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GLOBAL SECURITY CHALLENGES AND UNITED STATES STRATEGY

HEARING

BEFORE THE

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GLOBAL SECURITY CHALLENGES AND UNITED STATES STRATEGY

TUESDAY, MARCH 12, 2024

UNITED STATES SENATE,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

The Committee met, pursuant to notice, at 9:30 a.m. in room SH-216, Hart Senate Office Building, Senator Jack Reed (Chairman of the Committee) presiding.

Committee Members present: Senators Reed, Gillibrand, Blumenthal, Hirono, Kaine, King, Peters, Kelly, Wicker, Fischer, Cotton, Ernst, Scott, and Schmitt.

OPENING STATEMENT OF SENATOR JACK REED

Chairman REED. Good morning. The Committee meets today to discuss a range of global security challenges to the United States. As the Biden administration's National Defense Strategy (NDS) has made clear, we are in a long-term strategic competition with China and Russia. Ultimately, this competition is not just a rivalry of military or economic power but also a competition of ideas. This requires us to develop an understanding of our potential adversaries' strengths, weaknesses, philosophies, and objectives. This is where the knowledge and insights of the experts before us today are so valuable.

Dr. Paul Scharre is the Executive Vice President and Director of Studies at the Center for a New American Security. He is an expert on the future of technology and warfare, particularly with regard to artificial intelligence (AI) and autonomous weaponry, and has authored several influential books on these issues. Dr. Scharre worked previously as a policy expert in the Department of Defense (DOD) and served as an Army Ranger with multiple combat tours. Thank you.

Dr. Hal Brands is a Senior Fellow at the American Enterprise Institute and serves as the Henry Kissinger Distinguished Professor of Global Affairs at the Johns Hopkins School of Advanced International Studies. He worked previously as Special Assistant to the Secretary of Defense for Strategic Planning and was a lead writer for the 2018 National Defense Strategy Commission. He has authored several books on U.S. grand strategy and statecraft.

Thank you both for joining us today and for your long careers of service to the Nation.

Our objective today is to examine the national security issues that this Committee should consider as we prepare the Fiscal Year 2025 National Defense Authorization Act. There is a common un-

derstanding on the Committee that the future of America's national security is tied to our competition with China. To keep pace and maintain America's edge, the Department of Defense must understand China's competitive tactics, develop new competitive tools of its own, and integrate with our allies and partners.

For several decades, the People's Liberation Army (PLA) has studied America's way of war and focused its efforts on covering our advantages. China has invested in offsetting technologies like anti-access and aerial denial systems, artificial intelligence, unmanned vehicles, hypersonics, and nuclear weapons. Further, Beijing has leveraged a combination of military and civil power against its neighbors, include statecraft, economic pressure, coercion, and deception. China has sought ways to achieve its national objectives while avoiding a direct military confrontation with the United States military. As the Defense Department's new Joint Concept for Competing states, China seeks to win without fighting. The strategy warns that if we do not adapt our approach, compete more effectively, the United States risks ceding strategic influence, advantage, and leverage while preparing for war that never occurs. Indeed, the document warns that the United States could lose without fighting.

Just as Chinese leaders have studied America's way of war, we need to study theirs. With that in mind I would ask our witnesses for your assessment of how China is evolving its competitive strategies and objectives. I would also appreciate your views on what military and non-military factors are mostly likely to impact Chinese decisionmaking with respect to potential action against Taiwan and other regional partners.

Even as we chart this long-term competition with China, we must recognize the current threat Russia poses. Let's be clear. Russia's war against Ukraine is an active threat to our national security. Vladimir Putin has repeatedly said that if he succeeds in Ukraine he intends to reunify former Soviet states. This will almost certainly involve direct military conflict with a NATO [North Atlantic Treaty Organization] country, requiring the United States to send our own men and women into harm's way. We must continue our support for Ukraine so we can defeat Putin and cripple his ability to wage war elsewhere.

As we are seeing in Ukraine and the Middle East, the nature of conflict and deterrence is evolving quickly. Cyber information and space operations can shape the battlefield as fundamentally as air, land, and sea power. The interconnected nature of these activities must drive the way we develop and field new technologies.

The Defense Department continues to develop the Combined Joint All-Domain Command and Control (JADC2), concept, which would be a force multiplier in this regard. JADC2 will enable the Joint Force to detect, analyze, and act on information across the battle space quickly using automation, artificial intelligence, and predictive analysis.

If we can field these technologies and mass these techniques then we must quickly include our allies and partners in the system. Indeed, forging and maintaining strong international partnerships is likely to be the decisive factor in any future conflict. We have seen

this through Ukraine's remarkable performance against Russia, and it will hold true in the Indo-Pacific.

I look forward to our witnesses' testimonies, and I thank them again for their participation.

Let me now recognize the Ranking Member, Senator Wicker.

STATEMENT OF SENATOR ROGER WICKER

Senator WICKER. Thank you, Mr. Chairman. Our Chairman has just delivered a rather sobering opening statement.

Today's witnesses are here to help this Committee take stock of changing threats to American interests. They will help us reflect on our progress in mitigating and combating those threats over the past year or so.

The scorecard does not look good.

The Chinese Communist Party (CCP) shows no sign of stopping its military modernization project. In fact, China added 30 ships last year compared to our overall reduction of 2. In fact, the People's Liberation Army (PLA) also continues to improve its force readiness with complex exercises focused on the so-called reunification of China with Taiwan.

The CCP also continues its regional aggression on other countries' sovereign rights. For example, they have repeatedly harassed the Philippines' resupply ships in the Second Thomas Shoal. Although the San Francisco summit between Presidents Biden and Xi produced some feel-good headlines, Xi concluded the summit by reminding the United States that he intends to control Taiwan, peacefully or not.

A year ago, we all hoped for significant progress in Ukraine's much-awaited offensive. That progress fell short. We failed to capitalize on temporary Russian weakness, and now face a Vladimir Putin increasingly convinced he can win in Ukraine, or at least outlast us and outlast everyone else. China, Iran, and North Korea are all contributing to Russia's war effort.

Much has also changed in the past year with Iran. Tehran has used the chaos following Hamas' October 7th massacre as an opportunity to have its proxies attack United States Forces more than 160 times, including with deadly consequences in Jordan and in the Red Sea. Iranian-armed Houthis also continue to attack critical global maritime commerce in the Red Sea.

Not to be outdone, North Korea seems to have moved into an offensive war preparation mode. This shift from a long-held defensive posture is a significant development which further complicates the picture in East Asia.

Worse yet, all four of these adversaries drastically deepened their military and economic cooperation over the past year, even as we implement a National Defense Strategy that largely considers each adversary individually. I struggled to use the word "implement" because it seems to me that we have a strategy that is not being fully attempted.

I would like to hear from the witnesses how they assess the current threats from all of these adversaries.

The year 2023 was a discouraging year for U.S. national security, and 2024 will be worse without substantial investment in our military forces. This Committee recently heard about challenges across

maritime, air, and space domains, as well as challenges with insufficient inventories of long-range munitions in the Indo-Pacific theater. If we have any hope of deterring threats from China, we need to act immediately to enhance our capabilities.

Our needs across the combatant commands and within the services are much too long to list here. We need more submarines. We need more amphibious ships. We need to give our servicemembers more visibility through intelligence, surveillance, and reconnaissance tools. We need more torpedoes. We need more of the SM-6 multi-role missiles, more of the Tomahawk strike missiles our ships and submarines carry, and more of the Long-Range Anti-Ship Missiles that allow us to hit enemy ships precisely from a safe distance. We need all of these things now.

I welcome our witnesses' suggestions on how to improve the Pentagon's ossified planning, contracting, and budgeting processes, which continue to prevent us from producing cost-effective programs on time and at scale.

I would also be interested in our witnesses' perspective about the sufficiency of the overall topline defense budget. The budget proposed yesterday by President Biden requests yet another significant cut in defense. He proposed this even as the Chinese Communist Party announced a 7.2 percent defense budget increase just last week. Is it too much to ask that we return to the generous portion of GDP [gross domestic product] that gave us more than a decade of peace during the Reagan era?

We continue to ask our military to do too much with too little, and that needs to change. I hope this Committee, Mr. Chairman, on a bipartisan basis, is prepared to act this year to ensure we address this looming national security crisis.

Thank you, sir.

Chairman REED. Thank you very much, Senator Wicker. Dr. Scharre, please.

**STATEMENT OF PAUL SCHARRE, Ph.D., EXECUTIVE VICE
PRESIDENT AND DIRECTOR OF STUDIES CENTER FOR A
NEW AMERICAN SECURITY**

Dr. SCHARRE. Thank you, Chairman Reed, Ranking Member Wicker, and distinguished Senators. Thank you for having me here today.

We live in a period of tremendous technological change. This creates opportunities for the United States but also for our adversaries. The U.S. military must adopt technology faster than its competitors. The bulk of technological innovation is occurring outside DOD, and DOD must prioritize spinning-in commercial technologies and harnessing them for military advantage. This contest to rapidly adopt commercial technologies is an all-too-level playing field with our competitors.

China also has access to world-class technology companies, and the PLA is working to "intelligentize" its forces. DOD needs significant institutional change to keep pace with the speed of technological innovation. Without these changes, we risk falling behind competitors and the U.S. military being unprepared in a future conflict.

DOD cannot lead in 21st century technologies with a 20th century bureaucracy. The tech innovation landscape has changed dramatically in the past half century, but DOD institutions have not kept up. It is not merely that the technology itself has advanced. That alone would be manageable. The problem is that the role that DOD plays in tech innovation has changed, but DOD has not yet sufficiently adapted to this new reality.

The Defense Department used to be the main driver of global innovation, but not anymore. In 1960, DOD alone controlled 36 percent of global R&D (research and development) spending. DOD could single-handedly drive the shape of technological evolution around the world. DOD could make bets that others had to respond to.

Now today this dynamic has reversed. DOD controls only 3 percent of global R&D. Two trends have caused this shift. First, the Federal Government's share of U.S. domestic R&D has fallen, with the private sector picking up the slack. Second, the U.S. share of global R&D has dropped from nearly 70 percent in 1960 to 30 percent today.

A combination of these trends in the commercialization and globalization of research and development has dramatically changed the role that DOD plays in technology development. Instead of being a trend-setter, DOD is forced to react to technology trends exogenous to the defense industry.

The dominant trend in global technology innovation today is the information revolution. Network connectivity and bandwidth, big data, AI [artificial intelligence] and machine learning, genomics, Internet of Things devices, and computing hardware are all advancing at literal exponential rates. To give just one example, the amount of computing hardware used to train cutting-edge machine learning systems, such as large language models like ChatGPT, has grown 10 billionfold since 2010, and is doubling every 6 months. This is much faster than the historical 24-month doubling in chip performance associated with Moore's Law. This has dramatic implications for the military. Few other technologies are advancing this quickly. Missiles are not 10 billion times faster than they were in 2010.

Yet information technologies (IT) are advancing at a breathtaking pace, creating new opportunities for military applications, and these technologies are so widely available, coming out of a highly globalized, commercially driven R&D ecosystem, that our competitors have similar opportunities.

DOD should prioritize investment in digital capabilities that are riding these exponential curves—autonomy, robotics, sensors, communication networks, data, cloud computing, cyber, and electronic warfare, for example.

We can already see evidence of this dynamic in the war in Ukraine, with the proliferation of small, commercially available drones and counter-drone electronic warfare and jamming systems. Our adversaries will capitalize on these technologies. The only question is whether the United States also competes or falls behind.

In recent years, DOD has created a slew of new innovation organizations such as DIU [Defense Innovation Unit], AFWERX [Air

Force Work Project], SOWFEX [Special Operations Forces Works], CDAO [Chief Digital and Artificial Intelligence Office], and others, and many of these have yielded tangible successes. Yet DOD has often struggled to innovate quickly at scale.

The Defense Department must move beyond bespoke solutions to one-off problems and scale commercial tech adoption across the \$800 billion enterprise. DOD will need Congress' support to move fast, be flexible, experiment with new technologies, engage non-traditional companies, and take risks. Thank you.

[The prepared statement of Dr. Scharre follows:]



MARCH 12, 2024

TESTIMONY BEFORE THE SENATE ARMED SERVICES COMMITTEE

Global Security Challenges and U.S. Strategy

Preserving U.S. Military Advantage Amid Rapid Technological Change

BY

Paul Scharre

*Executive Vice President and Director of Studies
Center for a New American Security*

I. A Shifting Global Innovation Landscape

Chairman Reed, Ranking Member Wicker, distinguished Senators, thank you for having me here today.

We live in a period of tremendous technological change. This disruption creates opportunities for the United States but also for our adversaries. To sustain its battlefield advantage, the U.S. military must adopt technology faster than its competitors. In many cases, the Defense Department does not need to invent new technologies. The bulk of technological innovation is occurring outside the Department of Defense (DoD), a dramatic change from fifty years ago. DoD must prioritize spinning-in commercial technologies and harnessing them for military advantage. This contest to rapidly adopt commercial technologies is, unfortunately, an all-too-level playing field with our competitors. China, in particular, has access to world-class technology companies, and the People's Liberation Army (PLA) is working to "intelligentize" its forces.¹ The Defense Department needs significant institutional change to keep pace with the speed of technological innovation. Without these changes, we risk falling behind competitors, and the U.S. military being unprepared in a future conflict.

The core problem the Defense Department faces is that it is attempting to compete in 21st century technologies using a 20th century bureaucracy. The technology innovation landscape has changed dramatically in the past half century, but DoD's institutions have not kept up. It is not merely that technology itself has advanced. That alone would be manageable. The problem is that the role the Defense Department plays in the tech innovation ecosystem has changed, but the DoD has not yet sufficiently adapted to this new reality.

The Defense Department used to be the main driver of global innovation. But not anymore. In 1960, the Defense Department alone controlled 36 percent of global research and development (R&D) spending. The Defense Department could singlehandedly drive the shape of technological evolution around the world and for future wars. DoD could make bets that others had to respond to. Today, this dynamic has reversed. DoD controls only 3 percent of global R&D. Two trends have driven this shift. First, the federal government's share of U.S. domestic R&D has fallen from two-thirds of national R&D to less than one quarter, with private businesses picking up the slack. This pattern has been mirrored globally. In 1960, the United States as a nation accounted for nearly 70 percent of global R&D. Today, the U.S. portion of global R&D has fallen to 30 percent.² The combination of these trends in the commercialization and globalization of research and development has dramatically changed the role the Defense Department plays in technology development. Instead of being a trend-setter, the DoD is forced to react to technology trends exogenous to the defense industry.

