

Testimony before the House Committee on Armed Services subcommittee on Cyber, Innovative Technologies, and Information Systems

Hearing on Innovation Opportunities and Vision for the Science & Technology Enterprise.

Victoria Coleman, former Director of DARPA

February 23, 2021

Chairman Langevin, Ranking Member Stefanik, distinguished members of the House Committee on Armed Services subcommittee on Cyber, Innovative Technologies, and Information Systems, it is truly an honor to testify before you today on the innovation opportunities and vision for the S&T enterprise.

Context

Throughout the Cold War and the turn of the 21st century, the U.S. military enjoyed significant technological advantage over its adversaries. But this advantage has been steadily eroding over the past three decades. During that time, America's adversaries have made asymmetric strides in building their own technological advantage. This is not the result of reduced U.S. investment in national security science and technology. It is the result of the technology investments outside the defense sector surpassing those within it. The fruits of this commercial innovation are available equally to U.S. competitors and adversaries without any significant investment on their part. Conversely, the DoD struggles with accessing technology and talent outside the defense perimeter. Coupled with inefficiencies in the U.S. defense technology pipeline and China's aggressive national strategy of Military-Civil Fusion, the technology advantage of the U.S. military is being stressed to breaking point.

It is worth remembering how we got here. In the decades since the Sputnik experiment in the 1950s, and right up to the Cold War, technology innovation was driven by defense investments, and priorities were executed by a broad and vibrant defense R&D industry. With the end of the Cold War, as the U.S. started drawing on the peace dividend and defense investments began to shrink, commercial technology innovation and globalization took over. Frequently enabled by DoD investments, such as the Arpanet and microelectronics, companies like Intel, Microsoft, IBM, Hewlett-Packard, and others began to dominate the technology landscape that defined the ecosystem from which the DoD now draws many core technologies essential to its mission. But in the past 20 years or so, as these technologies spread beyond enterprise uses, consumer technology emerged as the driving force. The technology landscape today is not defined by the traditional powerhouses of the 1980s and 1990s, but by companies that bring these technologies to consumers. A phone maker—Apple—who put a computer in everyone's pocket; a retailer—Amazon—who invented cloud computing; an advertising company—Google—that made searching the Web child's play; and a company that keeps your personal address book—Facebook—that built social media as we know it. We know that these innovations have offered critical capabilities to foreign state and non state actors. Armed with commercial satellite imagery, GPS, and a Facebook account, an adversary can track highly sensitive military operations not only with accuracy, but also with zero technology investment. But this is just a manifestation of something far more insidious. *Commercial and consumer markets matter* because they drive change and technology evolution. And our peer competitor, China, also happens to be the world's single biggest consumer market.

Principal challenges

China's military-civil fusion (MCF) is an aggressive national strategy of the Chinese Communist Party. Overseen personally by President Xi Jinping it aims to enable the PRC to develop the most technologically advanced military in the world by eliminating the barriers between China's civilian research and commercial sectors and its military and defense industrial sectors. Under MCF, the CCP is systematically reorganizing the Chinese S&T enterprise to ensure that new innovations simultaneously advance economic and military development. In contrast, *the United States struggles to bridge the gap between commercial innovation and military technology needs* in key areas such as semiconductors, 5G, AI and aerospace technology.

Assuming that we are able to break down the barriers between the U.S. Defense Industrial Base and access technology and innovation originating outside, our next challenge is being able to rapidly and systematically transition the technology into deployed systems – enterprise or mission. Technology transition even within the same company or organization is a challenging business. It is especially so in the large, complex innovation network that our military depends on. Cornerstone technologies like AI and 5G are just the beginning. The world is full of good ideas. But, as Steve Jobs used to say, the idea accounts for, at most, 10 percent. The remaining 90 percent is execution, and it differentiates those who win and those who fail. Taking an idea from concept to deployment is a fiercely challenging process that requires unrelenting focus, exquisite execution, and precise alignment throughout the organization. *Innovation needs to be executable by the entire organization.*

Finally, in the coming years, devoting resources to priorities such as righting our country after the Covid-19 pandemic, rebuilding the middle class or meeting the challenges of climate change will mean that we will have to do more with less as we rebuild America's military technology advantage. Picking our priorities through the lens of a *clearly articulated Defense S&T strategy* will be more important than ever.

