 10 of them succeeded, so we only got a 10-for-1 return on that investment. But, it was things like the Pathfinder mission to Mars, which was one-fifteenth the cost of the Viking mission to Mars from 20 years earlier. Viking was a huge success, but it was so expensive, so complicated, NASA said, "Let's never do that again." It was 20 years before they tried to go back. Later on, for about half the time, a third of the team, one-fifteenth the cost, it was designed to last a week, they hoped it would last a month, it drove around for 83 days on the surface of the planet. And they said, "That was great. That was awesome. Let's do it again." They went back three more times: Spirit, Curiosity, Opportunity.

Senator KING. Well, I think that's a very important concept, and ought to be part of our thinking.

By the way, Mr. Chairman, I commend to you a book that Mr. Augustine sent me a couple of years ago called "The Free Enterprise Patriot." It's a humorous account of a blacksmith trying to make cannons for the Continental Army under today's procurement

process. The cannons never got built until, you know, 1785 or so. It's a fabulous story.

Mr. Augustine, you've been—you've mentioned several times the importance of good people. It seems to me we've built a system—I was just talking to another Senator about this, this morning—where good people don't want to put up with what they have to put up with in order to go to work for the government—financial disclosure, FBI [Federal Bureau of Investigation] checks, then you do everything else and your nomination can sit here for a year or more—not in this committee, but in the Senate. Talk to me about the problems—the mount—I've considered it a mounting problem of a disincentive of anybody that is—has, you know, consciousness of—why would they want to put themselves through this?

Mr. AUGUSTINE. Well, the Colonel mentioned going to Silicon Valley and that there were all kinds of people who were very excited about taking on some of these big challenges. The problem is, when they walk in the door to work on the big challenges, they're handed Jacques' 180,000-page set of rules, and they don't want to deal with that. And——

Senator KING. But, I'm talking about the top-level people to come in and manage. I mean, that's where a lot of the important decisions have to be made.

Mr. AUGUSTINE. I think that the mission is so important that that's very attractive, but it is so hard to go from industry to government. I'll just tell a story, if I might, briefly. I was asked——

Senator KING. Briefly, because the Chairman watches this little clock that——

Mr. AUGUSTINE. I'm looking at it, here, too. But, I was asked to take a position in the government. And—a few years ago—and they—I get a call from the White House, and they said they see I own stock in Lockheed Martin. And I said, "Yes, I own one share." And they said, "How much do you make on that?" And I said, "73 cents every 3 months." And they said, "Boy, that's a big problem. We probably can't deal with that. Will you sell it?" And I said, "No." And they said, "Why won't you sell it?" And I said, "It's share number one of Lockheed Martin. I—it's my signature approving the sale of it. I bought it." And I said, "I won't sell it." And they said, "Well, that's a big problem." And the conversation went downhill from there.

[Laughter.]

Mr. AUGUSTINE. I didn't take the job.

Senator KING. Well, that—I think that's the point.

This is a question for the record. Many of you have mentioned the problem of regulations and how it impedes our ability to go—I would like some specific examples of regulations and how they impede our ability to contract effectively and efficiently. You know, Rule 14(a), 302(b), which says you have to file all your applications in triplicate, or whatever it is. I think it would be helpful to understand exactly what we're talking about.

Senator KING. And then, finally, Mr. FitzGerald—and again, perhaps for the record—modularity, it seems to me, is an important concept. When we're building 40-year platforms, that we not try to cram all the technology into the new *Ohio*-class, but that we build

it in such a way that it can be upgraded. I'd like your thoughts on that.

Mr. FITZGERALD. Sir, I completely agree. There are multiple ways that we can address this. Modularity in the design of systems, but also pairing the payloads with the platforms, as former CNO [Chief of Naval Operations] Greenert talked about. So, the B–52 was flown for a long time. It's not an especially smart platform, but if you put a smart munition in it, it becomes a very effective way of thinking about things. So, I think modularity there is important. I think there are also significant opportunities that are soon to be available to us technologically, in terms of advanced manufacturing, where we can use 3D printing and robotic assembly to assemble different components in very compelling ways. I'm happy to share with you a paper that I wrote on this a couple of years ago that explains how that might work.

So, if we take that approach, that allows us to get positive constraints, it allows us to compete out different parts and mitigate risks in very compelling ways. The challenge becomes, How do we take that approach and put it into our current acquisition system? Again, this is where things fall down.

Senator KING. Thank you.

Thank you, Mr. Chairman.

Chairman MCCAIN. You know, I agree, Mr. FitzGerald, but I also can cite you an example, the Littoral Combat Ship. Modularity has not succeeded. In fact, it's been disastrous, as far as the mine countermeasures modularity. So, I guess the moral of the story is, these are—there's not real simple answers. But, maybe you could begin by sending Senator King the 1,800 pages of regulations that need to be changed. And I'm sure he will enjoy reading them. It's very cold up in Maine this time of year.

Senator Shaheen.

Senator SHAHEEN. Thank you, Mr. Chairman.

And thank you all very much for being here.

And, as Senator King and Mr. Augustine, you note, talk about that book on the revolution of the continental army, it had to abide by the rules of the British Army. We never would have won the war. So, it's an important lesson in the importance of innovation.

Mr. AUGUSTINE. We would be speaking with a British accent here.

[Laughter.]

Senator SHAHEEN. Yes. Yes, we would.

Mr. FITZGERALD. I don't know what you're talking about. I'm Australian.

[Laughter.]

Senator SHAHEEN. You know, I don't really have a question, but I want to agree with the point that everybody has made about how we attract good people into work for the government. And it seems to me that some of the actions that Congress has taken have contributed significantly to that, whether it's sequestration or our ability to reach budget agreement so there's some certainty. You know, the Portsmouth Naval Shipyard is between New Hampshire and Maine. Senator King and I fight about that on a regular basis. But, it's one of our premier public shipyards. And they have very—a very good skilled workforce who is—that is now aging. And the

challenge of trying to replace that workforce in an environment where people are uncertain about the budget prospects and what sequestration is going to mean has been very challenging. And so, I think it's a good admonition to all of us that we need to try and address those concerns to keep good people here.