II. Exponential Growth in Information Technologies

The dominant trend in global technology innovation is the information revolution. Network connectivity and bandwidth, big data, artificial intelligence and machine learning, genomics, internet of things devices, and computing hardware are all advancing at literal exponential rates. To give just one example, the amount of computing hardware used to train cutting-edge machine learning systems, such as large language models like ChatGPT, has grown ten billionfold since 2010 and is doubling every six months.³ This is much faster than the historical 24-month doubling in chip performance associated with Moore's Law.⁴ This has dramatic implications for the military. Few other technologies are advancing this quickly. Missiles are not ten billion times faster than they were in 2010. Stealth aircraft are not ten billion times stealthier. Yet information technologies are advancing at a breathtaking pace, creating new opportunities for military applications. And these technologies are so widely available, coming out of a highly globalized, commercially-driven R&D ecosystem, that competitors have similar opportunities to develop and field these technologies.

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The rapid pace of advancement in information technologies suggests these are likely to have the most transformative effect on warfare in the coming decades. DoD should prioritize investments in capabilities that are riding these exponential curves. Autonomy, robotics, advanced sensors, communications networks, data processing, automated decision aids, AI and machine learning, computing hardware, cloud computing, electronic warfare, cyber operations, synthetic biology, and genomics are all examples of the kinds of technologies and capabilities that benefit from advances in information technology.

We can already see evidence of this dynamic in the war in Ukraine. Small, commercially available drones have transformed the battlespace, with both Russia and Ukraine using them for reconnaissance and strikes. Increasingly, these drones use AI tools such as machine learning image classifiers to identify objects. Counter-drone electronic warfare systems and jammers have also increased in response.

Our adversaries will capitalize on these technologies. The only question is whether the United States also competes or falls behind.

III. The Need for Institutional Change

How should the Defense Department adapt to this new reality?

Increased defense R&D spending is to be welcomed but cannot fundamentally change the diminished role that U.S. defense spending plays in the global technology ecosystem today. Doubling or even tripling defense R&D spending would still mean that 90 percent of tech innovation occurs outside the defense sector. The most urgent and important priority is for DoD to improve its processes for bringing commercial technology into the Department.

But it is not enough for DoD to buy commercial technology. It must also move faster to keep pace with the speed of technological change. The decades-long time horizon on which DoD typically develops weapon systems is too slow for information technology and will result in systems being out-of-date before they are fielded.⁵

DoD has made some progress on this front. Since 2015, DoD has created a raft of new, innovation-focused organizations, including the Defense Innovation Unit (DIU), Chief Digital and Artificial Intelligence Office (CDAO), Air Force Works (AFWERX), Special Operations Forces Works (SOFWERX), and many other organizations. Many of these have yielded tangible successes.⁶ DoD has also improved its ability to bring on non-traditional companies and use more flexible contracting vehicles, such as other transaction authority.⁷

Yet DoD has often struggled to innovate quickly at scale. DoD must move beyond bespoke solutions to one-off problems and scale commercial tech adoption across an \$800 billion enterprise. The Department's new Replicator initiative is a promising sign of the importance that senior Department leadership is placing on this effort and will be a crucial test of the Department's ability to innovate quickly at scale.⁸

There is no time to waste. U.S. competitors are also innovating. The PLA is similarly experimenting with new organizations to bring in commercial technology. In 2018, the PLA's Central Military Commission Science and Technology Commission created a "rapid response small group" in Shenzhen to adopt commercial technologies, which some Chinese commentators referred to as "China's DIUx."⁹ China also has access to world class technologies, and the United States will have to innovate faster to stay ahead.

DoD will need Congress's support to move fast, be flexible, experiment with new technologies, engage non-traditional defense companies, and take risks.

Thank you.

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Appendix A: Additional Reading

Paul Scharre and Ainikki Riikonen, *Defense Technology Strategy* (Center for a New American Security, November 17, 2020), <https://www.cnas.org/publications/reports/defense-technology-strategy>.

Obstacles and Opportunities for Transformative Change: Testimony Before the House Committee on Armed Services Subcommittee on Cyber, Information Technologies, and Innovation, 118th Cong. (October 19, 2023) (statement of Paul Scharre, Executive Vice President and Director of Studies, Center for a New American Security) https://armedservices.house.gov/sites/republicans.armedservices.house.gov/files/Paul_Scharre_Testimony_HASC-CITI_10.19.23.pdf.

Appendix B: Curriculum Vitae

Paul Scharre is the Executive Vice President and Director of Studies at CNAS. He is the award-winning author of *Four Battlegrounds: Power in the Age of Artificial Intelligence*. His first book, *Army of None: Autonomous Weapons and the Future of War*, won the 2019 Colby Award, was named one of Bill Gates' top five books of 2018, and was named by *The Economist* one of the top five books to understand modern warfare. *TIME* magazine named him in 2023 as one of the "100 most influential people in AI."

Scharre previously worked in the Office of the Secretary of Defense (OSD) where he played a leading role in establishing policies on unmanned and autonomous systems and emerging weapons technologies. He led the Department of Defense (DoD) working group that drafted DoD Directive 3000.09, establishing the department's policies on autonomy in weapon systems. He also led DoD efforts to establish policies on intelligence, surveillance, and reconnaissance programs and directed energy technologies. Scharre was involved in the drafting of policy guidance in the 2012 Defense Strategic Guidance, 2010 Quadrennial Defense Review, and secretary-level planning guidance.

Prior to joining OSD, Scharre served as a special operations reconnaissance team leader in the Army's 3rd Ranger Battalion and completed multiple tours to Iraq and Afghanistan. He is a graduate of the Army's Airborne, Ranger, and Sniper Schools and Honor Graduate of the 75th Ranger Regiment's Ranger Indoctrination Program.

Scharre has published articles in *The New York Times*, *The Wall Street Journal*, CNN, *TIME*, *Foreign Policy*, *Foreign Affairs*, *Politico*, and *USA Today*, and has appeared on CNN, MSNBC, Fox News, NPR, and the BBC. He has testified before the House and Senate Armed Services Committees and has presented at the United Nations, NATO, the Pentagon, the CIA, and other national security venues. He holds a PhD in war studies from King's College London and an M.A. in political economy and public policy and a B.S. in physics from Washington University in St. Louis.

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Appendix C: CNAS Intellectual Independence Policy

This testimony reflects the personal views of the author alone. As a research and policy institution committed to the highest standards of organizational, intellectual, and personal integrity, the Center for a New American Security (CNAS) maintains strict intellectual independence and sole editorial direction and control over its ideas, projects, publications, events, and other research activities. CNAS does not take institutional positions on policy issues and the content of CNAS publications reflects the views of their authors alone. In keeping with its mission and values, CNAS does not engage in lobbying activity and complies fully with all applicable federal, state, and local laws. CNAS will not engage in any representational activities or advocacy on behalf of any entities or interests and, to the extent that the Center accepts funding from non-U.S. sources, its activities will be limited to bona fide scholastic, academic, and research-related activities, consistent with applicable federal law. The Center publicly acknowledges on its [website](#) annually all donors who contribute.

¹ Elsa B. Kania, *Chinese Military Innovation in Artificial Intelligence: Hearing of the U.S. Economic and Security Review Commission* (June 7, 2019) (statement by Elsa B. Kania, Adjunct Senior Fellow, Center for a New American Security) <https://www.cnas.org/publications/congressional-testimony/chinese-military-innovation-in-artificial-intelligence>.

² John F. Sargent Jr. and Marcy E. Gallo, "The Global Research and Development Landscape and Implications for the Department of Defense," R45403, Congressional Research Service, June 28, 2021, <https://crsreports.congress.gov/product/pdf/R/R45403>.

³ Jaime Sevilla et al., *Compute Trends Across Three Eras of Machine Learning* (arXiv.org, March 9, 2022), <https://arxiv.org/abs/2202.05924>.

⁴ Gordon E. Moore, "Cramming More Components onto Integrated Circuits," *Electronics* 38, no. 8 (April 19, 1965), <https://ieeexplore.ieee.org/document/4785860>.

⁵ U.S. Government Accountability Office, *Weapons Systems Annual Assessment: Programs Are Not Consistently Implementing Practices That Can Help Accelerate Acquisition*, June 2023, 28, <https://www.gao.gov/assets/gao-23-106059.pdf>.

⁶ Defense Innovation Unit, "DIU FY22 Transitions: Generating Meaningful Revenue Opportunities for Commercial Vendors," January 2023, https://assets.ctfassets.net/3nanhbfkr0pc/4uzqWzUNidUs54ukuzNOhj/3f49f33bf4401add2d16dbf963eca8/FY_2022_DIU_Transitions_Impact_Memo_Website.pdf.

⁷ *Defense Acquisitions: DOD's Use of Other Transactions for Prototype Projects Has Increased* (report no. GAO-20-84, Government Accountability Office, November 2019), <https://www.gao.gov/assets/gao-20-84.pdf>.

⁸ Jim Garamone, "Hicks Discusses Replicator Initiative," *DoD News*, September 7, 2023, <https://www.defense.gov/News/News-Stories/Article/Article/3518827/hicks-discusses-replicator-initiative/>; Joseph Clark, "Defense Innovation Official Says Replicator Initiative Remains on Track," *DoD News*, January 26, 2024, <https://www.defense.gov/News/News-Stories/Article/Article/3657609/defense-innovation-official-says-replicator-initiative-remains-on-track/>.

⁹ Elsa B. Kania, "In Military-Civil Fusion, China Is Learning Lessons from the United States and Starting to Innovate," *Strategy Bridge*, August 27, 2019, <https://thestrategybridge.org/the-bridge/2019/8/27/in-military-civil-fusion-china-is-learning-lessons-from-the-united-states-and-starting-to-innovate>.

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Chairman REED. Thank you very much, Dr. Scharre.
Dr. Brands, please.

STATEMENT OF HAL BRANDS, Ph.D., SENIOR FELLOW AT THE AMERICAN ENTERPRISE INSTITUTE, HENRY A. KISSINGER DISTINGUISHED PROFESSOR OF GLOBAL AFFAIRS AT THE JOHNS HOPKINS SCHOOL OF ADVANCED INTERNATIONAL STUDIES

Dr. BRANDS. Chairman Reed, Ranking Member Wicker, distinguished Members of the Committee, thank you for inviting me. Let me just make three brief points at the outset here.

First, it is a perennial cliché to say that the international landscape is more threatening and complex than it has been at any

time in decades. Today that cliché actually happens to be true. All three key regions of Eurasia are experiencing severe conflict or the threat of conflict. Today we have Russia's war in Ukraine, the war between Israel, Hamas, and all of the violent spillover it has produced across much of the Middle East, as well as the growing threat of conflict with China in the Western Pacific.

When you add in the other persistent threats the United States must contend with from an increasingly belligerent North Korea to a nuclearizing Iran to the persistent threat of violent extremism, I think it is fair to say that the United States faces more and more severe security challenges than at any time since the end of the cold war, and perhaps even going back farther than that.

Second, to Senator Wicker's point, the connections between the threats the United States faces are growing, as is the threat of conflict that spans multiple regions. Ties between Russia and China, Russia and Iran, Russia and North Korea, and China and Iran are all becoming strongly and more tightly interwoven, which means that the conflicts in which these various actors are engaged, or could engage in, are becoming more tightly interconnected, as well.

I go into this issue in greater detail in my written statement, but let me just say that my gravest concern about the international security environment right now is not that United States adversaries will mount a comprehensive, highly coordinated assault on the international order. It is that the regional conflicts in which they are engaged will fuel and feed on each other, creating an atmosphere of growing global disorder.

As I mentioned, the United States right now already faces hot wars in two of the three key Eurasian theaters. If China were to attack Taiwan or otherwise violently upend the status quo in the Western Pacific, all three key theaters of Eurasia would be engulfed in violent conflicts simultaneously, a situation the world really has not seen since the run-up to World War II.

Third, the U.S. is not adequately prepared for the world it presently faces. For much of the past decade, the U.S. has been transitioning toward a one-war defense strategy in a world where it could easily face conflict in two or three theaters simultaneously. As we have seen since Russia invaded Ukraine, the United States defense industrial base would struggle enormously if the United States were engaged in a major conflict. U.S. defense spending is about as low, give or take, as a percentage of GDP, as it has been at any time since the late 1940's.

In other words, there is a growing gap between the challenges the U.S. faces and the resources with which it can face them. The longer that gap persists and the larger it grows, the greater the likelihood it will be revealed by our adversaries, at a time and place of their choosing, and at a tremendous cost to global stability and our own security. Thank you.

[The prepared statement of Dr. Brands follows:]



Statement before the Senate Committee on Armed Services
On Global Security Challenges and U.S. Strategy

Statement before the Senate Armed Services Committee: Global Security Challenges and U.S. Strategy

Dr. Hal Brands

Henry A. Kissinger Distinguished Professor, Johns Hopkins-SAIS
Senior Fellow, American Enterprise Institute

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Chairman Reed, Ranking Member Wicker, and distinguished members of the Committee: thank you for inviting me to appear here today to discuss global security challenges and U.S. strategy. While I address these subjects in my work at Johns Hopkins-SAIS and the American Enterprise Institute, my testimony here reflects only my personal views. The primary message I would like to convey in my testimony is that Americans are not adequately weighing the risk that interlocking regional crises in Eurasia's key theaters could create a situation approximating global conflict.¹

Today, Europe is experiencing its most devastating military conflict in generations. A brutal fight between Israel and Hamas is sowing violence and instability across the Middle East. East Asia, fortunately, is not at war. But it isn't exactly peaceful, either, as China coerces its neighbors and amasses military power at a historic rate. If many Americans don't realize how close the world is to being ravaged by fierce, interlocking conflicts, perhaps that's because they've forgotten how the last global war came about.

When Americans think of global war, they typically think of World War II—or the part of the war that began with Japan's strike on Pearl Harbor in December 1941. After that attack, and Adolf Hitler's subsequent declaration of war against the United States, the conflict was a single, all-encompassing struggle between rival alliances on a global battlefield. But World War II began as a trio of loosely connected contests for primacy in key regions stretching from Europe to the Asia-Pacific—contests that eventually climaxed and coalesced in globally consuming ways. The history of this period reveals the darker aspects of strategic interdependence in a war-torn world. It also illustrates uncomfortable parallels to the situation America presently confronts.

To be sure, the United States isn't facing a formalized alliance of adversaries, as it once did during World War II. It probably won't see a replay of a scenario in which autocratic powers conquer giant swaths of Eurasia and its littoral regions. Yet with wars in eastern Europe and the Middle East already raging, and ties between revisionist states becoming more pronounced, all it would take is a clash in the contested western Pacific to bring about another awful scenario—one in which intense, interrelated regional struggles overwhelm the international system and create a crisis of global security unlike anything since 1945. A world at risk could become a world at war. And the United States isn't remotely ready for the challenge.

HOW WORLD WAR II BEGAN

American memories of World War II are marked by two unique aspects of the U.S. experience. First, the United States entered the war late—more than two years after Hitler rocked Europe by invading Poland, and more than four years after Japan initiated the Pacific War by invading China. Second, the United States joined the fight in both theaters almost simultaneously. World War II was thus globalized from the moment the United States entered it; from December 1941 onward, the conflict featured one multicontinent coalition, the Grand Alliance, fighting another multicontinent coalition, the Axis, on multiple fronts. (The exception was that the Soviet Union remained at peace with Japan from 1941 until 1945.) Yet history's most terrible conflict didn't start that way.