Areas of opportunity

In the world of technology speed matters. As we strive to build technology advantage, we also have to strive to keep it. All technology advantage is temporary and comes to little unless fielded and leveraged at the speed of the next technology evolution. As new technology emerges, tactics are developed that use it. Then counter tactics are developed and technological parity is reached. And the cycle starts over again. The only way to get ahead and stay ahead is to be faster than our competitors. As our predecessors envisioned force multiplication as the key strategy for defeating the Soviet threat in Europe in the aftermath of WW II, we should aspire *to time compression as the key strategy of our generation*. Time compression means we can win the fight in a fraction of the time it would take to achieve the same objective otherwise. It means we control the time domain. We can speed up time when it suits us and we can slow down time when we need more time to achieve our objectives. And this certainly applies to imagining, creating and deploying innovation to secure the technological edge for our military.

In the struggle to achieve time compression and speed up time, our platforms matter. We need to *evolve our platforms from the monoliths they are today to agile, mosaic systems*. If we are successful we will be able to rapidly swap out components and always have the latest innovations deployed in our platforms. A lot has been said about doing over the air updates to the F-35. It may sound like science fiction but this is what happens every time your mobile phone gets an upgrade – so that you always have the latest and the greatest. Imagine a world where we can change the functionality of our platforms at such a dizzying rate that every morning our adversaries wake up and they are confronted with a brand new system and

capability against which they have 24 hrs to develop counter tactics. We just succeeded in slowing down time for them.

How could we get there? It has been said that bits eat atoms. *It's all about the software*. If we start thinking of the F-35 as an information appliance vs an airplane, the whole way we approach designing, building and maintaining it changes. We design it from the start to be software centric, modular and composable. In others words a mosaic vs a monolith. Increasing the software competency of our Defense S&T Enterprise and technology acquisition workforce is therefore at the heart of time compression.

A lot has been said about supply chains. In the Department of Defense we have worried for some time now about the trustworthiness of the supply chain for microelectronics for example. And as the Covid-19 pandemic has demonstrated our dependency on many other overseas supply chains is also a vulnerability. Building transparent, resilient and diverse supply chains is critical for our economy and our national security. But it also highlights the opportunity to not only innovate here at home but also to help create new businesses that translate the innovation into scalable domestic manufacturing. First because doing so reduces our dependency on potentially adversarial supply chains. Second because it creates good jobs here at home. Third, and perhaps most importantly, because unless we build and manufacture products right here in the United States, we will eventually lose our ability to innovate all together. A [recent New York Times article](#) by Noam Scheiber said it all:

“A 2012 book by the Harvard business professors Gary Pisano and Willy Shih made the case that when it comes to manufacturing, strength yields strength, and weakness yields weakness. They showed that the offshoring to Asia of the consumer-electronics industry, which executives believed was becoming too commoditized to be worth keeping entirely in the U.S., had weakened America’s so-called industrial commons — the ecosystem of research, engineering and manufacturing know-how that creates innovative products. In effect, getting out of the business of making stereos and TVs in the 1960s and ’70s made it harder for American manufacturers to produce more sophisticated technologies like advanced batteries. The Chinese, of course, took the other side of the bet — gaining know-how by starting with simpler products, which then led to the making of more sophisticated ones. That’s partly why the China shock started with exports of products like textiles and steel and eventually included smartphones.”

To ensure the future of our technology advantage *we must act to rebuild our industrial commons*.