I want to, Dr. Gansler, ask you about the SBIR [DOD Small Business Innovation Research] program, because that's a program that was started by Warren Rudman, from New Hampshire, so we feel a lot of personal commitment to that program. And I serve on the Small Business Committee as the Ranking Member, and I know how long it took us to get it reauthorized in the last go-round. It's up for renewal again in 2017. I think we need to start right now in order to get that done.

But, can you comment on how important you think it would be to make that program permanent so that we don't have to do this and, again, provide the uncertainty every go-round on the SBIR program?

Dr. GANSLER. Yes. I feel strongly that we should make it a permanent thing. What you'll notice is, a lot of country around the world are starting to copy us now with the SBIR program. I put into my presentation, my talk, for—specifically, that one figure, that last figure in there—that shows that, where we used to get most of our good ideas from industry, that industry is reluctant to make changes if they think it'll be disruptive to their business. Where the same thing is true about universities. Many cases now, the people in universities who have the good ideas are starting to set up their own small business. And I think increasingly that's going to become an opportunity for them. And I think, in many cases, we're getting many of our ideas—and that's what that chart shows—from now—if you just list the——

Senator SHAHEEN. Let—I don't want to interrupt you, but the clock is running, and so I just want to get——

Dr. GANSLER. Yeah.

Senator SHAHEEN. Is there anybody who disagrees that that program should be made permanent?

[No response.]

Senator SHAHEEN. Okay, thank you.

Mr. AUGUSTINE. I would just comment very briefly. I do think it should be made permanent, but there—as you know, there have been abuses. We need——

Senator SHAHEEN. Right.

Mr. AUGUSTINE.—we need to fix those. And I come from a world where our goal was not to become a small business, but it's a truth that I think could be shown that most of the new, creative disruptive ideas do come from small businesses.

Senator SHAHEEN. I agree.

And, Mr. FitzGerald, I know you wanted to respond to that, but let me ask you, as part of that—you talked about the problems with the export control system, which I totally agree with. I think we've got to do more to address that. And there have been efforts to reform it over the last couple of years. Do you think those have been helpful, or should we—do we need to scrap those and start all over?

Mr. FITZGERALD. So, just briefly, on the small business thing, I think that the SBIR program is excellent. The challenge is not that program. We have many ways of getting new ideas funded in the Department of Defense, from In-Q-Tel, from other places. The challenge is what happens after that initial funding. How do we integrate that into the——

Senator SHAHEEN. Right.

Mr. FITZGERALD.—mainstream Department of Defense? Otherwise, we are funding stuff that we never get a benefit on or it becomes commercial and, therefore, our adversaries and other people can buy it, and we can't. Very frustrating.

From an export-control perspective, I think that the current—the recent work has been excellent. We've removed a number of things from the lists. I think, ultimately, the challenge is the lists, themselves. I think of it kind of like the DHS alert system. No political leader is going to say, "We're moving from status red to status orange." You need to blow up the system and say, "It's going to be alpha-numeric now, and we're going to come up with a letter, instead, that will be a lower level of threat." Otherwise, we're going to have, sort of, the high priests of ITAR [International Traffic in Arms Regulation] continue to come out and tell us how the world's going to explode if we take something off the list. It's not going to—we can't reform that way.

Senator SHAHEEN. I totally agree.

And I'm out of time, but can I ask just one more question, Mr. Chairman, of Colonel Ward?

I was in Kuwait when they were bringing back a lot of the equipment from Iraq. And one of the things they showed me with great pride was the MRAP with the little contraption on its nose that could—had a heat source that detected IEDs, and how successful that had been. And they said that that had been designed by men and women in the field who had this idea about how to help. How do we get those kinds of ideas into our innovation research into the acquisition process so we can actually respond to what works in the field?

Colonel WARD. Sure. So, field mods are an important source of innovative ideas. Oftentimes, after they're successfully used and demonstrated, "Hey, this works great," the official response is, "Take that off. It's not authorized." So, there are some mechanisms and channels to provide those ideas and provide those inputs. I think those tend to be, again, sort of held at arm's length, much like the—but, again, the Army OIF [Operation Iraqi Freedom] report said that field mods are the primary channel of feedback to developers. As an engineer, I often didn't hear those, and—because they got filter out—filtered through—over-filtered.

So, the idea is that we need to encourage and—again, seek, support, and celebrate. Tell those stories, say, "Hey, this was a great example. We should do more of this." Because, for every situation and every story we hear, there's ten more that we didn't hear about—again, that got over-filtered. So, we need to create some channels to let those ideas filter through.

Senator SHAHEEN. Thank you all very much.

Chairman MCCAIN. Senator Cotton.

Senator COTTON. Thank you all very much for your thought-provoking testimony on this important topic.

Mr. Augustine, you had mentioned in your written testimony that you were present at the creation, so to speak, of In-Q-Tel, back in the 1990s. I'm familiar with the organization from my work on the Intelligence Committee. Could you give us your take on the lessons learned from the creation of In-Q-Tel and the way it's worked, and how it would apply to the Department of Defense, given their differences in mission and scale and so forth?

Mr. AUGUSTINE. Yes. I don't believe that In-Q-Tel can solve the broad problems of the Department of Defense, but I think a Department of Defense version of In-Q-Tel to deal with very high priority specific challenges could be very valuable. And the secret to In-Q-Tel is fairly straightforward, and that is that it has the capability to deal with firms just as they would deal with each other, as opposed to the way they have to deal with the government. And In-Q-Tel had a lot of latitude, it had a lot of flexibility. Is there room for abuse? Yes. But, thus far, there has not been a problem.

Senator COTTON. All right.

Mr. FitzGerald, the interaction between the Department of Defense and the private sector, especially given that technological development is now largely located outside of our defense industry, is something about which you wrote. You said there needed to be policy, legal, cultural changes, in your written testimony. Do you care to comment on the In-Q-Tel approach? You just—you had some comments earlier, but also what Mr. Augustine just said?