World War II was the aggregation of three regional crises: Japan's rampage in China and the Asia-Pacific; Italy's bid for empire in Africa and the Mediterranean; and Germany's push for hegemony in Europe and beyond. In some ways, these crises were always linked. Each was the work of an autocratic regime with a penchant for coercion and violence. Each involved a lunge for dominance in a globally significant region. Each contributed to what President Franklin Roosevelt, in 1937, called a spreading "epidemic of world lawlessness." Even so, this wasn't an

¹ This statement is lightly adapted from a recent article: Hal Brands, "The Next Global War," *Foreign Affairs*, January 26, 2024.

integrated mega-conflict from the outset.

The fascist powers initially had little in common except illiberal governance and a desire to shatter the status quo. And although these countries, beginning in 1936, would seal a series of overlapping security pacts, through the late 1930s they were as often rivals as allies. Hitler's Germany and Mussolini's Italy worked at cross-purposes in crises over Austria in 1934 and Ethiopia in 1935. As late as 1938, Germany was supporting China in its war of survival against Japan. Only gradually did regional crises merge, and rival coalitions cohere, due to factors that might sound familiar today.

First, whatever their specific—and sometimes conflicting—aims, the fascist powers had a more fundamental similarity of purpose. All were seeking a dramatically transformed global order, in which “have-not” powers carved out vast empires through brutal tactics—and in which brutal regimes surpassed the decadent democracies they despised. “In the battle between democracy and totalitarianism,” Japan's foreign minister declared in 1940, “the latter...will without question win and will control the world.”

Second, the world developed a perverse interdependence, as instability in one region exacerbated instability in another. By humiliating the League of Nations and showing that aggression could pay, Italy's assault on Ethiopia in 1935 paved the way for Hitler's remilitarization of the Rhineland in 1936. Germany then paid it forward in 1940, by crushing France, putting the United Kingdom on the brink, and creating a golden opportunity for Japanese expansion into Southeast Asia. Not least, the sheer number of challenges to the existing order disoriented and debilitated its defenders: the United Kingdom had to tread carefully in dealing with Hitler in crises over Austria and Czechoslovakia in 1938, because Japan threatened its imperial holdings in Asia, and because its Mediterranean lifelines were vulnerable to Italy.

Third, programs of extreme aggression polarized the world and divided it into rival camps. In the late 1930s, Germany and Italy banded together for mutual protection against the Western democracies. In 1940, Japan joined the party in hopes of deterring the United States from interfering with its expansion in Asia. This new Tripartite Pact didn't ultimately deter Roosevelt, but it did convince him, as he wrote in 1941, that “the hostilities in Europe, in Africa, and in Asia are all parts of a single world conflict.” Indeed, as the Axis cohered and its aggression intensified, it gradually forced a vast array of countries into a rival alliance dedicated to frustrating those designs. When Japan attacked Pearl Harbor, and Hitler declared war on Washington, they brought the United States into conflicts in Europe and the Pacific—and turned those regional clashes into a global struggle.

PARALLELS TO THE PRESENT

Today, as in the 1930s, the international system is facing three sharp regional challenges. China is rapidly amassing military might as part of its campaign to eject the United States from the Western Pacific. Russia's war in Ukraine is the murderous centerpiece of its longstanding effort to reclaim primacy in eastern Europe and the former Soviet space. In the Middle East, Iran and its coterie of proxies are waging a bloody struggle for regional dominance against Israel, the Gulf monarchies, and the United States. Once again, the fundamental commonalities linking the revisionist states are autocratic governance and geopolitical grievance; in this case, a desire to break an American-led order that deprives them of the greatness they desire.

Two of these challenges have already turned hot. The war in Ukraine is also a vicious proxy contest between Russia and the West. Hamas's attack on Israel last October—enabled by Tehran—triggered an intense conflict that is creating violent spillover across that vital region. In the Western Pacific and mainland Asia, China is still relying mostly on coercion short of war. But as the military balance shifts in sensitive spots such as the Taiwan Strait or the South China Sea,

Beijing will have better options—and, perhaps, a bigger appetite—for aggression.

As in the 1930s, the revisionist powers don't always see eye-to-eye. Russia and China both seek preeminence in Central Asia. They are also pushing into the Middle East, in ways that sometimes cut across Iran's interests there. If the revisionists do eventually push the United States, out of Eurasia, they might end up fighting among themselves over the spoils. Yet for now, the ties between revisionist powers are flourishing and Eurasia's regional conflicts are becoming more tightly interlinked.

Russia and China are drawing closer through their "no limits" strategic partnership, which features arms sales, deepening defense-technological cooperation, and displays of geopolitical solidarity such as military exercises in global hot spots. And just as the Molotov-Ribbentrop pact of 1939 once allowed Germany and the Soviet to rampage through Eastern Europe without risking conflict with each other, the Sino-Russian partnership has pacified what was once the world's most militarized border and enabled both countries to focus on their contests with Washington and its friends. More recently, the war in Ukraine has also enhanced other Eurasian relationships—between Russia and Iran, and Russia and North Korea—while intensifying and interweaving the challenges the respective revisionists pose.

Drones, artillery ammunition, and ballistic missiles provided by Tehran and Pyongyang—along with economic succor provided by Beijing—have sustained Moscow in its conflict against Ukraine. In exchange, Moscow appears to be transferring more sensitive military technology and know-how: selling advanced aircraft to Iran, reportedly offering aid to North Korea's advanced weapons programs, perhaps even helping China build its next-generation attack submarine. Other regional tussles are revealing similar dynamics. In the Middle East, Hamas is fighting Israel with Chinese, Russian, Iranian, and North Korean weapons that it has been accumulating for years. And in another echo of the past, tensions across Eurasia's key theaters stretch U.S. resources thin by confronting the superpower of the era with multiple dilemmas simultaneously.

One crucial difference between the 1930s and today is the scale of the revisionism. As bad as Putin and Iranian Supreme Leader Ali Khamenei are, they haven't devoured huge chunks of crucial regions. Another crucial difference is that East Asia still enjoys a tenuous peace. But with U.S. officials warning that China could become more belligerent as its capabilities mature—perhaps as soon as the second half of this decade—it is worth considering what would happen if that region erupted.

Such a conflict would be catastrophic in multiple respects. Chinese aggression against Taiwan could well trigger a war with the United States, pitting the world's two most powerful militaries—and their two nuclear arsenals—against each other. It would wrench global commerce in ways that make the dislocations provoked by the wars in Ukraine and Gaza look trivial. It would further polarize global politics, as the United States seeks to rally the democratic world against Chinese aggression—pushing Beijing into a tighter embrace with Russia and other autocratic powers.

Most critically, if combined with ongoing conflicts elsewhere, a war in East Asia could create a situation unlike anything since the 1940s, in which all three key regions of Eurasia are ablaze with large-scale violence at once. This might not become a single, all-encompassing world war. But it would make for a world plagued by war, as the United States and other defenders of the existing order confronted multiple, interlocking conflicts spanning some of the most important strategic terrain on Earth.

THE US RESPONSE

There are many reasons this might not happen. East Asia could remain at peace, because the United States and China have immense incentives to avoid a horrific war. The fighting in Ukraine

and the Middle East could subside. But thinking through this nightmare scenario is still worthwhile in hearing of this sort, because the world could be as little as one mishandled crisis away from pervasive Eurasian conflict—and because the United States is so unprepared for this eventuality.

Right now, the United States is straining to support Israel and Ukraine simultaneously. The demands of these two wars—fights in which the United States is not yet a principal combatant—are stretching American capabilities in areas such as artillery and missile defense. Deployments to the waters around the Middle East, meant to deter Iran and keep critical sea lanes open, are taxing the resources of the U.S. Navy. Strikes against Houthi targets in Yemen are consuming assets, such as Tomahawk missiles, that would be at a premium in a U.S.-Chinese conflict. These are all symptoms of a bigger problem: the shrinking ability and capacities of the U.S. military relative to its numerous, interrelated challenges.

During the 2010s, the Pentagon gradually shifted away from a military strategy meant to defeat two rogue-state adversaries at the same time, opting instead for a one-war strategy aimed at defeating a single great-power rival, China, in a high-intensity fight. In many respects, this was a sensible response to the extreme demands such a conflict would entail. But it has also left the Pentagon ill-equipped for a world in which a combination of hostile great powers and serious regional threats are menacing multiple theaters at once. It has also, perhaps, emboldened more aggressive American adversaries, such as Russia and Iran, who surely realize that an overstretched superpower—with a military desperate to focus on China—has limited ability to respond to other probes.

Of course, the United States wasn't ready for global war in 1941, but it eventually prevailed through a world-beating mobilization of military and industrial might. President Joe Biden evoked that achievement late last year, saying the United States must again be the "arsenal of democracy." To its credit, Biden's administration has invested in expanding production of artillery ammunition, long-range missiles, and other important weapons. But the harsh reality is that the defense industrial base that won World War II and then the Cold War no longer exists, thanks to persistent underinvestment over more than three decades and the broader decline of American manufacturing. Shortages and bottlenecks are pervasive; the Pentagon recently acknowledged "material gaps" in its ability to "rapidly scale production" in a crisis. Many allies have even weaker defense industrial bases.

Thus, the United States would have great difficulty mobilizing for a multi-theater war, or even mobilizing for protracted conflict in a single region while keeping allies supplied in others. It might struggle to generate the vast magazines of munitions needed for great-power conflict, or to replace ships, planes, and submarines lost in the fighting. It would surely be hard-pressed to keep pace with its most potent rival in a potential war in the Western Pacific; as a Pentagon report puts it, China is now "the global industrial powerhouse in many areas—from shipbuilding to critical minerals to microelectronics," which could give it a crucial mobilization advantage in a contest with the United States. If war does engulf multiple theaters of Eurasia, Washington and its allies might not win.

It is difficult to identify an obvious, near-term solution to these problems. Focusing U.S. military power and strategic attention overwhelmingly on Asia, as some analysts advocate, would take a toll on American global leadership in any circumstances. At a time when the Middle East and Europe are already in such profound turmoil, it could be tantamount to superpower suicide. Ramping up military spending to drive down global risk is strategically essential, in my view. But unfortunately, it is also politically difficult, at least until the United States suffers a more jarring geopolitical shock. There will thus be a strong temptation to muddle through in the coming years—to manage crises in Ukraine and the Middle East, make only marginal increases in military spending, and hope that China doesn't become dramatically more bellicose—despite the

growing risks associated with such a policy.

In closing, it is worth considering just how dramatically the international scene has darkened in recent years, thanks to Russia's invasion of Ukraine and the ongoing conflict in the Middle East. And if U.S.-China tensions aren't particularly severe at the moment, we should keep in mind that sharpening rivalry and a shifting military balance make for a dangerous mix. Great catastrophes often seem unthinkable until they happen. A starting point for dealing with a deteriorating strategic environment is recognizing just how thinkable global conflict has become.

Chairman REED. Thank you very much, gentlemen, for your very insightful testimony.

Dr. Scharre, with regard to technology, could you briefly describe the strategy of today and what you see as its strengths and weaknesses.

Dr. SCHARRE. Yes, of course, Senator. So I think that when you look at the DOD's national defense S&T strategy, I think one of the things that they have done very well is list a number of different

critical technologies. DOD, of course, has been doing this for the last several years and then updating them. The most recent one has a couple different bins that they have put these in, which I think is somewhat helpful to organize them.

I think there might be two things that I would suggest would be helpful to the Department to do to add onto this. One would be a sense of prioritization among these, that can drive actually spending and investments. The problem is 14 things is not really a list of priorities. It is a shopping list. It is just a lot of things. It is all the things.

To their credit, past DOD leaders, some of them have made very clear priorities. When he was Deputy Secretary of Defense, Bob Work said robotics, AI, autonomy, his number one priority. When he was Under Secretary, Michael Griffin said hypersonics, directed energy, his top priorities.

The concern that I have in looking at this is, you know, both things cannot be the number one thing, right? I think it would be helpful for the Department to have a repeatable process internally, a rubric, for prioritizing technologies that they could come then to excellent audiences, to the Hill, to industry, to others to say here is our process. These are the questions that we ask, looking at where the technology is coming from, its operational effects, its rate of growth. Based on those factors we have decided these are the ones that are the most important. This is the way it is going to drive our decisions. A process that everyone else could look at and understand it would be transparent. Instead of just kind of individual leaders saying, well, I think this is more important.

I think the other factor that I do not see included too often is looking at the rate of growth of these technologies, which I think matters quite a bit in sort of what do you think is going to be most impactful in maybe the relatively near future. You need to look at that differential rate of growth.

Chairman REED. Thank you very much.

Dr. Brands, before the 2023 Ukraine counteroffensive you were urging more rapid support of the Ukrainian Forces. Now we find ourselves in a position where we are deadlocked over this supplemental. What is your view on the importance of the supplemental and the timing of getting it done?

Dr. BRANDS. I think it absolutely crucial in the sense that, one way or another, 2024 is going to be a difficult year for Ukraine, where they will largely be on the defensive. The question is whether 2024 can be a year in which Ukraine can resist Russian advances and prepare itself for another counteroffensive, perhaps in 2025, and the supplemental is absolutely vital on both of those counts. Without additional United States aid there just will not be the wherewithal to mount another offensive, and as we are seeing right now, without United States aid Ukraine will start to run critically short of capability that it needs just to hold the line where it is.

The Ukrainian withdrawal from Avdiivka was occasioned largely by the fact that Ukrainian Forces simply did not have the ammunition to hold very strong defensive positions that they held there. When you take into account that most Ukrainian defensive lines are not as well developed or strong as the ones that they had to

leave in Avdiivka, the reality is that if they do not get this aid from the United States they are going to find it very difficult just to keep the line in place over the course of this year, which will further complicate the question of how the war ends on terms successful for Ukraine.

Chairman REED. Following that up, you have made the point that the danger might not be a concerned axis of enemies that come after us together but one exploiting the fighting in one region, et cetera. This raises the question of China's kind of observation of what is going on in Ukraine. So Dr. Brands, your views on that.

Dr. BRANDS. I think one of the most constructive influences on China's calculus relative to Taiwan over the past couple of years has been the degree to which Russia has struggled in Ukraine and the degree to which a coalition of countries, mainly advanced democracies, has rallied to help support Ukraine in its fight for survival.

I think it would be extremely damaging if the United States were essentially to throw in the towel in Ukraine and to allow Ukraine to be defeated, because the message that would send to Xi Jinping and other people who are observing United States behavior very closely is that the West may talk tough but ultimately you can outlast the United States and get your way in the end.