Recommendations

People first

Everything starts with people. We need to nurture our S&T Enterprise technical community by protecting them from onerous bureaucracy, giving them the tools they need to do their work and offering them opportunities to grow their skills and careers. Hiring the best and the brightest starts early. We need to grow the DoD STEM workforce by investing in the next generation of our technical national security professionals by for example expanding programs such as the SMART scholarship program. We also need to increase the diversity of the DoD STEM workforce by broadening the recruitment pool in terms of expertise, background and location. And we need to create a diverse and inclusive environment where everyone is welcome and can succeed. Empowering the DoD technical community and giving technology a strong voice at the decision making table is key.

What we work on

As Peter Drucker once said, if you don't know where you are going, all roads will take you there. Absent a defense R&D strategy, it is impossible for the Defense Department to focus and prioritize its technology investments. When the Department had a clearly articulated overarching technology strategy in the 1950s and the late 1970s U.S. investments translated to dramatic and lasting superiority. Compiling a list of current technology investments does not constitute a strategy. The 2018 USAF 2030 S&T Strategy provides a good example of S&T strategy making. It starts with articulating a *vision*: an Air Force that dominates time, space, and complexity in future conflict across all operating domains to project power and defend the homeland. It then identifies *5 strategic capabilities*: Global persistent awareness, resilient information sharing, rapid, effective decision making, complexity, unpredictability and mass and speed and reach of disruption and lethality. And then identifies a non exhaustive list of underpinning technologies that may be needed to implement the strategic capabilities: Enabling microelectronics, quantum science, AI and autonomy, hypersonic flight amongst others. Looking beyond the usual suspects, key areas of focus in our R&D strategy making should include R&D for transforming manufacturing to rebuild our industrial commons (starting with microelectronics) and technologies for countering digital authoritarianism that undermines democracy around the world and here at home.

How we work

We need to give our DoD innovation engine a tune up. We can radically enhance the productivity of the S&T Enterprise workforce by killing a paper cut every day, starting by offering them a performant information technology infrastructure: cloud, modern software development and collaboration tools. We can speed up execution and open up the door to non traditional innovators by innovating in contracting and using granted authorities. As mentioned earlier, innovation needs to be executable by the entire organization.

How we have impact

An efficient and responsive defense Tech pipeline is essential in allowing the transition of innovation from the lab to the warfighter. Commercial product development relies on this pipeline and has developed best known methods such product management to bridge the gap between a technology and its consumers. *We need to migrate these best known methods into the way we develop and acquire technology in the DoD.* And we need to innovate in transition. Going beyond the often elusive transition of a technology directly into a program of record by, for example, creating and supporting new startups that can develop, mature and transfer the technology to the warfighter. DARPA's Embedded Entrepreneur Initiative and National Security Seed Fund are great examples of what can be accomplished within existing authorities.

Who we work with

We need to broaden our reach into the non traditional innovation community *by establishing a national security open innovation network.* The companies that came to define the technology context within which the military has to defend the nation today all hail from the West Coast, as do many other disruptors, such as Uber, Tesla, and SpaceX. It is no wonder then that Silicon Valley is teeming with company outposts from all over the world. Their objective: to gain visibility into talent and technologies they can acquire to further their interests. Open innovation is about building a presence in and bridges with innovation hubs, such as Silicon Valley and the Boston Corridor. The

S&T Enterprise (with the notable exception of DIU and In-Q-Tel) is mostly absent from these hotspots. The innovation muscle of the Defense Department lies in the defense vendor base, the defense laboratories, DARPA, and the various other defense R&D agencies. The lack of a physical, substantial, and enduring presence of the S&T Enterprise in Silicon Valley and the other national innovation hotspots means that we do not have eyes and ears on the ground when it comes to emerging technologies and talent in these areas. The consequence is a chronic isolation of the defense technology establishment from the very commercial innovation that U.S. competitors and adversaries exploit to build asymmetric technology advantage against our country.

In closing

It is perhaps fitting to conclude this testimony with the words of Charles Kettering to the U.S. Chamber of Commerce in 1929:

“I am not pleading with you to make changes. I am telling you you have got to make them – not because I say so, but because old Father Time will take care of you if you don’t change. Advancing waves of other people’s progress sweep over the unchanging man and wash him out. Consequently, you need to organize a department of systematic change-making.”