Mr. FITZGERALD. I think that the In-Q-Tel model is an excellent one. A number of the advantages that it takes—that it is based on are particular to the intelligence community. Partially, that's about size, and it's also about their ability to link the people who own the problem with the people who fund the solution very quickly. And it's difficult for us to do that in the Department of Defense. So, I think that it helps us address a number of challenges.

The challenge with—for the Department of Defense is, How do you do that at scale? So, that's how we can build prototypes, that's how we can get new entrants into the marketplace. But, it—I don't—we don't have a good model yet to take us from that new idea into a large program of record, which isn't the failing of In-Q-Tel or those models, it's a failure of our program-of-record system.

Senator COTTON. Okay.

When you say that the Department of Defense needs—is going to need legal and policy and cultural changes, which one of those do you think are most important?

Mr. FITZGERALD. Ultimately, it's the cultural change, but that's probably going to be driven, in the first instance, by the law and policy. And I think the other factor, something that we've talked about significantly today, is about leadership and human capital. So, ultimately, I think—and I think this has been shown in our testimony and the understanding of the committee today—we know what most of the challenges are, and we have a pretty good sense, idea of what needs to be done. It's a—just a question of, How do we move the large institutions to implement on what we know needs to be done?

Senator COTTON. And, Colonel Ward, the human capital and leadership development is something about which you spoke in your written testimony; specifically, the ability of constraint-driven teams to innovate rapidly at lower cost. What's your perspective on this about the cultural or mindset shift that may need to occur?

Colonel WARD. Absolutely. So, the culture shift, I agree, is absolutely the right piece of the puzzle that's going to be the—have the biggest impact on improving acquisition outcomes. And when I say "acquisition outcomes," I mean programmatically as well as operationally. So, the ability to get the mission done on time, on budget.

The culture shift, I think—right now, we have a culture that tends to look at complexity as a sign of sophistication, budgets as a sign of prestige, and long timelines as a sign of strategic intelligence and strategic genius, when, in fact, I think we get better results when we have a culture that values speed, thrift, and simplicity.

I think the other piece of it, too, though, is—and we talked a lot of about regulations. I've found that ignorance of the FAR is a greater barrier to innovation than the regulations themselves. The prevailing perception in the culture is, "The FAR won't let you do that, the FAR won't let you be fast, the FAR won't let you simplify." In fact, when we go through and read the FAR—and you—there's plenty of clauses, plenty of pieces of the FAR that do, not only allow, but encourage speed, thrift, and simplicity. So, a greater awareness of what the FAR actually says, what it allows, what it encourages, I think can go a long way towards that.

Senator COTTON. What——

Colonel WARD. And it's just a matter of——

Senator COTTON. What's behind that lack of awareness among people who, by and large, make a living using the FAR?

Colonel WARD. Right. It's so big and so expensive—or the FAR, itself, is to complex that it's intimidating. I've found that people who can quote the FAR, chapter and verse, tend to be more convincing than people who can't. And the people who can quote the FAR, chapter and verse, are very, very few in number. It's easier to just say, "The FAR," which none of us have read, "doesn't let you do that." And so, it's the safer—it's the more risk-averse-type approach to just say, "Well, I'm sure we can't do that, because we didn't do it last time."

Senator COTTON. The military, by and large, has an up-or-out personnel management system. Do you think that's an appropriate system for our—the people who are involved in our acquisitions process?

Colonel WARD. That is a—challenging and problematic. I'm not sure I have a better solution for it. But, in my case, for example, I decided to retire from the military because I was not interested in getting promoted again, I wasn't interested in moving again, my kids were heading into high school, and we wanted them to start and finish in one place. And the Air Force's perspective was, "Either move or get out." There was no third option to sort of stay and keep doing this kind of work.

Senator COTTON. Okay.

Thank you. My time is expired.

Senator REED [presiding]: Thank you.

On behalf of the Chairman, Senator McCaskill.

Senator MCCASKILL. There's a lot of argument, I think, that can be made that "up-or-out" has really, in many ways, cannibalized our acquisitions processes, because it—longevity and having as much knowledge as the people who are trying to do business with the Federal Government—knowledge is power. And when there's a new person, then you've got opportunities. And I think that there—that there's something to be said for that.

You know, when you talk about incentives—I've spent an awful lot of time—and some of you know—on contracting and the problems there. It seems to me that the incentive in the private sector is so elegant and simple, speaking of simple—it's that speed and thrift pays more money. You make more money if you are efficient. And in the private sector, the bottom line matters. You can't have a new deputy deputy dog if you're not making money. In the Pentagon, you could have the Under Secretary to the Under Secretary to the Assistant Secretary to the Under Secretary, and there is no bottom-line pressure.

So, why is it that we can't change the incentives in a more simplified way? The incentives are there to get the bid, to be cost-effective in the bid. But, then the incentives kind of get murky. And that's when the regs come in, right? That's when the regs march with a resoluteness towards, "You must do this, you must do that." Because the system is trying to desperately—by fingernails sometimes—hold on to the concept that, "We're going to constrain your costs, we are going to constrain your costs. We will add a nother requirement to constrain your costs."

Why can't we incentivize more profit if you constrain the cost? I mean, I can think of so many systems—I mean, whether it's DCGS [Distributed Common Ground System] or whether it's the helicopter, or whatever. If you actually, during the lifetime of the development, said, "If you can do this, we will pay you more," as opposed to, "We're going to layer another regulation on you to make sure you don't up the cost when there's not a good reason for it," which, by the way, ups the cost without a good reason for it.

So, tell me, historically, have there been attempts that have not been successful to incentivize profit for constraining cost?

Colonel WARD. I think part of the challenge is, on a 10- or 20-year project, the incentives that we try to establish for the people who are in the early part of the program, we won't know how the program is going to end for another 10 or 20 years, so we don't see the end of other story, so it's hard to incentivize those outcomes for people who won't be around in 10 or 20 years. But, I——

Senator MCCASKILL. But, the company is going to be around, whether it makes money or not. I mean, we're down to—you know, I can count on my fingers and toes how many companies there are that are getting these bids. They certainly are way more sophisticated than the man or woman of the hour at acquisition, right?