Chairman REED. Thank you, and I will let the Ranger get the last word. Do you concur, Dr. Scharre?

Dr. SCHARRE. I do, absolutely, and I do think that, as Dr. Brands points out, our threats would worsen in Europe if we were to not continue to support Ukraine. In the end we would have an emboldened, stronger Russia as a result, which would be a much larger burden for us in terms of defending our allies in Europe, and the effects would be felt around the world, including most acutely with China, and impact their calculus.

Chairman REED. Thank you very much. Senator Wicker, please.

Senator WICKER. Thank you, Mr. Chairman. Dr. Brands, let me ask you about the National Defense Strategy (NDS). The law requires the Secretary of Defense to review the adequacy of the strategy and update it if circumstances have changed.

Now we got the latest strategy in October 2022, 17 months ago or so. Do you think events have changed? Do you think this situation has changed enough over that time that the Secretary needs to review the adequacy of the strategy and make changes?

Dr. BRANDS. I think two critical things have changed since the strategy was finalized and released in 2022. The first is that the assumption that Russia would emerge from the Ukraine war significantly weakened and ultimately defeated is no longer as tenable as it once was. We are seeing a Russia that is doing fairly well on the battlefield right now, and furthermore, is aggressively mobilizing economically and militarily in a way that will allow it to present a continuing threat to the eastern front of NATO for many years to come after this war ends.

The second thing that has changed, obviously, is that the Middle East has erupted once again. This was not a calculation that was foremost in the crafting of the National Defense Strategy. We are seeing increased persistent demands on United States military power in the Red Sea, in the Gulf of Aden, in Iraq and Syria, and

in a variety of other places where the United States is trying to push back against Iran and its proxies.

So when you put those two things together I think it indicates that we are living in a rather different world than was expected when the strategy was released.

Senator WICKER. Do we ever adequately fund the National Defense Strategy?

Dr. BRANDS. Well, “ever” is a strong statement. I guess I would say that the gap between our requirements and our resources is bigger at times and smaller at times, and I worry that it has gotten bigger in recent years. If you just think about defense spending as a percentage of GDP, during the cold war the United States spent, on average, about 7.5 percent of GDP on defense. During the 1980’s, during the period of the Reagan buildup, it was about 6 percent, 6.5 percent, on average. We are at about half of that today, just north of 3 percent.

When you compare that at the threat landscape that the United States faces to historical trends of defense spending, I think indicates that the gap between resources and commitments is getting larger.

Senator WICKER. Well, sir, in a recent Foreign Affairs essay, you mentioned that it is going to be hard to dramatically ramp up military spending until it is politically expedient, and you mentioned the possibility of Americans being convinced only in the case of a jarring geopolitical shock.

But let me ask you to comment on that. we had a jarring political shock in Pearl Harbor, because we were not ready. During that time you mentioned that we were spending 6, 7 percent of GDP the cold war. We never really had a jarring shock, did we?

Dr. BRANDS. We had shocks that were lesser than Pearl Harbor but that did catalyze significant growth in U.S. defense spending. So the Korean War, for instance, that led to a massive expansion of United States defense spending from I believe somewhere in the neighborhood of 3 or 4 percent of GDP up to about 14 percent of GDP, at the height of that conflict.

Senator WICKER. Okay, and let’s move ahead to the Carter administration, the end of the Carter administration, and then the beginning of the buildup in GDP under Reagan. What were those numbers?

Dr. BRANDS. I believe at its peak under the Reagan administration the U.S. was spending north of 6 percent of GDP on defense.

Senator WICKER. We avoided during that time a jarring geopolitical shock, did we not?

Dr. BRANDS. Yes.

Senator WICKER. Dr. Scharre, just real quickly, the technologies are important. In my opening statement I said we need more submarines, we need more amphibs, we need more missiles. The fact that we need to gain the lead in DOD in technologies does not take away from the fact that we need more tools, more ISR [intelligence, surveillance, and reconnaissance], more missiles, more ships. Is that correct?

Dr. SCHARRE. Yes, I think that is true. I mean, we obviously need physical platforms. We need ships. We need submarines. I also think it is true—and I think, actually, the Department understands

this—that what is on those platforms matters more than just the raw numbers. But we do need numbers, and that is a major problem right now for the Department.

Senator WICKER. Lack of numbers is a major problem.

Dr. SCHARRE. Absolutely.

Senator WICKER. Thank you. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Wicker. Senator Hirono, please.

Senator HIRONO. Thank you, Mr. Chairman. So we already spend north of \$800 billion for defense. Dr. Brands, you are suggesting that we double this to over a trillion. So it is not just how much we are spending, it is what we are spending on, is it not? So are we spending defense dollars in the kind of priorities that you would expect us to be spending this money on?

Dr. BRANDS. I think there are many constructive initiatives underway within the Department to try to prepare the U.S. for some of the conflicts that it might face. So I think a lot of the operational concepts that are being devised by the services that are geared toward conflict in the Western Pacific are promising.

I think, though, that ultimately all of those concepts require munitions, they require platforms, they require a number of things, where quantity really does matter, and so I think that while it is very important that we have the thrust of our defense program right. It is very important that we resource it adequately, as well.

Senator HIRONO. Well, when you said quantity does matter, because at some point the fact that China has so many more quantities of planes and ships and everything else. Our country, we could meet the challenge of China, for example, through innovation. Both of you are now saying that we are falling behind in our technological innovation. You say, Dr. Brands, that the NDS, which came out sometime in late 2022, is already not accurate with regard to Russia's powers and also what is happening in the Middle East.

What do we need to do to make sure that we are actually, we have the capacity to assess the needs that we have militarily based on what is going on in the world. Not to mention, by the way, how important are the alliances that we have at a time like this when we are facing the conflicts in the Middle East and in Russia and Ukraine? Either one of you.

Dr. BRANDS. I can talk about alliances and perhaps the assessment issue. We have been fortunate over the past couple of years in that we have gotten a real-time education in demands that modern war and major war would present for the U.S. Defense Department. We have seen in Ukraine the enormous quantities of munitions and platforms that would be consumed by a war between the United States and Russia, let alone the United States and China. So I think we have gotten a greater education in sort of the order of magnitude of what a major conflict would demand.

On the question of alliances, just briefly I would say that alliances are perhaps our greatest force multiplier in international affairs. They give us access and influence in key regions. They allow us to advocate the capabilities of other countries to our own. They give us the ability to influence the calculations of adversaries in an important way. In those and other ways, I think they add dramati-

cally to the influence the U.S. can observe on the international stage.

Senator HIRONO. I agree with you, and recently we have the Quad Alliance, the AUKUS [Australia, United Kingdom, and United States] agreements, trilateral relationship with the Republic of Korea, Japan, and us, the renegotiation of funding of the compact nations. So those are all very critical to our ability to be ready in meeting, I think, the demands of the near-peer people in China and Russia.

I am just curious. You both talk about how we are falling behind in terms of our technological decisionmaking. We recently got the report of the National Defense Industrial Strategy. So do we need some kind of a national defense that focuses on technological advancement?

Dr. SCHARRE. Yes, I think the new strategy and the defense industrial base was excellent, and I think actually the big challenge there is resourcing it. Because, in particular, the Ukraine conflict has highlighted for us these particular problems that we have seen in the defense industrial base, especially in munitions procurement. It has given us, in many ways, a golden opportunity to address those problems now, ahead of a potential conflict with China, both to increase munitions capacity and then scale production, and then look elsewhere in the defense industrial base where we probably have similar problems.

Senator HIRONO. Well, but you both highlighted that we are falling behind in terms of our technological capabilities. So do we need to have a special group, within an entity, or the development of a strategy that focuses on DOD capabilities in the technology area? Do we need a specific group that is paying attention to that need within DOD?

Dr. SCHARRE. I think so. I think maybe there are two maybe challenges I would see. One would be some improvements to how DOD thinks about S&T [science & technology] investments itself in terms of the prioritization and the trends. But also at a national level we are now competing with China at a national level in technology competition, and we do not really have anyone at the national level looking at that holistically. We have seen not just DOD but Commerce and other elements of national power come into form. I think we need to think more strategically about how to use those elements of national power.

Senator HIRONO. Do you agree, Dr. Brands? I am running out of time, but maybe you can respond briefly.

Dr. BRANDS. Yes.

Senator HIRONO. Thank you. Thank you, Mr. Chairman.

Chairman REED. Thank you, Senator Hirono. Senator Fisher, please.

Senator FISCHER. Thank you, Mr. Chairman. Dr. Brands, many analysts today, they seem to be relatively confident that the risk of Chinese aggression is overblown. Do you think that confidence is misplaced?

Dr. BRANDS. I would not hold a great degree of confidence in our ability to predict that China will not use force in the Western Pacific over the next several years, in part because even if it is not to China's advantage to do so, we have seen from the Ukraine war

and many other cases in history that the leaders often make bad decisions. They often make bad decisions when they sit atop authoritarian regimes where information flow is very restricted and there is a lot of incentive to tell the person at the top what he or she wants to hear.

I worry also because the reality is that the military balance in the Western Pacific is changing dramatically, and it is changing in real time. The United States has done a variety of important and constructive things over the past several years to try to arrest the erosion of deterrence. Everything from the coalition-building efforts that have been discussed to some of the operational concepts that are being put in place today. But the reality is that the scale of the PLA buildup is just such that I worry we are losing rather than gaining ground.

The one statistic that always stands out to me is that between 2022 and 2023, the PLAAF [People's Liberation Army Air Force] added 400 fourth-generation fighters, so basically F-16 equivalents, to its inventory. When you start getting into numbers like that, even a qualitatively superior military, which the United States clearly has, may struggle to defend Taiwan or otherwise uphold its commitments in the region.

So as this decade goes on, if the balance continues to shift I would become more worried about the PRC's [People's Republic of China] propensity for aggression.

Senator FISCHER. Dr. Brands, the United States has relied heavily on sanctions against Russia. When we watch the aftermath now of that in Ukraine it has failed to destroy. Russia's economy was initially anticipated, you spoke to that earlier, that the Russians are moving ahead with that. Do you think that China would be more susceptible or less so to those sanctions than Russia, and why?

Dr. BRANDS. I think it is complicated, Senator. On the one hand, China is a harder sanctions target than Russia because its economy is bigger, it is more diversified, and I think the financial implications of going after the Chinese economy in the way that the United States and its allies went after the Russian economy would be more globally severe than they have been in the Russian case. So for all of those reasons it might be more difficult to inflict even the level of pain on China that the United States and its allies have done to Russia.

The flip side of it, however, is that China is also, because it is more globally integrated it is more dependent on the global economy than Russia is. So the threat of having access to Western markets severed would, I think, be more impactful for China than it would for Russia, because I do not see how China can accomplish its objectives without access to the global economy over time.

Senator FISCHER. Dr. Scharre, do you have any comments on the sanctions on China, what we would see there?

Dr. SCHARRE. Yes, thank you, Senator. Actually, a colleague of mine, Emily Kilcrease, at the Center for a New American Security, recently released a very detailed analysis of this, and I am happy to share it with you all afterwards. Looking at different elements of China's economy and their exposure to potential sanctions. There are a lot of areas, particularly in the defense sector, that are fairly

insulated because they are not tied into the global economy, but their banking sector, in particular, is one that does have some vulnerabilities.

I think those are places where we want to think strategically about how do you leverage that? How do you sustain those vulnerabilities, because China is certainly aware of them, and they are looking to shore up their defenses and be less vulnerable. How do you sustain those? Then in the run-up to a potential conflict, how would you think about strategically leveraging them, potentially as a means of deterrence, which is a new way of thinking about sanctions than we have necessarily done in the past, but I think there is a lot of value there.

Senator FISCHER. How would you both characterize the relationship between Beijing and Tehran?

Dr. BRANDS. I think that China has been investing in this relationship over the past few years in hopes of strengthening its ties to a key player in the region. I think that China, however, has to balance its relationship with Iran with its efforts to deepen its relationship with Saudi Arabia and other key states in the gulf. So there may be a Governor on how far the China-Iran relationship can go that is less present in other cases where you have autocratic countries coming together.

Senator FISCHER. Thank you very much.

Chairman REED. Thank you, Senator Fisher. Senator Kaine, please.

Senator KAINE. Thank you, Mr. Chair, and thank you to the witnesses.

Dr. Brands, you talked about China's perception of the slow pace of Russia in Ukraine, and that that has affected their thinking about their own military ambitions. In particular you cited China's observation that when the democracies link arms it is pretty formidable. We do not have NATO in the Indo-Pacific, but we do have sort of a latticework of alliances—the Quad, the improved relationship between Korea and Japan, an improving relationship with the Philippines, and AUKUS.

I would like you to each talk about—this Committee has done a lot of work on AUKUS, as has the Foreign Relations Committee. There is funding for some parts of AUKUS in the supplemental bill pending in the House right now. I would like you to talk about how you view the AUKUS framework Pillars 1 and 2 in terms of our security posture in the Indo-Pacific.

Dr. BRANDS. I think it is incredibly important in a handful of different respects. In one respect, simply the geography of AUKUS is very important because it is proof of concept of how the United States can leverage individual alliances in order to bring countries together into a larger network of actors that are committed to pushing back against Chinese power, even when those countries span regional boundaries.

Obviously, the piece of AUKUS that gets a lot of attention, and rightly so, is the submarines piece of it, and that is important because undersea warfare is, I think, one of the few areas where the United States still enjoys unquestioned superiority over China, even at the vast distances of the Western Pacific.

Because it will take some time for the submarine dimension of AUKUS to really bear fruit, I think the other pieces of it, whether it is the advanced capabilities piece or sort of the accompanying piece, which is increased access and presence in northern Australia, are particularly important in terms of developing the ability to bring power to bear in a conflict in the Western Pacific and affecting China's calculations in terms of how a conflict would go over the next 5 to 10 years.

As important as that is in its own right it is also a critical bridge to the point where you can start to bring some of the undersea capabilities to bear.

Senator KAINE. Dr. Scharre, other thoughts?

Dr. SCHARRE. I think given the timing dimension I might prioritize things that involve joint exercises, things that demonstrate to China that jointness in our ability to operate with our allies in the region, things that involve basing posture kind of things. I would, in particular, emphasize things that are not physical capabilities but institutional elements of collaboration. So things like joint planning together, which we already obviously have deep ties with Australia and the U.K., but things like bringing them on board in terms of planning to actually, in the event of a conflict, enable us to be able to fight effectively together.

Senator KAINE. Australian sailors are already going through the training program at the nuclear power school with United States Navy and in South Carolina Australian shipbuilders are already here training at a manufacturing excellence facility in Danville, Virginia. So we are moving out before the sub transfers in the 2030's, which I am impressed by.

Let me conclude with an area where I am not happy with alliances and that is the Red Sea. I am worried about the lack of a real strategy in the Red Sea with the Houthis trying to defend shipping, I think, makes some strategic sense. But President Biden and others have acknowledged they do not think firing more missiles at the Houthis is going to lead the Houthis to fire fewer missiles. In fact, it seems like the pace might be escalating.

In particular I am concerned that the burden of defending commercial shipping in the Gulf of Aden and the Red Sea is pretty heavily on the U.S.'s shoulders. I think it is just the United States and the U.K. that are engaged in any kinetic activity to knock down Houthi drones and missiles. I believe the Italian navy might have engaged in one kinetic activity to protect an Italian-flagged vessel.

Why are not more nations engaging in this defense in the Red Sea when their probably commerce and trade is more affected by the Houthi attacks than is the United States economy?

Dr. BRANDS. Senator, I think the basic problem is that many of them do not have the capability to do so. Even in cases where our allies might be included to help out in providing this critical public good they are running short of the resources. So Australia had their debate about whether they would contribute to Operation Prosperity Guardian and ultimately decided they would not, because I believe Australia has a total of three ships that could be useful in this sort of context, and they have decided that they are needed closer to home.

So the lack of resources relative to challenges unfortunately is not a distinctly American problem. It is a larger free world problem at this moment.

Senator Kaine. I yield back. Thank you, Mr. Chairman.

Chairman REED. Thank you very much, Senator Kaine. Senator Schmitt, please.

Senator SCHMITT. Thank you, Mr. Chairman. Thank you both for being here. Dr. Brands, in your book I am really interested in the Danger Zone book, and how you balance, in trying to understand the Chinese perspective, they certainly view themselves as a 5,000-year-old civilization, the middle kingdom, who, the last 200 years, has been an aberration, a humiliation, in their view. They are not going to let that happen again, they have a longer view, all those sorts of things that are sort of baked into the understanding of their mentality and how they are on the march now, in a very real way, and probably more than people think. Their shipbuilding capacity alone is striking, and I am not sure many people in the general public understand that. They have a bigger navy—not a better navy, but a bigger navy.

So that longer view, and you write about the 2020's being absolutely critical, which is a very short-term issue in setting the stage for this longer, great powers competition. You have got the demographic cliff that they are facing. They are no longer publishing a lot of economic data. Their youth unemployment, which I think drives—GDP is really important to us. I think unemployment for the Chinese is most important, for a variety of reasons. When you are an authoritarian regime a lot of young men not working is a real problem.

So how do you balance this, in your view of how they view where they are at right now—and, of course, you have got this big Taiwan question—where they are at right now. Do they view that as, in your estimation, as a reason to go quicker, or do they fall back to the traditional view of the longer-term strategy?

Dr. BRANDS. Senator, my view—and this is by no means a unanimous view among China watchers, I should add—but my view is that China is being motivated by a dangerous mixture of weakness, strength, and personalization at this point. The weakness comes from the demographic and economic problems that you noted, which are already having a pronounced effect on Chinese growth, and that effect will only become more pronounced over time. At the same time, the military modernization program is still going gangbusters, if you look at the increases in military spending.

You have a country whose long-term economic prospects are dimming as its near-term military position becomes stronger. Historically, that has been a recipe for trouble, because that is exactly the sort of combination that tempts countries to use force sooner rather than later to lock in advantages while they still can. It is reinforced, in this case, because China's fortunes have become increasingly entangled with Xi Jinping's fortunes, as he personalizes the political system and does away with this system of something closer to collective rule that China had for a couple of generations after Mao Tse-Tung.

You sometimes hear Xi Jinping say things like, "The question of Taiwan cannot be passed down from generation to generation."

That is sometimes read as him saying, "It cannot be passed down to the next generation of Chinese leaders."

When you put all those things together it makes me worry that we may be dealing with a China that is in a bit of a hurry by the time we get to the latter part of this decade.

Senator SCHMITT. He is already in an unprecedented third term.

Dr. BRANDS. With no indication that he is planning on stepping down any time soon.

Senator SCHMITT. Correct, and so if you were a betting man, if you had to place a wager, red he goes, black he does not go, where are you betting?

Dr. BRANDS. I think an operation against Taiwan would be sufficiently daunting that there are lots of things that the United States, Taiwan, and other countries in the region can do to drive down the chances of a Chinese attack on Taiwan. But on the current trajectory I am very worried about where we will end up.

Senator SCHMITT. Then one last question about the CCP and China. So there has always been this sort of natural distrust between them and Russia, or the USSR [Union of Soviet Socialist Republics], or the Russian Empire, whatever phase Russia is in. How do you view that? Even though they seem to be working more collaboratively than they have in recent memory, there is still this natural tension. They share a border. How do you gauge the reality of that relationship right now?

Dr. BRANDS. The historic mistrust is still there. In fact, China will occasionally print maps that show it controlling parts of Russia, as it is currently constituted. Certainly I think the Russians, in particular, know that if China comes anywhere close to achieving its ambitions in Eurasia that is going to be a very challenging situation for Russia itself. Those concerns are rather distant at the moment.

Ideologically, these are two countries. They are both autocratic powers trying to make it in a world dominated by a democratic superpower. They both view the United States and its allies as their primary enemies, and by all indications, Xi and Putin seem to have similar world views and get along fairly well.

So those historic tensions may reassert themselves, but perhaps not on a timeline that would help us in this decade or a little bit beyond.

Senator SCHMITT. So maybe the United States exploiting some of those traditional differences as opposed to driving them together probably makes the most sense for us, right?

Dr. BRANDS. It could. I will spare you a long excursion into history, but if you look back at the prior Sino-Soviet relationship, the United States actually pursued a strategy in the 1950's of trying to drive them closer together as a way of exploiting those frictions within the relationship. I would argue that it worked fairly well at the time.

Senator SCHMITT. Okay. Thank you.

Chairman REED. Thank you, Senator Schmitt. Senator King, please.

Senator KING. Thank you, Mr. Chairman. I would like to thank both of you for very thoughtful and insightful testimony. Talking about some of the issues that we have already touched upon, in

1962, as you have testified, our defense was something like 8 or 9 percent of GDP. Today it is under 3 percent. The projection I just saw was 2.7 for 2024.

The cornerstone of our national security policy is deterrence. I would argue that this dramatic decline, by two-thirds, is a chink in the armor of deterrence. Would you concur? In other words, the Chinese and the Russians and others look at that number as part of measuring how fearful they should be of our ability to respond.

Dr. BRANDS. I think it is certainly unhelpful, Senator, and I think that whether it is the number they look at or the speed at which the U.S. would exhaust its munitions inventory in a particular conflict, those are precisely the sort of issues that would worry me about whether deterrence was eroding.

Senator KING. The second question along those lines is our failure to continue to support Ukraine, how would that affect Xi's calculus in terms of Taiwan and his analysis of our staying power?

Dr. BRANDS. I think Xi is predisposed to think that the United States and its allies lack the endurance and the stamina to hold the line against China and its partners over the long term. If the United States were to terminate support for Ukraine or would allow Ukraine to be defeated, I think it would simply reinforce that perception. Which would be unhelpful, as Dr. Scharre had pointed out, not just in Europe but in the Asia Pacific as well.

Senator KING. Dr. Scharre, do you agree?

Dr. SCHARRE. Absolutely. I mean, Xi already believes that America is in decline. That we do not have staying power, and it would certainly reinforce that assumption that even in the event of a conflict, if the United States were to be directly engaged in defending Taiwan, that we simply would not be able to go the distance and China could outlast us.

Senator KING. My impression from the initiation of the Ukraine war was that Xi was somewhat surprised by the reaction of the West, the unification, expansion of NATO, and that surprise and concern would be dissipated if we indeed abandoned Ukraine.

Dr. SCHARRE. Right. Precisely.

Senator KING. I like it when witnesses say precisely in answer to a question.

I want to go back to the very beginning, and also I want to associate myself with the questions of Senator Wicker in terms of the GDP percentage. The American public does not realize, we hear this big number, \$800 billion, and at ten times other countries, but in terms of the percentage of our economy devoted to defense it has fallen by almost two-thirds in the last 60 years.

R&D, real problem. New technologies win wars. Genghis Khan conquered the world because of the invention of the metal stirrup. The longbow turned the tide. The British had 5,000 at the Battle of Agincourt, the French 20,000. The use of the longbow was generally considered by historians to be crucial in turning that battle, and indeed, the 100 Years War.

I worry, it is obviously that there are new technologies that we have been slow. Directed energy and hypersonics are the two that strike me as most obvious. How do we get the Pentagon to understand the role of new technology? Dr. Scharre, what is your view?

Dr. SCHARRE. I think that the Defense Department, basically in its DNA, understands the value of technology. I actually think what is missing right now is a sense of where the priorities ought to lie, because I think the DOD is still stuck in a mindset from the 1960's where DOD believes that it has to invent all the technologies itself. But there is so much technological innovation happening outside the Defense Department that I think that is going to matter more.

I would say that it is true that technology is absolutely critical to winning wars, but what matters most is finding the best ways of using the technology. That is clear looking at history. So having institutional processes that can figure out how do we capitalize on this. Because in many ways—

Senator KING. One of the problems—we have had testimony to this Committee that smaller companies in Silicon Valley do not even bother applying for contracts to the Department of Defense because it is so cumbersome, slow, and we are losing access to innovation.

Dr. SCHARRE. I would actually, so even worse, we are building barriers to access, right. Those barriers are self-constructed by us, red tape that makes it hard for companies that would like to work with DOD to work with us. So we need to find ways to tear down those barriers.

Senator KING. In the meantime, we are spending \$5 million a missile to knock down \$200,000 to \$300,000 drone out of the Houthis, when directed energy could do it for about 50 cents a shot. We have just got to break down this barrier, both in terms of working with smaller and innovative companies but also, as you say, taking advantage of technologies developed in the private sector and then transferring them into our arsenal, if you will.

Thank you very much, Mr. Chairman. I yield.

Chairman REED. Thank you, Senator King. Senator Gillibrand, please.

Senator GILLIBRAND. Hi. Thank you so much for your testimony today. I want to ask some larger questions.

The United States has always had a theory that mutually assured destruction and deterrence would restrict an adversary from taking the United States on domestically anywhere in our country. We have an assumption that we would never have to defend a war here in the United States. Well, that assumption does not play out when you are looking at the arena of cyber or AI or other types of disruption that could be lethal.

We have seen cyberattacks over the last 5 years in an array of places—solar winds, shutting down our supply chain for food, affecting oil production and delivery. We have seen cyberattacks in every industry, whether it is in health care most recently, or in banking, or in any domain within the United States.

Yesterday I sat on the Intel hearing, and asked each of the witnesses, from Director Burns to Director Haines and other military personnel doing intelligence for DIA and other entities. I asked them the question of—I gave one example, let's say an adversary decides to use AI and different kinds of generated content to spew out false information from an elected leader or a candidate to such a degree that it misleads the American public in a U.S. election.

What are you doing to prevent that or to respond to that efficiently, and who here is responsible for telling the American people the facts of any given incident? None of them had a plan, and none of them took responsibility for the protection of the United States.

I would like to get your assessment of how do we protect the United States? Let's just say China, in its effort to invade Taiwan, uses the first 2 or 3 months to just do as many cyberattacks as possible in our critical infrastructure, around our bases, around our ability to launch from, let's say Guam, which they just tested a few months ago. Takes our electric grid, takes out our capacity, creates chaos, undermines the economy significantly. We have no plan to defend against that. I think the response is, well, you have got the FBI [Federal Bureau of Investigation], which is a response organization, you have got CISA [Cybersecurity and Infrastructure Security Agency], which can offer best practices but has no mandate, but you have no one who is in charge of protecting anything in CONUS [Continental United States].

I would like you to talk about how should we realign our assessment of what the role of the Department of Defense, NSA [National Security Agency], CIA [Central Intelligence Agency], National Security Operations and Forces, what is the responsibility to protect America from an attack from an adversary in the United States, whether it is cyber, to create chaos and death and destruction, or any other type of attack, from, you know, drones attacking our bases, or spy balloons hovering over our most secret assets. What should the United States be doing?

Dr. SCHARRE. Well, thank you, Senator. I would look at both of these, the cyber dimension and the disinformation one, as warning shots that we are getting now, none of which have been critical yet to the U.S. but we have an imperative to respond to these, to shore up our defenses.

I think on the cyber front there is clearly a lot more we could do. We continue to have challenges. As you point out, just recently in the health care system, and putting the onus on industry putting in place government standards for cybersecurity across a wide range of sectors that has been critical to be shoring up our defenses here.

On the disinformation, too, there are a wide range of things that we could be doing. For example, requiring that AI-generated content is watermarked and is labeled appropriately when it is online. Something like a bot disclosure law, that if someone is using AI—California has this—they have to share that it is AI generated, and then cracking down on foreign efforts to message, whether using AI or elsewhere, and spread disinformation here in the United States, are all things that I think we should be doing now.

Dr. BRANDS. Senator, I would not add anything substantial. I would just say that when the United States war games potential Taiwan conflicts or things like that, the Homeland dimension is often the piece that gets short shrift, in large part because, you know, war-gaming is traditionally a DOD competency so it focuses heavily on that aspect of the response. But the more that you can get relevant stakeholders together to really game through what the domestic disruptions would be in this sort of conflict, the more I think you can get them talking about the ways in which their re-

sponsibilities might overlap or where they might need to develop new competencies in order to defend the U.S.

Senator GILLIBRAND. Thank you.

Chairman REED. Thank you, Senator Gillibrand.

Gentlemen, thank you for your excellent testimony. I have one question which was frequently overlooked today, and that is we are emerging into a new world of nuclear competition between three powers. Not bipolar competition which shaped the whole theory of deterrence, and then, of course, we have the other nuclear entities—North Korea, Pakistan, and other countries.

So what is your take on how we should address this nuclear issue?

One other point I would make is it used to be the custom of every presidency to seek out at least one agreement with the Russians, even if it was a minor one. But we have not had much discussion about Russia, and China, I do not think, will talk to us until they get up to our level of missiles. But this is an issue that is overlooked often, and since I have two extremely intelligent gentlemen here, your view. I will start with Dr. Scharre, please.

Dr. SCHARRE. Thank you, Senator. I would actually argue that we have three interlocking problems. There are others that complicate what you are describing. There is certainly the fact that we are moving into a tripolar nuclear era, with China's nuclear build-up. We have emerging technologies that are complicating a lot of the strategic dimensions, maybe outside of nuclear weapons, but in space and elsewhere, of nuclear deterrence. Then also, of course, we have seen with Russia an increased salience of nuclear weapons, and a risk that we may actually see them used in ways that maybe are heightened from what we might have thought a couple of years ago.

I think it is clear that we need increased investments in this space, that if we are going to maintain a deterrent against two adversaries simultaneously we are going to need more dimensions here. The simultaneity problem is, I would argue, most acute in the nuclear dimension because of this issue, more so than in the conventional space.