Colonel WARD. Yes, absolutely. Absolutely. But, I think on the military side, on the practitioner side, you know, we want to incentivize good decisionmaking for the engineers, the program managers, and the contracting officers. On a 3-year assignment, which just ends up being a year and a half on this project and a

year and a half on some other project, but each of them are 10-year projects, so the longer timelines really create barriers to smart incentives.

Senator MCCASKILL. Yeah. Well, they certainly do on the military side. I guess I'm——

Colonel WARD. Right.

Senator MCCASKILL.—trying to think more from on the side of the people who are actually getting paid by the government to develop these systems.

Mr. FITZGERALD. So, in my experience, Senator, the challenge was a misapplication of well-intended regulations. So, when I was running a small business, I was running a strategy firm. We weren't building products, it was fairly low-risk stuff. Despite that, many of the contracts that I suffered under were "cost-plus-fixed-fee." I was—I had to do "cost-plus-fixed-fee" contracts because the worker I had done had never been done before, and they were concerned that there would be too much risk. So, I was, like, "Let me understand this. You're going to tell me up front what my profit is going to be, and you're going to drive that down over time, but the amount that I spend can increase almost as much as I would like it to."

Senator MCCASKILL. That's how we got monogrammed hand towels in Iraq.

Mr. FITZGERALD. Well, the—well, this was a thing. When I was speaking to my board, who were not familiar with the defense—with the U.S. defense world, I'm saying, "So, why don't you just go out and buy, like, really nice furniture and all of these other things for the office?" And I was, like, "Because that would make us an unhealthy and sick business if we try to do anything other than live off this contract." So, ultimately we didn't, but only for—out of self-interest. If all we had done—for the—in terms of the culture and health of our organization. If we had followed the incentives as they were laid out, we would——

Senator MCCASKILL. Right.

Mr. FITZGERALD.—have become big and bloated, because I was only going to get 7 percent profit, so I might as well have nice perks in the office so that I could hire people——

Senator MCCASKILL. Exactly.

Mr. FITZGERALD. It was crazy.

Senator MCCASKILL. I mean, the cost-plus is, like, ridiculous.

Mr. FITZGERALD. So——

Senator MCCASKILL. I mean, if we are going to be a risk-free organization, I think defense is the wrong area to be in.

Mr. FITZGERALD. I completely agree.

Senator MCCASKILL. Right? I mean, it's kind of inherently risky, isn't it? It seems to me embracing risk ought to be part of the equation.

Well, my time is out. I've got a awful lot of other questions. I would like—and will have some for the record for you, because you all represent an awful lot of expertise. IT drives me crazy, the inability of the various branches to talk to one another, the absolute aversion to off-the-shelf that is beyond the pale of ridiculous. Speaking of complexity, that—and these are people buying stuff that don't know what they're buying, so it is needlessly complex

and needlessly expensive, and there is an aversion to off-the-shelf IT products that I think needs to come to a screeching halt at the Pentagon.

So, thank you, Mr. Chairman.

Senator REED. Thank you, Senator McCaskill.

And, gentlemen, thank you for your extraordinary testimony and also for your great service to the Nation in so many different ways.

And on behalf of Chairman McCain, I will declare the hearing adjourned.

[Whereupon, at 11:36 a.m., the hearing was adjourned.]

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR JACK REED

LEVERAGING COMMERCIAL PRODUCTS

1. Senator REED. It is imperative that DOD maintain military superiority in the global defense space and this will require the department to develop more nimble acquisition processes. However, a "one size fits all" acquisition approach may not be appropriate.

In what technologies or weapon systems should DOD pursue a co-development strategy with both non-traditional and traditional companies versus incorporating available, commercial off the shelf technologies (i.e., harvesting what the market has to offer)?

Under what circumstances / conditions have other transaction agreements been used effectively to acquire innovative, commercial technologies?

What steps can be taken to increase the knowledge of DOD's acquisition workforce of the flexibilities available to them using other transactions, or for that matter, the flexibilities provided under the FAR, to leverage commercial products?

Mr. WARD. I would point to two documents. First, the *Innovative Contracting Case Studies playbook,* published by OMB and the White House OSTP, which provides information about using OT. It is currently available as a PDF. Second, is an upcoming publication titled A Brief Reference Guide to Agilities, Flexibilities, and Simplifications within the Federal Acquisition Regulation. It is scheduled to be published by Carnegie-Mellon's Software Engineering Institute in early 2016.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. GANSLER. I agree that "one size fits all" doesn't apply to DOD acquisitions e.g., acquiring an I.T. system is definitely different than acquiring a missile. Similarly, hiring an engineer for a study or a design is definitely different than buying a tank—you don't have to put the engineer through live—fire testing. If we want to maintain a strategy of "technological superiority" we can not keep cutting funding for R&D (as both the Congress and the DOD have been doing)—while other nations are stressing innovation and increasing funding for it. To enhance the understanding of the DOD's workforce of the "barriers" to buying commercial and/or of civil/military industrial integration—and of its benefits: these need to be part of the curriculum of the Defense Acquisition University—along with teaching "best practices", vs. just teaching "conformance to the rules". The Acquisition workforce must learn what incentivizes industry to achieve higher performance at lower costs—and then practice it. (***note that Dr. Gansler was not asked for his response to this question, but it will be included in the record)

SETTING REQUIREMENTS

2. Senator REED. DOD's approach for setting and articulating requirements was raised as a deterrent for attracting non-traditional firms. One commercial solution that was mentioned involved DOD articulating its needs in terms of a problem that needs to be solved, rather than identify specific requirements that have to be met. Defining needs in terms of a problem statement would require a different mindset within DOD's requirements-setting community.

How could DOD develop well-articulated "problems" internally and effectively communicate them to commercial contractors? Are there areas of acquisition where DOD might need to continue to offer a more requirements-based approach to articulate its needs to ensure the reliability, maintainability, and cybersecurity of a system?