I think we are also going to need a lot of new thinking. The reality is that sort of among the defense intellectuals that work on these topics, the sort of nuclear community has, over many years, atrophied because nuclear weapons have not been as salient until more recently. So I think increased war-gaming and studies and investments to buildup that intellectual capital and to get senior leaders thinking about these challenges. Okay, if an adversary uses a nuclear weapon in a conflict to try to maybe terminate on their terms, how do we respond accordingly?

Chairman REED. Thank you. Dr. Brands, please.

Dr. BRANDS. Just three things, very briefly. One, the scenarios that we worry about nuclear use now I think are very different than they were during the cold war. Now what we worry most about is sort of limited nuclear use or coercive use to back up limited conventional aggression as opposed to in a conflict that would engulf Europe as a whole. Which indicates to me that the United States is probably going to need more investment in limited nu-

clear capability of its own to close the gap between the conventional arsenal and the strategic deterrent.

The second is that the force sizing issue becomes particularly complicated in a tripolar nuclear environment. Because having enough to assure a second strike capability against one adversary, that may not do you much good if you then find yourself in a position of inferiority against another. So I am not convinced that we have given that the attention that it deserves.

The third is that, unfortunately, I think bilateral United States-Russia arms control is probably dead for the foreseeable future. The good news is that that gives us a chance to rethink what sort of arms control agreements might be to United States advantage in an environment where most of them may need to be trilateral rather than bilateral to begin with.

Chairman REED. Just a final point before I recognize Senator Kelly, it may have been that China, for their own benefit, gave us a little help in Ukraine. Because I think they were very, very much opposed to Putin's threats to use nuclear weapons. Not because of Ukraine but because they do not want to see South Korea, Japan, et cetera, become nuclear powers.

It is a complicated world, and it is a new world for us now, and I think we have to approach it that way. But thank you.

Senator Kelly, please.

Senator KELLY. Thank you, Mr. Chairman, and thank you to both of you for being here today.

As a Member of the Senate Intelligence Committee, I see firsthand the importance of intelligence gathering to our national security and also to strengthening our international partnerships. Building these relationships is vital to advance our shared goals and protect the American people.

As you said recently, Dr. Brands, quote, "strategy is the art of balancing power without subverting democratic purpose," unquote, and there is clearly an art to successful intelligence partnerships. Can you speak to how intelligence partnerships are vital to the art of national strategy?

Dr. BRANDS. Senator, I have looked at this mostly in a historical context during the cold war. I guess I would say that just as alliances are a force multiplier in general, they are certainly a force multiplier when it comes to intelligence. One of the things we found historically is that through our intelligence liaison programs with allies we may gain access to expertise on particular countries or regions that we have not invested in heavily ourselves. If we look at the way that Australia, for instance, can be helpful in understanding events in the South Pacific.

We may also gain access to particular sources, human sources, that the U.S. intelligence system may not have access to itself, and so we end up being in a stronger national position by dint of the relationships that we have with other countries in this realm.

Senator KELLY. One concern I have had lately is our ability to gather intelligence in North Korea. We have got an unpredictable actor with an arsenal, and without the intelligence flowing in our direction it is just really hard to make predictions on what he is going to do.

A little bit more on Ukraine. Dr. Brands, you have also written extensively on our need to provide support to Ukraine. I agree that this is one of our top priorities. You know, Putin is not going to stop with Ukraine if we do not stop him in Ukraine.

In addition to supporting them militarily, can you give your perspective on building an intelligence partnership to support Ukraine in its struggle against Russia?

Dr. BRANDS. From what I read in the news, United States intelligence support to Ukraine has been absolutely vital in everything from helping the Ukrainian Government understand the nature of the threat that was coming at it in February 2022 and after, to providing more actionable insights in the months and years that have followed.

But I would also, Senator, encourage people to think about it, the other way around, where the United States will gain enormous benefits from an intelligence partnership with Ukraine. Because just to put it very bluntly, Ukraine has fought Russia and we have not. Ukraine has gained insights into the way that modern war works in a high-intensity environment, that even the United States military, with all of its experience over the last 20-plus years does not have.

So I would prefer to think of it as a two-way partnership in the sense that the U.S. itself will benefit tremendously.

Senator KELLY. Yes, and not just with intelligence. I have made a couple of trips to Ukraine in the last 18 month or so, and I made this point with the Ukrainians. At the beginning of this conflict. We had much better intel on the Russians and experience, combat experience. Fast forward 2 years later, They are the ones that have been—they are on the ground here fighting every single day and fighting for their lives bravely. Now they have that experience, and we have a lot to learn from them.

Dr. SCHARRE, you have written extensively about the importance of AI in military operations. I also noted your recent House testimony on the Replicator initiative, which intends to field thousands of autonomous systems in about 2 years. Can Replicators successfully make long-term, fundamental changes to the DOD acquisition process?

Dr. SCHARRE. I hope so. We will see. I think that DOD set a very ambitious goal for itself. I think that is good. They are going to need congressional support to make that happen. I would like to see them succeed. I think it is too early to tell, but hopefully.

Senator KELLY. In my last minute could you comment a little bit about how AI should be integrated into our national strategy?

Dr. SCHARRE. I guess on a couple of levels. I think certainly in the military space we need to be moving forward very quickly to bring in AI technology, putting in place the infrastructure on data and on computing hardware, cloud computing, inside the DOD to make DOD ready for AI, to use it effectively. But also nationally we need to protect our advantages in AI. The best AI companies in the world are here in the United States, and right now the reality is we are giving a lot of those advantages for free to China. That a lot of the technology proliferates very quickly to China, within 18 to 24 months. Those best AI models have gone open

source, they have proliferated to China. I think we also need to look at protecting the crown jewels of United States AI advantage.

Senator KELLY. All right. Well, thank you. Thank you, Mr. Chairman.

Chairman REED. Thanks, Senator Kelly. Senator Cotton, please.

Senator COTTON. Gentleman, welcome. Dr. Brands, last Thursday night we had the President yelling at us for an hour, sounding like it was 1941, with threats to democracy around the world. Yesterday we got his budget. He seemed more like Harry Truman in the 1940's or Bill Clinton in 1993, drawing down our military after the wars. It only had a 1 percent increase in defense spending compared to last year's request. Given continued high inflation, that amounts to a real cut. China recently announced that it was going to increase its defense budget by 7.2 percent.

Do you think the President's Budget Request accurately and soundly addresses the severity of the threats that we face today?

Dr. BRANDS. No. I worry both about the topline, and then from what I can tell from a quick skim of the budget submission, particularly what it will mean for procurement in the coming years, where I think we are looking at an absolute cut, which would be, even in relative, inflation-adjusted terms, more severe still.

Senator COTTON. Could you tell us a little bit more about the specific concerns you have on procurement, going forward in the future?

Dr. BRANDS. Well, one of the major challenges we face at this point is generating and procuring the number of munitions we would need for particular contingencies as well as simply some of the platforms that would be used to deliver them. It is helpful to have investment in R&D, in modernization and things that look forward down the future. But you are not going to be able to get there unless you have the money to actually buy things once they become available.

Moreover, procurement spending at this point provides a double benefit, because the only way you can really strengthen the defense industrial base is by providing guarantees that money to buy things will actually be there. If you are looking for firms to expand or ramp up new production lines, invest in a new workforce. That is the sort of money you need to be spending now that would make possible further investments down the road.

Senator COTTON. A kind of multi-year procurement authority, that some in Congress have resisted.

Dr. BRANDS. Yes, I think that is going to be critical.

Senator COTTON. Yes. That is because you cannot expect those companies, or more to the point, the companies' owners in the form of their shareholders, to lay out significant capital up front if they do not have confidence of a return down the road?

Dr. BRANDS. If the business case is there, then they will make the investments. But for the business case to be there they have to be persuaded that this is not just a 1-year bump in, say, procurement of 155 mm artillery ammunition, or whatever the capability is. Because otherwise they cannot justify all the new investments that will be necessary to get to that point.

Senator COTTON. Dr. Scharre, you are nodding your head. Do you have anything to add to that?

Dr. SCHARRE. I do, and I guess I would add, Senator, that, you know, we have heard from lots of experts in Government, outside of Government I have talked to, Dr. Brands, of course, has written extensively on this, that we are entering this dangerous window at the end of the decade with China.

It seems to me that if we believed that we would be putting our Defense Department, our defense industry on a wartime footing. We would be expanding capacity. We would be increasing our defense industrial base capacity, building our munitions stockpiles, building our ability to surge. We have a few years of critical warning now, and we need to seize that opportunity, or I think there is a very real risk that we look back on this moment and realize that we missed the opportunity to be ready.

Senator COTTON. Yes. So you make those outlays now, and you want to ensure companies will get a reasonable rate of return on their investments now. Is there any reason to think the world is going to be safer in 3 or 5 or 10 years than it is now, and we will not need all that stuff we are investing in? Dr. Brands, do you want to take that?

Dr. BRANDS. No, there is no reason to believe that. We are going to be dealing with a hyper-revisionist and perhaps hyper-mobilized Russia for some time to come. We are going to be dealing with a China whose military buildup continues at a very alarming rate. We are going to be dealing with a North Korea whose nuclear arsenal and missile arsenal is going to outpace United States missile defenses at some point this decade, as well as all the challenges in Iran and from terrorist groups. So no, there is no reason to think the threat environment will become less severe.

Senator COTTON. Dr. Scharre?

Dr. SCHARRE. I might just add that the best thing that we could do to buy down the risk of a conflict with China is to make investments now that increase deterrence.

Senator COTTON. It is always costly, investment of resources and national effort, to preserve the peace, but more costly, I presume, to win a war when the peace is not preserved.

Thank you, gentleman.

Chairman REED. Thank you very much, Senator Cotton. Gentleman, thank you for excellent testimony, and I hope that this will not be the last time we have you before the Committee and reach out for advice, and I encourage you to feel free, please, to let us know what your thoughts are and what we should be thinking about.

We are hopeful that having passed the last batch of appropriations bills will get the defense bill done next week, but if not then we have problems, immediate problems.

But again, let me thank you all for excellent testimony and for your continued wise insights into the national security of the United States.

With that I will adjourn the hearing.

[Whereupon, at 10:47 a.m., the Committee adjourned.]

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR ELIZABETH WARREN

BLAST OVERPRESSURE AND BLAST EXPOSURE

1. Senator WARREN. Dr. Scharre, you published a Center for New American Security report in 2018 on the impact of blast overpressure on servicemembers. What steps do you think the Department of Defense (DOD) should take now to improve how it is protecting servicemembers from blast overpressure and blast exposure?

Dr. SCHARRE. DOD has taken some steps to improve its understanding of the effects of blast overpressure on the brain but significant work remains.¹ Most notably, DOD has yet to implement a comprehensive blast surveillance program that would collect blast exposure data for all servicemembers at risk of blast exposure in training and combat. The basic technology to collect this data in a quantitative, automated, and cost-effective manner has existed since 2011 and have been deployed on servicemembers in combat zones. DOD has undertaken a pilot program (Blast Overpressure Studies—Pilot) but has not yet implemented a comprehensive blast surveillance program that would cover all troops who are at risk of blast exposure in training and combat.

This failure has significant consequences for troops today and over the long term. In the immediate term, U.S. troops are denied the opportunity to change their firing tactics based on feedback from blast gauges that report their amount of blast exposure. The DOD CONQUER program found that that troops were able to reduce blast pressure exposure by 30 to 90 percent by modifying firing tactics, but they cannot do so without the feedback that blast gauges provide.² In long term, without blast exposure data in their service records, troops may be denied care for traumatic brain injury by the DOD and VA. Finally, a failure to collect comprehensive data on blast exposure makes it more difficult for DOD to gain the necessary information to understand the relationship between blast exposure and potential brain injury. The first step toward better understanding and mitigating potential harm from blast exposure is to collect the data.

2. Senator WARREN. Dr. Scharre, which military occupational specialties are at highest risk for blast overpressure and blast exposure?

Dr. SCHARRE. The unfortunate reality is that we do not have good, quantitative data to assess which military occupational specialties are most at risk from blast exposure because DOD has not collected this data. The 4 November 2022 memo from Assistant Secretary of Defense for Readiness Shawn G. Skelly, “Interim Guidance for Managing Brain Health Risk from Blast Overpressure,” identified several weapon systems whose blast overpressure exceeds 4 pounds per square inch (psi). Troops exposed to blast overpressure in excess of 4 psi have demonstrated degradation in neurocognitive performance. Weapon systems identified in the memorandum include breaching explosives, shoulder-fired anti-tank weapons, 0.50 caliber sniper rifles and machine guns, howitzers, and mortars. Troops who regularly use these weapon systems, such as those in breaching, artillery, mortars, anti-tank, or sniper duty positions, may be at heightened risk. However, to more fully understand the risk profile of troops in various roles, DOD must take several additional steps:

- Undertake additional weapons testing using blast pressure monitoring devices (blast gauges) to better characterize the blast effects of these weapons.
- Conduct computer simulations of how the blast waves travel to estimate the actual amount of blast overpressure exposure to the brain.
- Conduct neurocognitive testing of troops before and after firing to understand the immediate neurocognitive effects from blast exposure when firing weapons.
- Conduct a longitudinal medical study of troops in high-risk occupations or duty positions to better understand the cumulative effects of repeated exposures over the course of a servicemember’s career.
- Institute a blast surveillance program to comprehensively monitor and record blast exposures across the force to better understand how many exposures, of what intensity and over what duration, troops are experiencing in training and combat.

¹See also Samantha McBirney, “Repeated Exposure to Low-Level Military Occupational Blasts: An Overview of the Research, Critical Gaps, and Recommendations,” Testimony presented before the U.S. Senate Armed Services Committee, Military Personnel Subcommittee on February 28, 2024, https://www.rand.org/content/dam/rand/pubs/testimonies/CTA3200/CTA3250-1/RAND_CTA3250-1.pdf.

²Suthee Wiri et al., “Significant Mitigation of Blast Overpressure Exposure During Training by Adjustment of Body Position as Demonstrated With Field Data,” *Military Medicine*, November 7, 2023, <https://academic.oup.com/milmed/advance-article/doi/10.1093/milmed/usad429/7422180>.

DOD has taken some of these actions but has not pursued all of them comprehensively. For example, the DOD CONQUER program was a pilot blast monitoring program to better characterize training-related blast exposure for servicemembers using breaching explosives, shoulder-fired anti-tank weapons, artillery, mortars, and .50 caliber machine guns and sniper rifles. This data has helped improve understanding of the type of blast exposure caused by firing various weapon systems. Similarly, DOD has conducted a pilot blast surveillance program (Blast Overpressure Studies—Pilot). However, there is much more that needs to be learned about the effects of repetitive blast exposure on the brain. Gaining this information will help DOD better understand which duty positions are most at risk and ultimately establish training safety standards that will reduce risk to servicemembers while preserving readiness.

3. Senator WARREN. Dr. Scharre, what would be the benefits of the Department of Defense updating and disseminating thresholds for blast exposure safety, including on the basis of brain injury risk and over longer periods of time such as 72 to 96 hours, yearly, and annual limits?