Mr. WARD. I think the key word is "communicate," and the secret to effective communication is to understand it is a two-way process. So rather than trying to develop fully articulated problems, then handing them over to commercial contractors (large or small), I recommend the DOD adopt a more interactive, collaborative approach to problem definition. This should be a joint process, in which developers are involved from the start. The Coast Guard Logistics Information Management System (CG–LIMS) used this approach very successfully. CAPT Dan Taylor explained this in *a blog post from 2011,* writing "we're opening up communications with industry by posting requirements documents early in the process on FedBizOpps, using a blog to keep all stakeholders informed, and using the wiki hosted on GSA's citizen.apps.gov platform to give everyone information on what we're thinking and solicit industry ideas as we form an acquisition strategy."

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. GANSLER. The one area of the DOD "requirements process" that currently is largely ignored is "unit and life cycle cost as a requirement." The commercial would certainly make cost a requirement, and quantity is certainly critical in defense—and, with limited dollars, quantity is dependent on unit cost; so this needs to be stressed more as a "military requirement". Also, currently a major cost factor on DOD acquisitions are the over 180,000 pages of the Code of Federal Regulations—which adds over 2000 pages of new regulations each year. Perhaps Congress needs to mandate a Commission to see which of these regulations are driving the costs up; and which are no longer needed. Incidentally, these regulations, and the auditing of them, not only drive up the costs; but they also drive away commercial firms, and the innovative small businesses.

ADEQUATELY FUNDING AND TARGETING RESEARCH AND DEVELOPMENT FUNDS

3. Senator REED. During the hearing, witnesses repeatedly expressed concern about DOD's research and development funding levels. However, Deputy Defense Secretary Bob Work recently stated that DOD will have to curtail some innovation-focused investments DOD had planned because the two-year budget deal reflects $14.9 billion less for fiscal year 2017 than DOD had originally sought.

In an era of budget constraints and big ticket weapon system investments, what new approaches can DOD and the Congress use to protect research and development funding, or make the available funding more efficiently and effectively used?

Dr. GANSLER. As noted in my answer to question #1 we already have been cutting innovation funding in DOD, not only in the Service budgets, but even for DARPA. Meanwhile other countries (e.g. China, India, Israel, Japan, and Singapore) recognize the value of not only funding innovation, but supporting the leadership who are pushing for change (i.e. to overcome the institutions' resistance to change—both from the established defense industries and the military services themselves). Clearly, the leadership needs to be focused on using innovation (both in technology related to processes and to products) to achieve greater performance at lower costs. We need to be intellectually honest in continuously comparing current capability (including numbers) with what could be—if we innovate and move ahead to new capability at lower costs.

DEVELOPING OPEN SYSTEMS

4. Senator REED. What role can open systems architecture play in contributing to meaningful acquisition reform?

What are the most significant barriers to using open systems architectures in DOD?

What are the key enablers or practices used in industry that could most effectively move DOD in the direction of open systems architectures?

Is there a discrepancy between how the government and contractors define "open"? If so, how can this be resolved?

Mr. WARD. The most significant barrier to using open system architecture is a lack of awareness of the methods and tools available to acquisition professionals. While open system approaches are endorsed by regulation, many in the DOD are still unaware of what "open" really means, what tools and mechanisms are available, and how to implement open architectures on their programs. The last project I led while on active duty (in 2014) was chartered to serve as a "pathfinder" program for open architecture methods, aiming to help validate open architecture as an approach and to show how it can be done. The fact that pathfinders are still considered necessary shows that the path has hitherto not been well established. Whether the DOD needs more pathfinders or simply more awareness of existing pathfinders is an open question.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

USE OF COMMERCIAL TECHNOLOGY

5. Senator REED. In the past two decades, Congress and DOD have made a number of changes related to the use of commercial items. Dr. Gansler, you noted that more needed to be done to further encourage the use of commercial items. At this point in time, what steps should be taken, through legislation, policy, or culture, to encourage the use of commercial items?

Dr. GANSLER. Perhaps the best, and easiest, way to convince people to utilize commercial parts and practices is with "case studies" (to show it can be, and should be, done). —that's a lesson Senator Sam Mann taught me; long ago.

Some examples include:

- Allowing the JDAM missile to use commercial electronics, sensors, and actuators lowered the cost from 69,000 each to 18,000 each; and with improved accuracy and reliability.
- Forcing Boeing to split the common production of military and commercial transports raised the prices of both (because they lost the economies of scale from the lower quantities).
- Logistics comparisons of FedEx and U.P.S. logistics information systems with the DOD system. The commercial systems have "total asset visibility" and the DOD system doesn't.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

LOWEST-PRICE TECHNICALLY ACCEPTABLE CONTRACTS

6. Senator REED. In your statement and testimony you expressed concern about DOD's increased use of lowest-price technically acceptable contracts. Can you elaborate on your concerns about the use of this approach? Are there situations where you think the use of this approach is particularly detrimental, and/or situations where the use of this approach makes sense?

Dr. GANSLER. When two competitive approaches give the same performance, then picking the lower-cost one makes sense. But in the commercial world—which we want to be the same—first we check to see if the performance is comparable if not, we don't simply pick the cheapest—even if the performance is significantly worse. This balanced—solution criteria is known as "Best Value" (i.e. the combination of high performance and low price). However, the DOD approach of "Low Price, Technically acceptable" (without a clear understanding, or even a definition of "Technically Acceptable) simply is buying "cheapest"—even if it doesn't work, or fails to meet "requirements" (including even reliability). Whether it is for professional services or military equipment, the DOD should not simply buy the cheap stuff—too much (including lives) is at stake.

INNOVATIVE FINANCING

7. Senator REED. In addition to leasing, what other alternative financing techniques can DOD adopt to drive affordability and for which types of weapon systems?

Mr. Ward did not respond in time for printing. When received, answer will be retained in committee files.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

INCENTIVES TO WORK WITH DOD

8. Senator REED. In your testimony, you stated that government budgetary processes such as sequestration and continuing resolutions allow for funding instabilities that negatively affect and potentially jeopardize the viability of commercial companies.

In this fiscal climate, what incentives exist for commercial companies (particularly small to continue to pursue DOD business? What else could DOD do to incentivize commercial businesses?

What sort of funding / contract mechanisms could DOD / Congress create to reduce funding uncertainty or prevent companies from being adversely impacted by continuing resolutions and sequestration?

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

CONSTRAINTS

9. Senator REED. In your testimony, you identified three principal areas that DOD needs to incentivize: speed, thrift and simplicity. You also stated that small teams with short schedules, tight budgets, and deep commitments to simplicity—in other words, teams with a constraint mindset—are more creative and effective.

What short- and long-term changes can DOD make to increase the mix of its weapon system portfolio focused on less expensive, quicker turnaround programs?

What can be done to ensure less expensive programs do not face the same problems as major programs, just on a smaller scale?

How would this approach change the way DOD staffs program offices?

To what extent might constraints make program managers less willing to adopt innovative technologies into their programs?

Could the new "middle tier" of acquisition for rapid prototyping and rapid fielding" provided by Section 804 of the National Defense Authorization Act for fiscal year 2016 encourage the type of speed, thrift, and simplicity that you advocate, while also helping minimize program risk? If not, why not?

In addition to rewarding programs that perform under budget, what else could Congress do to create an environment conducive to "constrained" acquisition programs?

Mr. WARD. One very simple change which could be implemented immediately is to require every contract to include a clause that states the contract can be cancelled if cost growth exceeds 15 percent. NASA used this clause very effectively during their Faster, Better, Cheaper missions, and nothing prevents the DOD from inserting this clause into every contract. This would not only provide a straightforward contracting mechanism to allow termination of programs before cost growth gets out of control, it would also communicate to all involved that excessive cost growth will not be tolerated. It would not require cancellation but would put an important tool in the government's hands.

Second, the DOD should limit the number of Key Performance Parameters (KPP's) on each program. More than three or four KPP's dilutes the importance of each one. The US Navy's Virginia Class submarine program provides an outstanding example—they removed three KPP's from the requirements list when it was determined that they would cost more than they were worth and that the submarines could still accomplish the mission without those KPP's.

Many of the problems experienced by large programs are a direct result of the program's size. Smaller, less-expensive programs will therefore not experience the same problems that big, expensive programs do. Smaller programs do have problems of their own, but they tend to be fewer, more manageable, and less harmful. And even if they do experience the same problems on a smaller scale, this is preferable to experiencing the problem on a large scale.

The constrained approach could change the way the DOD staffs program offices by making them smaller (i.e. fewer people per project). It would also increase alignment between tour length and project length, because programs with shorter timelines create the opportunity to increase personnel stability and increases the likelihood of having consistent leadership throughout the program's duration. In fact, this would make it easier for the DOD to set a program manager's tour duration based on the duration of the program they are managing.

Constraints of time and money should make PM's less willing to adopt immature technologies into their programs, which is very much by design. A program manager with a long development timeline may allow a design to include immature technology, based on a belief that the technology will be mature by the time it is needed. This often does not come to pass. Constraints help to discourage that type of decision making, and instead encourages PM's to put existing, mature technology together in new and interesting ways—which is in fact the definition of innovation.

In addition to rewarding programs for performing under budget, Congress could provide rewards for speed and simplicity. The idea is to reward programs for delivering ahead of schedule and for taking steps to simplify their organizations, processes, and technologies.

FAR FLEXIBILITIES

10. Senator REED. During the hearing, Mr. Ward stated that ignorance of the FAR is a greater barrier to innovation to than the regulations themselves.

What steps can be taken to increase the knowledge of DOD's acquisition workforce of the flexibilities available to them under the FAR, and to empower the workforce to make better use of these flexibilities?

Mr. WARD. In a 2013 paper titled Changing Acquisition Culture: What and How (Published by the Center for National Policy), I identified four "influence channels"

that can be used to inform and influence the federal acquisition workforce. These channels are: Leadership, Peer Network, Publications, and Training & Education. I would suggest launching a concerted effort to spread the word about FAR flexibilities, using those four channels. The specifics of this strategy are available in the aforementioned paper.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

ACQUISITION WORKFORCE TRAINING

11. Senator REED. In testimony, Dr. Gansler stated that one of the six areas for improvement is "A focus on the education and training of the DOD's acquisition workforce." What suggestions do you have for how to improve the training, education, and overall professional development of the acquisition workforce?

Mr. WARD. While the Defense Acquisition University is formally chartered to provide education and training to the workforce, it tends to focus on compliance rather than creativity. I would suggest taking a closer look at DAU's curriculum and incorporating a greater emphasis on innovation (see answer to question #10.

I also suggest making greater use of civilian academic institutions. For example, the University of Tennessee's National Defense Business Institute has a very strong aerospace MBA program and has also provided very effective training on innovative acquisitions, primarily for Air Force customers. To the best of my knowledge UT's focus on defense acquisition is unique, but several other universities have the capacity to contribute to this topic as well, including West Virginia University's Center for Smart Defense, Duke University's Corporate Education program, and Georgia Tech's Contracting Education Academy.

Finally, I strongly believe that conferences are an important contributor to professional development. They allow practitioners to establish and strengthen their networks, expose practitioners to new ideas, and provide an important forum for sharing and exploring new approaches. In recent years the DOD has severely limited the ability of people to participate in technology conferences, and I suggest this policy is worth re-evaluating. The recent conference policy update (Sept 2015) is a step in the right direction, and I hope it will have the intended impact.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

CONFLICT OF INTEREST RULES

12. Senator REED. Do you believe that conflict of interest laws dissuade top-tier candidates from joining DOD?

What steps can be taken to address this issue, while still protecting the public's interests?

Mr. Ward did not respond in time for printing. When received, answer will be retained in committee files.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

DETERMINING FAIR PRICES

13. Senator REED. One of the fundamental challenges in defense acquisition is trying to determine if we are paying a fair price for complex systems? that have no commercial market.

What steps can we take to improve our ability to determine what major, complex systems should cost so that we pay fair prices?

How can we take those steps without creating extended review and oversight processes or driving potential suppliers away from the defense market?

How should we think about fair profit margins for defense contractors providing unique services and systems to the government?

Mr. WARD. The government should not waste time trying to guess or estimate what a fair price might be for any given program. Instead, determine fair price by having a series of real competitions, between multiple vendors, using open system architectures and common maintenance capabilities.