Dr. SCHARRE. The benefit would be to improve safety standards, adjust training practices, and ultimately reduce the amount of potentially harmful exposure that U.S. troops have to blasts, including from firing their own weapons. The long-term effect of reducing blast exposure to safer levels would be reduced incidents and severity of traumatic brain injury among the force, increasing long-term health, reducing cognitive impairments, and improving readiness.

4. Senator WARREN. Dr. Scharre, what would be the benefits of the Department of Defense developing strategies to mitigate blast exposure and blast overpressure to the military occupational specialties most at risk?

Dr. SCHARRE. There are several potential strategies that DOD could employ to reduce potentially harmful blast exposure to safer limits. One of the easiest ways to do so is to provide blast gauges to troops when firing heavy weapons or conducting breaching, which provides immediate feedback on blast overpressure exposure. In prior tests using blast gauges during training, the feedback from blast gauges allowed units to identify flaws in firing positions that cause individuals to receive excessive amounts of exposure, such as standing in the wrong location or having the wrong body position when firing the weapon. Feedback from blast gauges allows troops to immediately modify their firing techniques to reduce exposure. The DOD CONQUER program found that that troops were able to reduce blast pressure exposure by 30 to 90 percent by modifying firing tactics.³ Other strategies to reduce blast exposure could include reducing the number of rounds that servicemembers are exposed to during training, requiring mandatory rest periods after exposures to allow the brain to heal, mandating greater standoff for non-firing troops on firing ranges, increasing protection such as through improved helmet designs that could reduce blast exposure, limiting the total amount of time in their career that servicemembers can spend in high-risk duty positions, such as anti-tank roles that involve firing shoulder-fired heavy weapons, and potentially modifying certain weapons to reduce the amount of blast overpressure exposure when firing. The benefit of these and potentially other strategies would be to reduce potentially harmful blast exposure and, as a result, reduce incidents of brain injury while minimizing the impact to training and operational effectiveness.

5. Senator WARREN. Dr. Scharre, how would servicemembers benefit if the Department of Defense establishes blast exposure and traumatic brain injury logs to track their exposure over their career?

Dr. SCHARRE. I have personally spoken with multiple servicemembers who were exposed to excessive amounts of blasts from firing their own weapons during training well beyond approved limits, particularly the Carl Gustaf recoilless rifle, and now suffer traumatic brain injury as a result. However, since this exposure is not documented in their service records and the VA and DOD have been slow to acknowledge the link between blast exposure and brain injury, these servicemembers have struggled to receive care through the VA for their injuries.

6. Senator WARREN. Dr. Scharre, what would be the benefits of requiring DOD to consider blast exposure in the weapons acquisition process and for companies to provide blast overpressure and blast exposure safety data under their contract requirements?

³Wiri et al., "Significant Mitigation of Blast Overpressure Exposure During Training by Adjustment of Body Position as Demonstrated With Field Data."

Dr. SCHARRE. DOD currently lacks good data on the amount of blast overpressure that certain weapons may expose troops to when firing. Collecting this data is essential to understanding the relationship between blast exposure and brain injury and establishing safe limits and blast exposure reduction strategies. DOD will not be able to fully understand and mitigate potentially harmful blast exposure—or even understand what levels and types of blast exposure are potentially harmful—without first collecting the data.

7. Senator WARREN. Dr. Scharre, what steps should the Department take to mitigate the higher risk levels to blast exposure and blast overpressure that training instructors face?

Dr. SCHARRE. DOD should take several steps to mitigate blast exposure for training instructors:

- Issue blast gauges to instructors so that they can modify their positions on the range to minimize their blast exposure based on immediate, quantitative feedback on blast exposure.
- Enroll instructors in a blast surveillance program to record their cumulative blast exposures over time.
- Conduct regular neurocognitive assessments of training instructors, including pre- and post-training events, to identify and document any changes in performance.
- Continue to update range safety standards based on the best available data from ongoing DOD studies on blast exposure.

8. Senator WARREN. Dr. Scharre, New York Times reporting from November 2023 revealed that despite DOD taking some steps to improve safety for blast overpressure, “things have hardly changed on the ground.” Instead, “[t]raining continues largely as it did before” and “[t]roops say they see little being done to limit or track blast exposure.” What are the biggest challenges to implementing safety measures for mitigating exposure on the ground?

Dr. SCHARRE. The biggest obstacle to improving safety measures for mitigating blast exposure is the failure of DOD leaders to prioritize understanding and mitigating harm from blast exposure. DOD has generated presentations, briefings, documents, and some modest pilot programs but taken few meaningful steps since our CNAS report was published in 2018. DOD has not implemented a comprehensive blast surveillance program that would track and monitor blast exposure among servicemembers in training and combat. DOD has not actually implemented a longitudinal medical study that would collect data on blast exposures, neurocognitive performance, and potential biomarkers on high-risk servicemembers who are exposed to blasts over the course of their career so that DOD can better understand the effects of cumulative blast exposures over time.

These failures cannot be chalked up to merely a slow-moving bureaucracy. They represent a failure of DOD leaders to prioritize this issue and take meaningful and urgent action to mitigate the potential harm to servicemembers from blast exposure.

9. Senator WARREN. Dr. Scharre, what steps should the Department take to improve training and education for servicemembers on the dangers of this exposure and safety measure to address these concerns, and ensure that servicemembers are following through on implementation of these safety measures?

Dr. SCHARRE. DOD has ample mechanisms to ensure that troops comply with safety standards and conduct hazardous training in a safe manner. For example, DOD regularly conducts training on airborne operations and has extensive procedures in place to ensure that troops successfully train on high-risk activities in a safe manner. DOD is more than capable of enforcing training safety standards for firing heavy weapons, such as firing limits, if it prioritizes doing so.

QUESTIONS SUBMITTED BY SENATOR JACKY ROSEN

TECHNOLOGICAL EDGE

10. Senator ROSEN. Dr. Scharre, history shows us that harnessing new technologies creates a significant advantage on the battlefield. The country that manages to use these technologies effectively and efficiently will have the upper hand in any future wars. What do you predict will be the defining weapons of the next war and how can the United States ensure it uses these weapons effectively and responsibly?

Dr. SCHARRE. Technology is critical to modern warfighting, and disruptive technologies have often led to profound changes in the character of warfare, necessitating changes in tactics, doctrine, and military organization. In recent years, the Defense Department has identified priority technology areas for investment that may have a significant effect on U.S. and adversary warfighting capabilities. What is often missing from DOD lists of technology areas is prioritization among these technologies and a sense of the relative speed at which these technologies are advancing. Technologies are advancing at dramatically different rates of progress. In particular, information technologies are currently growing at literal exponential rates. This creates opportunities for significant disruptions in warfare from military capabilities that leverage information technologies.

A few examples of the current exponential growth trends in information technology:

Global communications networks are growing exponentially in speed and size. From 2018 to 2023, broadband speeds grew 20 percent annually and wireless network speeds 27 percent annually. During that same time, the number of Internet of Things (IoT) devices grew 20 percent per year and the number of global public Wi-Fi hotspots 30 percent annually. As of 2023, two-thirds of the world's population was online and there were nearly 30 billion connected devices.⁴ While militaries will operate military-specific networks on the battlefield, the same underlying technological advancements that enable exponential growth in civilian network bandwidth and connectivity also enable military networks.

Artificial intelligence capabilities are similarly growing exponentially. The amount of data and computational power applied to cutting-edge machine learning systems is growing at a breathtaking pace. Between 2010 and 2022, the amount of computational power used to train cutting-edge machine learning models increased ten billionfold.⁵ The amount of computing power used to train the largest and most capable AI models is currently doubling every 7 months.⁶ Chip performance is doubling approximately every 2 years.⁷ And algorithms are also improving, doubling in performance approximately every 9 months.⁸ The combined effect of these exponential growth trends is such that by 2030, the most capable AI models could be trained on one million times more effective computing power than today.⁹

With the digitization of biology, genomics is also benefiting from exponential growth in information technology. It cost \$300 million to sequence the first human genome, which was completed in 2000.¹⁰ By 2023, the cost to sequence a human genome had dropped to \$200, over a million times cheaper,¹¹ allowing scientists to build massive genomic data bases.¹² AI models can predict biochemical interactions, such as how proteins fold,¹³ enabling scientists to computationally explore hundreds of millions of possibilities, including those not found in nature.¹⁴ The price of DNA

⁴ Cisco, Cisco Annual Internet Report, 2020, <https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.pdf>.

⁵ Jaime Sevilla et al., Compute Trends Across Three Eras of Machine Learning, arXiv.org, March 9, 2022, <https://arxiv.org/abs/2202.05924>.

⁶ Epoch, ML Inputs Visualization, <https://epochai.org/mlinputs/visualization?startDate=2015-9-1&startLargeScaleEra=2015-9-1&largeScaleAction=isolate&preset=Largepercent20scalepercent20modelspercent20-percent20compute&labelEras=false&labelPoints=true>, accessed on 11/11/23.

⁷ Marius Hobbhahn et al., "Trends in Machine Learning Hardware," (Epoch, November 9, 2023), <https://epochai.org/blog/trends-in-machine-learning-hardware>.

⁸ Danny Hernandez and Tom B. Brown, Measuring the Algorithmic Efficiency of Neural Networks, arXiv.org, May 8, 2020, <https://arxiv.org/abs/2005.04305>; Florian E. Dörner, Measuring Progress in Deep Reinforcement Learning Sample Efficiency, arXiv.org, February 9, 2021, <https://arxiv.org/abs/2102.04881>; Ege Erdil and Tamay Besiroglu, Algorithmic progress in computer vision, arXiv.org, December 16, 2022, <https://arxiv.org/abs/2212.05153>; and Anson Ho et al., Algorithmic Progress in Language Modeling, forthcoming.

⁹ Paul Scharre, "Future-Proofing Frontier AI Regulation: Projecting Future Compute for Frontier AI Models," (Center for a New American Security, March, 2024), https://s3.us-east-1.amazonaws.com/files.cnas.org/documents/CNAS-Report_AI-Trends_FinalC.pdf.

¹⁰ National Human Genome Research Institute, "The Cost of Sequencing a Human Genome," November 1, 2021, <https://www.genome.gov/about-genomics/fact-sheets/Sequencing-Human-Genome-cost>.

¹¹ Illumina, "Illumina's revolutionary NovaSeq X exceeds 200th order milestone in first quarter 2023," press release, April 4, 2023, <https://www.illumina.com/company/news-center/press-releases/2023/4b48580b-42d4-419b-8512-5adcbb069836.html>.

¹² Broad Institute, "Human Genome Sequencing Dashboard," n.d., <https://broadinstitute.github.io/gp-dashboard/>.

¹³ AlphaFold Protein Structure Data base, <https://alphafold.ebi.ac.uk/>.

¹⁴ B.I.M Wicky et. al, "Hallucinating symmetric protein assemblies," Science, September 15, 2022, <https://www.science.org/doi/10.1126/science.add1964>.

synthesis machines, which allow scientists to manufacture artificial proteins, is dramatically dropping.¹⁵ And automated labs use information technology to accelerate the speed and scale of physical experimentation in biology.¹⁶

Military capabilities enabled by information technology riding these exponential curves are the most likely to see dramatic changes in the coming decades. These include capabilities relying on autonomy, robotics, advanced sensors, communications networks, data processing, automated decision aids, AI and machine learning, computing hardware, cloud computing, electronic warfare, cyber operations, synthetic biology, and genomics. While other non-digital military capabilities will continue to be valuable, they are often not growing at the same pace, and are therefore unlikely to see the same degree of change. Missiles are not ten billion times faster than they were in 2010. Stealth aircraft are not ten billion times stealthier. Yet information technologies are advancing at a breathtaking pace, creating new opportunities for military applications.

The war in Ukraine provides an example of this dynamic. The conflict is a blend of War War I style trench and artillery warfare, combined with 21st century drones and social media. Yet the most dramatic changes are happening in the evolution of drone technology and tactics. Drones are increasingly adopting AI tools to identify targets and autonomous capabilities to carry out attacks in the face of electronic warfare countermeasures and jamming. Counter-drone systems have led to a rapid cycle of innovation in drones and countermeasures. This pace of adaptation is not matched, for example, in trench construction.

If the United States is to be prepared for future conflicts, it must remain at the forefront of rapidly evolving digital technologies or risk falling behind competitors. In addition to their rapid growth, many information technologies come from the commercial sector and are highly globalized, making them widely available, including to State and non-State competitors.

11. Senator ROSEN. Dr. Scharre, new technologies depend on a fragile and global supply chain—from critical minerals to semiconductors. Access to raw and refined critical minerals will have a role to play in these technologies, but only if we make a concerted effort to strategically leverage our resource advantages to overcome global supply chain challenges. What specific strategies can the United States employ to mitigate such vulnerabilities, invest in domestic industry, and help strengthen our supply chain resilience?

Dr. SCHARRE. For many years, China has held an advantage in both the mining of rare earth minerals and their processing. Thanks to discoveries of large deposits off the coast of Japan,¹⁷ in Sweden,¹⁸ and in Wyoming,¹⁹ the United States and its allies have an opportunity loosen China's stranglehold on mining. The United States and its allies should also work to reduce their reliance on China for rare earth mineral processing. The United States should invest in storage capacity for processed versions of these minerals and maintain a strategic reserve to reduce the ability for China to use rare earth minerals as leverage as it did to Japan in 2010.²⁰ The United States should work with its allies to develop the deposits that have been discovered in the United States and partner nations to reduce reliance on Chinese mining. Reducing China's advantage in processing will be more difficult due to both

¹⁵David Baker and George Church, "Protein design meets biosecurity," *Science*, January 25, 2024, <https://www.science.org/doi/10.1126/science.adol671>.

¹⁶Strateos, "Cloud Lab Automation-as-a-Service," n.d., <https://strateos.com/>; Emerald Cloud Lab, "Transcend the Lab," n.d., <https://www.emeraldcloudlab.com/>; Carnegie Mellon University Cloud Lab, "The Future of Automated Science is at CMU," n.d., <https://cloudlab.cmu.edu/>; Chase Armer, Florent Letronne, and Erika DeBenedictis, "Support academic access to automated cloud labs to improve reproducibility," *PLOS Biology*, January 3, 2023, <https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3001919>.

¹⁷Yen Nee Lee, "A massive, 'semi-infinite' trove of rare-earth metals has been found in Japan," *CNBC*, April 12, 2018, <https://www.cnbc.com/2018/04/12/japan-rare-earth-huge-deposit-of-metals-found-in-pacific.html>.

¹⁸Jackie Northam, "It's a journey to the center of the rare earths discovered in Sweden," *National Public Radio*, July 18, 2023, <https://www.npr.org/2023/07/18/1187075988/europe-rare-earth-sweden>.