For example, buying a single KC–46 tanker creates artificial pressure on bidders and rewards unrealistically low bids, because whichever company loses the competi-

tion is out of the tanker business forever. This situation also provides only a single data point on what a tanker aircraft should cost. A better approach is to buy multiple tankers from multiple vendors, perhaps buying one type of tanker in a particular year and having a competition for a new tanker five years later. Open architectures and common maintenance standards can help reduce the costs of maintaining a diverse fleet. Based on the consistent cost growth experienced on previous one-shot programs (B–2, JSF, etc), I suspect the multiple-system approach would actually save money.

On the topic of profit margins, as long as we treat huge price tags as inevitable attributes of defense acquisition programs, it makes sense to limit the profit percentage. However, reducing the total cost of a program and increasing the profit margin potential can serve the interests of both the government and industry. For example, rather than insisting on a 7 percent profit margin limit on a $1M project, both sides might be better served by allowing a 30 percent profit on a $500,000 effort.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

REQUIREMENTS PROCESS

14. Senator REED. One of the major challenges in acquisition reform is reviewing the weaknesses and shortfalls in our requirements development processes. For example, some argue that requirements are developed without being informed by cost or technical realities, and that they are too ambitious, or continually change over the course of a program—which drives up costs and extends schedules.

What reforms would you recommend for this process?

Mr. WARD. My recommendation is to introduce tight constraints on cost, schedule, and budget. To paraphrase the Hon Richard Danzig's excellent paper "Driving In The Dark," the DOD should build more for the short term (spend less time and money, building simpler systems). Taking a constrained approach to requirements in particular introduces several important, impactful limits. First, the sheer number of requirements (and KPP's) should be kept to a minimum (see answer to #9 above). This serves to provide focus, priority, and clarity for the project leaders. It also increases the team's ability to accurately assess, understand, and incorporate realistic cost and technical realities. Shorter timelines also reduce the project's exposure to change during the development cycle, thus reducing exposure to factors which increase costs and delay schedules. One particularly helpful FAR reference on this point is 39.103, which describes Modular Contracting.

Second, the requirements process should be a more collaborative approach, involving both technologists and operators in an interactive, incremental discussion that addresses both the state of the art and the operational environment. Rather than worrying about requirements creep, the focus should be on avoiding stale requirements which no longer describe the operational needs, as well as on avoiding overstated requirements which exceed actual needs. Two particularly helpful FAR references on this point are FAR 15.306(d)(4) and FAR 35.008.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

ACQUISITION REFORM

15. Senator REED. As you know, the most recent National Defense Authorization Act (NDAA) restored some authority to the Service Chiefs with respect to acquisition. In contrast, Secretary Carter raised concerns with this approach, indicting in a letter to OMB that the language in the NDAA would "significantly affect my ability to oversee Service programs and overcome the very strong incentives and inherent bias within the military departments to be overly optimistic in their planning, particularly when budgets are tight."

Do you think that the military departments are overly optimistic in their planning? Why?

If so, what can we do to mitigate against that unwarranted optimism?

Does OSD provide an appropriate counterbalance against Service optimism?

Mr. WARD. The problem with optimistic planning is less about optimism as it is about the scope, scale, and duration of the plans. An optimistic 1-year project, with a well-defined objective, a stable leadership team, and a tightly controlled budget

will a) be more likely to deliver meaningful & relevant capabilities than a 10-year proect, and b) incur less harm if the optimism proves unwarranted.

So my suggestion on how to mitigate the problem is not to discourage optimism, because we want and need acquisition leaders who embrace a can-do mentality and are willing to take risks, etc. Rather, we should discourage stretching that optimism out into timelines that exceed our capacity to act or exceed our involvement with the program. By all means, be optimistic. But do so on a timescale that aligns with the Program Manager's tenure. This introduces a degree of accountability that is impossible to provide on a 10+ year program.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

QUESTIONS SUBMITTED BY SENATOR CLAIRE MCCASKILL

BREAKING THE COST CURVE

16. Senator MCCASKILL. Over the past several years, the Department of Defense has recognized the unsustainable growth for development programs and has highlighted the need to break the cost curve. In response, some in industry has been pursuing ways to reduce development and production costs. Do you believe the Department is doing enough in source selection to recognize industry cost cutting and innovation efforts?

Mr. AUGUSTINE. There can be no question but that we are on an unsustainable path with regard to the cost of major items of military equipment. It is my belief that this problem has less to do with source selection than with the requirements process and the design and development processes.

We have now reached that point in the so-called "death spiral" wherein items of equipment cost so much that we can buy very few of them (usually even fewer than were planned when the program was established and program costs initially estimated) and individual unit costs thus become untenable. This is particularly the case when development costs must be amortized over the (often reduced) production buy. I believe that what is needed in many cases is far greater emphasis on somewhat less sophisticated equipment that can be purchased in substantially larger quantities, often drawing on commercial hardware and software. This will require a less "linear," less rigid and less procedural requirements process than exists today. Specifically, what is needed is a "closed-loop" process that simultaneously involves military operators; design, development and production engineers; cost estimators; and budget analysts. Only through an iterative process involving all four of these groups do I believe that we can arrive at affordable designs with today's tight budgets and small quantities of equipment that are generally purchased in peacetime.

QUESTIONS SUBMITTED BY SENATOR JEANNE SHAHEEN

ACQUISITION WORKFORCE

17. Senator SHAHEEN. How can the contracting workforce be more effective in engaging with small and non-traditional contractors in order to maximize benefits to both DOD and the taxpayer?

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

Mr. AUGUSTINE. The In-Q–Tel model has proven to be a highly successful means for dealing with the kinds of issues addressed in Question 19. It is premised on the notion that in many instances the government should enable commercial procurement practices to replace government procurement practices. This is of course not without risk, nor is it easy, but that risk, in my experience, is trivial compared with the cost of meeting all the so-called "protections" built into defense procurement as it has evolved over the years. The In-Q–Tel concept is really quite simple: it allows companies to deal with government (intermediaries) much as it deals with other firms in the free enterprise system.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Mr. WARD. The contracting workforce could begin by increasing its awareness of, understanding of, and compliance with the FAR. For example, FAR 13.003 states "Agencies shall use simplified acquisition procedures to the maximum extent practicable," which clearly points in the direction of engaging with smaller and non-tra-

ditional vendors, and yet there is a widespread reluctance to take advantage of this procedure.