¹⁹Michael Auslin, "Wyoming Hits the Rare-Earth Mother Lode," *Wall Street Journal*, February 14, 2024, <https://www.wsj.com/articles/wyoming-hits-the-rare-earth-mother-lode-natural-resources-policy-china-mining-8e559cec>.

²⁰Simon Evenett and Johannes Fritz, "Revisiting the China-Japan Rare Earths dispute of 2010," (Centre for Economic Policy Research, July 19, 2023), <https://cepr.org/voxeu/columns/revisiting-china-japan-rare-earths-dispute-2010>.

their edge in the technology²¹ and their lax environmental standards.²² The United States needs to build on its funding of new processing plants through the Defense Production Act²³ and create additional incentives for companies to invest in and open processing facilities.

STAYING AHEAD

12. Senator ROSEN. Dr. Scharre, what are the competitive advantages of the United States in comparison to China when it comes to artificial intelligence (AI)? How can the United States ensure that our public and private institutions stay ahead of the curve in this critically important field?

Dr. SCHARRE. The United States has two asymmetric advantages over China in AI: chips and human talent.

U.S. companies occupy critical chokepoints in the supply chain for manufacturing high-end chips, especially in the electronic design automation software used to manufacture advanced chips. Collectively, the United States, Japan, and the Netherlands control 90 percent of the global market for semiconductor manufacturing equipment. The United States has used this leverage, in concert with Japan and the Netherlands, to deny China access to leading-edge AI chips by prohibiting the export to China of any advanced chips made using United States technology. Given the dominance of U.S. companies in semiconductor manufacturing equipment chokepoints, United States export controls have, in the near term, successfully denied China access to the cutting-edge AI chips used to train the largest and most capable AI models. To fully capitalize on this advantage, however, the United States must take several additional steps.

First, in the near term, the United States must extend protections on high-end chips to include other aspects of the supply chain for the computation used to train cutting-edge AI models. This includes regulations on cloud providers and trained AI models with certain dual-use capabilities, such as the ability to aid in cyber, chemical, or biological attacks. Restrictions on cloud computing infrastructure and trained AI models need not be as broad as the current chip export controls. Cloud computing infrastructure, for example, provides the opportunity for more tailored and fine-grained restrictions, since the chips themselves remain in the United States.²⁴ Similarly, the overwhelming majority of AI models are safe to release open source. However, a small set of the most computationally intensive AI models, which can only be trained using the most advanced, export-controlled AI chips, may need to be export controlled.²⁵ Without additional controls on cloud computing infrastructure and trained AI models, U.S. chip export controls will not be effective. China can simply access chips through the cloud. Or Chinese AI labs can download trained United States AI models for free, such as Meta's Llama 2 model, negating the need to train their own large models from scratch, effectively circumventing United States export controls.

Second, the United States must take steps now to preserve its control over key chokepoints in semiconductor manufacturing equipment, so that the United States retains the ability to deny China access to advanced chips in the future. United States leverage over China's access to advanced AI chips stems from the dominant role that United States companies play in semiconductor manufacturing equipment, especially in the electronic design automation software used to design the most advanced chips. A major focus for the CHIPS Act should be ensuring that U.S. companies remain in a dominant position in these key chokepoints for the next generation of chip manufacturing technology. The United States can help achieve this by supporting research and development in next-generation semiconductor manufacturing technology. Additionally, building leading-edge fabs in the United States can help

²¹ Siyi Liu and Dominique Patton, "China bans export of rare earths processing tech over national security," Reuters, December 22, 2023, <https://www.reuters.com/markets/commodities/china-bans-export-rare-earths-processing-technologies-2023-12-21/>.

²² Jaya Nayar, "Not So 'Green' Technology: The Complicated Legacy of Rare Earth Mining," Harvard International Review, August 12, 2021, <https://hir.harvard.edu/not-so-green-technology-the-complicated-legacy-of-rare-earth-mining/>.

²³ Gracelin Baskaran, "What China's Ban on Rare Earths Processing Technology Exports Means," (Center for Strategic and International Studies, January 8, 2024), <https://www.csis.org/analysis/what-chinas-ban-rare-earths-processing-technology-exports-means>.

²⁴ Tim Fist and Paul Scharre, "The Cloud Can Solve America's AI Problems," Foreign Policy, October 7, 2023, <https://foreignpolicy.com/2023/10/07/cloud-computing-artificial-intelligence-chips-sanctions-us-china/>.

²⁵ Caleb Withers, "Response to NTIA Request for Comment: 'Dual Use Foundation Artificial Intelligence Models with Widely Available Model Weights,'" (Center for a New American Security, April 4, 2024), <https://www.cnas.org/publications/commentary/response-to-ntia-request-for-comment-dual-use-foundation-artificial-intelligence-models-with-widely-available-model-weights>.

create a vibrant ecosystem of chip manufacturers, designers, and equipment suppliers—and the human talent that supports those innovations—in the United States.

The United States also has significant advantages over China in human talent. China produces more of the world's top AI scientists than any other country, but they don't stay in China—they come to the United States.²⁶ Over half of China's top undergraduates studying AI come to the United States for their graduate studies.²⁷ And 90 percent of Chinese undergraduates who gain a PhD in AI in the United States stay in the United States after graduation.²⁸ China's brain drain is a brain gain for the United States. China has engaged in a massive campaign of intellectual property theft and academic espionage, including by tapping into the global diaspora of Chinese scientists and engineers. The United States must improve research security, visa screening, and investigations to crack down on academic espionage. But the United States Government should not cutoff the flow of Chinese talent to the United States, which overwhelmingly benefits the United States over China.

13. Senator ROSEN. Dr. Scharre, over 66 years ago, in response to the launch of the Soviet satellite Sputnik, Congress passed the National Defense Education Act, which became a successful legislative investment in higher education. You have argued that “talent” is going to be one of the important cornerstones to dominate the future, but it seems like it may take a Sputnik-like moment to motivate us to make such large changes. With the speed at which technology evolves, will we be too late when that moment comes, and how do we attract the right people today to prepare for tomorrow?

Dr. SCHARRE. Our Sputnik moment for AI is here. ChatGPT and subsequent breakthroughs set off a wave of excitement, investment, and government attention on AI in the United States, China, and around the world. The question is whether we choose to rise to this moment.

The United States has many advantages in the competition for talent. Seven of the top ten institutions publishing deep learning research are American universities or corporate research labs. Only two are Chinese.²⁹ Yet these advantages will not be enough to secure continued American leadership in AI. The United States must reinvest in human talent through improved STEM education and high-skilled immigration if it is to remain a global technology leader.³⁰

The congressionally mandated National Security Commission on AI (NSCAI) recommended in 2021 that Congress pass a “National Defense Education Act II” to strengthen “digital skills, like mathematics, computer science, information science, data science, and statistics.” The NSCAI recommended that the new National Defense Education Act cover talent development across the spectrum of educational programs, including K–12, community college, university, graduate, PhD, and reskilling programs.³¹

Educators and students also need the resources to leverage AI tools effectively. The National Artificial Intelligence Research Resource (NAIRR), if fully funded by Congress, will be able to provide much-needed data and computing resources for under-resourced STEM departments.³² Additionally, recent changes to STEM education should be expanded to improve STEM teacher fluency, increase programs for underserved communities, and increase science-themed organizations for children.³³

²⁶ MacroPolo, “The Global AI Talent Tracker 2.0,” n.d., <https://macropolo.org/digital-projects/the-global-ai-talent-tracker/>.

²⁷ Paul Mozur and Cade Metz, “A U.S. Secret Weapon in A.I.: Chinese Talent,” New York Times, June 9, 2020, updated April 13, 2021, <https://www.nytimes.com/2020/06/09/technology/china-ai-research-education.html>.

²⁸ Remco Zwetsloot, Keeping Top AI Talent in the United States (Center for Security and Emerging Technology, December 2019), 22, <https://cset.georgetown.edu/wp-content/uploads/Keeping-Top-AI-Talent-in-the-United-States.pdf>.

²⁹ “The Global AI Talent Tracker 2.0,” Macro Polo, n.d., <https://macropolo.org/digital-projects/the-global-ai-talent-tracker/>.

³⁰ Portions of this answer are adapted from Paul Scharre, “America Can Win the AI Race,” Foreign Affairs, April 4, 2023, <https://www.foreignaffairs.com/united-states/ai-america-can-win-race>, and Paul Scharre, Four Battlegrounds: Power in the Age of Artificial Intelligence (New York, NY: W.W. Norton & Company, 2023), pp. 30–34.

³¹ National Security Commission on Artificial Intelligence, Final Report, 2021, <https://reports.nscai.gov/final-report/>, 175.

³² U.S. National Science Foundation, “National Artificial Intelligence Research Resource Pilot,” n.d., <https://new.nsf.gov/focus-areas/artificial-intelligence/nairr>.

³³ U.S. Department of Education, “U.S. Department of Education Launches New Initiative to Enhance STEM Education for All Students,” December 7, 2022, <https://www.ed.gov/news/>

Improvements in domestic STEM education, while necessary to sustain America's long-term competitive edge in science and technology, will also take time to fully come to fruition. The foundations for science and technology education begin early, and it will take a generation to fully reap the benefits of reformed STEM education. This places a premium on improving STEM education now. But these steps will also not be enough.

High-skilled immigration, by contrast, can bring skilled scientists and engineers immediately into the United States, injecting much-needed talent into America's workforce. More fundamentally, as a nation of 330 million people, the United States will always be at a disadvantage competing against China's 1.4 billion if the United States restricts itself to home-grown talent.³⁴ Yet America has an asymmetric advantage over China in the talent competition: American universities and companies are a major draw for AI researchers from around the world. Indeed, American leadership in AI is already heavily powered by foreign talent. Two-thirds of the top AI researchers in the United States did their undergraduate studies overseas, with the top sending regions China, India, and Europe.³⁵ If the United States draws on the best and brightest of the world's 8 billion people, the United States will be able to maintain a leadership position over China in AI talent. Yet America's biggest barrier to AI talent is its own immigration policies.

Numerical caps on visas and green cards, long wait times, and limitations on visa sponsorship all create obstacles for foreign scientists who want to work in the United States.³⁶ A numerical cap on H-1B work visas arbitrarily constrains U.S. companies from hiring foreign talent. Per-country caps on green cards create especially long wait times for Indian scientists, who make up a quarter of Silicon Valley's workforce.³⁷ One study estimated an 89 year wait time for Indian nationals applying for an employment-based green card.³⁸ It is not surprising, then, that nearly 70 percent of top machine learning researchers residing in the United States said visa and other immigration problems were an obstacle to recruiting foreign scientists.³⁹ Immigration policy is the single biggest area where government regulation is harming American competitiveness.

The Biden administration has taken some steps to make it easier for international STEM students to come to the United States.⁴⁰ The White House has, for example, increased the number of foreign exchange programs, expanded the number of fields qualifying for the STEM Optional Practical Training (OPT) visa for recent college graduates, and updated policies on the evidence STEM PhDs can present when applying for the O-1A "extraordinary ability" visa. These are valuable steps but have a minor impact relative to the scale of self-imposed barriers to talent. The United States needs comprehensive reform of high-skilled immigration policy to make it easier for U.S. universities and companies to recruit international scientists and engineers. This should include reducing barriers for STEM PhD graduates to stay in

press-releases/us-department-education-launches-new-initiative-enhance-stem-education-all-students.

³⁴ Remco Zwetsloot, "China's Approach to Tech Talent Competition: Policies, Results, and the Developing Global Response," (Brookings Institution, April 2020), https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_china_talent_policy_zwetsloot.pdf; Remco Zwetsloot, "Strengthening the U.S. AI Workforce," (Brookings, September 2019), <https://cset.georgetown.edu/publication/strengthening-the-u-s-ai-workforce/>.

³⁵ "The Global AI Talent Tracker 2.0;" and Remco Zwetsloot et al., Skilled and Mobile: Survey Evidence of AI Researchers' Immigration Preferences (arXiv.org, May 5, 2021), <https://arxiv.org/pdf/2104.07237.pdf>.

³⁶ Tina Huang and Zachary Arnold, "Immigration Policy and the Global Competition for AI Talent," (Center for Security and Emerging Technology, June 2020), <https://cset.georgetown.edu/publication/immigration-policy-and-the-global-competition-for-ai-talent/>

³⁷ Silicon Valley Institute for Regional Studies, "Share of Residents in Technical Occupations with a Bachelor's Degree or Higher, by Place of Origin," 2021, <https://web.archive.org/web/20230121023908/https://siliconvalleyindicators.org/data/people/talent-flows-diversity/tech-talent/share-of-residents-in-technical-occupations-with-a-bachelors-degree-or-higher-by-place-of-origin/>.

³⁸ David Bier, "Backlog for Skilled Immigrants Tops 1 Million: Over 200,000 Indians Could Die of Old Age While Awaiting Green Cards," (CATO Institute, March 30, 2020), <https://www.cato.org/publications/immigration-research-policy-brief/backlog-skilled-immigrants-tops-1-million-over#>.

³⁹ Zwetsloot et al., Skilled and Mobile.

⁴⁰ The White House, "Biden-Harris Administration Actions to Attract STEM Talent and Strengthen our Economy and Competitiveness," fact sheet, January 21, 2022, <https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/21/fact-sheet-biden-harris-administration-actions-to-attract-stem-talent-and-strengthen-our-economy-and-competitiveness/>.

the United States by exempting them from the H-1B cap and easing the path to permanent residency.⁴¹

IRAN

14. Senator ROSEN. Dr. Brands, you have argued for the enduring importance of the Middle East to United States foreign policy and the challenges posed by Iran. What key elements should be included in a reassessment of United States strategy toward Iran to address its nuclear ambitions, regional aspirations, and warfare via terrorist proxies?

Dr. BRANDS. Regardless of what happens in the current Middle East crisis, the United States will face an expanded challenge from an Iran whose nuclear program continues to advance and whose foreign legion of proxies has become far more potent than many American observers had expected. In any reassessment of United States strategy in the region, the United States will need to reestablish redlines beyond which further progress toward a nuclear capability would bring a swift and dramatic response, which will, in turn, require establishing more credible threats to use force against Iran's nuclear program and its accompanying military capabilities. It will also need to develop a strategy that inflicts higher costs on Iran for the actions of the proxies it has empowered. It is not sustainable, for instance, for the US to be playing defense in the Red Sea and Gulf of Aden against Huthi attacks, while taking no action against the Iranian naval assets that are assisting those attacks with intelligence and other support. Only when Tehran becomes convinced that it will pay a major price for actions of its proxies will it move to distance itself from them or restrain them. Finally, any strategy in the region must be accompanied by a strengthening of United States ties with key regional players, in the Gulf and beyond, that are most likely to join Washington in pushing back against Iranian influence.



⁴¹For recommendations on additional steps to increase high-skilled immigration, see National Security Commission on Artificial Intelligence, Final Report, 175–179.