Similarly, although FAR 39.103 states that the government should use modular contracting "to the maximum extent practicable," many CO's seem unaware of what modular contracting is, how it works, or how to use it. In the simplest terms, modular contracting involves breaking large efforts into a series of smaller efforts, which reduces the barriers to participation for smaller, non-traditional contractors.

18. Senator SHAHEEN. What is your assessment of the training and education of the acquisition workforce? What improvements should be made?

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Mr. WARD. As I mentioned in the answer to Question 11, the Pentagon would do well to augment the DAU training with material from civilian academic institutions such as the University of Tennessee, West Virginia University's Center for Smart Defense, Duke University's Corporate Education program, and Georgia Tech's Contracting Education Academy.

Similarly, it is definitely time to refresh the curriculum at DAU. They do good work and have a challenging charter, but I would like to see a greater emphasis on innovation over compliance, on clarity and flexibility over death-by-PowerPoint and school-house answers.

GOVERNMENT CONTRACTING

19. Senator SHAHEEN. In your view, what are the benefits of engaging small and non-traditional businesses in contracting for the federal government? What are the tools at the government's disposal to meet these needs?

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

Mr. Augustine did not respond in time for printing. When received, answer will be retained in committee files.

QUESTIONS SUBMITTED BY SENATOR JEANNE SHAHEEN

20. Senator SHAHEEN. Are these tools sufficient? Are there barriers that should be removed to better encourage small and innovative companies to participate in defense acquisition?

Dr. Gansler did not respond in time for printing. When received, answer will be retained in committee files.

Mr. AUGUSTINE. The In-Q–Tel model has proven to be a highly successful means for dealing with the kinds of issues addressed in Question 19. It is premised on the notion that in many instances the government should enable commercial procurement practices to replace government procurement practices. This is of course not without risk, nor is it easy, but that risk, in my experience, is trivial compared with the cost of meeting all the so-called "protections" built into defense procurement as it has evolved over the years. The In-Q–Tel concept is really quite simple: it allows companies to deal with government (intermediaries) much as it deals with other firms in the free enterprise system.

Mr. FitzGerald did not respond in time for printing. When received, answer will be retained in committee files.

Mr. WARD. My observation is that small, non-traditional businesses are more than willing to work on projects for the federal government if they see an opportunity to contribute to a meaningful objective on a reasonable timeline. They are discouraged when it takes too long to get started or when their contribution is limited, either because the large prime contractor does not allocate meaningful tasks or because the project itself does not actually address a meaningful problem. Establishing short timelines and well-focused projects helps address both of these barriers.

QUESTIONS SUBMITTED BY SENATOR MAZIE HIRONO

STEM EDUCATION IN THE U.S.

21. Senator HIRONO. Mr. Augustine, I know that you have done significant work in the STEM arena. Preparing our youth for future jobs in the science and engineering fields is vital for our national security and economy. We discussed during the hearing that we are being significantly outpaced by other countries in this area. In your opinion, what can be done to improve the quality and quantity of our STEM graduates?

Mr. AUGUSTINE. Thank you for this question; it is a very important question indeed. Today, for every PhD that U.S. universities award in engineering to U.S.-born individuals, these universities, on average, award two PhDs to individuals who were not born in the U.S. In short, we have been importing much of the nation's engineering talent insofar as the research sector is concerned.

I believe that when it comes to expanding the nation's engineering talent base we have issues at both the primary and secondary school levels as well as at the university level. In the case of the latter, most states have now chosen to disinvest in higher education, and as such the current, extraordinary high ranking of our institutions of higher education are very much endangered. We must encourage our states once again to underwrite higher education at a level consistent with its importance.

With regard to primary and secondary education, simply stated, we need to bring the Free Enterprise system to grades K–12. This system has been enormously successful in American business, making our economy the strongest in the world, and in higher education, making our universities the finest in the world. This requires creating competition among schools, among teachers, and among administrators; paying quality teachers much more than they are now paid; and helping teachers not suited to the classroom to find other careers which they might more successfully pursue.

We also need a change in the attitude of our engineering schools, which for many years seem to have embraced the notion of trying to see how many candidates could be driven out of engineering into other fields, presumably to prove how difficult is an engineering curriculum. Typically, between a third and half of those beginning in engineering at U.S. universities do not graduate in that field. This has recently been recognized and the curriculum is being modified at many universities, particularly for the freshman year.

22. Senator HIRONO. What specific steps should DOD be taking in STEM educational activities to support their missions and needs?

Mr. AUGUSTINE. I believe there are several constructive pursuits that DOD could undertake in STEM education that would also support the DOD mission. One of these would be to create practical, out-of-the-classroom experiences in engineering for young students. This would help them understand the relevance of their studies to everyday work in science and engineering. One very good program in this regard is underway at the Pensacola, FL Navy base.

Another initiative would be to establish a number of Defense Scholarships for extraordinarily exceptional high school graduates. Still another would be to address the problem that the children of our military are frequently required to move from school to school and often to attend inferior public schools that happen to surround many military bases in the United States. In this regard, there is a program called the National Math and Science Initiative that is currently working with DOD to help improve these schools, particularly in the STEM fields, I would encourage the expansion of this relationship. (For the record, I am one of the founders and a member of the board of directors of the National Math and Science Initiative, a not-for-profit organization designed to improve the quality of education offered to America's students.)

23. Senator HIRONO. What can be done to support STEM education for the children of service members?

Mr. AUGUSTINE. Please see response to Question 22.

24. Senator HIRONO. How can we create incentives for industry to work with DOD on these issues?

Mr. AUGUSTINE. Industry is, by and large, devoting a substantial fraction of its charitable giving to K–12 education. I believe that a greater portion of these resources could be allocated to schools at which the children of the nation's service members attend. Additionally, one might replicate something that I have done, which is to specify that the scholarships that my wife and I have established at various universities give priority to children of individuals serving in the military as well as to individuals who themselves have formerly served in the military.

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